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GEOLOGY OF CRY LAKE AND DEASE LAKE MAP AREAS, NORTH-CENTRAL BRITISH COLUMBIA

H. Gabrielse

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Cover illustration

View southwest over Meek Lake to Mount Dalton in northwestern Cry Lake map area. Rocks underlying Mount Dalton and in the foreground are part of the Early Cretaceous Cassiar batholith. The cirque on Mount Dalton with its smooth bounding ridges and lack of significant erosional debris is typical of high level cirques in the Cassiar Mountains that have been overriden by a northerly moving ice sheet. Photograph by H. Gabrielse. GSC 1998-043

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PREFACE

Dease Lake and Cry Lake map areas are underlain by six discrete geological terranes, each bounded by regional faults and characterized by unique stratigraphic, metamorphic, and structural attributes. The northeastern part of the study area includes strata and structures typical of the western margin of Ancestral North America. On the other hand, much of Cry Lake map area and almost all of Dease Lake map area exemplify the geology of accreted terranes added to Ancestral North America during Mesozoic time. Mineral deposit types reflect their association with continental margin, oceanic basin, volcanic island arc, and overlap assemblages.

This bulletin presents an account of the stratigraphy, structure, metamorphism, igneous history, and mineral deposits of the two map areas. The compilation is based on research dating back to Operation Stikine, a large, wide ranging reconnaissance survey in northwestern British Columbia, carried out by the Geological Survey in 1956. Later projects further defined the geology and provided a framework for integrating the tectonic evolution and mineral deposits into a regional context, thereby forming the basis for further mineral exploration and research.

M.D. Everell
Assistant Deputy Minister
Earth Sciences Sector

PRÉFACE

Les régions cartographiques des lacs Dease et Cry couvrent six terranes géologiques distincts, qui sont chacun limités par des failles régionales et caractérisés par une stratigraphie, un métamorphisme et un style structural propres. La partie nord-est de la région à l'étude montre une stratigraphie et des structures représentatives de la marge ouest du protocontinent nord-américain. D'un autre côté, une grande partie de la région cartographique du lac Cry et presque toute la région du lac Dease offrent une vue représentative de la géologie des terranes accrétés au protocontinent nord-américain durant le Mésozoïque. Les gîtes minéraux reflètent de diverses façons leur association à des milieux de formation variés : marge continentale, bassin océanique, arc insulaire volcanique et assemblages de recouvrement.

Le présent bulletin passe en revue la stratigraphie, le style structural, le métamorphisme, le magmatisme et la gîtologie des deux régions cartographiques. La compilation est basée sur des recherches remontant à l'opération Stikine, vaste levé de reconnaissance réalisé dans le nord-ouest de la Colombie-Britannique par la Commission géologique du Canada en 1956. Les travaux ultérieurs ont permis de mieux définir la géologie et de présenter un cadre général permettant d'intégrer l'évolution tectonique et la variété de gîtes minéraux reconnus dans un même contexte régional, ce qui permet de constituer une base sur laquelle peuvent s'appuyer les activités futures d'exploration et de recherche.

M.D. Everell
Sous-ministre adjoint
Secteur des sciences de la Terre

GEOLOGY OF CRY LAKE AND DEASE LAKE MAP AREAS, NORTH-CENTRAL BRITISH COLUMBIA

Abstract

Cry Lake and Dease Lake map areas include six well defined terranes each characterized by distinctive lithological assemblages of different ages, structural styles, and contained mineral deposits.

Miogeoclinal strata of Ancestral North America range in age from Late Proterozoic to Early Mississippian. They have been intruded by voluminous Mesozoic and Cenozoic granitic rocks, in places associated with tungsten, lead, and zinc occurrences.

The Slide Mountain Terrane contains Devonian to Permian rocks typical of oceanic and island arc environments. The Kootenay(?) Terrane is characterized by strongly tectonized, mainly weakly metamorphosed, siliceous strata. Ultrabasic rocks have potential for jade occurrences and a few vein deposits of lead, zinc, gold, and silver have been explored.

Rocks assigned to Quesnellia are of Mesozoic island arc lithologies. In one locality, granodiorite is host to an important copper deposit. Low grade nickel and chromite deposits are hosted by an Alaskan-type ultramafic body.

The Cache Creek Terrane is dominantly oceanic in lithology but includes some assemblages of island arc or rift affinity. The terrane ranges in age from Devonian through Early Jurassic. Ultrabasic rocks host jade and asbestos deposits and are spatially related to numerous placer gold deposits. The island arc or rift volcanics host a large zinc and copper volcanogenic sulphide deposit.

Rocks of Stikinia represent upper Paleozoic to Lower Jurassic island arc assemblages which are overlain by upper Mesozoic to Recent sedimentary and volcanic overlap assemblages. Copper, molybdenum, gold, lead, and zinc occurrences are found in the volcanic and plutonic rocks. Coal occurs locally in overlap sedimentary rocks.

Résumé

Les régions cartographiques des lacs Cry et Dease couvrent six terranes bien définis, chacun se caractérisant par des assemblages lithologiques caractéristiques qui montrent des âges, des styles structuraux et des variétés de gîtes minéraux différents.

La succession de miogéoclinal du protocontinent nord-américain s'est déposée entre le Protérozoïque tardif et le Mississippien précoce. Elle a été recoupée au Mésozoïque et au Cénozoïque par de grands volumes de roches granitiques auxquelles sont associés, par endroits, des indices de tungstène, de plomb et de zinc.

Le terrane de Slide Mountain contient des roches du Dévonien-Permien typiques des milieux océaniques et d'arc insulaire. Le terrane de Kootenay(?) est caractérisé par la présence de couches siliceuses faiblement métamorphisées et fortement tectonisées. Des roches ultrabasiques également présentes dans ce terrane pourraient potentiellement receler des indices de jade, et quelques gîtes filoniens de plomb, de zinc, d'or et d'argent dans ces roches ont fait l'objet de travaux d'exploration.

Les roches attribuées à la Quesnellie sont des lithologies d'arc insulaire du Mésozoïque. En un endroit, une granodiorite renferme un important gisement de cuivre. Des gîtes de nickel et de chromite à faible teneur sont logés dans un massif de roches ultramafiques de type alaskien.

Dans le terrane de Cache Creek, les lithologies océaniques prédominent, mais on reconnaît également dans celui-ci des assemblages ayant des affinités avec un arc insulaire ou un rift. Les unités du terrane varient en âge du Dévonien au Jurassique précoce. Les roches ultrabasiques contiennent des gîtes de jade et d'amiante et de nombreux placers aurifères leur sont spatialement associés. Les roches volcaniques d'arc insulaire ou de rift sont les lithologies hôtes d'un grand gisement de sulfures volcanogènes de zinc et de cuivre.

Les roches de la Stikinie représentent des assemblages d'arc insulaire du Paléozoïque supérieur au Jurassique inférieur qui sont surmontés d'assemblages de recouvrement formés de roches sédimentaires et de roches volcaniques du Mésozoïque supérieur-Holocène. Des indices de cuivre, de molybdène, d'or, de plomb et de zinc sont présents dans les roches volcaniques et plutoniques. Localement, du charbon peut être observé dans les roches sédimentaires des assemblages de recouvrement.

SUMMARY

Dease Lake and Cry Lake map areas are underlain by rocks assigned to six, well defined terranes, each characterized by distinctive lithological assemblages of different ages, structural styles, and contained mineral deposits.

Miogeoclinal strata of Ancestral North America range in age from Late Proterozoic to Early Mississippian. They are best exposed in northeastern Cry Lake map area where their exposed thickness is more than 6500 m. They show a marked sedimentary polarity from shallow water sediments on the east to deeper water sediments on the west. Dominantly clastic, lower Paleozoic strata to the west are less than 1000 m thick. Until late Devonian time the rocks appear to have been deposited along the western, presumably rifted margin, of the North American craton. The strata have been intruded by voluminous Mesozoic and Cenozoic granitic rocks, in places associated with tungsten, lead, and zinc occurrences.

Devonian to Permian rocks of the Slide Mountain Terrane are of typical oceanic and island arc lithology. The rocks are strongly imbricated so that stratigraphic thicknesses are difficult or impossible to estimate. One of the oldest units is black, banded chert of Late Devonian(?) age possibly more than 200 m thick. A Mississippian to Permian black chert sequence including members of argillite, black arenite, and lithic greywacke may be as much as 800 m thick but tectonic thickening is probable. Pennsylvanian, tightly folded, banded orange and green chert, appears to be several tens of metres thick. Two distinctive limestone units of Mississippian and Pennsylvanian ages are about 500 m and 100 m thick, respectively. Permian granodiorite, tonalite, diorite, and granite form important bodies within the Slide Mountain assemblage. Ultrabasic rocks have potential for jade occurrences and a few vein deposits of lead, zinc, gold, and silver have been explored. Pyrite and chalcopyrite are known in a few places.

The Kootenay Terrane(?) consists of mainly weakly metamorphosed, strongly tectonized siliceous rocks, hundreds of metres thick, intimately associated with the Slide Mountain assemblages. Just to the north, in the McDame map area the terrane includes Late Devonian and Early Mississippian granitic rocks and metamorphic rocks to amphibolite grade. The Kootenay(?) Terrane has some characteristics suggesting an origin along a distal North American margin or from a rifted, crustal block related to Ancestral North America. The Slide Mountain and Kootenay(?) terranes were thrust onto Ancestral North America in the Mesozoic.

SOMMAIRE

Les roches des régions cartographiques des lacs Dease et Cry sont attribuées à six terranes bien définis, chacun se caractérisant par des assemblages lithologiques caractéristiques qui montrent des âges, des styles structuraux et des variétés de gîtes minéraux différents.

La succession de miogéoclinal du protocontinent nord-américain s'est déposée entre le Protérozoïque tardif et le Mississippien précoce. C'est dans la région cartographique du lac Cry qu'elle est le mieux exposée, l'épaisseur de la coupe de surface y dépassant les 6 500 m. Une polarité sédimentaire marquée peut être reconnue dans cette succession, polarité définie par l'existence de roches sédimentaires d'eau peu profonde à l'est et d'eau plus profonde à l'ouest. À l'ouest, la succession du Paléozoïque inférieur, formée principalement de lithologies clastiques, affiche une épaisseur inférieure à 1 000 m. Jusqu'au Dévonien tardif, les sédiments semblent s'être déposés le long de la marge ouest du craton nord-américain, que l'on présume être une marge de divergence. Dans les couches se sont injectés de grands volumes de roches granitiques au Mésozoïque et au Cénozoïque, auxquelles sont associés par endroits des indices de tungstène, de plomb et de zinc.

Les roches du Dévonien-Permien du terrane de Slide Mountain présentent les caractéristiques de lithologies océaniques et d'arc insulaire. Elles sont si fortement imbriquées que les épaisseurs stratigraphiques sont difficiles ou impossibles à estimer. L'une des unités les plus anciennes est un chert rubané noir du Dévonien tardif (?) Dont l'épaisseur peut atteindre 200 m. Une séquence de chert noir du Mississippien-Permien renfermant des membres d'argilite, d'arénite noire et de grauwacke lithique pourrait mesurer jusqu'à 800 m d'épaisseur mais un épaississement d'origine tectonique est probable. Un chert rubané orange et vert du Pennsylvanien, déformé en plis serrés, semble présenter une épaisseur de plusieurs dizaines de mètres. Deux unités distinctes de calcaire du Mississippien et du Pennsylvanien mesurent 500 et 100 m d'épaisseur, respectivement . De la granodiorite, de la tonalite, de la diorite et du granite du Permien forment des massifs importants au sein des assemblages du terrane de Slide Mountain. Des roches ultrabasiques pourraient receler des indices de jade, et quelques gîtes filoniens de plomb, de zinc, d'or et d'argent ont fait l'objet de travaux d'exploration. De la pyrite et de la chalcopyrite ont été décelées à quelques endroits.

Le terrane de Kootenay(?) est surtout composé de roches siliceuses fortement tectonisées et faiblement métamorphisées, formant une succession de quelques centaines de mètres d'épaisseur, qui est intimement associée aux assemblages du terrane de Slide Mountain. Juste au nord, dans la région cartographique de McDame, le terrane renferme des roches granitiques du Dévonien tardif et du Mississippien précoce, ainsi que des roches métamorphiques du faciès des amphibolites. Le terrane de Kootenay(?) possède des caractéristiques propres à un terrane initialement situé le long de la marge du continent nord-américain, en position distale, ou associé à un bloc crustal séparé par rifting du protocontinent nord-américain. Les terranes de Slide Mountain et de Kootenay(?) ont été charriés sur le protocontinent nord-américain au Mésozoïque.

The narrow belt of rocks assigned to Quesnellia represents an Upper Triassic, and perhaps older, volcanic-plutonic arc assemblage overlain by a Lower Jurassic, clastic sedimentary sequence as much as 500 m thick. In one locality, granodiorite is host to an important copper deposit. Low grade nickel and chromite deposits are hosted by an Alaskan-type ultramafic body.

L'étroite bande de roches attribuées à la Quesnellie représente un assemblage d'arc volcano-plutonique du Trias précoce, ou peut-être de temps plus anciens, que surmonte une séquence de roches sédimentaires clastiques du Jurassique inférieur atteignant 500 m d'épaisseur. À un endroit, un massif de granodiorite est l'hôte d'un important gisement de cuivre. Des gîtes de nickel et de chromite à faible teneur sont encaissés dans des amas de roches ultramafiques de type alaskien.

The Cache Creek Terrane, dominantly oceanic in lithology but including some assemblages of island arc or oceanic rift affinity, is in part a mélange with accretionary wedge characteristics. The terrane, ranging in age from Devonian through Early Jurassic, has several distinctive units including Upper Paleozoic argillite, chert, greenstone, gabbro, and diorite, at least 1500 m thick; Permian volcanics, in places 500 m thick; Permian limestone, 300 to 600 m thick; a Lower Triassic volcanic-plutonic complex with bimodal volcanics as much as 1000 m thick; Upper Triassic limestone, locally 75 m thick; and Lower Jurassic greywacke at least 1500 m thick. All rocks have been strongly cleaved and many lithological contacts are along faults. Ultrabasic rocks host jade and asbestos deposits and are spatially related to numerous placer gold deposits. The island arc or oceanic rift volcanics host a large zinc and copper volcanogenic sulphide deposit.

Le terrane de Cache Creek, dans lequel les lithologies océaniques prédominent mais où des assemblages d'arc insulaire ou de rift océanique sont aussi présents, est en partie un mélange montrant les caractéristiques d'un dépôt de prisme d'accrétion. Le terrane, dont les lithologies varient en âge du Dévonien au Jurassique précoce inclusivement, contient plusieurs unités à l'aspect distinctif dont les suivantes : une succession du Paléozoïque supérieur d'au moins 1 500 m d'épaisseur formée d'argilite, de chert, de roches vertes, de gabbro et de diorite; une succession de roches volcaniques du Permien dont l'épaisseur atteint, par endroits, 500 m; une unité de calcaire du Permien, de 300 à 600 m d'épaisseur; un complexe volcano-plutonique du Trias précoce renfermant une séquence de roches volcaniques bimodale dont l'épaisseur peut atteindre 100 m; une unité de calcaire du Trias supérieur, dont l'épaisseur peut atteindre, par endroits, 75 m; et une succession de grauwacke du Jurassique inférieur d'au moins 1 500 m d'épaisseur. Toutes les roches montrent un clivage fortement développé et de nombreux contacts lithologiques se situent le long de failles. Des roches ultrabasiques renferment des gîtes de jade et d'amiante et sont spatialement associées à de nombreux placers aurifères. Les roches volcaniques d'arc insulaire ou de rift océanique renferment un vaste gisement de sulfures volcanogènes de zinc et de cuivre.

Volcanic, plutonic, and sedimentary rocks of Stikinia represent late Paleozoic to Lower Jurassic island arc assemblages. Permian strata, perhaps more than 500 m thick, include limestone, mafic volcanics, and fine grained clastics. The Triassic rocks are dominated by augite porphyry and coarse bladed feldspar porphyry with a distinctive Lower to Middle Triassic, fine grained sedimentary unit. The Upper Triassic volcanics and the overlying, maroon-weathering Upper Triassic and/or Lower Jurassic feldspar porphyry volcanics are more than 1000 m thick. Numerous Late Triassic and Early Jurassic plutons are associated with the volcanic rocks. In many places they, and the surrounding volcanic rocks contain copper occurrences. Lower Jurassic volcanics, greywacke, shale, conglomerate, and minor limestone are the youngest strata in Stikinia.

Les roches volcaniques, plutoniques et sédimentaires de la Stikinie représentent des assemblages d'arc insulaire du Paléozoïque supérieur-Jurassique inférieur. La succession permienne, dont l'épaisseur pourrait être supérieure à 500 m, renferme des calcaires, des roches volcaniques mafiques et des roches sédimentaires clastiques à grain fin. Les roches du Trias sont principalement constituées de porphyres à augite et de porphyres à lamelles grossières de feldspath, ainsi que d'une unité sédimentaire à grain fin du Trias inférieur-moyen d'aspect distinctif. Les roches volcaniques du Trias supérieur et les roches volcaniques à phénocristaux de feldspath susjacentes à patine de couleur marron du Trias supérieur ou du Jurassique inférieur montrent ensemble une épaisseur de plus de 1 000 m. De nombreux plutons du Trias tardif et du Jurassique précoce sont associés aux roches volcaniques. En plusieurs endroits, ces masses intrusives et les roches volcaniques qui les encaissent contiennent des indices de cuivre. La succession la plus récente de la Stikinie en est une du Jurassique inférieur formée de roches volcaniques, de grauwacke, de shale, de conglomérat et d'un peu de calcaire.

Overlap assemblages include numerous Middle Jurassic to Early Tertiary granitic plutons, a Middle to Upper(?) Jurassic sedimentary sequence in southeastern Cry Lake map area, Lower Cretaceous sedimentary rocks in and along the Grand Canyon of the Stikine, Lower Tertiary strata along and north of Tanzilla River and the upper reaches of the Nahlin River, and numerous Miocene to Recent volcanic flows and edifices. Late Cretaceous plutons are locally associated with molybdenum and copper deposits and the Early Tertiary sediments locally contain coal.

Three regional faults, Kechika, Kutcho, and Thibert are the loci of large, dextral offsets. The King Salmon Fault juxtaposes the Cache Creek Terrane on Stikinia. The physiographically conspicuous Pitman Fault and the Beady Range Fault each appear to have effected several kilometres of sinistral displacement.

Southwestward verging folds and related thrust faults of probable late Early to Middle Jurassic age are well displayed in Ancestral North American strata, in Cache Creek rocks and along the northern margin of Stikinia. The Kootenay(?) and Slide Mountain Terranes contain evidence of middle and late Paleozoic and Mesozoic tectonism. The regional, dextral, transcurrent faults were active in mid-Cretaceous through early Cenozoic time. Two sinistral faults postdate the emplacement of Early Cretaceous plutons and a significant normal fault in northern Stikinia is of early Cenozoic age.

Les assemblages de recouvrement, qui sont traversées de nombreux plutons granitiques du Jurassique moyen-Tertiaire précoce, se composent des unités suivantes : une séquence sédimentaire du Jurassique moyen-supérieur(?) dans le sud-est de la région cartographique du lac Cry; des roches sédimentaires du Crétacé inférieur à l'intérieur et en bordure du Grand canyon de la rivière Stikine; une succession du Tertiaire inférieur en bordure et au nord de la rivière Tanzilla et du cours supérieur de la rivière Nahlin; et, finalement, de nombreux édifices et coulées volcaniques du Miocène à l'Holocène. Des gîtes de molybdène et de cuivre sont localement associés à des plutons du Crétacé tardif, alors que des roches sédimentaires du Tertiaire inférieur contiennent localement du charbon.

Trois failles régionales (Kechika, Kutcho et Thibert) sont le lieu d'importants rejets transversaux dextres. La faille de King Salmon juxtapose le terrane de Cache Creek à la Stikinie. La faille de Pitman, qui montre une forte expression physiographique, et la faille de Beady Range semblent toutes les deux être le siège d'un déplacement senestre de plusieurs kilomètres.

Des plis et failles de chevauchement associées à vergence sud-ouest, dont la formation remonte probablement à la fin du Jurassique précoce ou au Jurassique moyen, sont en évidence dans les couches du protocontinent nord-américain, dans les roches du terrane de Cache Creek et le long de la marge nord de la Stikinie. Les terranes de Kootenay(?) et de Slide Mountain contiennent des indices d'activités tectoniques remontant au Paléozoïque moyen-tardif et au Mésozoïque. Des failles de coulissage dextres régionales ont été actives du Crétacé moyen au Cénozoïque précoce. Deux failles senestres se sont formées après la mise en place des plutons du Crétacé précoce et une faille normale d'importance dans le nord de la Stikinie date du Cénozoïque précoce.

INTRODUCTION

Cry Lake and Dease Lake map areas cover about 25 850 km^2 in north-central British Columbia bounded by north latitudes 58° and 59° and west latitudes 128° and 132° (Fig. 1). Since the early 1870s the region has been important for placer gold mining and big-game hunting. During the last twenty years the south-central part of Cry Lake map area has become one of the world's leading producers of jade. Significant deposits of copper, zinc, and asbestos have been discovered by mineral exploration geologists and the varied geology offers favourable conditions for occurrences of tungsten and lode gold. The magnificent Grand Canyon of the Stikine River and the spectacular alpine scenery of much of the Cry Lake map area have high potential for tourism.

Access

Highway 37 runs north-south near the boundary of Dease Lake and Cry Lake map areas. It connects the village of Dease Lake with the town of Cassiar, 73 km to the north and to the Alaska Highway, 157 km to the north. A somewhat tortuous motor road, 127 km long extends southwestward from the settlement of Dease Lake to Telegraph Creek, the head of navigation on Stikine River. A tractor road runs east from Highway 37 in Tanzilla River valley to Wheaton Creek in Turnagain River valley and beyond to Letain Lake, Provencher Lake, and Kutcho Creek.

The settlement of Dease Lake is the transportation, communications, and supply centre for the region. An asphalt airstrip 1829 m long lies on a broad terrace on the north side of Tanzilla River a few kilometres southwest of the settlement of Dease Lake. Helicopters and fixed-wing aircraft have been available for charter there for a number of years. Float-equipped, fixed-wing aircraft also can be chartered at a base at the south end of Dease Lake. Numerous large and well distributed lakes make most of the region accessible to float-equipped aircraft. A gravel airstrip which was in good condition during the early 1980s lies in the valley of Kutcho Creek about 15 km south of Rainbow Lakes. A shorter and less well graded airstrip has been constructed in the valley of Letain Creek about 4 km southwest of Wolverine Lake. Another airstrip suitable for small aircraft but little maintained is located just northwest of Sheslay in southwestern Dease Lake map area.

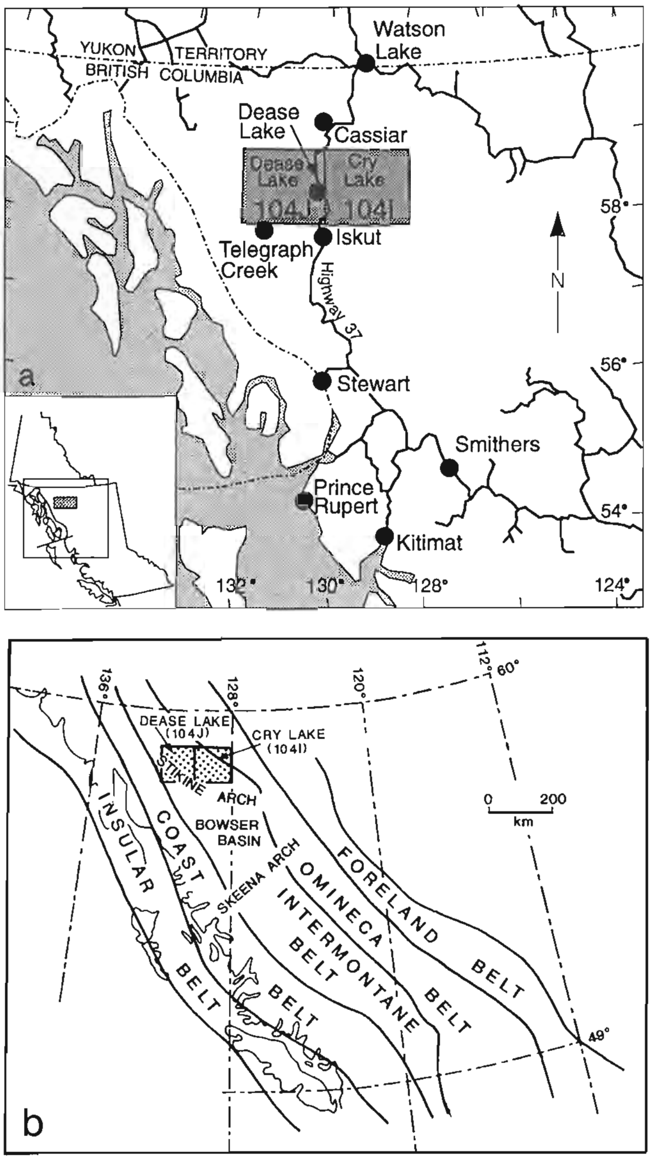

Figure 1. ***a)*** *Location map for Dease Lake (104J) and Cry Lake (104I) map areas and* ***b)*** *setting relative to the Cordilleran morphogeological belts.*

Travel by pack train is exceptionally easy throughout most of the region. Many high, open valleys provide excellent routes and abundant feed for horses.

Climate

Data concerning temperature and precipitation are summarized in Figure 2. The climate at Cassiar is probably similar to that in the Cassiar Mountains in Dease Lake and Cry Lake map areas, whereas that at Dease Lake is probably representative of much of Tanzilla Plateau. The Tanzilla River valley southwest of Cariboo Meadows occupies a dry belt in the rain shadow of the Coast Mountains and probably receives less than 350 mm of precipitation per year.

Dease Lake is normally free of ice during the last week in May or the first week in June. Generally, prospecting can be carried out on Tanzilla Plateau from May until October but, in the Cassiar Mountains, snow may hamper work before mid-June and after mid-September. Unsettled weather is common during the summer months when the region gets its maximum precipitation. On average the latter part of July until the end of August provides the best weather for travel in the high mountains. Occasionally September affords ideal conditions because of low water, pleasant temperatures, and relatively few insects. The use of aircraft may be hampered by frequent showers and gusty winds, and by morning fog after the middle of August in many of the major valleys.

Flora and fauna

Timber line ranges from about 1400 to 1600 m (4593 to 5249 ft.) above sea level but good stands of timber are generally restricted to much lower elevations along the main river valleys. White spruce and cottonwood, the largest trees, grow mainly in the valley bottoms whereas lodgepole pine, trembling aspen, and minor birch are found commonly on flanking gravel and sand terraces.

Many valleys between elevations of about 1070 and 1370 m (3500 and 4500 ft.) support the growth of grasses and sedges and, in some cases, extensive areas of dwarf birch and willow ("buck brush"). Dwarf birch and willow are abundant on parts of Kawdy Plateau but some of the thickest stands occur in the valley of Eaglehead Lake and upper Eagle River. Verbal reports suggest that there has been a rapid acceleration in the growth of the dwarf varieties during the last 50 years. Balsam fir is locally abundant near timber line and clumps of these trees provide scenic and protected camp sites.

Remarkable growths of juniper occur along the north bank of the Grand Canyon of the Stikine River and in the dry valley southwest of Cariboo Meadows. Many varieties of this bush grow in luxuriant clumps spectacular not only in colour but in their large dimension. With the juniper in the valleys of Stikine, Tanzilla, and Tuya rivers is sagebrush seen elsewhere only along the south-facing dry slopes along Major Hart River and the lower reaches of Turnagain River.

Edible wild fruits include raspberry, strawberry, cranberry, several varieties of blueberry, and saskatoon (service berry).

Big-game animals include moose; caribou (Osborne); black, brown, and grizzly bear; stone sheep; and goat. Smaller animals of importance are wolf, beaver, marten, fisher, mink, wolverine, fox, hoary marmot, ground squirrel, muskrat, and lemming. There appears to have been a marked decline in the numbers of moose and caribou since 1950. Part of the decline in the moose population may be attributed to the enhanced access by aircraft and all-terrain vehicles which permit residents of British Columbia to hunt in much of the region. Big-game hunting under the control of guides is probably not a large factor. G.C.F. Dalziel (pers. comm., 1960) suggested that the caribou population may have suffered from the rapid growth of scrub birch and willow which limited grazing and

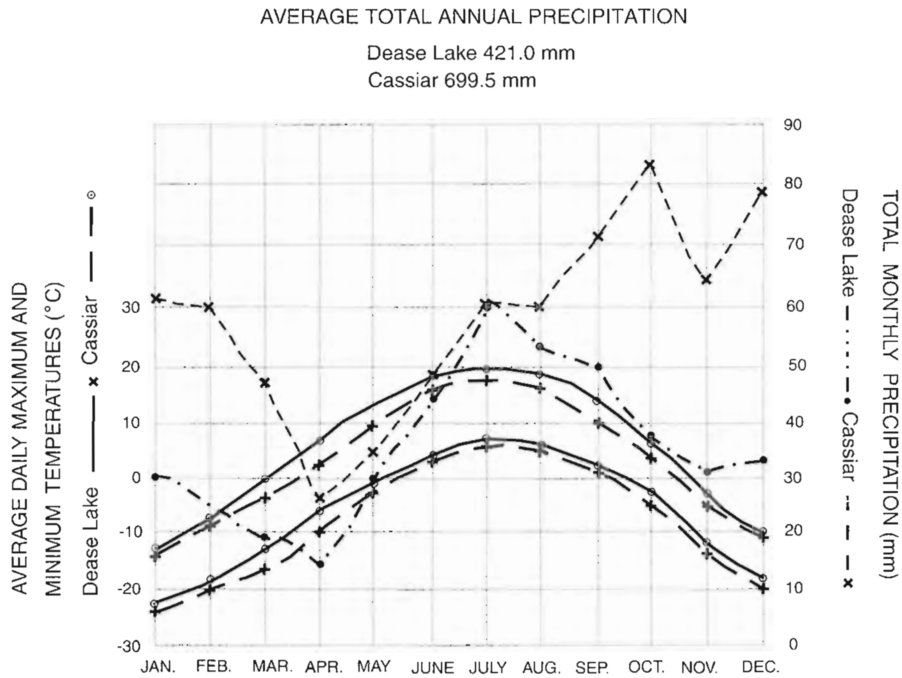

Figure 2. *Average daily minimum and maximum temperatures, and average total monthly precipitation for Dease Lake and Cassiar. Data for Cassiar collected from 1954 to 1990 and for Dease Lake from 1944 to 1990 (Canadian Climate Normals, Department of the Environment, Canada).*

afforded cover for predators. This may be particularly true for the large upland areas on the Kawdy Plateau and in the Eaglehead and Snowdrift Creek valleys which once sustained large herds.

Ptarmigan are most abundant on Kawdy Plateau but are common everywhere at higher elevations. Franklin's grouse (spruce hen), blue grouse, and ruffed grouse are plentiful in some areas below timber line. A wide variety of waterfowl includes ducks (mallard, Barrow's golden-eye, merganser, harlequin, teal, and scoter), geese, loons, grebes (Holboell's), and terns.

Grayling, lake trout, Dolly Varden, and whitefish are common in the lakes and rivers. Rainbow trout abound in Letain and Rainbow lakes on the Arctic drainage and in Hottah Lake on the Pacific drainage.

History

In 1824 Samuel Black, in the employ of the Hudson's Bay Company, travelled westward from Rocky Mountain Portage in the Peace River area and explored the headwaters of Finlay River (Rich, 1955). During this trip he entered the Cry Lake map area southeast of Hottah Lake and eventually reached Turnagain River about 13 km east of the pass to Major Hart River.

In 1834 J.M. McLeod of the Hudson's Bay Company explored Liard River upstream from Fort Halkett near the mouth of Smith River to the mouth of Dease River and then ascended Dease River to Dease Lake. He named the lake and river after Peter Warren Dease, the Arctic explorer (Dawson, 1889). Robert Campbell, also with the same company, attempted to establish a trading post at Dease Lake in 1838 but the post was abandoned in 1839 following a winter of extreme hardship.

A great surge of activity in the area was precipitated by the discovery of placer gold on Thibert Creek in 1873. By 1874 an estimated 1500 people had reached the country and during part of 1876 the population was estimated at 2000 (Dawson, 1889).

Placer gold was discovered on Dease Creek in 1873 and the town of Laketon was built at the mouth of the creek in 1874. Following the discovery and mining of gold on Defot Creek in 1878 production steadily declined and the number of miners in the district decreased.

G.M. Dawson (1889), W. Pike (1896), and C. Camsell (1954) described travel in the Dease Lake area before the turn of the century. In addition, Dawson's account contains one of the best summaries of the history of the region to 1887. A useful reference to placer-gold mining during the period between 1860 and 1880 is contained in a thesis by Trueman (1935). His work described not only the history of placer mining but many of the details of life in the region at that time. R.M. Patterson (1966) gave an excellent description of a trip from Wrangell up the Stikine River to Telegraph Creek, over the road from Telegraph Creek to Dease Lake, and down Dease Lake and Dease River by canoe to Lower Post on Liard River. His book contains a number of historical notes concerning residents and travellers during the latter part of the nineteenth century and the first half of the twentieth century.

Hydraulic mining for placer gold was carried out on Thibert Creek between 1901 and 1922 except for a six-year period when operations were suspended (Johnston, 1925). Small scale mining exploration on Dease Creek has continued to the present and recently there has been renewed placer mining activity on Thibert and Defot creeks. A resurgence of placer mining activity accompanied the discovery of placer gold on Goldpan Creek in 1924. This led to the construction of a motor vehicle road from Telegraph Creek to Dease Lake to facilitate transportation of equipment and supplies. Wheaton Creek gold placers have been the most productive in the region since their discovery in 1932. In 1937 a gold nugget (1477 grams), one of the largest ever found in British Columbia, was discovered on Alice Shea Creek, a tributary to Wheaton Creek (Holland, 1940).

Construction of the airport at Watson Lake, Yukon Territory, in 1941 brought increased activity to the area as equipment for this project was transported by vehicle from Telegraph Creek to Dease Lake and then by barge down Dease Lake and Dease River to Lower Post. The importance of this route ceased with completion of the Alaska Highway in 1943.

In 1973 Highway 37 linked Dease Lake to the south with Stewart at the head of Portland Canal and Kitwanga on Skeena River and Highway 16. The highway greatly changed transportation patterns between central British Columbia and Yukon Territory and Alaska. The result has been a large increase in travel within the region and much easier access for mining exploration companies, tourists, and fishing and hunting enthusiasts.

Industries

Placer gold and jade mining have been the main industries in the region. Trapping for furs has provided income for a limited number of people as has big-game hunting for a small number of guides and outfitters. Most income is derived from the role played by Dease Lake in transportation, communications, and supply. Tourism now is important to the economy and presumably will increase as Highway 37 is improved.

Previous geological investigations

In 1887 G.M. Dawson (1889) traversed the route from Telegraph Creek to Dease Lake and then travelled down Dease River to Lower Post on Liard River. Dawson gave the name 'Cassiar' to the prominent mountain range cut by Dease River. He also introduced the names 'Hotailuh' after the Indian name for the mountains southeast of Tanzilla River and 'McLeod', for the prominent mountain on the west side of Dease Lake. Dawson described in some detail the relationships between lava flows and river gravels near the mouth of Tahltan River.

F.A. Kerr (1925) undertook the first geological bedrock mapping near Dease Lake. His studies were concerned mainly with the geology along Dease Lake; Dease, Thibert, and Canyon creeks; and in the French Range. He discovered the remarkable Permian fauna of the French Range identified by E.M. Kindle as resembling that of the Salt Range fauna of India. In conjunction with Kerr's work, W.A. Johnston (1925) examined placer deposits of the Dease Lake area and described the surficial geology.

George Hanson and D.A. McNaughton (1936) carried out geological reconnaissance mapping in the western part of Cry Lake map area. They introduced the terms 'Cassiar' and 'Hotailuh' for two of the large granitic batholiths in the area. They perpetuated the use of the stratigraphic terms 'Dease Series' and 'McLeod Series' for dominantly sedimentary rocks presumed to be of Paleozoic age and dominantly volcanic rocks of presumed Mesozoic age, respectively. This nomenclature, proposed by Kerr (1925), has been abandoned because it suggested correlation of rocks subsequently known to be of widely different age and lithology.

Following investigations mentioned above by officers of the Geological Survey of Canada, parts of the map areas were mapped by parties under the direction of the British Columbia Department of Mines. During the summer of 1939, S.S. Holland (1940) carried out a detailed examination of placer deposits in the Wheaton Creek area. He deduced correctly that the dominant ice movement had been from south to north and described the extent of late Tertiary rejuvenation of the drainage system. M.S. Hedley and S.S. Holland (1941) traversed part of eastern Cry Lake map area in their reconnaissance of the upper Kechika and Turnagain rivers. Their map, bordering on that produced by Hanson and McNaughton, afforded a general physiographic and geological cross-section of the Cassiar Mountains. In 1943 K. de P. Watson and W.H. Mathews (1944) mapped the Tuya-Teslin area which included a small part of the northern Dease Lake map area. Their report contains an excellent account of glacial and volcanic features which extend into Dease Lake map area. It also formed the basis for the stratigraphic nomenclature used for similar rocks in subsequent studies of the region to the southeast.

Annual reports of the British Columbia Department of Mines contain details of placer-mining operations in the district dating back to 1875.

Current geological investigations

This report represents a compilation of data obtained mainly by the Geological Survey of Canada between 1956 and 1991. During the 1956 field season the map areas were mapped as part of 'Operation Stikine' which covered an area of about 78 000 km^2 in northwestern British Columbia (Geological Survey of Canada, 1957). This vast reconnaissance survey employed more than 50 personnel and utilized fixed-wing aircraft, helicopters, and pack trains for transportation. Most of the work done in Dease Lake and Cry Lake map areas was supported by two pack trains under supervision of the author. The results of these investigations supplemented by further work by E.F. Roots in 1958, J.G. Souther in 1961, and the author in 1957, 1960, and 1961 were published as revised maps for the two map areas (Gabrielse and Souther, 1962; Gabrielse, 1962b). The revised Cry Lake map also contained information obtained in a Ph.D. study in the Major Hart and Turnagain river areas by B.S. Norford (1959).

J.W.H. Monger studied the stratigraphy and structure of the Cache Creek Complex rocks in and bordering the French Range in 1966. He was the first to apply the term Cache Creek to the upper Paleozoic strata of the region and his research led eventually to the recognition that the Cache Creek oceanic succession contained a Tethyan fusulinid fauna anomalous to bordering regions in the Cordillera (Monger, 1969).

Three weeks were spent, with helicopter support, by the author in the area in 1967.

In 1971 and 1972 T. Clark mapped the Turnagain ultramafic body as part of a Ph.D. thesis project (Clark, 1980).

An increasing awareness of the potential for lode mineral deposits in the region resulted in the project 'Operation Dease' designed to produce modern 1:250 000 geological maps for Dease Lake, Cry Lake, and Spatsizi (104H) map areas. Preliminary, revised maps for these areas have been published (Gabrielse et al., 1979, 1980; Gabrielse and Tipper, 1984; Evenchick, 1993). Spatsizi map area has now been transferred to the 'Bowser Basin' project under the direction of C.A. Evenchick. Fieldwork for Operation Dease was supported by helicopter and fixed-wing aircraft during the summers of 1977, 1979, 1981, and 1983. A detailed study of the Hotailuh batholith was carried out by R.G. Anderson during the summers of 1977 to 1979 (Anderson, 1983). H.W. Tipper studied Jurassic stratigraphy and biostratigraphy, particularly in the area southeast of Turnagain Lake, in 1977. J.W.H. Monger devoted parts of the 1977 and 1979 field seasons to research of the Cache Creek Terrane in Dease Lake and Cry Lake map areas. L.E. Thorstad examined the Kutcho Formation in southeastern Cry Lake map area during the summers of 1977 to 1979 (Thorstad and Gabrielse, 1986) and T.A. Harms studied the Sylvester Allochthon during the summers of 1983 and 1984 and for brief periods in the field seasons of 1985 and 1986 (Harms, 1986). S.F. Leaming mapped jade deposits from 1977 to 1981 and included a preliminary discussion of his results in a publication on jade in Canada (1978). Specific investigations were carried out by W.H. Fritz on Cambrian stratigraphy in 1977, by N. Irvine on the Turnagain ultramafic body and B.S. Norford on Ordovician and Silurian stratigraphy in 1979, and by H. Geldsetzer on Devonian stratigraphy in 1983. J.L. Mansy conducted stratigraphic and structural work, mainly in the northeastern part of Cry Lake map area, as part of a regional synthesis of Precambrian and Cambrian stratigraphy in the Cassiar and Omineca mountains (Mansy, 1986). Limited fieldwork was done by the writer on selected areas during the 1985, 1988, 1989, and 1991 field seasons.

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PHYSIOGRAPHY AND GLACIATION

Physiography

The two map areas include parts of three major physiographic elements in the Canadian Cordillera. These are the Kaska Mountains represented by the Cassiar Mountains; the Stikine Plateau represented by the Spatsizi, Tanzilla, and Taku plateaus; and the Coast Mountains represented by the Boundary Ranges (Fig. 3; Mathews, 1986). Most of Cry Lake map area lies within the Cassiar Mountains, a moderately rugged, mountainous region with a local relief of as much as 1370 m (Fig. 4). Dease Lake map area, on the other hand, lies mainly within the Taku and Tanzilla plateaus, a region of generally subdued topography (Fig. 5).

Cassiar Mountains are characterized by irregular mountain masses deeply dissected by stream valleys and glacial cirques. Particularly rugged topography commonly reflects the presence of underlying granitic or volcanic rocks. The highest point in the Cassiar Mountains within the map areas is King Mountain with an elevation of 2425 m. A number of peaks exceed 2280 m in elevation but the mean summit level approximates 1980 m. The mountain masses are separated either by deeply incised valleys occupied by the main streams or by high level, broadly flaring valleys such as those in the areas southwest of Cry Lake and the upper reaches of Eagle River and in the upper Turnagain River drainage area.

The contrast between Cassiar Mountains and Stikine Plateau is sharp, especially northeast of Dease Lake. There the plateau is a generally low-lying, timbered area with numerous lakes. In the southeastern part of Cry Lake map area the Cassiar Mountains merge with the low-lying, timbered area of the Spatsizi Plateau. West and southwest of Dease Lake a number of mountain masses in Tanzilla Plateau rise to more than 1800 m in elevation but they are much less rugged than those in Cassiar Mountains and are surrounded by broad areas of gently rolling topography. The northwestern part of Tanzilla Plateau in the Dease Lake map area is a gently undulating surface upon which the spectacular Miocene and younger volcanic cones have been constructed.

The western part of Dease Lake map area is dominated by the Level Mountain massif a vast, shield-like volcanic edifice also of Miocene and younger age.

The jagged, glacier-hung Boundary Ranges occupy only a small part of southwestern Dease Lake map area. The boundary between these ranges and the plateau to the east is abrupt and spectacular.

The divide between Arctic and Pacific drainage trends southerly through the eastern part of Dease Lake map area and then swings eastward, passing just south of Dease and Turnagain lakes. The major streams occupy deep, broad, U-shaped valleys, some of which cut directly through the Cassiar Mountains. Perhaps the most remarkable valley is

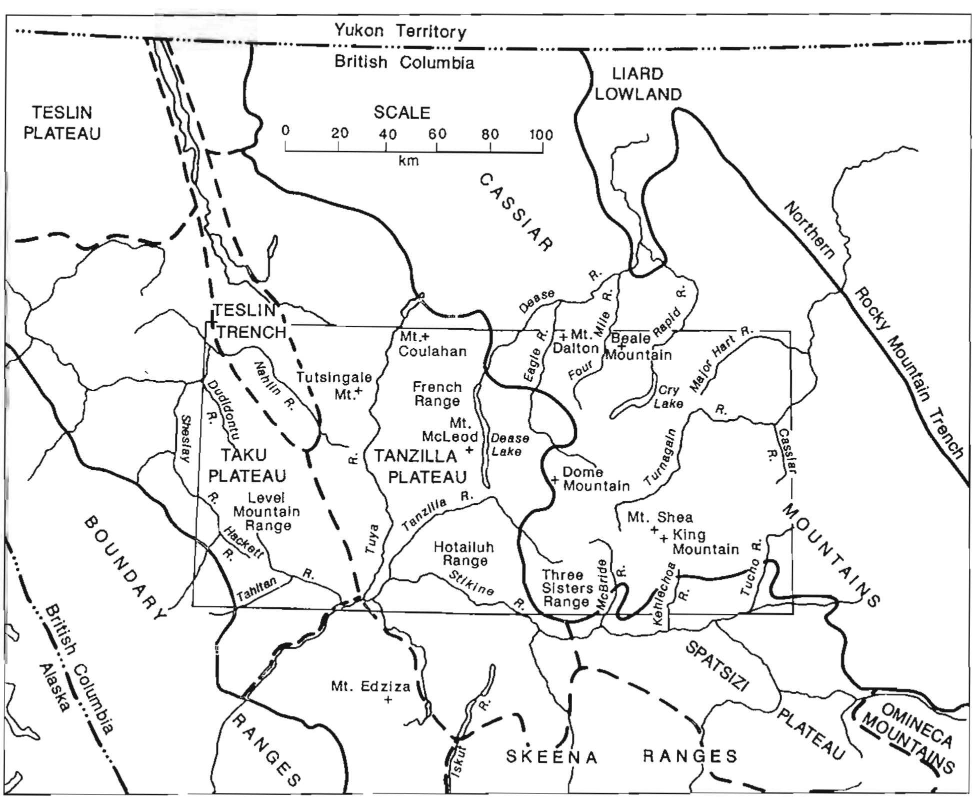


Figure 3. *Physiographic map of Dease Lake and Cry Lake map areas and surrounding regions. Major subdivisions taken from Mathews (1986).*

Figure 4.

View southerly from a locality about 5 km north of the central part of Cry Lake over typical topography in the Stikine Ranges. Note the high level esker at an elevation of 1450 m. GSC 1996-125CCC

Figure 5.

View north over Cody Lakes in east-central Dease Lake map area showing typical subdued topography of the Stikine Plateau. Dark ridges in the French Range are underlain by the Permian French Range Formation. Photograph by J.W.H. Monger. GSC 1996-125BBB

occupied by Dease Lake. This deeply incised, trough-like feature trends north in Tanzilla Plateau and, linked with the Dease River valley to the north, constitutes one of the lowest passes through the western Cordillera. Kerr (1925) reported a measured depth of Dease Lake southeast of Steamboat Point (just south of Porter Landing) as 116 m. To the north the depth decreases rapidly and to the south as far as the mouth of Dease Creek, it ranges irregularly between 110 and 55 m. From Laketon to Gull Rock near Nine Mile Point the lake is, in most places, more than 90 m deep and averages 76 m for the next 4.8 km to the south. The depth then gradually shallows toward the south end of the lake.

The upper part of Eagle River occupies a broad, flaring valley but north of its junction with Little Eagle River it lies in a deep, north-trending U-shaped trough like that containing Dease Lake to the west and the lower part of Four Mile River to the east. Rapid River flows in a U-shaped valley continuous with the valley occupied by Cry Lake. Similar to the aforementioned streams it is evenly graded throughout.

The upper, broad valley of Turnagain River is continuous with a wide valley occupied by Major Hart River. East of the pass to Major Hart River, Turnagain River has cut a steep canyon marked by numerous rapids and falls. The stream then flows northeastward in another broad valley beyond its confluence with Cassiar River.

The upper courses of Four Mile and Cassiar rivers present a youthful appearance being deeply incised and locally floored by bedrock. The upper tributaries of Cassiar River lie in valleys that connect with the valleys of Rainbow and Hottah lakes.

Tucho, Kehlechoa, and McBride rivers flow southward in prominent valleys from their headwaters in Cassiar Mountains.

Tanzilla River is a graded stream flowing in an open valley for much of its length. Near Stikine River, however, it has cut a deep, steep-sided canyon.

Figure 6.

View easterly from east of the confluence of Tanzilla and Stikine rivers over the Tanzilla Plateau showing the deeply incised Grand Canyon of the Stikine. Light coloured rocks in the canyon are part of the Lower Cretaceous Tango Creek Formation which unconformably overlie dark-weathering Triassic rocks of the Stuhini Group north of the canyon. Photograph by C.A. Evenchick. GSC 1996-125AAA

The Grand Canyon of the Stikine River is a remarkable, extremely youthful gorge through which the river flows with incredible velocity and turbulence (Fig. 6). The valley east of the canyon is broad and has a gentle gradient.

Tuya River occupies a broad, open valley in which, for the most part, it is deeply incised.

The Tahltan River lies in an east-southeast-trending open valley continuous with that of the Hackett and Sheslay rivers to the northwest. It enters the Stikine River through a deep, steep-sided gorge cut in part through young volcanic flows.

The headwaters of the Dudidontu River lie in a broad valley west of Level Mountain but to the northwest the river has cut an impressive gorge to its junction with the Nahlin River. The upper reaches of the Nahlin River occupy a wide valley continuous with the Teslin Trench to the northwest (Mathews, 1986).

No detailed study of the physiographic evolution of the region has been attempted. Some of the more obvious aspects of topographic and drainage development are discussed below.

It is clear that the extensive, Miocene or earlier surface that underlies the northwestern part of the Tanzilla Plateau was the product of a long period of erosion. That it may have been as old as Eocene is suggested by the presence of overlying Eocene nonmarine sediments along the Nahlin River in the Teslin Trench and the lower part of the Tuya River. It is unlikely that these rocks would have been preserved if widespread peneplanation had occurred later. The nature of Eocene sediments along the lower part of the Tanzilla River show that the area to the southeast was uplifted during that time along northeast-trending faults. The base of the Miocene and younger lavas on Level Mountain and on Heart Peaks is generally a little above 1200 m. This is similar to the elevation of the surface below the volcanic cones on the Tanzilla Plateau and it is likely that the two surfaces were co-extensive. The base of the lavas is about 1070 m along the Teslin Trench and in the area near Sheslay. The change in elevation could be explained either by pre-existing relief on the erosion surface, in which case the Teslin Trench and perhaps the Sheslay-Hackett river valleys were already present, or by doming of the Level Mountain massif during volcanism.

The Grand Canyon of the Stikine River may have resulted from a disruption by late Tertiary volcanism of an earlier Tertiary drainage when the river flowed southerly and was part of the Iskut River system. According to this hypothesis the river was dammed by volcanic rocks northeast of Mount Edziza (Geological Survey of Canada, 1957) and was forced to cut a channel to the northwest. The steep canyon cut by Tanzilla River near its confluence would be a natural consequence of the diversion.

The great trough occupied by Dease Lake must have been sculpted by a major stream before Pleistocene time although its form was strongly modified by ice action. It seems probable that the Tanzilla River once flowed north into the Dease Lake valley. The river is separated from the lake by a low gravel terrace where it swings sharply to the southwest. Extrapolating from a suggestion by Kerr (1948) it is possible that in the early Tertiary the part of Stikine River northeast of the mouth of Chutine River drained towards the interior, perhaps creating the large valleys of Tanzilla River and Dease Lake. On the other hand, Johnston (1925) observed that the high level bedrock channel of Thibert Creek, where it enters the Dease River valley, is about 30 m higher than the similar channel on Dease Creek. He proposed the possibility, therefore, that the late Tertiary flow of the trunk stream in the Dease valley may have been to the south.

The youthful character of Turnagain River downstream from the pass to Major Hart River indicates that the drainage of the Turnagain was diverted from its earlier course through the pass, possibly by capture by a more vigorous stream tributary to Cassiar River. Holland (1940) presented evidence for late Tertiary rejuvenation of the upper Turnagain River valley which resulted in downcutting by the river of about 150 m. Wheaton Creek and nearby creeks now bear a hanging relationship to the main stream although this could be the result, partly, of overdeepening of the main valley by glaciation.

Considerable relief must have been present in the Cassiar Mountains during the Eocene because coarse conglomerate of about that age was deposited along the Kechika Fault. Clasts in the conglomerate include lithologies clearly derived from the Sylvester Allochthon to the west. The uplift coincided with a period of plutonism and, locally, volcanism.

Glaciation

Pleistocene glaciation has greatly modified the preglacial topography of the region. The characteristic ruggedness of Cassiar Mountains results largely from the affects of alpine glaciation. Numerous lakes are a consequence of damming by deposits of late stage valley ice. On the other hand, many local features of erosional and depositional origin owe their presence to the advance and retreat of one or more ice sheets. Johnston (1925) presented evidence for two advances of ice in the Dease and Thibert creeks area. Hanson and McNaughton (1936) also inferred two ice advances from the presence of glaciated volcanic cones on fresh, and thus presumably glaciated, surfaces near Eagle River.

Features of ice movement

It is clear that a major ice sheet advanced in a general northward to northeastward direction in Cry Lake map area and northward to west-northwestward in Dease Lake map area (Fig. 7, 8, in pocket). From evidence in the Hotailuh Range, on Mount McLeod, Johnson Knolls, and Mount Coulahan the latest movement of an ice sheet in eastern Dease Lake map area was almost directly northward. In the western part of the Hotailuh Range and in the French Range the direction was to the northwest and in the northern part of the Tanzilla Plateau the flow was almost directly west. The presence of strongly developed glacial grooves shows that the ice level reached a level above 1675 m in the Level Mountain Range and on Heart Peaks. Tutsingale Mountain, elevation 1728 m, was completely covered by westward moving ice as was Nuthinaw Mountain to the west (Fig. 9). Glacial erratics are abundant on the north ridge of Kawdy Mountain to above 1675 m. On the other hand, the volcanic edifice at the headwaters of the Teslin River in northernmost Dease Lake map area seems to have been constructed largely upon a previously glaciated surface (Fig. 10). At lower levels along the Teslin Trench and in the valley at the headwaters of the Dudidontu River, ice movement was northwest and north, respectively (Fig. 11).

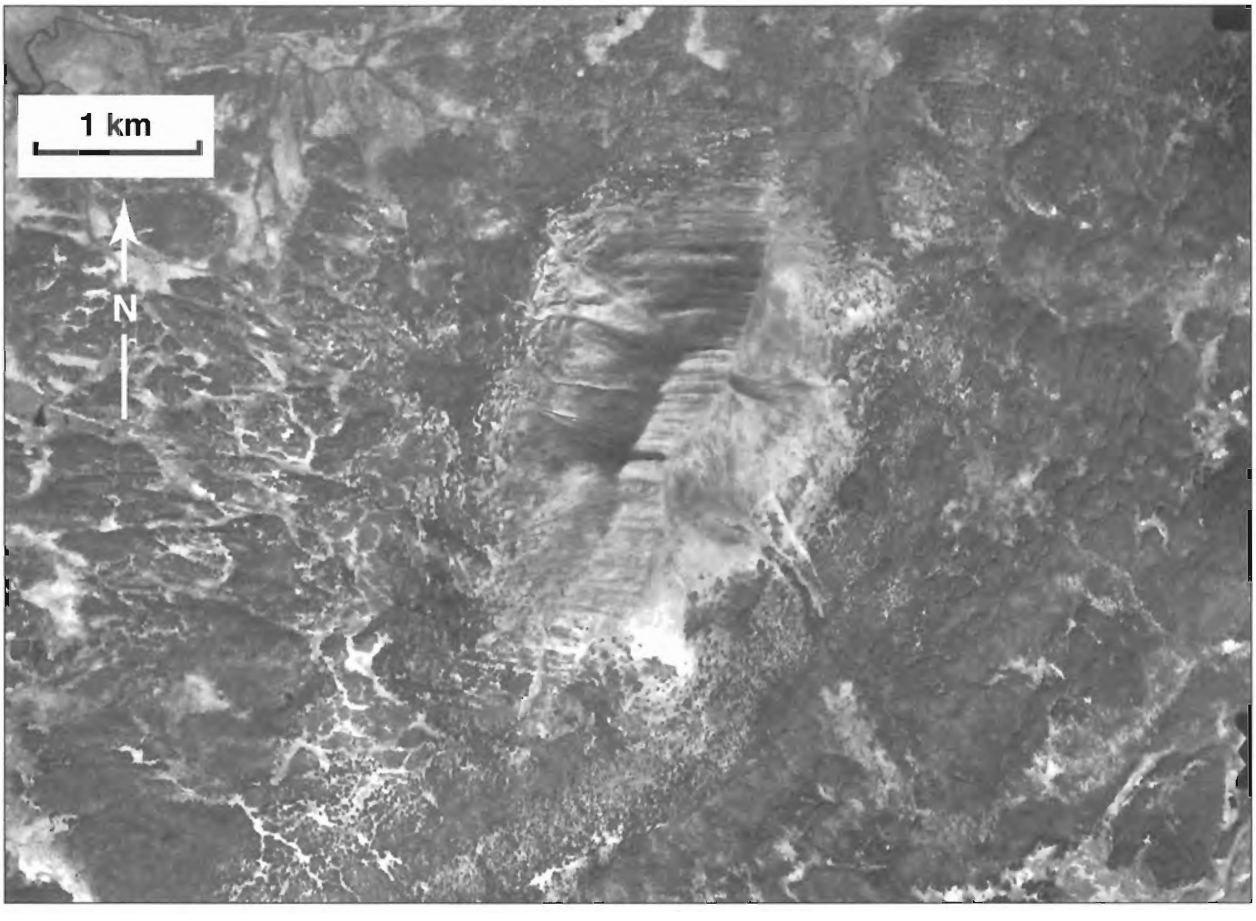


Figure 9. *British Columbia air photograph 5623 039 showing strongly grooved volcanics of the Tuya Formation on Tutsingale Mountain, elevation 1860 m, Dease Lake (104J) map area.*

East of Dease Lake glacial grooves are evident on Mount Dalton and Beale Mountain to elevations of more than 1980 m. Glacial erratics and glacial grooves are present on many summits above an elevation of 1825 m and Holland (1940) reported glacial erratics on the top of Mount Shea, elevation 2002 m. Granitic erratics were noted on a ridge at elevation 2024 m about 5 km east-southeast of the east end of Beale Lake. Grooves are especially well developed between Dease Lake and Dease River valley and Four Mile River valley but are also conspicuous elsewhere (Fig. 11). Southerly derived glacial erratics from strata of the Bowser Lake and Sustut groups abound in southeastern Cry Lake map area.

Erosion by the ice sheet does not appear to have effected major changes in pre-Pleistocene topography. Except for the truncation of spurs and the widening and deepening of valleys, the main evidence of ice erosion lies in the general rounding, grooving, and plucking of outcrops.

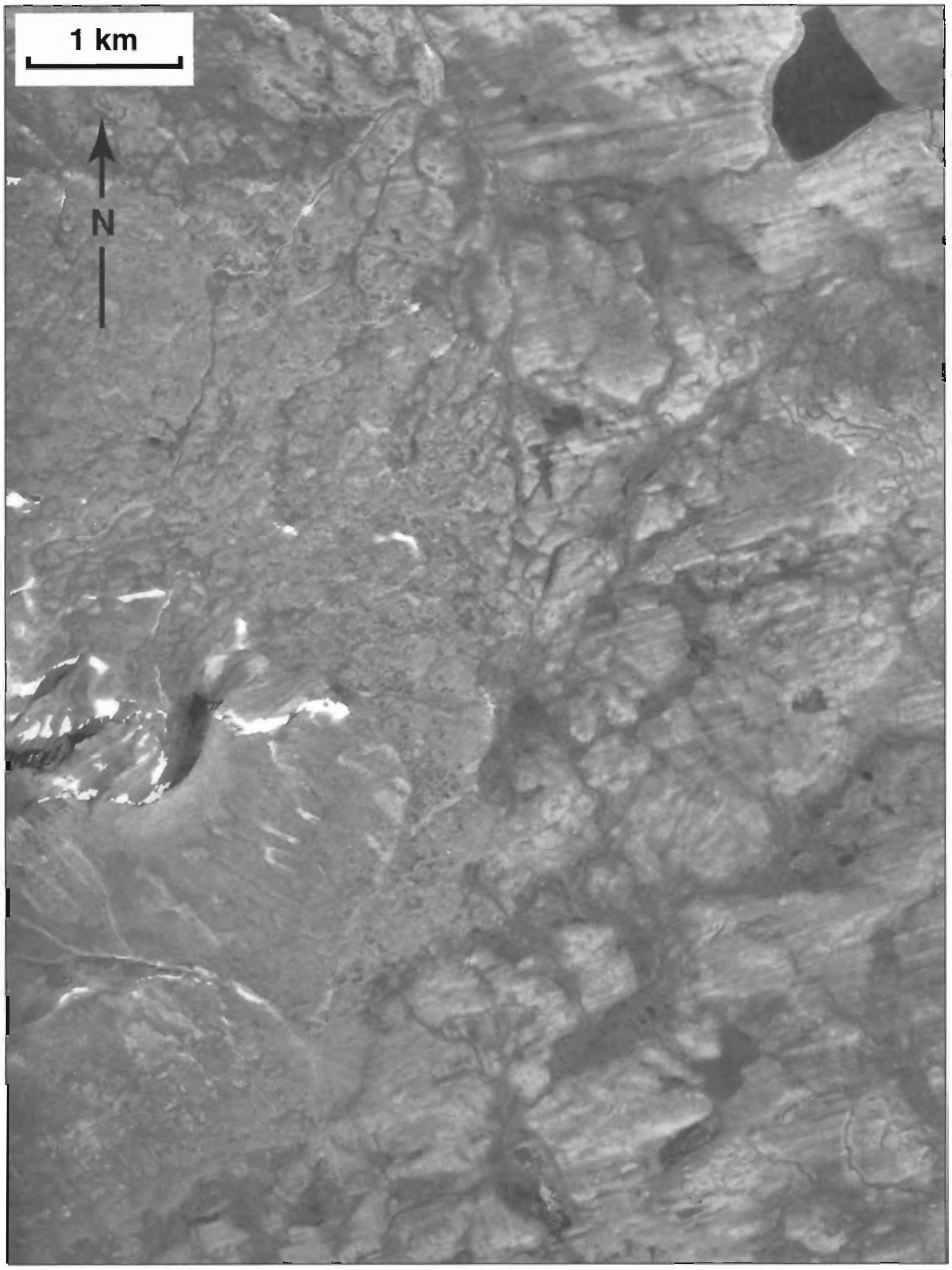


Figure 10. *Volcanic edifice 10 km north-northeast of Kawdy Mountain apparently constructed on strongly grooved surface of the Kawdy Plateau. British Columbia air photograph 5680 135.*

In summary, evidence of ice sculpture and the distribution of erratics point to a major centre of ice accumulation south of the map areas, perhaps in the Skeena Mountains and eastern Boundary Ranges. Combined with information from the north in Jennings River (Watson and Mathews, 1944; Gabrielse, 1969) and McDame (Gabrielse, 1963) map areas the data suggest that a northerly trending ice divide along the western side of the Cassiar Mountains separated westward- from northward- and eastward-flowing ice.

Features of deglaciation

Abandoned stream channels ranging from inconspicuous, shallow, grassy valleys along hillsides to spectacular, deep, steep walled gorges incised in bedrock provide information on the waning stages of glaciation. Gradients of abandoned channels show that in general the ice sheet retreated southward. As the thickness of ice decreased, meltwater at first cut channels directly across ridges (direct overflow channels). Later, when the ice was confined almost entirely to valleys,

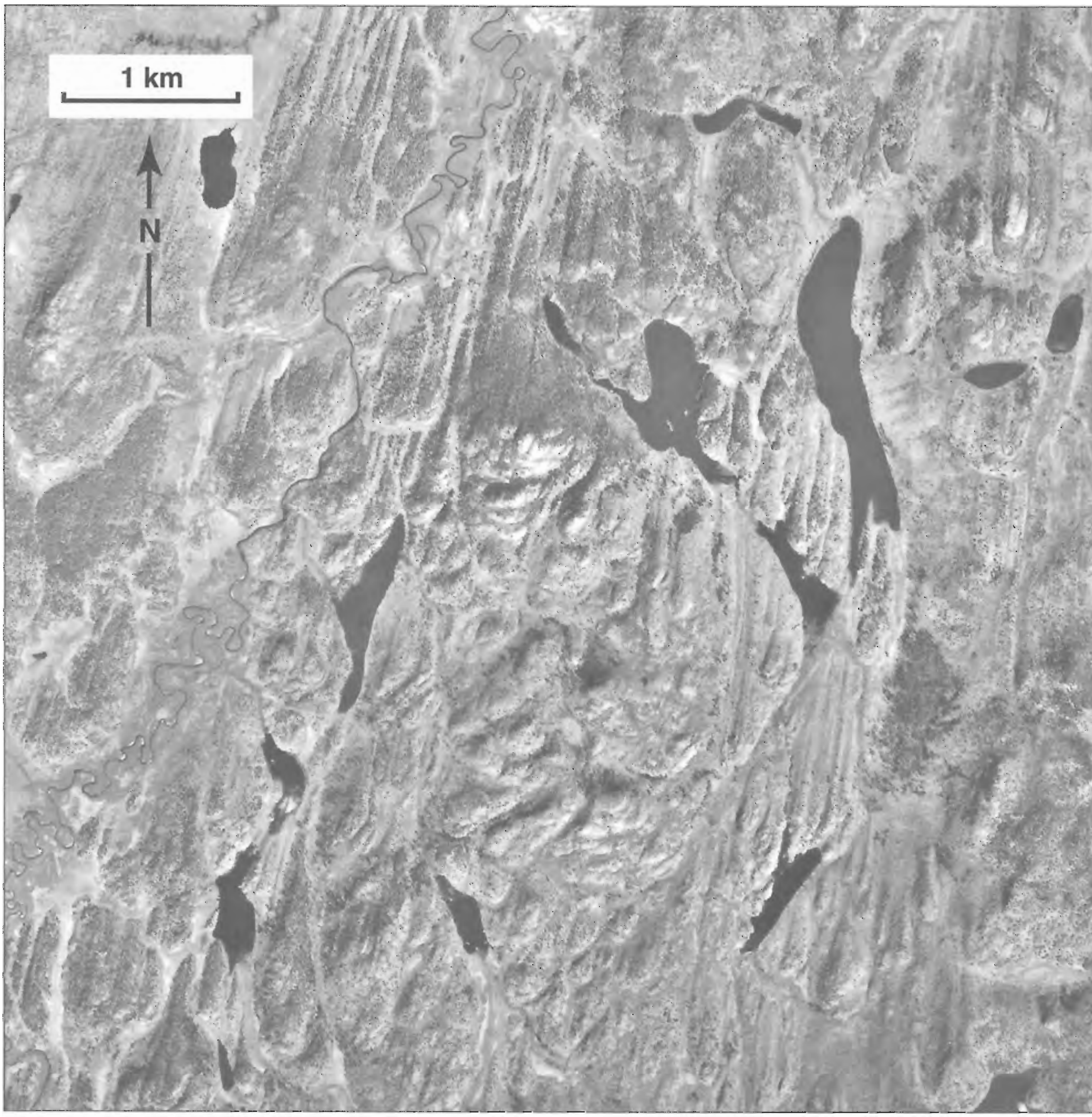


Figure 11. Drumlinoid ridges in bedrock along the upper reaches of the Dudidontu River in northwestern Dease Lake (104J) map area. Note the characteristic steep-facing southern slopes and the long northerly sloping tails indicating late ice movement to the north. This direction of ice movement resulted when ice was restricted to the Dudidontu River valley and is almost at right angles to the earlier, high level, westerly ice movement. RCAF air photograph A 12110 230.

channels were cut in valley sides along the margins of the ice. The channels commonly occur in parallel sequences, each lower channel representing an adjustment of drainage to the retreating ice. Parallel sequences of abandoned channels are particularly well displayed on the northwest side of the Three Sisters Range, on the northern Tanzilla Plateau (Fig. 12), on the southwest side of Level Mountain Range, and on the east flank of Heart Peaks.

Kame terraces at four distinct levels between elevations of 1370 m and 1525 m are seen on a northeast-facing valley wall 9 km south of Dome Mountain (Fig. 13). The two highest levels are linked directly to overflow channels cutting the ridge top and lead northeastward to eskers at the valley divide. Sets of terraces at slightly lower elevations occur northeast of Dome Mountain and east of Eaglehead Lake. When ice was confined mainly to the major valleys and low-lying areas, deposition from meltwater streams formed extensive sand and gravel deposits. The valleys are characteristically wide and flat bottomed. The outwash material is commonly terraced and locally pitted. Good examples showing these phenomena are the valleys of upper Thibert Creek, Little Dease Creek, Snowdrift Creek, upper Eagle River and Eaglehead Lake, the valley between Hard and Cry lakes, and the valley west of Beale Lake. Hummocky outwash material in the upper valley of the Dudidontu River occurs below an elevations of 1525 m. Most, if not all, of the lakes in the region owe their existence to the damming effect of glacial outwash in the valleys.

Figure 12. Ice marginal drainage channels and morainal ridges on Tanzilla Plateau east of Tuya River along the northern boundary of Dease Lake map area. British Columbia air photograph 5680 126.

Alpine glaciation

Features typical of alpine glaciation are abundant in Cassiar Mountains but farther west are present only near the crest of the Level Mountain Range and in the Boundary Ranges. The only remaining alpine glaciers are on the north side of King Mountain at the head of Ferry Creek and in the Boundary Ranges.

Cirques, generally facing northward, and intervening sharp crested, serrated aretes contribute to the rugged topography in parts of the Three Sisters Range, the range southwest of Hottah Lake, and the Boundary Ranges. It is evident that cirques in these areas have been active since the retreat of the last ice sheet. Similarly, the presence of lateral and terminal moraines near the crest of the Level Mountain Range attest to late-stage alpine glaciation. It is also evident, however, that the formation of high-level cirques generally preceded the last advance of an ice sheet. Many cirques are flanked by rounded and grooved ridges and, in addition, contain minor glacial deposits. Valley moraines are insignificant, further suggesting that erosion by alpine glaciers has been unimportant since retreat of the last ice sheet.

Summary of glaciation

Evidence for glaciation in Cry Lake and Dease Lake map areas indicates that following a period of widespread cirque formation, possibly during a phase of typical alpine glaciation, the map areas were overridden by a northward-advancing ice sheet. At the maximum stage of glaciation, the

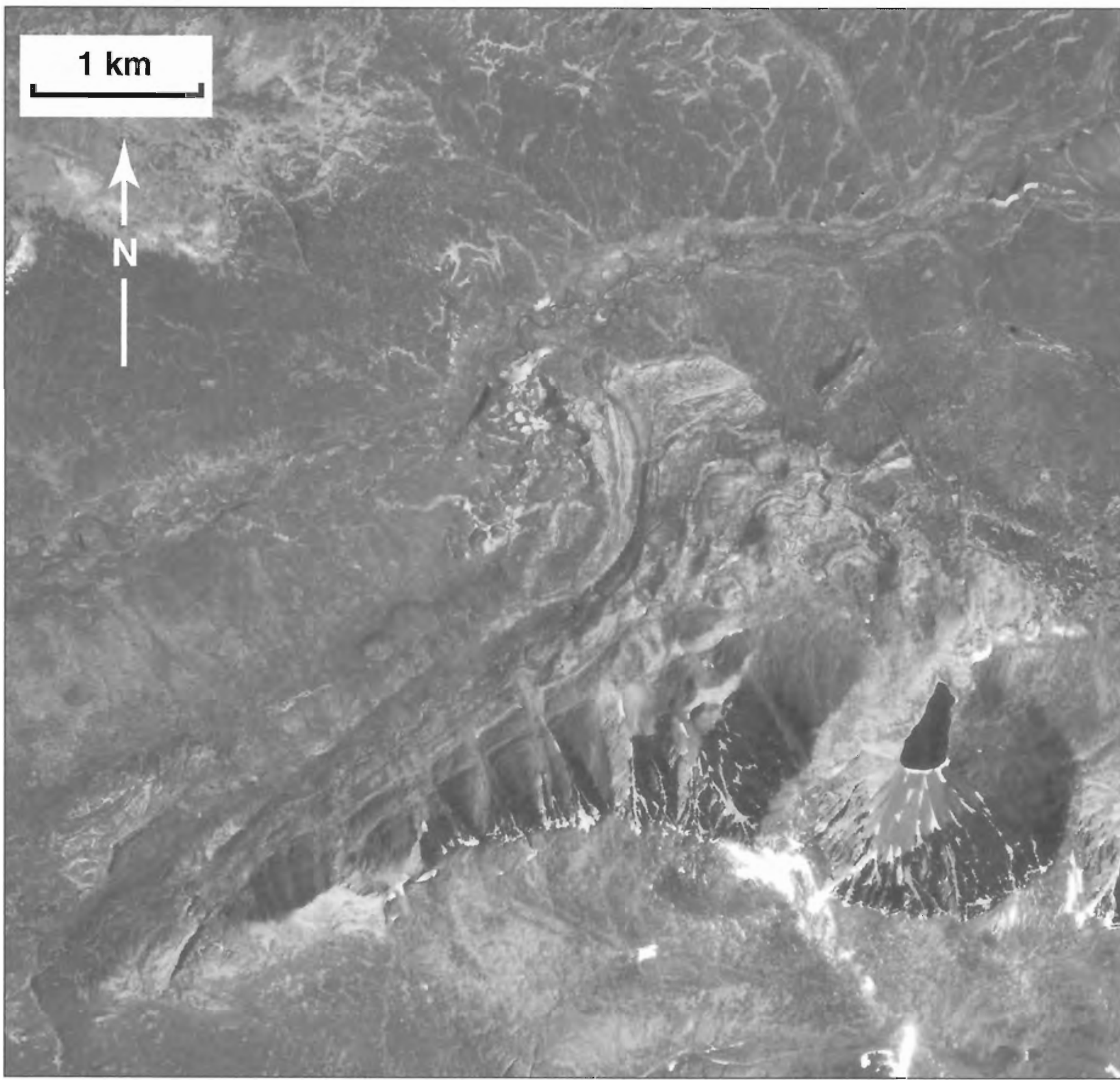


Figure 13. *Kame terraces and marginal drainage channels on the northwest side of the mountain south of the head of Zuback Creek in western Cry Lake (1041) map area. These features formed along the margin of an ice lobe that extended eastward from the valleys to the west. British Columbia air photograph 5381 161.*

ice covered most, if not all, of the highest mountains. Local evidence points to two advances of ice but it is not known whether glaciation preceding the last advance was widespread. The retreat of ice was followed by a limited rejuvenation of cirques but this activity was not related to widespread alpine glaciation.

GENERAL GEOLOGY

The map areas are underlain by a great variety of lithostratigraphic and lithodemic bedrock units ranging in age from Late Proterozoic to Tertiary (Fig. 14, in pocket; GSC Map 1907, 1908, in pocket). The rocks represent many different kinds of tectonic settings and paleogeographic environments of formation. Traditionally, in reports dealing with regional geology, it has been the practice to describe rock units in order of decreasing age for the region as a whole. Recently, however, the recognition of terranes, areas bounded by faults and consisting of geological assemblages distinct from those in adjacent terranes, has focused on difficulties of regional correlation. Six distinctive terranes occur in Cry Lake and Dease Lake map areas (Fig. 15). From northeast to southwest these are: Ancestral North America, Slide Mountain Terrane, Kootenay(?) Terrane, Quesnellia, Cache Creek Terrane, and Stikinia. The stratigraphic, structural, plutonic, and metamorphic history of each terrane is summarized in Table 1. Until their juxtaposition these entities had markedly different histories of evolution and for descriptive purposes it seems preferable to deal with each separately. Relationships between the terranes before and during accretion are discussed in the text.

Ancestral North America

Strata of Ancestral North America (Table 1) occur in Cry Lake map area northeast of Kutcho Fault and north of Hottah Fault, in a window(?) between Kutcho and Thibert faults and in the footwall of Klinkit Fault. Metamorphosed equivalents form several pendants within the Cassiar batholith. Because of their well defined lithologies and continuity, the stratigraphy of these rocks is much better known than that of terranes to the southwest.

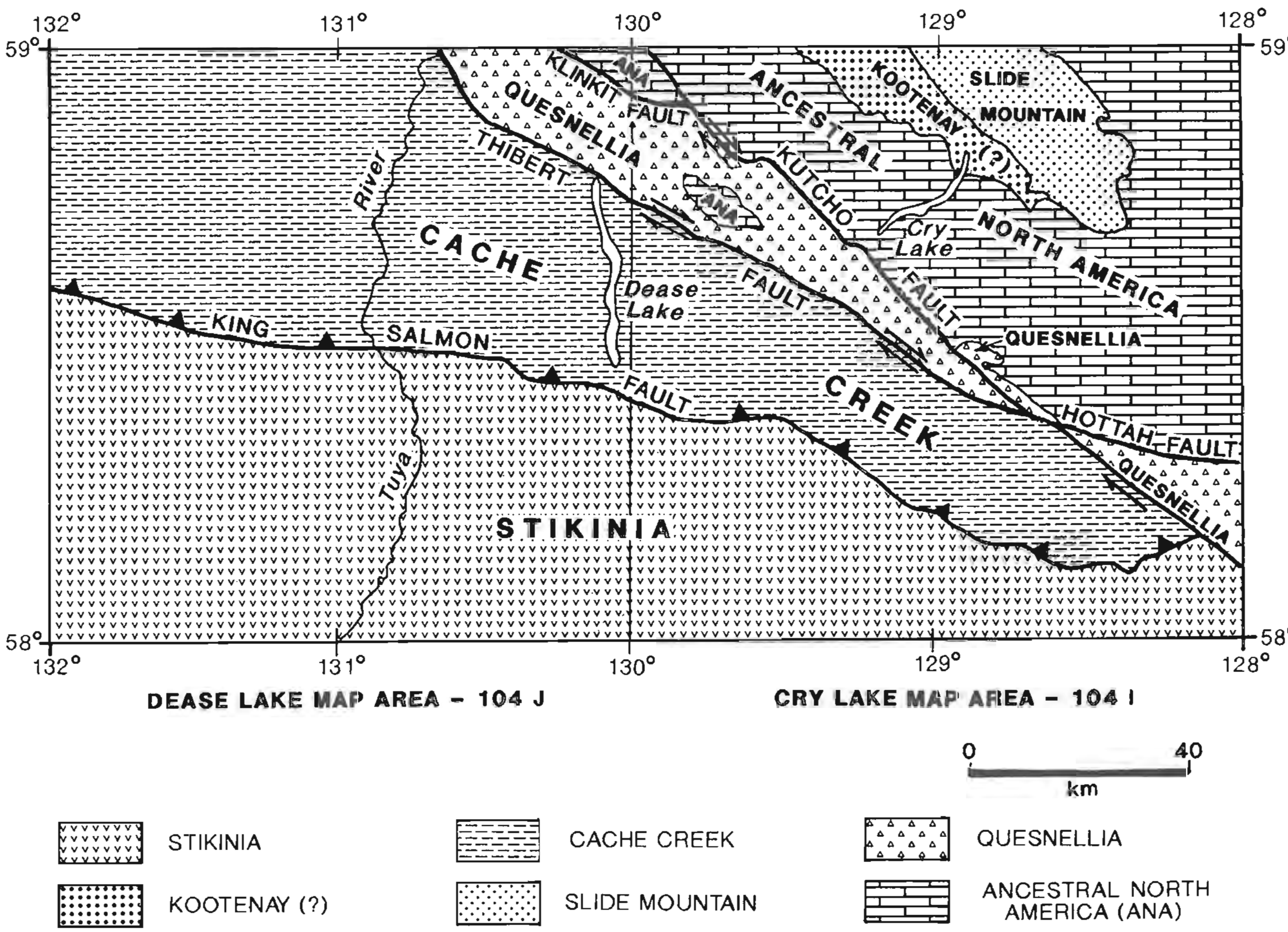


Figure 15. Distribution of terranes in Dease Lake (104J) and Cry Lake (104I) map areas.

Ingenika Group

The Ingenika Group was first defined by E.F. Roots in the Omineca Mountains of the Aiken Lake map area (Roots, 1954). The group was redefined by Mansy and Gabrielse (1978) to include four formations in ascending order as follows: Swannell, a succession of fine- to coarse-grained clastic rocks, more than 1100 m thick, characterized by members of quartz-feldspar conglomerate; Tsaydiz, a fine grained clastic unit, as much as 185 m thick with some limestone beds in the upper part; Espee, a distinctive carbonate unit, in places more than 400 m thick, dominantly limestone with a few dolostone members and containing abundant ferrodolomite particles; and Stelkuz, including a wide variety of clastic and carbonate, varicoloured lithologies, locally more than 600 m thick, with conspicuous red- and green-weathering shale, siltstone, and limestone beds.

In the Cry Lake map area the Ingenika Group underlies extensive areas in the Four Brothers Range and north and south of the lower reaches of the Turnagain River. The oldest part of the group may be represented by metamorphic rocks within a roof pendant of the Cassiar batholith north of Hottah Lake and the youngest part may be included in a metamorphosed clastic succession southwest of the batholith between Hard Lake and Kutcho Creek.

Table 1. Table of formations for Cry Lake and Dease Lake map areas.

ANCESTRAL NORTH AMERICA						
Era	Period	Group	Formation	Map unit	Lithology	Thickness (m)
PALEOZOIC	Upper Devonian and Mississippian		Earn Group	DME	Shale, pyritic; slate, porcellanite, cherty argillite, siltstone, chert arenite, tuff (?)	200+
	Structurally conformable; regionally unconformable					
	Middle and Upper Devonian		McDame Formation	DM	Upper member: platy, grey limestone Lower member: fetid, dark grey dolostone	225
	Disconformable to unconformable					
	Upper Silurian and Lower Devonian (?)		Ramhorn Formation	DR	Upper member: laminated fine grained dolostone (100 m) Lower member: sandstone, laminated dolostone, sandy dolostone (85 m)	185
	Disconformable (?)					
	Lower and Middle Silurian		Sandpile Formation	SS	Dolostone, cherty dolostone, dolostone breccia	300
	Disconformable					
	Ordovician and Silurian		Road River Formation	OSRR	Upper member: platy siltstone, shale Lower member: black, graptolitic shale	100-140
	Upper Cambrian to Lower Ordovician		Kechika Formation	ЄOK	Argillaceous limestone, calcareous phyllite, limestone, calcareous siltstone	300-600
	Disconformable					
	Lower Cambrian	ATAN GROUP	Rosella Formation	ЄR	Limestone, dolostone, minor shale	500±
			Boya Formation	ЄB	Quartzite, siltstone, slate, argillite	200+
UPPER PROTEROZOIC	Conformable (?)					
		INGENIKA GROUP	Stelkuz Formation	uPS	Chloritic sandstone, siltstone, slate, phyllite, limestone	150+
			Espee Formation	uPE	Limestone, dolostone	400-550
			Tsaydiz Formation	uPST	Sericitic and chloritic phyllite, schist, calcareous phyllite, phyllitic limestone	300+
			Swannell Formation	uPST	Micaceous quartzite, quartz-feldspar grit, siltstone, shale	700+

Swannell and Tsaydiz formations

Dark-weathering, well layered strata of the Swannell and Tsaydiz formations underlie much of the area south of Turnagain River in the enclave bounded by granitic rocks to the northeast and southwest. They outcrop also farther east along the river and in the eastern part of Four Brothers Range. Probable equivalent rocks form pendants in the Cassiar batholith north of Hottah Lake. Although the rocks of each formation are fairly distinctive, the effects of metamorphism and the scale of mapping have precluded their separation on the accompanying maps (Fig. 14, GSC Map 1907, 1908).

South of Turnagain River the stratigraphically lowest strata belong to the Swannell Formation and comprise well bedded micaceous schist, micaceous quartzite, and feldspathic grit in members up to tens of metres thick. Local, dark coloured layers in the southeasternmost exposures may be

Table 1. (cont.)

SLIDE MOUNTAIN TERRANE

Note: Table includes only those units for which ages are available. Most contacts are faults so original stratigraphic relationships are commonly unknown.

Era	Period	Complex	Formation or Pluton	Map unit	Lithology	Thickness (m)
PALEOZOIC	Permian	SYLVESTER		DPs	Chert, tuff, basalt	2000±
	Early Permian			Pt	Tonalite, porphyritic	1000±
			Meek Creek Pluton	EPMC	Granite, megacrystic	
			Nizi Creek Pluton	EPNC	Diorite, gabbro, foliated	
	Pennsylvanian and Permian			PP	Chert, tuff, basalt, limestone	500+
	Pennsylvanian			Pc	Limestone, cherty	100
				Pch	Chert, orange and green	20+
	Mississippian		Nizi Formation	MN	Limestone, greywacke, conglomerate, shale, siltstone	500
				Ms	Argillite, siltstone, limestone	200-250
	Devonian and Mississippian			DMch	Chert, black banded	200-300

KOOTENAY(?) TERRANE

Era	Period	Complex	Formation or Pluton	Map unit	Lithology	Thickness (m)
PALEOZOIC	Devonian and Mississippian	SYLVESTER		DMgd	Granodiorite, diorite, agmatite	
				Dmst	Tectonite, siliceous, chloritic, micaceous, locally calcareous	500+?

Table 1. (cont.)

QUESNELLIA					
Era	**Period**	**Formation or Pluton**	**Map unit**	**Lithology**	**Thickness (m)**
MESOZOIC	Middle Jurassic		MJgd	Quartz monzonite, granodiorite	
	Lower Jurassic	Nazcha Formation	lJN	Greywacke, conglomerate, silstone, shale	500
	Unconformable				
	Early Jurassic	Eaglehead Pluton	EJE, EJgd	Quartz monzonite, granodiorite	
	Late Triassic	Cow Lakes Pluton	LTRCL LTRgd	Granodiorite, diorite	
			LTRb LTRu	Basalt Peridotite, dunite, serpentinite	
	Upper Triassic		LTRc	Limestone	50
		Shonektaw Formation	UTRSH	Augite and feldspar porphyry, tuff, agglomerate, breccia, pyroxenite, greywacke	800±
Relationship unknown					
UPPER PALEOZOIC AND/OR MESOZOIC	Rocks of uncertain terrane assignment		uPTR	Mafic to felsic volcanics, tuff, chert, phyllite	200+

CACHE CREEK						
Era	**Period**	**Complex**	**Formation or Pluton**	**Map unit**	**Lithology**	**Thickness (m)**
MESOZOIC	Lower Jurassic		Inklin Formation	Jl	Slate, greywacke, pebble conglomerate, diamictite	1500
			Unconformable(?)			
	Upper Triassic		Sinwa Formation	uTRs	Limestone, fetid	75
	Lower Triassic		Kutcho Formation	CTRK	Basalt, dacite rhyolite, tuff, conglomerate	1000
	Upper Triassic	CACHE CREEK	Kedahda Formation (upper part)	MTRK	Greywacke, chert	100+
PALEOZOIC	Permian		Teslin Formation	PT	Limestone, mafic volcanics	300-600
			French Range Formation	PFR	Basalt, tuff, agglomerate	600-
	Upper Mississippian to Permian		Horsefeed Formation	MPH	Limestone	1500-
			Kedahda Formation (lower part)	MTRK	Chert, argillite, siltstone, mafic volcanics	1500
				MPu	Periodotite, pyroxenite, dunite	
				MPg	Gabbro, diorite	

amphibolite but were not examined in the field. The lowest strata are the most highly metamorphosed and include quartz-mica schist bearing garnet, staurolite, andalusite, and fibrolite. At higher stratigraphic levels impure, micaceous quartzite is dominant and typically weathers into ledges from less than a metre to several metres thick.

The Swannell Formation in Four Brothers Range consists of impure gritty quartzite, feldspathic grit, quartz- and feldspar-pebble conglomerate, and mica schist. Quartzite generally has a greenish-grey cast and under the microscope is seen to include plagioclase feldspar (calcic oligoclase), quartz, and minor muscovite and chlorite. Quartz and plagioclase crystals are locally clouded with abundant inclusions, trains of which show a preferred orientation.

Table 1. (cont.)

STIKINIA						
Era	**Period**	**Group or Suite**	**Formation or Pluton**	**Map unit**	**Lithology**	**Thickness (m)**
MESOZOIC	Early to Middle Jurassic	Three Sisters Plutonic Suite	Three Sisters Pluton	MJTS	Granodiorite, monzodiorite, potassic monzodiorite	
			Tanzilla Pluton	JT	Granodiorite	
			Takwahoni Formation	lJT	Greywacke, siltstone shale, conglomerate; minor limestone	1000+
				lJv	Epiclastic sandstone, agglomerate, flows	650+
	Unconformable on TRJv and uTRST					
	Early Jurassic		Pallen Creek	JPC	Monzodiorite, monzonite	
			McBride River Pluton	EJMR	Granodiorite	
			Tahltan Pluton	EJT	Pyroxenite, syenite	
	Upper Triassic and Lower Jurassic			TRJv	Plagioclase porphyry andesite, rhyolite breccia, tuff	700
	Upper Triassic	Stuhini Group (upper part)		uTRc	Limestone	50
				uTRST	Augite porphyry, feldspar porphyry conglomerate, argillite greywacke	700+
	Nonconformable on lTRCH					
	Late Triassic	Stikine Plutonic Suite	Beggerlay Creek Pluton	lTRBC	Diorite, gabbro, pyroxenite	
			Gnat Lakes Ultramafite	lTRGL	Hornblende clinopyroxenite, hornblendite	
			Cake Hill Pluton	lTRCH	Monzodiorite, granodiorite, foliated	
			Latham Creek Pluton	lTRLC	Diorite, monzodiorite, foliated	
			Cariboo Meadows Pluton	lTRCM	Metagabbro, hornblendite	
			Kaketsa Pluton	lTRK	Diorite	
			Mansfield Creek Pluton	lTRMC	Diorite, gabbro	
	Lower and Middle Triassic	Stuhini Group (lower part)		mTRST	Augite porphyry, breccia	55
				lmTRST	Argillite, greywacke, chert, augite porphyry breccia	300
Disconformable						
PALEOZOIC	Lower Permian			Pc	Limestone, massive; gypsum	350-400
				Pp	Phyllite, ribbon chert	50+
				Pv	Phyllite, greenstone, chert	50?

South of Turnagain River the Tsaydiz Formation is represented by a succession of dark-weathering, thinly bedded, argillaceous strata which are increasingly calcareous in the upper part (Fig. 16). Siltstone and fine grained quartzite are not uncommon. The formation, in general, is more recessive than the underlying Swannell Formation. Most of the rocks are phyllitic and, near granitic plutons, contain abundant andalusite.

Table 1. (cont.)

OVERLAP ASSEMBLAGES						
Era	**Period**	**Group or Suite**	**Formation or Pluton**	**Map unit**	**Lithology**	**Thickness (m)**
QUATERNARY	Pleistocene to Recent			QS	Glacial deposits, stream deposits, felsenmeer, soil	
	Pleistocene			PV	Olivine basalt	
TERITIARY TO QUATERNARY	Miocene to Pleistocene		Tuya Formation	lMPT	Olivine basalt, tuff, agglomerate	
	Unconformable					
	Eocene		Tanzilla Canyon Formation	lETC	Shale, sandstone conglomerate, breccia, coal	200
				lEV	Rhyolite	
		Unconformable				
			Major Hart Pluton	lEMH	Granite, miarolitic	
			Meehaus Pluton	lEM	Granodiorite	
MESOZOIC(?) TO QUATERNARY	Upper Cretaceous(?) to Eocene		Sifton Formation	KlES	Conglomerate, sandstone, shale	150
		Unconformable on uPE				
		Sloko Group		KTS KTI	Rhyolite, dacite, trachyte Quartz latite porphyry	150
Unconformable						
MESOZOIC	Lower and(?) Upper Cretaceous	Sustut Group	Tango Creek Formation	KTC	Conglomerate, sandstone, siltstone, shale	300+
	Unconformable on uTST					
	Late Cretaceous	Surprise Lake Plutonic Suite	Little Eagle Pluton	LKLE	Granite	
			Snow Peak Granite	LKSP	Granite	
	Early Cretaceous	Cassiar Plutonic Suite	Cassiar batholith	EKC	Granite, granodiorite	
			Turnagain Pluton	EKT	Granite, miarolitic	
			Beady Range Pluton	EKBR	Granite	
	Middle to Late Jurassic		Snowdrift Creek Pluton	JSC	Granodiorite	
			Tachilta Lakes Pluton	MJTL	Granodiorite	
			Granite Lake Pluton	MLJGL	Granodiorite	
	Middle Jurassic	Bowser Lake Group		mJBL	Conglomerate, siltstone, shale, andesite, tuff breccia, agglomerate	1000
Unconformable						

In Four Brothers Range the Tsaydiz Formation is characterized by strongly crenulated, silvery grey and green schist, sericitic phyllite, and calcareous phyllite. Phyllitic limestone in beds 5 to 20 cm thick within the top 100 m of the formation appear to be gradational with limestone of the overlying Espee Formation.

Probable equivalents of the Swannell and Tsaydiz formations occur in the pendant of high grade metamorphic rocks north of Hottah Lake. There, strongly banded metasedimentary strata form lit-par-lit gneiss with leucocratic granitic sills and dykes (Fig. 17). Micaceous quartzofeldspathic layers alternate with amphibole-rich layers to impart a strong banding on the scale of a few centimetres to more than a metre thick. Microscopic examination reveals that, in addition to hornblende, the rocks include plagioclase (calcic labradorite), biotite, quartz, garnet, sillimanite, and abundant zircon.

Combined thickness of the Swannell and Tsaydiz formations probably exceeds 1000 m. The base of the Swannell Formation is nowhere exposed and the only complete sections are those for the Tsaydiz Formation which, in places, is about 300 m thick.

Age and correlation. On the basis of regional correlations the Swannell and Tsaydiz formations are considered to be Late Proterozoic. Strata of similar lithology and stratigraphic position are well exposed in the Omineca Mountains to the southeast (Roots, 1954; Mansy and Gabrielse, 1978) and in the Cariboo Mountains where they are assigned to the Kaza Group and Isaac Formation (Campbell et al., 1973). Metamorphosed equivalents form the core of the Horseranch Range in the McDame map area to the north (Gabrielse, 1963). The Tsaydiz Formation underlies an extensive area in

Figure 16.

Strata of the Tsaydiz (lower slopes), Espee (light coloured unit) and Stelkuz-Boya (dark-weathering ridge tops) formations east of the confluence of Cassiar and Turnagain rivers. GSC 1996-125ZZ

Figure 17.

Strongly foliated and banded, metamorphic rocks of probable Precambrian age in roof pendant within Cassiar batholith 8 km north of Hottah Lake. Width of exposure about 15 m. GSC 1996-125YY the Kechika map area southwest of the Kechika Fault (Gabrielse, 1962c). Metamorphosed rocks in the Sifton and Butler ranges west of the northern Rocky Mountain Trench include strata correlative with the Swannell and Tsaydiz formations (Gabrielse, 1975; Evenchick, 1988).

Espee Formation

Creamy white to light grey, resistant strata of the Espee Formation constitute the most distinctive rocks of the Upper Proterozoic succession. They underlie the core of Four Brothers Range and are well exposed along and near Turnagain River. South of Turnagain River the carbonate rocks range from thin bedded and platy to thick bedded and massive. In places, light to dark grey limestone is dominant, whereas in others cream- to buff-weathering dolostone is abundant. Typical of the Espee carbonate is the presence of buff to orange-buff particles of ferrodolomite. Some beds are pisolitic and others are sandy. Near granitic plutons, the rocks have been strongly recrystallized and have a rock salt texture. In Four Brothers Range a basal unit, more than 200 m thick, consists of dark blue-grey, banded crystalline limestone which may include specks of buff-weathering ferrodolomite. These rocks are overlain by very thick bedded, creamy white, fine- to medium-grained crystalline limestone, possibly 150 m thick. Some of these beds are dolomitic and others are extremely siliceous. In a few places sedimentary breccia occurs near the base of the thick bedded unit. Small brown garnets are present in the crystalline limestone but are generally detectable only under the microscope. The upper part of the sequence, about 200 m thick, consists of interbedded blue-grey and white crystalline limestone overlain by green-grey shale and dark green-grey calcareous slate of the Stelkuz Formation.

The Espee Formation appears to be conformable with the Tsaydiz Formation below and the Stelkuz Formation above (Fig. 16) although, along and south of Turnagain River, interformational faults locally obscure relationships.

Estimated thicknesses of the Espee Formation are about 550 m in Four Brothers Range and more than 400 m in the Turnagain River area. Near the mouth of Cassiar River, the formation seems to have been greatly thinned by deformation.

Age and correlation. The Espee Formation is well exposed in its type area in the Omineca Mountains (Mansy and Gabrielse, 1978). It is a lithostratigraphic correlative of the Cunningham Formation in Cariboo Mountains (Campbell et al., 1973). Excellent exposures of the formation underlie large areas northeast of the Kechika Fault in the Kechika map area (Gabrielse, 1962c). In the McDame map area correlative strata were included in the lower part of the Good Hope Group (Gabrielse, 1963). It is recommended that the name Good Hope Group be abandoned and the rocks assigned to the Ingenika Group to emphasize the regional correlation. The Espee Formation has been mapped also in the Wolf Lake area of southern Yukon Territory (Murphy, 1988).

Stelkuz Formation

The Stelkuz Formation is a dark-weathering, fine grained clastic unit which is neither typically developed or well exposed in the Cry Lake map area. It occurs in a faulted, overturned limb of an anticline in the Four Brothers Range and in a succession difficult to separate from the overlying Boya Formation along and near Turnagain River. Correlative rocks probably constitute the lower part of a thick, metamorphosed clastic unit southwest of the Cassiar batholith between Hard and Wolverine lakes. The most abundant lithologies are thin to medium bedded, chloritic siltstone and sandstone and greenish-grey, calcareous slate. Minor limestone occurs locally. In places, distinctive maroon- and green-weathering phyllitic slate occurs in the lower part. The metamorphic rocks southwest of the Cassiar batholith include well layered, dark-weathering, chloritic to actinolitic, amphibolitic rocks intercalated with garnet-staurolite-muscovite-quartz schist.

The top of the Stelkuz Formation is placed at the base of the lowest clean, quartzitic sandstone member of the Boya Formation. In the Cry Lake map area this horizon may be somewhat arbitrary and on data available it has not been possible to define an unequivocal boundary. Therefore, the formations have not been subdivided along and near the Turnagain River or southwest of the Cassiar batholith.

In Four Brothers Range the Stelkuz Formation is about 150 m thick but the section is incomplete. A similar thickness may apply in the Turnagain River area.

Age and correlation. Fritz and Crimes (1985) suggested that in the McDame map area, the boundary between Precambrian and Cambrian strata, based on trace fossils, be placed tentatively at a level 190 m below the base of the Boya Formation. There, more than 609 m of strata have been assigned to the Stelkuz Formation. Thicknesses in the Cry Lake map area are much less and detailed correlation with more typical successions in the McDame area and in the Omineca Mountains to the south is not possible. It is clear, however, that the Stelkuz Formation in the Cry Lake map area is Late Proterozoic and probably Early Cambrian. Good exposures of the formation occur in the Kechika map area to the southeast (Gabrielse, 1962c) and excellent sections are available for study in the Omineca Mountains (Mansy and Gabrielse, 1978). The rocks are correlative with the Yankee Belle Formation in the Cariboo Mountains (Campbell et al., 1973). There, Ediacaran fossils are found a short distance below the base of the Cunningham Formation (Ferguson and Simony, 1991).

Figure 18.

View north to overturned anticline and syncline north of Major Hart River exposing strata of dark coloured Boya Formation overlain by carbonate and lesser shale of the Rosella Formation. Dark weathering rocks on the ridge to the left are siltstones assigned to the basal Kechika Formation. GSC 1996-125XX

Atan Group

The Atan Group consists of a lower, dominantly quartzitic sandstone unit named the Boya Formation and an upper, mainly carbonate unit named the Rosella Formation (Fritz, 1980). The group is best exposed northwest of Major Hart River (Fig. 18). Southeast of the river a structurally disrupted succession occurs on the southwest side of the Four Brothers Range. Thick sequences occur southeast of Blue Sheep Lake where the rocks have been metamorphosed near granitic bodies. Relatively thin Atan Group rocks outcrop south of Turnagain River. South of the Cassiar batholith between Hard and Wolverine lakes the Atan Group rocks form the upper part of a thick, dominantly clastic, metamorphic succession. There, the Rosella Formation is very thin. Rocks probably correlative with the Boya Formation are exposed in a window(?) surrounded by Quesnellian lithologies along Eagle River.

Boya Formation

The Boya Formation is characterized by resistant, grey, green, tan, and brown, well bedded, fine- to medium-grained, quartzitic sandstones interbedded with micaceous slate and shale. In most sections the upper part of the formation is dominantly argillaceous. Beds are from a few centimetres to 3 m thick and some are distinctly crosslaminated. In thin section the sandstone is seen to be generally strongly recrystallized. Feldspathic varieties have been noted in a few places. Where gently dipping, the sandstone members form conspicuous ledges which impart the characteristic banding to the formation. Southwest of the Cassiar batholith exceptionally well bedded micaceous siltstone and sandstone beds have thin phyllitic shale partings. There, quartz-feldspar granule and pebble conglomerate forms beds up to 1.5 m thick. In the window(?) of metamorphic rocks between Kutcho and Thibert faults along Eagle River, tightly folded and strongly foliated micaceous quartzite is interlayered with quartz-mica schist. The quartzite, locally containing calcareous lenses, occurs in beds up to 2 m thick. In some localities the beds are very platy. Quartz pebble conglomerate with strongly recrystallized matrix was seen in one exposure.

Attitudes of crosslaminations in sandstones of the Boya Formation were not measured in the Cry Lake map area but were recorded for areas in McDame map area to the north. Westward and southward directions of sedimentary transport are indicated (Fig. 19), comparable to the southwestward transport suggested by data for the older Swannell and Tsaydiz formations in the Toodoggone map area to the south (Mansy and Gabrielse, 1978).

Contacts with the underlying Stelkuz Formation are gradational and the boundary with the overlying Rosella Formation appear to be conformable.

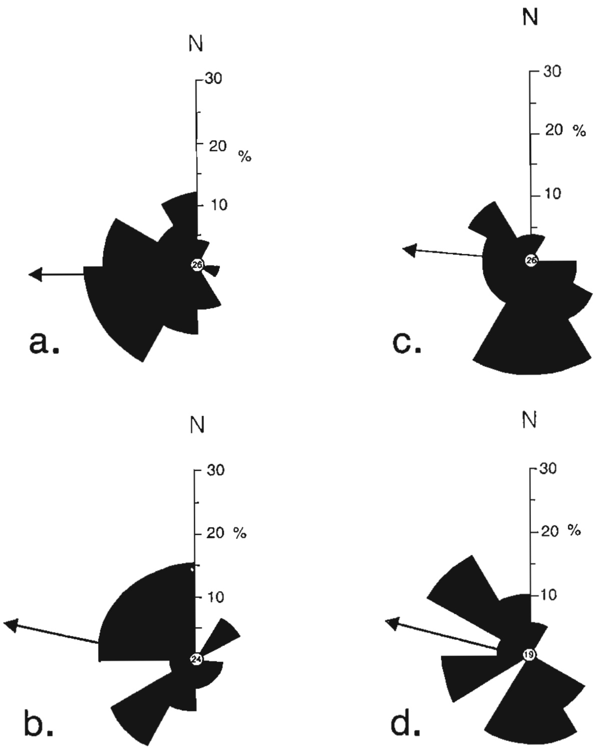
The Boya Formation is more than 200 m thick in the overturned anticline northwest of Major Hart River. Combined thicknesses for the Boya and Stelkuz formations are commonly in excess of 500 m. In its type locality in the McDame map area the Boya Formation is about 400 m thick.

Rosella Formation

Resistant carbonates of the Rosella Formation form one of the most distinctive stratigraphic markers in the miogeoclinal succession (see Section 1, Appendix 1). Its light grey colour contrasts strongly with the dark-weathering strata of the Boya Formation below and its resistance contrasts markedly with the incompetent rocks of the Kechika Formation above. A complete section is exposed northwest of Major Hart River from where the rocks can be followed southeastward to along

Figure 19.

*Plots of crossbed data for strata of the Boya Formation near Good Hope Lake (**a**) and northwest of Ewe Lake (**b, c, d**) in the McDame map area. Arrows indicate mean direction of sedimentary transport.*



and near Turnagain River. A thin sequence of the formation outcrops southwest of the Cassiar batholith north of Wolverine Lake.

A section of the Rosella Formation northwest of Major Hart River measured by W.H. Fritz (1978 and see Appendix 1) has a basal unit of silver-grey-weathering siltstone, 26 m thick, overlain by nodular, calcareous siltstone and thin bedded limestone 67 m thick. Overlying strata, more than 600 m thick, are thicker bedded and comprise finely crystalline limestone interbedded with lesser green- to rusty-weathering siltstone and shale and orange, cream, buff, and brown dolostone. Diabase sills from less than a metre to as much as 9 m thick are present at several horizons. The uppermost member, about 160 m thick, is medium to thick bedded, cream-, orange-, buff-, and brown-weathering dolostone with some limestone. Limestone immediately southeast of Major Hart River is blue-grey-weathering, fine- to medium-grained and thick bedded (Norford, 1959). Strata rich in oolites are common. Dolostone is rare except near the fault separating the Rosella and Kechika formations.

Southeast of Blue Sheep Lake the carbonates have been strongly recrystallized to a coarse rock salt texture near granitic rocks. Elsewhere the rocks are fine grained and dark grey to medium grey on the fresh surface. Beds range from thin bedded and platy to thick bedded and massive. Buff- to orange-weathering dolostone is locally sandy and, in places, contains ubiquitous limonite.

South of Turnagain River a relatively thin section of Rosella Formation, locally little more than 100 m thick, includes an upper unit of mottled, blue-grey-weathering well bedded limestone underlain by massive buff-orange-weathering dolostone. Beds are commonly from 1 to 2 m thick. In the southwesternmost outcrops the lower part of the formation consists of light grey-weathering, thin bedded, laminated, platy limestone.

Resistant, well bedded to massive limestone and dolostone of the Rosella Formation form ledges and cliffs at several localities along the Turnagain River to near the mouth of Three Forks Creek. The dolostone is characterized by buff-orange to reddish-orange weathering and in some exposures is strongly pyritic.

Platy, crystalline limestone forms a thin, continuous band of strata north of Wolverine Lake. The limestone is reported to contain archaeocyathids but none were seen by the writer.

The Rosella Formation may be conformable with the underlying Boya Formation although the contact is relatively sharp. Fritz (1980) suggested the possibility of a minor disconformity separating the formations in the type area. A disconformity between the Rosella and Kechika formations is indicated by the lack of Middle Cambrian fauna anywhere in the region.

The composite section measured northwest of Major Hart River is about 850 m thick but this may be somewhat excessive because of structural complications. Southeast of the river the strata may be as much as 500 m thick. The formation south of Turnagain River is probably not more than 200 m thick and in places seems to be much thinner. There, the formation is commonly bounded by faults and thicknesses may be minimal. North of Wolverine Lake estimates of thickness range from 15 m to about 45 m.

Age and correlation of Atan Group

Fossils collected from strata of the Rosella Formation northwest of Major Hart River include trilobites and archaeocyathids indicating the *Nevadella* and *Bonnia-Olenellus* zones of the Lower Cambrian. In the McDame map area the top of the *Fallotaspis* zone has been placed just above the top of the Boya Formation (Fritz and Crimes, 1985).

The group outcrops in Kechika map area to the southeast as far as the Northern Rocky Mountain Trench (Gabrielse, 1962c). In this belt the Boya Formation is exceptionally thick. The Atan Group is better exposed in the McDame map area (Gabrielse, 1963) and has been mapped northwestward into the Wolf Lake map area in southern Yukon Territory (Poole, 1956). Correlative strata occur in the Pelly Mountains, Yukon Territory where they are unconformably overlain by Upper Cambrian rocks (Read, 1980). Excellent sections of the Boya Formation are exposed in the Russel Range of the Omineca Mountains (Mansy, 1986) but the Rosella Formation there is discontinuous because of structural dislocations (Gabrielse et al., 1977) and possibly because of original depositional variations. Rocks correlative with the Boya and Rosella formations in the Cariboo Mountains are named the Yanks Peak and Mural formations, respectively (Campbell et al., 1973).

Kechika Formation

The term Kechika Group was originally proposed for two undivided rock units of Cambro-Ordovician age, best exposed in the Kechika Ranges in the McDame map area (Gabrielse, 1963). No type section was designated. It is proposed herein that the lower limestone and phyllite unit be redefined as the Kechika Formation and the upper, graptolitic shale unit be assigned to the Road River Formation. A good reference section for the Kechika Formation occurs on a ridge about 7 km south-southeast of Moodie Lakes at latitude 58°45'00"N and longitude 127°32'15"W in the Kechika map area. There, the base and top of the formation are exposed but have not been studied in detail.

Incompetent, thin bedded, recessive strata of the Kechika Formation are exposed in Kechika Ranges and in a belt trending southeastward across Major Hart River. The rocks outcrop also near Blue Sheep Lake and in small areas south of Turnagain River. Correlative rocks have been mapped southwest of the Cassiar batholith and north of Wolverine Lake and may be present in the pendant of metamorphic rocks southeast of Cry Lake.

Thin bedded, dark-weathering, glossy, calcareous phyllite is the typical lithology of the Kechika Formation southwest of Kechika Ranges. Interbedded with the phyllite is dark grey-weathering, cryptograined, nodular argillaceous limestone in beds generally less than 2 cm thick. The highly cleaved, soft, light to dark grey phyllite, commonly weathering a light lustrous grey, forms glistening talus slopes and, in many places, poor outcrops. Locally, the limestone beds have a boudinage structure. Northwest of Major Hart River the basal part of the Kechika Formation consists of more than 60 m of grey to dark grey, rust-brown-weathering siltstone (Fig. 18).

Thin sections of phyllite reveal little information not obtained in megascopic examination. Fine grained calcite crystals, ranging upwards from a few per cent are conspicuous in a very fine grained matrix of quartz, sericite, and minor feldspar. In places, quartz and feldspar are concentrated in thin lenses parallel with foliation. Discontinuous en echelon shear planes, averaging about 1 mm apart effect a crumpling of laminae which appears in hand specimens as subparallel crenulations with amplitudes of less than 1 mm. In these cases the shear planes may represent an incipient development of axial plane cleavage. The limestones consist of an extremely fine grained mosaic of calcite crystals. Rare, small feldspar and quartz grains are concentrated locally in lenses parallel with contacts of adjacent phyllitic rocks.

In contrast to the rocks described above, the Kechika Formation in Kechika Ranges includes significantly more limestone and calcareous phyllite and commonly weather to light grey, buff, or reddish-buff. In many sequences calcareous phyllite is subordinate to thin bedded, nodular limestone containing thin partings of phyllite. Fine grained, reddish-buff- and buff-weathering limestone interbedded with blue-grey limestone forms conspicuously banded outcrops. Laminated, calcareous siltstone and silty limestone are not uncommon.

Outcrops of Kechika Formation south of Turnagain River are much more argillaceous than those to the north and weather medium to dark grey. North of Wolverine Lake only a very thin section of alternating calcareous siltstone and limestone in beds 2 to 3 cm thick are clearly of Kechika lithology.

The base of the Kechika Formation is probably a disconformity throughout the region. Its upper contact is conformable with the overlying Road River Formation and the two formations may also be in part lateral equivalents as the Kechika Formation becomes more argillaceous to the southwest.

The lack of marker horizons and the effects of strong deformation makes thicknesses of the Kechika Formation difficult to estimate. In the Kechika Ranges the rocks must be more than 600 m thick whereas in the Stikine Ranges they range up to 300 m thick. North of Wolverine Lake typical Kechika Group rocks are not more than 10 m thick.

Age and correlation

In the southeastern part of the McDame map area a single trilobite, initially dated as early Middle Cambrian, was collected from siltstone in the basal part of the Kechika Formation (Gabrielse, 1963). The fossil has been reidentified by A.R. Palmer as *Hedinaspis* sp. of Late Cambrian

(Trempealeauan) age. Arenigian graptolites have been collected from overlying Road River strata just southeast of Major Hart River. On these sparse data the Kechika Formation is restricted to a Late Cambrian to Early Ordovician age.

Strata of Kechika Formation and correlative rocks are widespread in the eastern part of the northern Cordillera. They underlie extensive areas in Toodoggone (Gabrielse et al., 1977), Kechika, Rabbit River, and McDame map areas (Gabrielse, 1962a, c, 1963) and underlie parts of Jenning River in northern British Columbia (Gabrielse, 1969; Nelson and Bradford, 1987, 1993).

In Yukon Territory exposures are found in Wolf Lake (Poole, 1956), Quiet Lake, and Finlayson Lake map areas (Tempelman-Kluit, 1977) southwest of the Tintina Trench. The Kechika Formation is an important unit in the northern Rocky Mountains (Taylor and Stott, 1973; Gabrielse, 1975; Gabrielse et al., 1977; Cecile and Norford, 1979; Taylor et al., 1979; Thompson, 1989) where, like in the Cassiar Mountains, the rocks show a marked facies change to more basinal facies from east to west.

Road River Formation

Strata of the Road River Formation were originally included in the upper part of the Kechika Group in McDame map area (Gabrielse, 1963). As noted above, it is considered preferable to regard the Kechika as a formation and to assign Ordovician and Silurian graptolitic rocks to the Road River Formation. The latter were regarded tentatively as part of the Sandpile Group but are lithologically distinct even though they are of the same age.

The Road River Formation is coextensive with the Kechika Formation and weathers recessively so that completely exposed sections are rare. The best outcrops of Ordovician rocks occur just southeast of Major Hart River, southwest of Four Brothers Range. The only section in which the bottom and top of the formation are exposed is found south of Turnagain River. Southwest of the Cassiar batholith the lower part of a black slate and argillite unit probably contains correlative rocks. Metamorphic equivalents outcrop in a pendant within the Cassiar batholith that crosses Cry Lake.

The best exposed and most fossiliferous sequence of Road River rocks in the region underlies the northeast slope of a ridge 6 km northeast of Sheep Mountain in the south-central part of the McDame map area. The graptolitic strata there occur in a belt continuous with that on the northeast side of the McDame Synclinorium in the Cry Lake map area. At the McDame locality the Road River Formation consists of three members: a lower, in part calcareous, black, graptolitic shale more than 35 m thick; a middle, laminated dolomite, about 25 m thick; and an upper, platy, calcareous siltstone and shale, possibly 35 m thick. The lower member is Ordovician and the overlying dolomite contains fragmentary horn corals suggestive of Late Ordovician (B. Norford, pers. comm., 1978). The upper member can be subdivided into a lower, dark grey shale unit about 13 m thick and upper, platy siltstone unit, 22 m thick, both of Early to possibly Middle Silurian age.

A section of black, slaty, pyritic shale southeast of Major Hart River is more than 20 m thick and contains Early Ordovician (Arenigian) fossils (R. Thorsteinsson, pers. comm., 1957).

South of Turnagain River, a section studied by B. Norford (pers. comm., 1980) is about 140 m thick and comprises slightly metamorphosed graphitic, fissile shale; argillaceous, microcrystalline, dark grey limestone; and a member about 12 m thick of variably argillaceous, fine grained quartz sandstone, (see Appendix 1). Poorly preserved graptolites were noted only in the upper half of the section and the lithological subdivisions recognized in the McDame sequence were not observed. The sandstone unit is similar to one southwest of Deadwood Lake in the McDame map area where it lies immediately below an argillaceous limestone unit of late Middle or early Late Ordovician age (Gabrielse, 1963).

A few thin tongues of Silurian, graptolitic, dolomitic siltstone are interbedded with a sequence of Silurian and Devonian undivided carbonates in the Kechika Ranges.

Southwest of Cassiar batholith, black slate and argillite overlie strata typical of the Kechika Formation. The succession may include Road River rocks and younger strata of basinal character.

Dark grey to black, pyritic hornfels in the Cry Lake pendant probably includes Road River strata. Tight folding, metamorphism, and intrusion by numerous granitic sills and dykes, however, has frustrated attempts to subdivide the rocks.

The base of the Road River Formation appears to be conformable with the underlying Kechika Formation. The nature of the contact with the overlying, undated sandstone member of the Ramhorn Formation is in doubt although the two formations are structurally conformable.

Age and correlation

Graptolites indicate an age range of the Road River strata from Early Ordovician (Arenigian) to Early and possibly Middle Silurian (Late Llandoverian to Early Wenlockian; see Section 2, Appendix 1).

Thin sequences of Road River strata are present throughout the Kaska Mountains (Kaska Mountains include Pelly, Cassiar and Ominaca mountains; see Mathews, 1986). Much thicker sections occur in the northern Rocky Mountains (Cecile and Norford, 1979).

Sandpile Formation

The name Sandpile Group was proposed for a succession of cherty dolostone and overlying dolomitic sandstone exposed in southeastern McDame map area (Norford, 1962; Gabrielse, 1963). The fossiliferous dolostone member is restricted to the area northeast of the Kechika Fault but the upper, dolomitic sandstone member is probably correlative with strata of similar lithology, thickness, and stratigraphic position on the limbs of the McDame Synclinorium. In this report it is recommended that the term Sandpile Formation be applied to the lower, fossiliferous, cherty dolostone unit of the former Sandpile Group and a new name, Ramhorn Formation, be used for the much more widespread, upper, dolomitic sandstone unit.

The Sandpile Formation outcrops in the extreme northwest corner of the Cry Lake map area where it is continuous with strata in the type locality (Norford, 1962) to the northwest in McDame map area. The formation is characterized by well banded, light to dark grey dolostone in beds from 15 cm to 3 m thick. Lamination is well developed in places and many beds contain abundant nodules and lenses of chert. Minor quartz sand is present locally. One dolostone member, 29 m thick, in the upper part of the formation, contains a rich coral and brachiopod fauna (Norford, 1962).

To the southwest across the Major Hart River the abundantly fossiliferous member is missing and the Sandpile Formation is included in an undivided sequence of Silurian and Devonian carbonate; sandy, silty, and argillaceous carbonate; and calcareous sandstone. In a section studied by H. Geldsetzer (pers. comm., 1983) the formation consists of yellow- to grey-weathering, laminated and cherty dolostone; thin bedded, silty and argillaceous limestone; dolostone breccia; and thin units of graptolitic, dolomitic shale and shaly dolostone. Limestone is almost as abundant as dolostone and chert nodules are rare. The lithology of these rocks suggests a transitional facies between the typical dolostone of the type Sandpile Formation locality and the graptolitic siltstone of the Road River Formation in the region southwest of the Kechika Fault.

In the type locality the Sandpile Formation is about 300 m thick and rests disconformably on various stratigraphic levels of the Road River Formation (Norford, 1962; Gabrielse, 1963). The contact with the overlying Ramhorn Formation is structurally conformable but a disconformity may be present. Locally, the formation is overlain unconformably by the Middle Devonian McDame Formation.

Age and correlation

The Sandpile Formation is of Late Llandoverian to Early Wenlockian age (B. Norford, pers. comm., 1979). It is, therefore, correlative with the Nonda Formation in the northern Rocky Mountains (Norford et al., 1966).

Outcrops of the formation extend southeastward about 50 km in the Kechika map area (Gabrielse, 1962c) and northwestward on the northeast side of the Kechika Fault to Blue River in the McDame map area. Correlative rocks have been included in an undivided succession of Silurian and Devonian carbonates in the Pelly Mountains, Yukon Territory (Tempelman-Kluit, 1977).

Ramhorn Formation

This name is recommended for previously, in part unnamed, sandstone and dolostone strata which overlie the Sandpile Formation in Kechika Ranges and the Road River Formation southwest of Kechika Fault. The type section is completely exposed on a northwest-trending ridge at the head of Ramhorn Creek, 1.4 km southwest of the peak, elevation 2036 m (see Section 4, Appendix 1). An excellent reference section is completely exposed on a ridge 4.4 km northeast of Sheep Mountain in the McDame map area. The lower member of the Ramhorn Formation was originally included in the Sandpile Group but as discussed above it is advantageous for descriptive and correlation purposes to regard the lower part of the group as the Sandpile Formation and assign the upper part to the Ramhorn Formation.

The Ramhorn Formation consists of two intergradational members. The lower one is a light grey to dark grey, well bedded, resistant, even grained, vitreous quartz sandstone unit with variable amounts of dolomitic sandstone, sandy dolostone, and light grey laminated dolostone. Generally, the member is spectacularly crossbedded (Fig. 20) and in some places ripple marks are well developed (Fig. 21). Some beds show a vertical grain gradation upwards from coarse to fine. Locally, the arenaceous beds contain concretionary structures, possibly of algal origin, about the size of ping-pong balls. In thin section the sandstones are seen to be remarkably pure. Quartz grains have a high sphericity except where locally replaced by a dolomite matrix. In hand specimens the clear, vitreous quartz grains in a siliceous or dolomitic matrix impart the typical 'tapioca' texture to the rocks. Where the sandstone has a siliceous matrix, the rocks are extremely resistant and cliff-forming but where they have a dolomitic matrix, they are friable and weather easily.

Crossbed data from the lower part of the Ramhorn Formation suggest a dominant northwest direction of sedimentary transport (Fig. 22).

The upper member of the Ramhorn Formation is gradational with the lower member and is made up of well bedded and banded, light grey, creamy grey, and minor dark grey, cryptograined to fine grained dolostone (Fig. 23). Beds range from 15 cm to 1 m thick and, commonly, are strongly laminated.

The formation has not been mapped separately in Kechika Ranges but correlative rocks include platy, silty, and sandy dolostone and dolomitic sandstone.

In the pendant southeast of Cry Lake, thick bedded, clean sandstone, in part crossbedded and calcareous, is perhaps 10 m thick and structurally underlies a fetid limestone unit possibly correlative with the McDame Formation.

In Kechika Ranges sandstone of the Ramhorn Formation appears to gradationally overlie dolostone of the Sandpile Formation. West of the Kechika Fault the Ramhorn Formation overlies Road River strata with a sharp contact which may be a disconformity.

The lower, sandstone member of the Ramhorn Formation is 85 m thick in the type section and the upper, dolostone member is 100 m thick. For comparison, thicknesses of the two members in a section northeast of Sheep Mountain in the McDame area are 168 m and 140 m, respectively.

Age and correlation

A poorly preserved halysitid coral (probably *Catenipora simplex* (Lambe)) collected from silty and sandy dolostone in the basal part of the Ramhorn Formation at the type locality of the Sandpile Formation indicates a Silurian age (Norford, 1962). Elsewhere, no fossils have been found and correlation of the sandy beds in the Kechika Ranges with those southwest of the Kechika Fault remains speculative. Although rocks of similar lithology and stratigraphic position are present in Pelly Mountains southwest of Tintina Trench they also apparently are unfossiliferous (Tempelman-Kluit, 1977). In the Rabbit River map area in the northern Rocky Mountains Late Silurian (Pridolian) fish fragments have been collected from a thin siltstone member interbedded with laminated dolostone similar to that in the Ramhorn Formation (Gabrielse, 1962a; R. Thorsteinsson, pers. comm., 1984). The most conspicuous sandstone unit in the northern Rocky Mountains in about the same stratigraphic position as the Ramhorn Formation is the Wokkpash Formation of presumed Early Devonian age (Taylor and Stott, 1973).

Figure 20. *Planar crossbeds in sandstone of Ramhorn Formation at the type section near the head of Ramhorn Creek. GSC 1996-125WW*

Figure 21. *Ripple marks on bedding surface of sandstone in the Ramhorn Formation north of Blue Sheep Lake. Photograph by D. Moncrieff. GSC 1996-125VV*

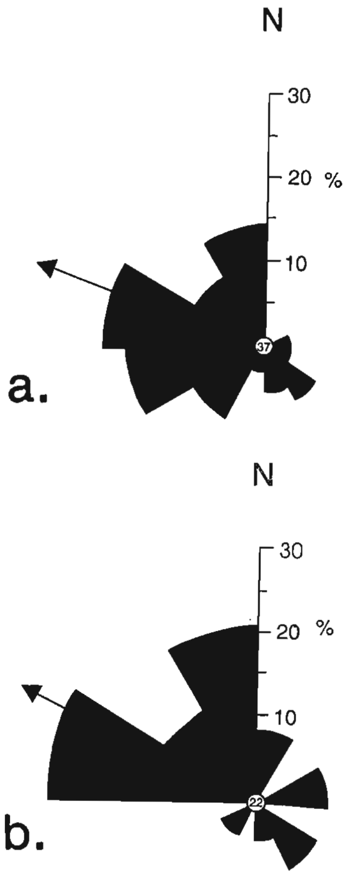


*Figure 22. Plots of crossbed data for sandstone of the Ramhorn Formation at two sites (**a, b**) near the head of Ramhorn Creek. Arrows indicate mean direction of sedimentary transport.*

McDame Formation

The name McDame Group has been used for the uppermost carbonate units in the miogeoclinal succession southwest of Kechika Fault (Gabrielse, 1963). Completion of the regional mapping has shown, however, that in many places the two members of the McDame Group are intergradational and difficult to separate. It is preferable, therefore, to redefine the rocks as a formation in which two members can be recognized locally.

Southwest of Kechika Fault the McDame Formation includes two distinct members, an upper platy limestone and a lower fetid dolostone (see Section 4, Appendix 1; Fig. 24). The lower member is conspicuously dark grey-weathering and consists of dark grey, black, and earthy grey, fine- to medium-grained, fetid dolostone (Fig. 25). Beds, many of which are laminated grey and dark grey dolostone, range from 15 cm to 1 m thick. Breccias with dark grey dolostone fragments in a matrix of crystalline white dolomite are common. Near the top of a ridge at the head of Ramhorn Creek 1.4 km southwest of the peak, elevation 2036 m, a spectacular channel, about 5 m wide and 15 m deep is filled with dolostone breccia. The precise stratigraphic level of the channel is uncertain and it may be in the upper part of the Ramhorn Formation. Some beds are termed 'spaghetti stone' because of an abundance of grey-white-weathering, cylindrical amphiporids in a dark grey matrix. Poorly preserved fossils, including the diagnostic *Stringocephalus* sp., are abundant.

The upper member of the McDame Formation is a well bedded, light grey-weathering, fine grained to cryptograined limestone unit (Fig. 26). Beds are from 30 cm to more than 1 m thick and are thicker in the lower part and platy to thin bedded in the upper part. The uppermost units locally contain argillaceous beds including some platy calcareous siltstone.

Figure 23.

Laminated dolostone of the upper, dolostone member in the Ramhorn Formation near the head of Ramhorn Creek. GSC 1996-125UU

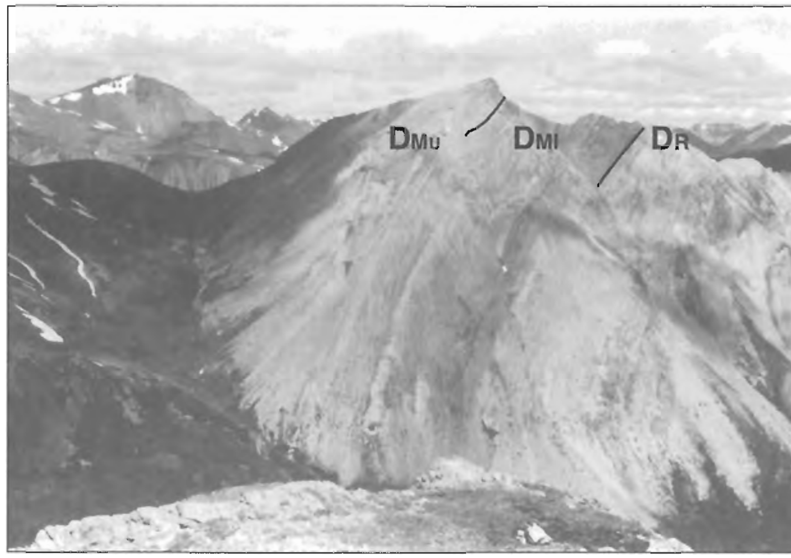


Figure 24.

View north near the headwaters of Ramhorn Creek to exposures of the Ramhorn Formation (DR, light coloured strata on lower slopes), lower dolostone member of the McDame Formation (DMl, dark-weathering beds) and the upper limestone member of the McDame Formation (DMu, uppermost light-weathering beds). GSC 1996-125TT

Near the headwaters of Ramhorn Creek, the lower, dolostone member and the upper, limestone member of the McDame Formation are 180 m and 107 m thick, respectively. Northeast of Sheep Mountain, in the McDame map area, the two members are 102 m and 53 m thick, respectively. In marked contrast, the formation in the Kechika Ranges southeast of Major Hart River can be little more than 20 m thick.

Locally, in the Kechika Ranges of southeastern McDame map area, the McDame Formation lies with a profound unconformity on strata of the Sandpile and Kechika formations. Elsewhere, the contact with underlying strata is structurally conformable. Northwest of Blue Sheep Lake the relationship between the formation and overlying rocks of the Earn Group is obscured by poor exposures but the two successions appear to be structurally concordant.

Age and correlation

Fossils from the dolostone member of the McDame Formation indicate a Middle Devonian (Givetian) age (see Appendix 2). Poorly preserved brachiopods from the limestone member suggest an early Late Devonian (Frasnian) age. T.A. Harms collected Early Frasnian conodonts from the same limestone member (M.J. Orchard, pers. comm., 1985).

Givetian carbonate rocks containing *Stringocephalus* sp. have been mapped in McDame and Jennings River map areas to the northwest (Gabrielse, 1963, 1969). They occur in the Wolf Lake map area in southern Yukon Territory (Poole, 1956) and in the Pelly Mountains (Tempelman-Kluit, 1977). No carbonates of the same age have been recognized northeast of Tintina and Northern Rocky Mountain trenches in Selwyn and Kechika basins where correlative rocks are in an argillaceous facies (Gabrielse, 1985).

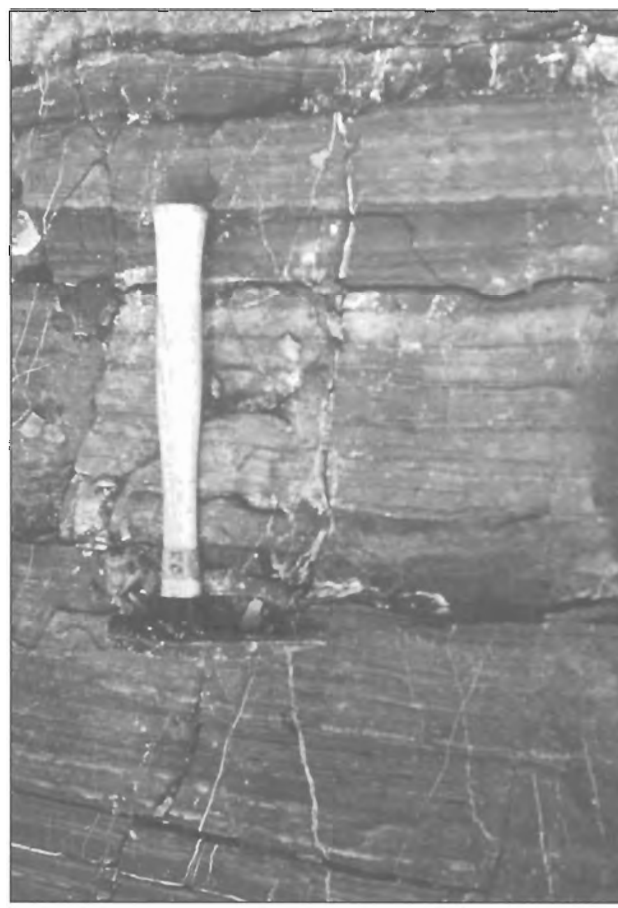


Figure 25. *Laminated, fetid dolostone of the lower member of the McDame Formation near head of Ramhorn Creek. GSC 1996-125SS*

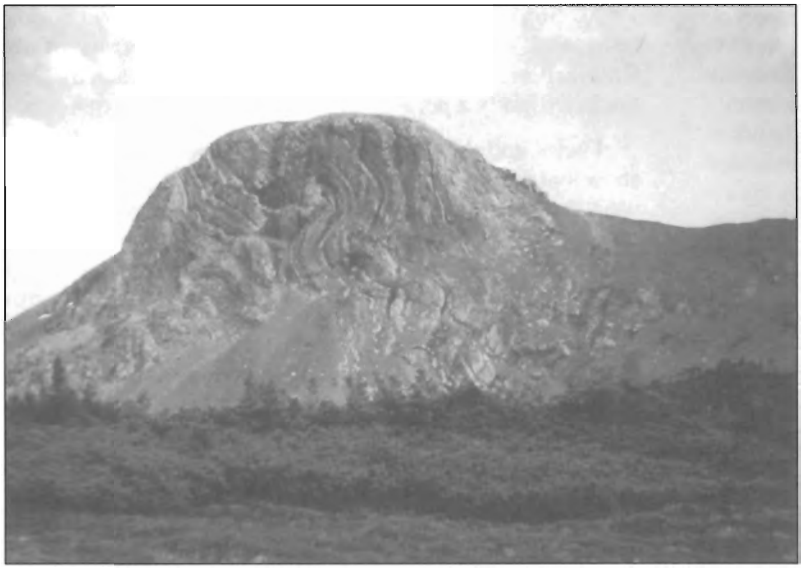


Figure 26.

Platy, well bedded, limestone member of McDame Formation bounded on the right by recessive shale of the Earn Group. View south near headwaters of Ramhorn Creek. GSC 1996-125RR

Earn Group

The youngest miogeoclinal rocks in the Cry Lake map area, formerly included in the basal part of the Sylvester Group, are assigned to the Earn Group. This follows the usage of Nelson and Bradford (1987, 1993) for a much thicker and varied assemblage of strata exposed in the northeastern part of the Jennings River map area.

Northwest of Blue Sheep Lake the group consists of blue-grey, black, and light grey slate, shale, and argillite; fine grained siltstone and siliceous argillite; and porcellanite. Some of the black shaly sediments are pyritic. In Kechika Ranges the succession includes dark brown-weathering, grey to black, in part pyritic, siliceous, slightly shaly or slaty argillite and thin bedded, dark grey to black porcellanite or chert. Highly fractured green-grey, apple green, and red-brown siliceous argillite form the highest beds. Limestone concretions are common in some beds. Under the microscope angular silt-sized particles of quartz and chert can be detected. Whole rock and X-ray diffraction analysis of a sample of a dark grey siliceous band in the lower part of the group suggests that it may be a potassic, siliceous tuff (H. Geldsetzer, pers. comm., 1989). In Kechika Ranges the top of the group is not exposed whereas, northwest of Blue Sheep Lake, only a thin sequence has been preserved beneath the basal fault of the Sylvester Allochthon.

East of the north end of Cry Lake and southeast of Cry Lake are thick successions of well jointed, hornfelsed, massive, locally pyritic, porcellanous, dark-weathering argillite. They may include Earn Group equivalents but remain undated. Southeastward, along and near Turnagain River, well layered, in part laminated, siliceous slate, siltstone, and fine grained chert arenite are assigned to the Earn Group.

In the Kechika Ranges, the Earn Group may be as much as 400 m thick with the lower, black slate member about 50 m thick. The group could be fairly thick near Cry Lake but the rocks are too massive to permit useful estimates of thickness and their stratigraphic assignment is in doubt.

The Earn Group is structurally conformable with strata of the McDame Formation although on a regional basis it is clear that in places a significant erosional unconformity is present (Nelson and Bradford, 1987, 1993). The top of the group is nowhere exposed in the Cry Lake area.

Age and correlation

Northeast of Sheep Mountain, in the McDame map area, conodonts from concretionary shaly rocks in the lower part of the Earn Group are Late Devonian (late Frasnian or Famennian) (B.E.B. Cameron, pers. comm., 1978). Middle Frasnian to Tournaisian conodonts were reported by T.A. Harms from similar strata near Major Hart River (Orchard, 1992, 1993). Mississippian (late Tournaisian to early Visean) conodonts were collected by H. Geldsetzer in the Kechika Ranges and identified by C.M. Henderson (pers. comm., 1988).

The Earn Group can be traced beneath the Sylvester Allochthon through the McDame map area where it is rarely more than 50 to 100 m thick. At the northeastern extremity of the allochthon in Jennings River map area it is as much as 650 to 1000 m thick and contains coarse conglomeratic facies (Nelson and Bradford, 1993). A fairly thick sequence of Earn Group is exposed in the Pelly Mountains, Yukon Territory, where it overlies a unit of felsic volcanic rocks (Gordey, 1981). Correlative strata underlie large areas in Selwyn Basin and the northern Rocky Mountains (Gordey et al., 1992). Commonly, in the Kaska Mountains and in the areas east of Tintina Trench and the Northern Rocky Mountain Trench, the basal strata consist of black, siliceous, gunsteel grey-weathering shale and porcellanite which are overlain by turbiditic, chert-rich clastics.

Undivided Paleozoic(?) rocks

An enigmatic assemblage of well layered, phyllitic and schistose rocks outcrops between Klinkit and Kutcho faults north of Dease Lake. Near the Klinkit Fault the dominant lithologies are sericite, muscovite, and biotite-quartz schist. The rocks are strongly foliated and locally there is a strong development of porphyroblastic plagioclase. Beds range from several centimetres to more than a metre in thickness. The entire sequence south of Goathorn Creek appears to dip uniformly to the southwest suggesting a thickness of several hundred metres. North of Goathorn Creek, dark grey, well laminated argillite is the most abundant lithology. In these rocks, cleavage is commonly at an angle to the bedding and details of the structure are unknown. Also present are units of chloritic quartz schist, chloritic metatuff, calcareous phyllite, and minor marble and quartz-pebble conglomerate. Near Anvil Creek two distinctive members consist of creamy white, foliated, sericitic quartzite about 3 m thick and black, rusty laminated argillite with black calcareous sericitic argillite at least 40 m thick. Immediately southwest of the Kutcho Fault, grey-weathering fetid carbonate forms a unit more than 10 m thick. Pods and lenses of greenstone and metagabbro are present locally.

The age of the assemblage between Klinkit and Kutcho faults is unknown. Fetid carbonate near Anvil Creek resembles Devonian carbonate in off-shelf sequences near Cry Lake and the thick succession of laminated argillite and slate in the same area could be correlative with Earn Group strata. Isotopic ages on mica from schists are as old as 156 Ma (Hunt and Roddick, 1987). The assemblage can be traced northward along the west side of the Cassiar batholith into the northern part of the Jennings River map area (Gabrielse, 1969).

Tectonic settings of miogeoclinal rocks, Ancestral North America

Although detailed sedimentological studies remain to be done, the general aspect of the miogeoclinal rocks permits speculation on their environments of origin. The Upper Proterozoic Swannell and Tsaydiz formations, like lithostratigraphic correlative strata the length of the Canadian Cordillera, may represent the initial filling of basins which formed during a rift-related episode of tectonism along the western margin of Ancestral North America. Sediments of the Swannell Formation are, in part, turbiditic, suggestive of deposition in deep water. The fine grained sediments of the Tsaydiz Formation indicate continued deposition in deep water with a more remote or lower relief source area. The upper part of the Tsaydiz Formation reflects a change to a shallower water environment leading to deposition of the Espee Formation as a shallow water carbonate bank.

The mixed siltstone, shale, sandstone, and limestone lithologies of the Stelkuz Formation are mainly shallow water sediments probably deposited along the inner margin of a miogeocline. Strata in the westernmost exposures may represent a deeper water, turbidite environment.

Relatively pure quartzose sandstones of Early Cambrian age again suggest deposition along the eastern margin of a miogeocline with deeper water to the west where finer grained sediments were deposited. Sedimentary transport based on the orientation of crossbeds was mainly to the west and west-northwest (Fig. 19). The character of the Boya sediments implies a deeply weathered source area, which perhaps included quartzose rocks of the Swannell Formation. Deposition of the Lower Cambrian sandstones (Boya Formation) was succeeded by carbonate bank deposits of the Rosella Formation. The presence of diabase sills and dykes in the latter imply a period or recurring periods of extension.

Facies and thickness changes in the Kechika Formation show that deeper water sedimentation took place to the southwest thus maintaining the depositional polarity interpreted for all previous strata. The overlying Road River Formation was deposited in a starved, euxinic basin of great extent but unknown depth. Sedimentation was slow for a period exceeding 60 Ma.

The Early to Middle Silurian Sandpile Formation marked a return to platformal conditions in a block now in fault contact to the northeast and southwest with areas in which conditions typical of Road River Formation sedimentation persisted. The boundary between the platform and deep basin seems to have been abrupt although in the Kechika Ranges a transitional facies can be observed locally.

During Late Silurian(?) and Early Devonian a carbonate platform in the northeastern part of the area (Cassiar Platform) was the site of lagoonal environments which, in its early history, was subjected to influxes of clean quartz sand, perhaps in part eolian (Ramhorn Formation). Crossbeds and ripple marks indicate dominantly southwestward sedimentary transport for the sandstone (Fig. 20). The platform was bounded on the southwest by a deeper water basin which accumulated fine grained clastic sediment.

Platformal to subsiding shelf environments persisted through deposition of the Middle to Upper Devonian McDame Formation and was terminated in Late Devonian time by the deposition of fine grained clastic sediments. The lowermost, euxinic facies was the first product of tectonism which resulted in rifting along the western margin of the miogeocline (Gordey et al., 1987).

A schematic restored section across the Ancestral North American miogeocline (Fig. 27) shows the remarkable thinning of the Paleozoic succession accompanied by the change to deeper water facies to the southwest off the Cassiar Platform. The establishment of the platform began in the Early Silurian (Sandpile Formation) but became much more widespread in later Silurian to early Late Devonian. In the Cry Lake area there is no stratigraphic record in Ancestral North America for the latter part of the Mississippian to the Cretaceous.

Slide Mountain and Kootenay(?) terranes

The Slide Mountain and Kootenay(?) terranes in the Cry Lake map area are included in the Sylvester Allochthon which consists of a stack of interleaved, gently to moderately dipping, lithotectonic slices overlying Ancestral North American rocks along a subhorizontal to broadly synformal, basal fault (Harms, 1986). Radiolarian chert, basalt, argillite, carbonate, diorite, gabbro, and ultramafic rocks of oceanic character are typical lithologies and range in age from Late Devonian(?) to Permian.

It is now clear the allochthon also consists of lithologies which contrast to those of typical Slide Mountain. They include an extensive unit of siliceous tectonite and a body of possibly Late Devonian or early Mississippian dioritic rock which may be partly equivalent to the Nisutlin subterrane of the Kootenay Terrane in Yukon Territory. In addition, there are potassic, Permian granitic rocks unlike any of the other lithologies. Because these units are intimately related structurally and spatially to the Slide Mountain rocks they are described in this section.

As originally defined in the McDame map area, the term Sylvester Group was applied not only to the rocks noted above but included, also, underlying, autochthonous, clastic rocks now assigned to the Earn Group (Gabrielse, 1963). Recent work emphasizing the structural complexity and resulting heterogeneous distribution of the various lithologies (Harms, 1986; Harms et al., 1988; Nelson and Bradford, 1989, 1993) suggest that the allochthonous succession should, more appropriately, be referred to as a complex. This usage is followed herein.

On the basis of detailed stratigraphic and structural studies, Harms (1986) has recognized a number of fault bounded lithological packages in the Sylvester Complex each of which has an unique stratigraphy (Fig. 28). The scale of this kind of analysis is beyond the scope of reconnaissance mapping so that the following description of lithologies does not discriminate between the various packages. The following descriptions of rock units is based on work by Harms (1986) and the author.

Sedimentary rocks

Sedimentary rocks occur throughout the area of outcrop of the Sylvester Complex but because of structural dislocations stratigraphic successions can rarely be mapped for more than a few ridges along trend. Everywhere they are intercalated with minor to significant members of tuff and basaltic flows. Near Beale Lake, dark grey to light green, locally feldspathic, grey, commonly fine grained quartzitic rock is the dominant lithology in an interbedded sequence including thin bedded, fine grained, crystalline, blue-grey, sandy limestone, siliceous argillite, and ribbon chert. The quartzite ranges from fairly pure to argillaceous and is locally carbonaceous. Some of the arenaceous rocks are finely banded and very fine grained. These rocks may be, in part, recrystallized cherts because a metamorphic aureole extends for more than a kilometre away from contacts with intrusive Late Permian diorite and Early Cretaceous granite. In thin sections all gradations from slightly recrystallized chert to strongly recrystallized chert can be seen. Some of the latter contain anhedral quartz grains as much as 0.5 mm in diameter in layers several millimetres wide separated by thin septae containing abundant minute crystals of garnet and minor chlorite. One thin section of feldspathic quartzite contains about equal amounts of elongate, anhedral quartz crystals and turbid albite. Minor chlorite, biotite, epidote, and apatite are also present. In places, the generally fine banding of rocks in the Beale Lake area suggests a tectonic origin and they are included, for mapping purposes, in the siliceous tectonite unit described below.

On a ridge about 8 km south of the point where the Rapid River crosses the northern boundary of the map area a fault-bounded unit of chert, quartzite, and minor limestone includes members of coarse grained grit with blue-opalescent quartz grains. Locally, sequences of radiolarian ribbon chert have thin intercalations of dark grey-weathering, fine grained, quartz arenite.

Interbedded with chert and quartzite are units of siliceous, commonly phyllitic argillite. The colour of the argillaceous rocks mimics that of the associated siliceous lithologies and ranges from light and dark grey to green to black.

Ribbon chert is abundant and occurs in beds a few centimetres thick separated by thin partings of phyllite (Fig. 28). Pea green, grey, and black chert are common and a distinctive member of red chert occurs along the northern boundary of the map area east of Rapid River. The red chert member can

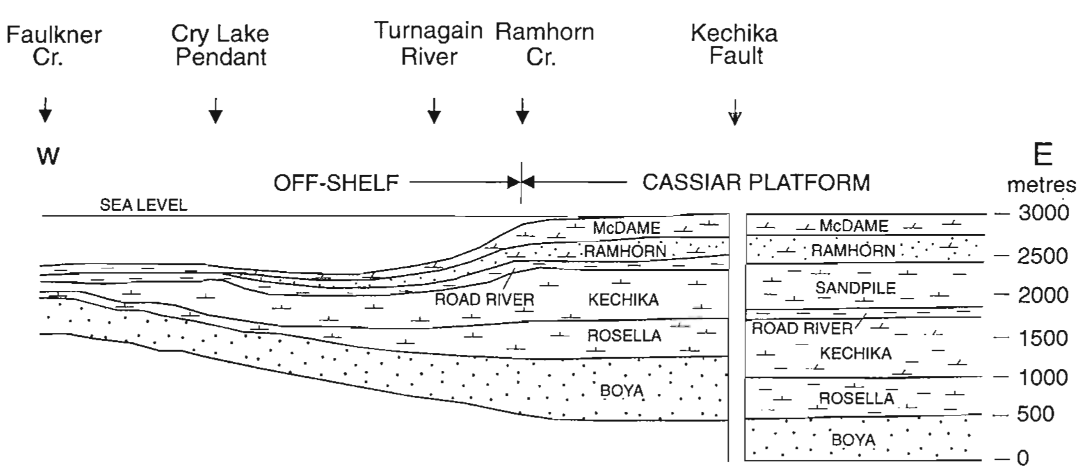


__Figure 27.__ Schematic restored cross-section for formation of the miogeocline (see Table 1) from Cassiar Platform to the off-shelf area to the west. Note the abrupt thinning of platformal units to off-shelf, fine grained clastic rocks.

be traced northward to southeast of Sheep Mountain in the McDame map area. A conspicuous salmon pink chert with light green phyllite partings forms the basal unit of the Sylvester Complex immediately southeast of Major Hart River. Identifiable radiolaria are found in cherts remote from intrusive dioritic and granitic rocks where they have not been significantly recrystallized.

About 8 km east of the mouth of Beale Creek, the western slope of the ridge above the through valley extending from Rapid River to the head of Major Hart River, is underlain by well banded black chert with an apparent thickness of between 200 and 300 m. The chert, containing little argillite, has yielded radiolaria of possibly Middle and Late Devonian ages.

Two limestone formations, in fault contact along the northern boundary of Cry Lake map area northwest of Rapid River, are easily recognized because of their light grey-weathering colour. The upper fault slice includes part of the Nizi Formation which is more fully preserved in the McDame map area (Mamet and Gabrielse, 1969). There, the basal part of the formation consists of greywacke, pebble conglomerate, and calcareous sandstone with abundant crinoid columnals up to 2 cm in diameter. The overlying succession is well bedded, dominantly limestone with two dolostone members in the lower part. A maroon-weathering siltstone and shale unit near the top of the formation is about 3 m thick and forms an excellent stratigraphic marker. Chert nodules and lenses are common and most of the macrofauna which includes corals and brachiopods is silicified. The formation is about 500 m thick but only a fraction of this occurs in the faulted slice in Cry Lake map area. The other limestone formation, about 100 m thick locally, is also well bedded. It contains a distinctive sea green chert member from 1 to 2 m thick as well as abundant irregular replacement bands of silica. It includes rare, poorly preserved crinoid columnals and fusulinids. Unlike the Nizi Formation, this limestone unit does not appear to be coralline. Elsewhere, small pods and lenses of limestone are

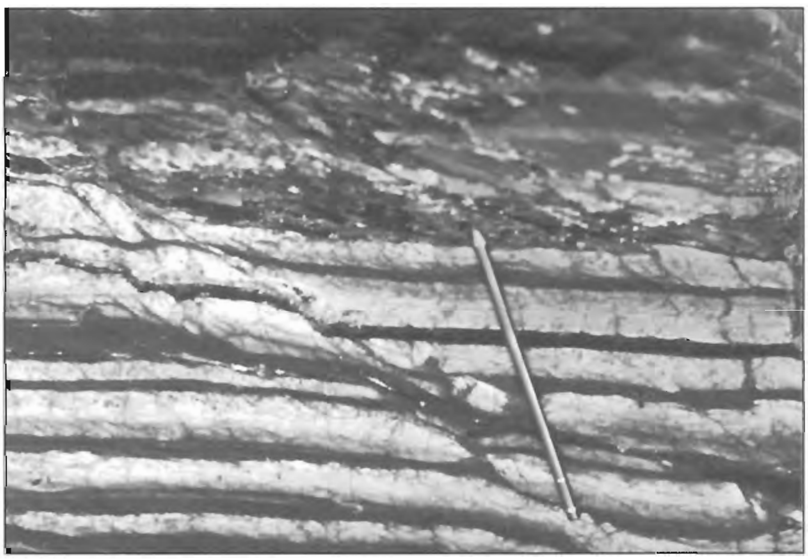


Figure 28.

Ribbon chert directly above the Sylvester Fault near headwaters of Ramhorn Creek. GSC 1996-125QQ

Figure 29.

View northerly along ridge 15 km northeast of the north end of Cry Lake. The ridge is underlain by volcanic rocks of the Sylvester Complex. Note the weakly defined, west-dipping layering of Sylvester rocks on the ridges in the left distance. GSC 1996-125PP enclosed within dominantly volcanic or sedimentary rocks and lack stratigraphic continuity. One body, about 8.5 km northeast of the north end of Cry Lake, is more than 70 m thick and contains poorly preserved corals. It may be correlative with the Nizi Formation.

Volcanic rocks

Volcanic rocks in the Sylvester Complex are relatively resistant, dark-weathering, commonly massive flows, tuff, and agglomerate (Fig. 29). Most of the volcanics are chloritized and saussuritized but relict mineralogy suggests that they were mainly pyroxene andesites and basalts. Aphanitic to fine grained varieties are abundant. Locally they contain phenocrysts of altered pyroxene and plagioclase from 1 to 2 mm in diameter. Vesicular basalt was seen in a few places but seems to be rare. Coarser grained rocks generally have a diabasic texture. In places epidote and prehnite are important alteration products.

On a sharp, southeasterly trending ridge 6 km southeast of Rapid River near the peak, elevation 1996 m, and 4 km to the east near the peak, elevation 2146 m, well developed pillowed basalt forms conspicuous outcrops. A steep, north-facing slope at the north end of the first locality exposes more than 150 m of this lithology.

Well layered tuff and breccia forms sequences as much as 150 m thick. Layers consisting of fine- to coarse-grained breccias with green, aphanitic, volcanic clasts range from 10 to 25 cm thick.

Some of the volcanics are hornblende-plagioclase porphyries with fairly fresh acicular hornblende crystals. Similar rocks occur as dykes.

Chemical analyses of representative volcanic rocks from the McDame map area collected by S.P. Gordey and from the Cry Lake map area collected by T.A. Harms and the writer confirm petrographic data that the rocks are extremely low in potassium and relatively high in titanium (Table 2). The analyses are typical for oceanic, volcanic rocks.

Siliceous tectonite (Kootenay(?) Terrane)

An extensive band of strongly foliated, finely banded, chloritic and sericitic rocks underlies much of the southwestern side of the Sylvester Allochthon from northwest of Beale Lake to northwest of Turnagain River. Strongly sheared and mylonitic lithologies are common (Fig. 30). Included are mafic metavolcanics, amphibolite, chloritic phyllite, pods and lenses of limestone and arenaceous limestone, lenses of serpentinite, abundant siliceous rocks, perhaps in part recrystallized chert, and felsic volcanic and/or intensely cataclastized plutonic rocks. Fine grained muscovite and chlorite are common on foliation surfaces. In places, tight folds are conspicuous and they may be accompanied by well developed lineation and mullion structure

The tectonite assemblage is similar to lithologies described by Harms (1986) and Harms et al. (1993) which outcrop in northern Cry Lake map area northwest of Rapid River and in McDame map area west of Four Mile River. In the latter area a monzodiorite body (U-Pb age on zircon of 362 ± 2.7 Ma) both crosscuts and is parallel with foliation in the metatectonic rocks (Gabrielse et al., 1993). A monzodiorite dyke which cuts the pluton yields a U-Pb age on titanite of about 350 Ma. A granodiorite body 10 km east of the north end of Cry Lake, described below, may also be part of the tectonite assemblage.

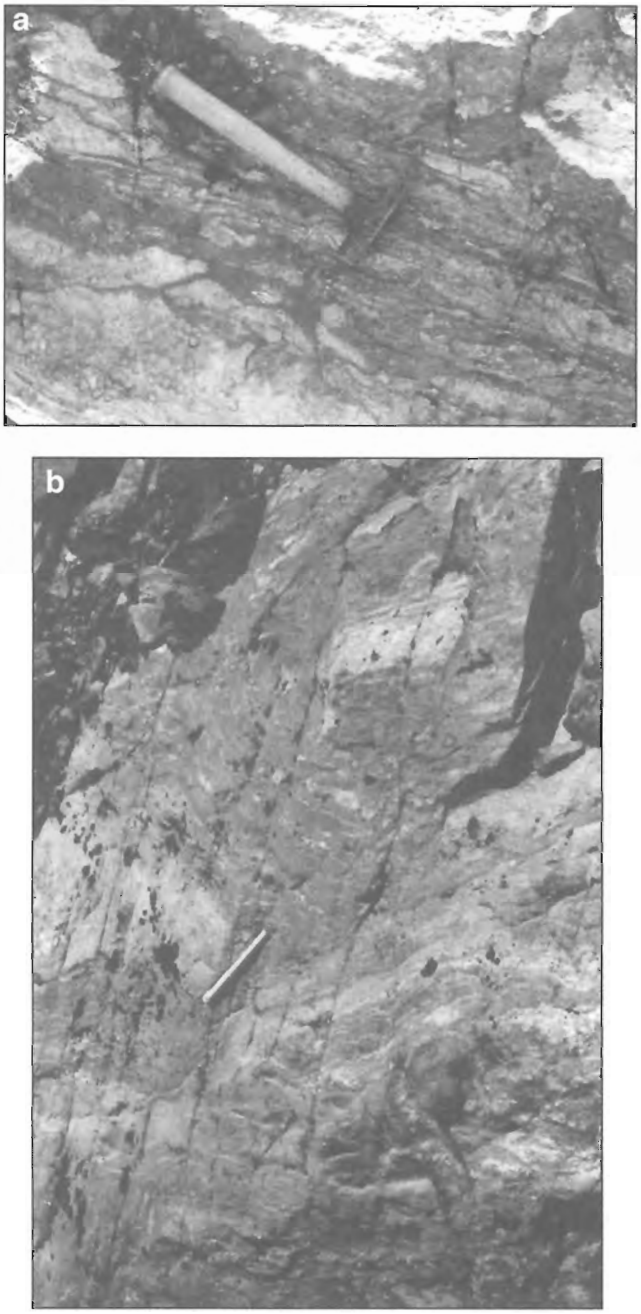


Figure 30. a, b) *Two examples of intensely strained, siliceous tectonite unit 2.5 km east of the north end of Cry Lake. Darker bands contain abundant amphibole. GSC 1996-125OO; GSC 1996-125NN*

Plutonic rocks

Permian and older plutonic rocks with a wide variety of textures and compositions occur as fault-bounded slices or have intruded volcanic and sedimentary rocks in the Sylvester Complex. Some of the larger bodies have been named. Many smaller ones have not been completely outlined and are included with associated volcanics. Indeed, some seem to grade texturally into finer grained massive volcanic rocks.

Nizi Creek Pluton

The Nizi Creek Pluton, bisected by the northeast-flowing Nizi Creek, underlies an area of about 50 km^2 northeast of Beale Mountain (Gabrielse and Harms, 1989). It is a mesocratic, medium grained, commonly foliated, hornblende diorite consisting of about 40% hornblende and 60% sodic andesine feldspar. In places the amphibole is strongly chloritized and feldspar is generally clouded by alteration. Zircon and apatite are common accessory minerals. The chemical composition of these rocks is similar to that of volcanics in the Sylvester Complex (Table 2). Sills of similar composition

Table 2. Chemical analyses of volcanic and related plutonic rocks in the Sylvester Complex. Analyses done by Mineral Resources Division of the Geological Survey in Ottawa, Ontario.

Sample No.	GGA-81-4D$_1$	GGA-81-5A$_2$	GGA-81-8A$_1$	GGA-81-8D$_2$	GGA-81-12C$_1$	GGA-81-14E$_2$	GGA-81-15B$_4$	GGA-81-15C$_1$
Lithology	gabbro	gabbro, altered	basalt	andesite/ basalt	tuff	tuff	pyroxene/ basalt	pyroxene/ basalt
Location – lat./long.	59°11'22"N 129°19'48"W	59°12'45"N 129°23'35"W	59°09'45"N 129°26'30"W	59°08'45"N 129°25'00"W	59°08'15"N 129°26'00"W	59°08'50"N 129°42'30"W	59°11'15"N 129°32'50"W	59°11'00"N 129°34'15"W
SiO_2 %	49.2	60.2	50.2	60.1	53.8	49.6	47.9	48.8
TiO_2 %	1.84	0.73	1.47	0.85	1.11	1.64	1.10	0.62
Al_2O_3 %	13.5	15.4	13.9	16.0	15.7	11.8	14.4	12.5
Fe_2O_3T %	11.8	9.80	10.6	7.67	9.20	11.2	9.80	9.08
Fe_2O_3 %	3.4	4.9	1.9	2.9	2.9	1.9	1.7	1.9
FeO %	7.6	4.4	7.8	4.3	5.7	8.4	7.3	6.5
MnO %	0.21	0.23	0.21	0.13	0.13	0.28	0.17	0.19
MgO %	5.76	1.13	5.66	3.17	6.23	8.38	8.00	12.6
CaO %	12.4	3.55	9.44	4.27	6.11	11.5	10.7	11.1
Na_2O %	2.26	5.79	2.81	3.98	2.73	2.15	1.32	1.85
K_2O %	0.22	0.52	1.69	0.97	1.58	0.62	0.45	0.30
H_2O %	2.9	2.0	2.8	2.6	3.9	2.5	4.5	3.9
CO_2T %	1.4	0.1	0.9	0.00	0.1	0.00	0.7	0.00
P_2O_5 %	0.21	0.23	0.37	0.33	0.45	0.16	0.18	0.08
S %	0.08	0.02	0.02	0.02	0.05	0.01	0.00	0.00
Ba ppm	150	3600	1100	920	1200	2100	260	260
Co ppm	43	19	40	28	36	48	44	58
Cr ppm	190	13	190	19	65	280	260	670
Cu ppm	43	10	110	21	43	21	82	44
Ni ppm	130	130	160	80	110	220	140	230
V ppm	380	58	370	180	300	380	330	280
Zn ppm	100	100	110	78	94	93	88	76
Totals	101.0	99.6	99.4	99.7	100.6	99.2	98.6	100.5

Comments: Analyses by G.S.C., 1988. All analysis by ICP, except FeO, H_2OT, CO_2T, CO_2, and S by chemical methods. Fe_2O_3 is calculated using $Fe_2O_3 = Fe_2O_3T$ (ICP) - 1.11134 * FeO (volumetric). ICP-MJ1 (major elements SiO_2 to S) data are obtained on 0.5 g of sample fused with lithium metaborate, dissolved in 5% HNO_3 and diluted to 250 mL. ICP-tR1 (trace elements Ba to Zn) data are obtained on 1.0 g of sample (acid + fusion of residue) dissolved in 10% HCl and diluted to 100 mL.

occur in hornfelsed metasedimentary rocks of the Sylvester Complex along the southern and southwestern contact which everywhere dips to the southwest. The body is more strongly foliated near its margins than elsewhere. Inclusions of mafic-rich rocks are locally abundant. Metasedimentary rocks in the metamorphic aureole which extends for more than a kilometre from the southwestern and southern contact include well banded garnet-muscovite-biotite schist and hornfels.

Meek Creek Pluton

This pluton, more than 35 km^2 in extent, lies northwest of the Nizi Creek Pluton and extends northerly into the McDame map area. The rocks were included formerly in the Four Mile batholith (Gabrielse, 1963) but recent mapping and isotopic age dating has shown that three distinct bodies separated by volcanic and sedimentary rocks are present (Gabrielse and Harms, 1989). Two of the bodies occur west of Four Mile River in the McDame map area. Within the Cry Lake map area the Meek Creek Pluton is a remarkably fresh, nonfoliated, coarse grained granite which forms bold, strongly

Table 2. (cont.)

Sample No.		GGA-81-16B$_1$	GGA-81-18A$_3$	GGA-81-19A$_3$	GAH-317B	GAH-321C	GA-84-30	GA-84-30A	GA-84-31A
Lithology		pyroxene/ basalt	pyroxene/ basalt	andesite/ basalt	Sylvester Complex - Rapid River		tonalite cutting Nizi Formation		Nizi Creek Pluton
Location – lat./long.		59°09'00"N 129°34'30"W	59°10'10"N 129°35'00"W	59°10'15"N 129°20'55"W	58°58'45"N 128°42'00"W	58°58'50"N 128°41'30"W	59°01'00"N 128°56'00"W	59°01'00"N 128°56'00"W	58°56'00"N 129°05'00"W
SiO_2	%	48.0	47.5	54.8	48.5	49.5	63.5	61.8	53.3
TiO_2	%	0.67	1.23	1.14	0.92	1.52	0.60	0.57	1.53
Al_2O_3	%	12.0	14.3	14.0	13.0	14.0	15.4	15.5	16.5
Fe_2O_3T	%	9.50	10.1	10.7	10.0	11.3	4.52	4.31	9.90
Fe_2O_3	%	1.9	1.8	2.1	1.8	3.5	1.1	0.6	2.0
FeO	%	6.8	7.5	7.7	7.4	7.0	3.1	3.3	7.1
MnO	%	0.19	0.19	0.19	0.19	0.20	0.11	0.10	0.20
MgO	%	11.6	10.9	4.13	12.6	6.71	2.93	2.81	4.12
CaO	%	13.4	8.71	7.19	9.70	10.5	3.67	3.85	8.34
Na_2O	%	0.52	1.92	3.55	2.67	3.19	4.50	4.44	3.58
K_2O	%	0.53	1.49	0.22	0.27	0.17	2.44	2.32	1.02
H_2O	%	4.1	4.0	3.0	4.2	3.8	1.6	1.6	1.4
CO_2T	%	0.00	0.00	0.2	0.00	0.00	0.1	0.2	0.00
P_2O_5	%	0.09	0.27	0.24	0.10	0.16	0.16	0.14	0.28
S	%	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.07
Ba	ppm	270	680	320	960	250	1800	1600	1000
Co	ppm	54	53	36	66	50	26	26	38
Cr	ppm	510	490	20	550	150	93	96	26
Cu	ppm	60	37	140	76	19	20	22	38
Ni	ppm	200	250	74	350	150	120	120	110
V	ppm	280	320	400	280	440	120	110	320
Zn	ppm	78	93	110	79	90	74	69	110
Totals		100.0	100.0	98.6	101.6	100.4	99.4	97.5	99.6

jointed outcrops. It is characterized by a high content of coarsely megacrystic, perthitic, K-feldspar (30%) in crystals up to 2 cm long, and quartz (25-30%). Calcic oligoclase (40%) is zoned and the cores of crystals are locally sericitized. Biotite, with minor chloritic alteration, is the only mafic mineral present. Accessory minerals are allanite and abundant zircon. On glacially smoothed outcrops near the southern margin of the pluton, many inclusions of dioritic composition containing megacrysts of K-feldspar are sharply defined (Fig. 31). The northeastern part of the Meek Creek Pluton in the McDame map area is a darker weathering, more mafic rock of generally finer grain size. It consists of calcic oligoclase (40-50%), K-feldspar (10-15%), quartz (15-20%), and hornblende (15%). Zircon is an abundant accessory mineral. K-feldspar locally forms spectacular micrographic intergrowths with quartz. Oligoclase is strongly sericitized.

Strongly foliated and brecciated limestone and argillaceous strata along the southern margin of the pluton show no evidence of metamorphism and the contact there is believed to be a fault.

Plutons along and north of Rapid River

Massive, blocky, medium grained, mesocratic hornblende diorite underlies an area in excess of 10 km^2 on the ridge north of the confluence of Beale Creek and Rapid River. On its north and south sides, the body, which appears to be a southwest-dipping sill, is in contact with amphibolitic, fine grained, dark green volcanic rocks.

Another southwestward dipping sill-like body of tonalitic composition, locally as much as 1000 m thick, occurs on the ridge across the valley to the east of the above occurrence and can be traced from near the McDame-Cry Lake boundary

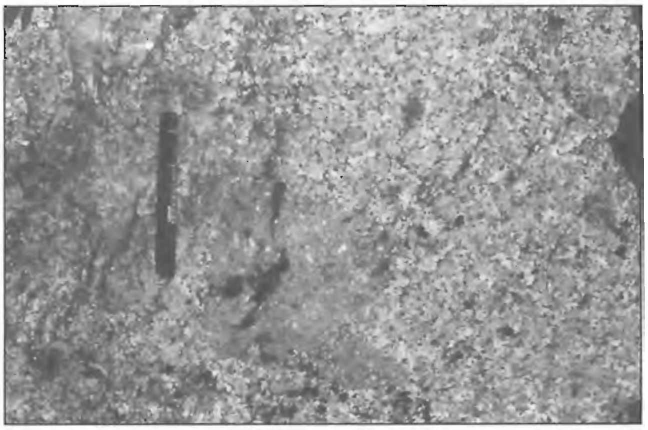


Figure 31. *Megacrystic granite of the Meek Creek Pluton south of creek draining Meek Lake. Note porphyroblasts of potassium feldspar in dark-weathering inclusion. GSC 1996-125LL*

Table 2. (cont.)

Sample No.	GAB-56-168-9	GA-56-228-2	GAB-56-238-10	GAN-56-17-8	GAN-56-18-8-5	GAB-56-218-6	GAB-56-188-8	GABu-61-198-1	GAB-56-188-4
Lithology	amphibolite	basalt	basalt	amphibolite	amphibolite	basalt	amphibolite	amphibolite	amphibolite
Location – lat./long.	58°58'00"N 128°59'00"W	58°50'00"N 128°30'00"W	58°57'00"N 128°36'00"W	58°54'00"N 128°52'00"W	58°52'00"N 128°49'00"W	58°50'00"N 128°52'00"W	58°50'00"N 128°52'00"W	58°52'00"N 128°47'00"W	58°50'00"N 128°52'00"W
SiO_2 %	49.3	49.3	54.1	47.3	54.9	50.8	46.5	43.3	49.4
TiO_2	0.65	1.77	1.22	2.63	0.94	0.92	1.95	2.05	2.19
Al_2O_3	12.7	17.4	17.9	14.3	14.1	16.6	16.8	13.3	14.3
FeO	7.6	10.2	7.6	10.9	6.8	6.5	9.6	10.0	9.9
Fe_2O_3	1.0	0.7	1.3	0.7	1.3	1.9	1.6	3.3	3.3
MnO	0.18	0.21	0.16	0.20	0.18	0.16	0.14	0.21	0.21
MgO	9.7	6.4	3.3	7.3	5.9	7.3	8.2	11.7	6.5
CaO	9.9	9.7	3.5	10.5	8.4	7.4	8.5	9.9	9.8
Na_2O	2.0	3.9	4.3	2.5	3.0	4.9	3.2	1.5	2.5
K_2O	2.2	0.2	1.4	0.6	1.8	0.1	0.6	0.6	0.2
H_2O_T	2.4	1.6	4.2	2.3	2.1	3.1	1.4	3.1	2.0
CO_2	0.4	-90.1	-90.1	-90.1	-90.1	-90.1	-90.1	-90.1	-90.1
P_2O_5	0.41	0.17	0.25	0.21	0.23	0.05	0.13	0.24	0.18
Totals	98.8	101.6	99.2	99.4	99.7	99.8	98.6	99.2	100.5

Analyst: S. Courville, GSC, 1971.
All analyses by XRF except FeO, H_2O_T, CO_2 by rapid chemical methods.

southeastward beyond Rapid River for about 20 km (Harms, 1986). It has an unique texture and composition consisting of quartz and rectangular, creamy to pinkish-white plagioclase phenocrysts from 2 to 4 cm long in a finer grained grey matrix of plagioclase, hornblende, biotite, and quartz. Zircon and sphene are abundant. The rocks have considerably higher quartz and potassium feldspar contents than the typical volcanic rocks of the Sylvester Complex (Table 2). The rock is unfoliated. In its southeastern exposures the sill is in part intrusive and in part floored by a thrust fault. In many other places to the northwest, intrusive relationships are evident. Carbonate strata of the Nizi Formation near the contact locally contain ophicalcite. North of Rapid River, large inclusions of grey chert and maroon and white rhyolite intercalated with red and buff argillite and minor carbonate are present (Harms, 1986).

Seven kilometres east of the north end of Cry Lake a body of hornblende diorite to granodiorite, in part coarse grained, has a complex contact relationship with enclosing strata. The ridge to the northwest is underlain by thinly bedded and banded, quartzitic chert interbedded with mafic-rich tuff or greywacke assigned to the siliceous tectonite unit. Near the contact the chert beds are recrystallized and the tuff or greywacke is gneissic with a coarse development of amphibole. Amphibolite contains garnet crystals as much as 5 mm in diameter. Finally, the quartzofeldspathic rocks show evidence for remobilization resulting in unoriented blocks of amphibolite and coarse grained hornblende diorite in a creamy white quartzofeldspathic matrix. Within the pluton, the hornblende diorite is of variable grain size including some pegmatitic segregations. Marginal phases are strongly foliated and contain angular inclusions of finer grain size than the host rock. In thin section the amphibolites consist of amphibole, showing pale green to olive green pleochroism, andesine, and quartz. Euhedral sphene is abundant. Spectacular examples of remobilization can be seen on a ridge along the southeastern margin of the pluton. There, strongly foliated hornblende diorite is in contact with foliated amphibolite which locally occurs as unoriented blocks in a quartzofeldspathic matrix (Fig. 32). All gradations exist between well banded and foliated rocks to complexly jumbled breccias (agmatite) depending on the degree of mobility of the leucocratic material. Many areas of medium grained diorite or gabbro are intimately associated with massive greenstone throughout the Sylvester Complex. Locally, contacts appear to be gradational or have been obscured by alteration.

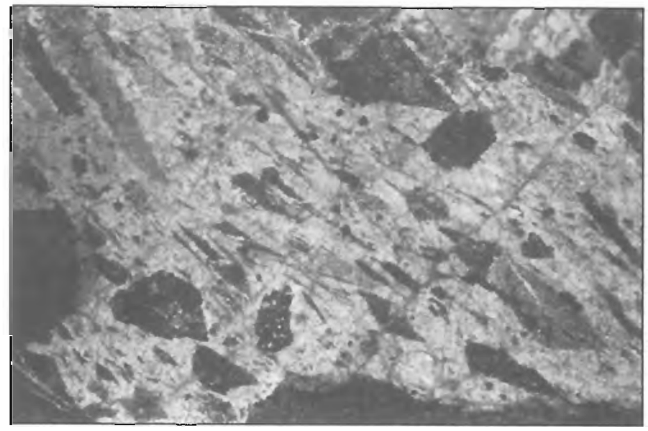


Figure 32. Agmatite consisting of amphibolitic inclusions in a feldspathic matrix along the eastern margin of a pluton 10 km east-northeast of the north end of Cry Lake. Width of exposure about one metre. Photograph by T. Harms. GSC 1996-125MM

Ultramafic rocks

Two large and numerous small ultramafic bodies occur in the Sylvester Complex within the Cry Lake map area. In all cases they mark fault zones and, commonly, both upper and lower contacts are faulted. The smaller bodies are generally completely serpentinized and highly sheared with a fish-scale texture. Slickensided surfaces bound flat to lens-shaped fragments and the variable orientation of the slickensides suggests rotation of the fragments during deformation. Some bodies contain lenses of creamy white to light green calc-silicate rock known as rodingite. Very minor cross fibre chrysotile veinlets are present in a few places.

One of the large ultramafic bodies extends southeastward from Rapid River for about 8.5 km as a moderately westward dipping slab. It is mainly serpentinized but pseudomorphs of antigorite after rhombic pyroxene suggest that the rocks are altered peridotites. In places the ultramafics are very fine grained and massive with a characteristic yellow to dun-brown weathered surface indicating an original dunite composition. The body is bordered above and below by zones more than 100 m wide of foliated to gneissic amphibolite. At the north end, the lower contact is marked by a zone of quartz-carbonate alteration (listwanite) which separates the body from a mylonitic, sheared, siliceous, metasedimentary unit.

On trend to the southeast two bands of dun-brown-weathering dunite dip westerly on the northeast side of the mountain. They are about 100 m thick and are bounded by well foliated amphibolite. The contacts between the amphibolite and dunite are sharp but apparently unfaulted. On the next mountain to the south a southwest-dipping layer of similar dunite at least 50 m wide is flanked by distinctly banded amphibolite (Fig. 33).

The other large ultramafic body lies about 15 km east-northeast of the north end of Cry Lake and weathers a conspicuous dun-brown. It has been intruded on the south and southwest side by a miarolitic, Early Tertiary, granitic pluton. The body seems to consist mainly of little serpentinized dunite locally cut by grey-green-weathering, fine grained, greenstone dykes. One dyke near the southern contact is a dark grey diabase.

Age and correlation

The Nizi Formation contains a rich foraminiferal fauna of late Visean to early Namurian age (Mamet and Gabrielse, 1969). The other main limestone unit has yielded fusulinids of Pennsylvanian (middle Moscovian) age (C.A. Ross, pers. comm., 1983) and conodonts of Morrowan to Atokan age (Orchard, 1992, 1993). Conodonts and radiolaria from other limestone units and various chert sequences give ages ranging from

Late Devonian(?) to Late Permian. Some of the distinctive chert sequences include Devonian and Mississippian black chert, Pennsylvanian salmon pink and green chert, Pennsylvanian bottle green chert, and Permian brick red chert.

The sill-like tonalite body which crosses Rapid River and which cuts some of the structures in the Sylvester Complex gives zircon and titanite ages of 269 Ma and 269 Ma, respectively (Gabrielse et al., 1993). Hornblende from the Nizi Creek Pluton has been dated isotopically at 262 ± 8 Ma (Hunt and Roddick, 1988). Zircon from the Meek Creek Pluton has been dated isotopically at 262 ± 0.5 Ma and 270 ± 4 Ma (Gabrielse et al., 1993) and biotite by the K-Ar method at 266.5 ± 3.9 Ma. All of these bodies, therefore, are considered to be Early Permian.

A tentative Devono-Mississippian age for the granodiorite pluton 10 km east of the north end of Cry Lake is based on its similar structural relations to the siliceous tectonite unit as that of the monzodiorite pluton (U-Pb age on zircon of 362 ± 5 Ma) west of Four Mile River in the McDame map area (Gabrielse et al., 1993). In addition, amphibolite which forms part of an agmatite along the southeastern part of the body has a K-Ar age of 341 ± 7 Ma.

Rocks of the Sylvester Complex have been mapped northwestward through the McDame map area (Gabrielse, 1963; Harms et al., 1988, 1989; Nelson and Bradford, 1989, 1993) through Jennings River map area (Gabrielse, 1969; Nelson and Bradford, 1987, 1993) into the Wolf Lake map area in southern Yukon Territory (Poole, 1956). Correlative strata on both sides of Tintina Trench in southern Yukon Territory have been included in the Anvil Allochthon (Tempelman-Kluit, 1979). To the southeast in Kaska Mountains, correlative rocks, assigned to the Slide Mountain Terrane, occur in Mesilinka and Manson Creek map areas (Gabrielse, 1975; Ferri and Melville, 1989). The Slide Mountain Terrane derives its name from exposures in the Cariboo Mountains (Struik, 1988)

Rocks assigned to the Kootenay(?) Terrane are similar to those included in the Yukon-Tanana terrane (Hansen, 1990) and to the Nisutlin subterrane (see Nisutlin Allochthon, Tempelman-Kluit, 1979) in Yukon Territory.

Tectonic setting of the Sylvester Complex

Much of the Sylvester Complex has a clear oceanic affinity. Sequences of ribbon chert deposited during the Late Devonian to Late Permian attest to a long lived, probably deep basin in which clastic sediments from a cratonal source were relatively unimportant (Fig. 34). Local occurrences of clean, quartzose sediments, including one unit of coarse grained grit with bluish, opalescent quartz grains suggest continental, but not necessarily nearby, origin. Tholeiitic volcanism occurred at intervals, perhaps in part from oceanic rifts but also from spreading centres which also produced ultramafic complexes. Shallow water Mississippian and Pennsylvanian limestone units may have accumulated on seamounts. During the Early Permian the oceanic environment was interrupted by the construction of island arcs, the sites of andesitic volcanism (in the McDame map area, Nelson and Bradford, 1993) and related plutonism. By the close of Permian time the Slide Mountain ocean, which must have been of considerable width before its closure, ceased to exist. Upper Triassic strata found in the McDame map area may represent an overlap assemblage linking the Sylvester Complex with Ancestral North America (Nelson and Bradford, 1993). Deformation during Early Permian and subsequent time imbricated not only the contents of the ocean basin and island arcs but also affected the ultramafic substrate so that slices of ultramafic rocks and related amphibolites were juxtaposed with all other lithologies

The latitudinal position of the Sylvester Complex before its obduction onto Ancestral North America is problematical. Paleomagnetic results suggest that at least part of the complex

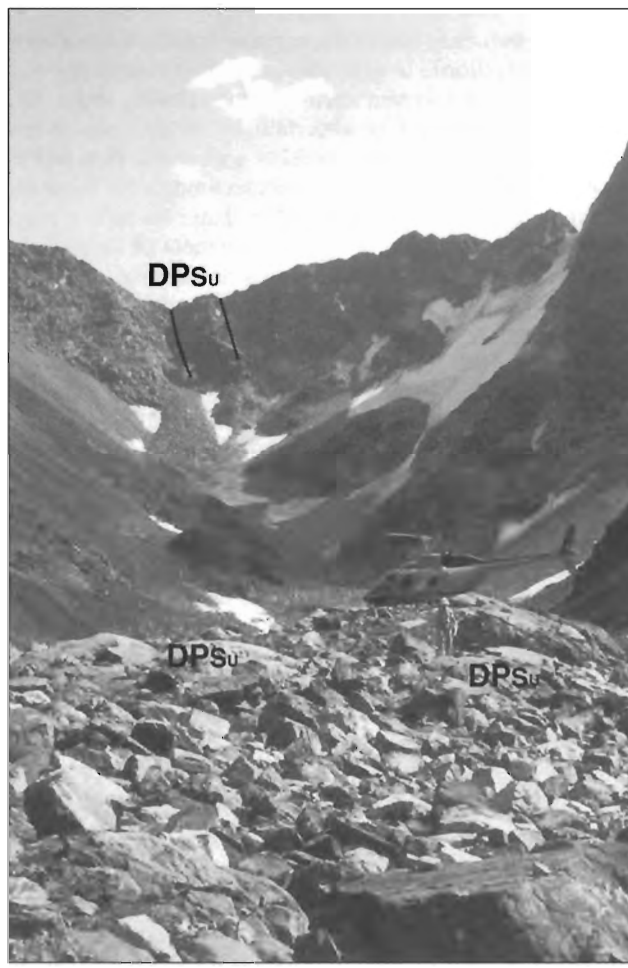
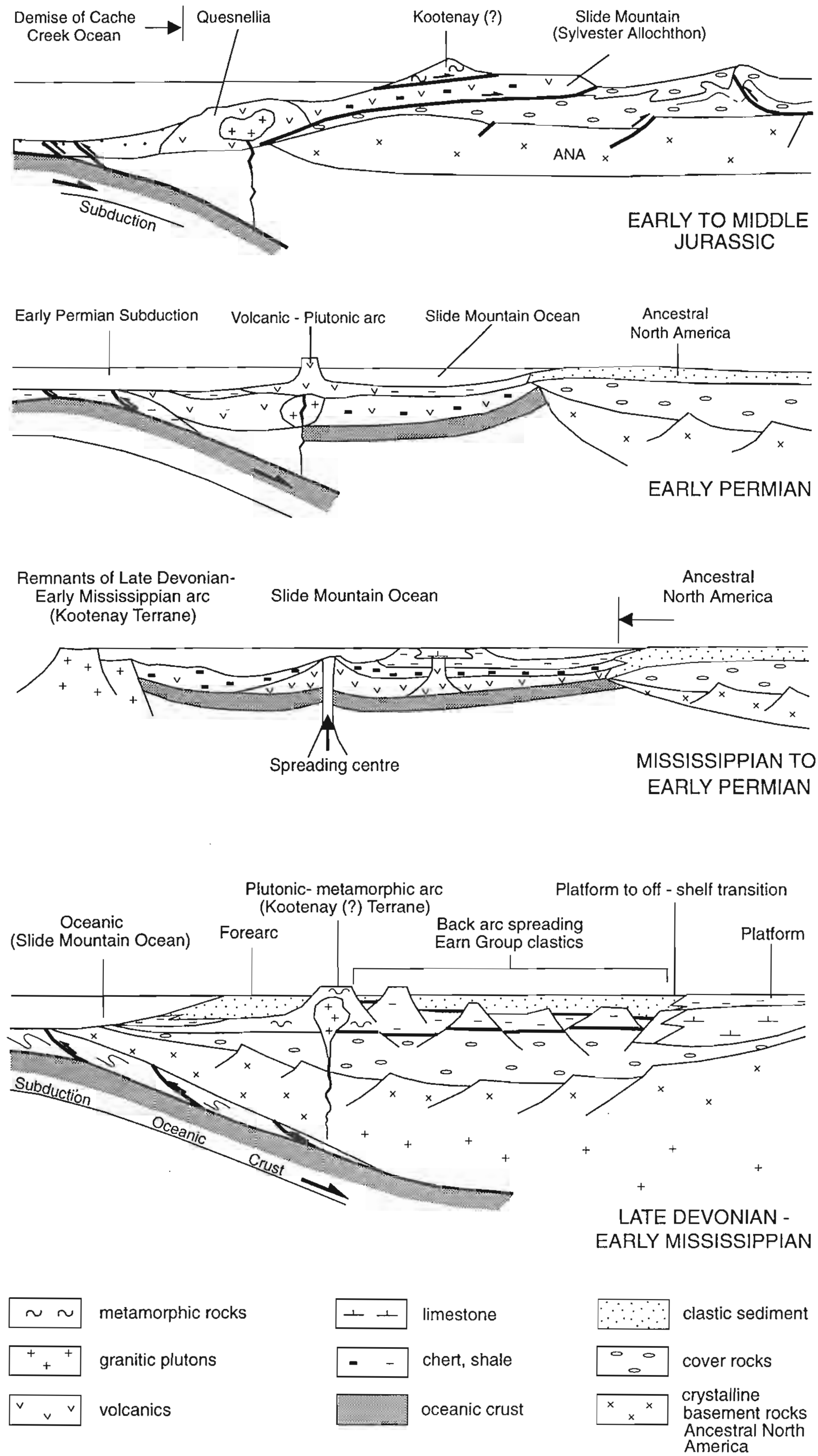


Figure 33. *Dun-weathering, serpentinized peridotite (DPSu) enclosed in amphibolite 13 km east-southeast of the north end of Cry Lake. Peridotite forms resistant rib in gulley, left distance, and underlies area where person is standing. GSC 1996-125KK*

Figure 34. *Diagram showing hypothetical relationships between Ancestral North America, Kootenay Terrane(?), Slide Mountain Terrane, and Quesnellia.*



Demise of Cache Creek Ocean
Quesnellia
Kootenay (?)
Slide Mountain (Sylvester Allochthon)
ANA
Subduction
EARLY TO MIDDLE JURASSIC
Early Permian Subduction
Volcanic - Plutonic arc
Slide Mountain Ocean
Ancestral North America
EARLY PERMIAN
Remnants of Late Devonian-Early Mississippian arc (Kootenay Terrane)
Slide Mountain Ocean
Ancestral North America
Spreading centre
MISSISSIPPIAN TO EARLY PERMIAN
Plutonic- metamorphic arc (Kootenay (?) Terrane)
Platform to off - shelf transition
Oceanic (Slide Mountain Ocean)
Forearc
Back arc spreading Earn Group clastics
Platform
Subduction
Oceanic
Crust
LATE DEVONIAN - EARLY MISSISSIPPIAN
metamorphic rocks
granitic plutons
volcanics
limestone
chert, shale
oceanic crust
clastic sediment
cover rocks
crystalline basement rocks Ancestral North America

may have formed far to the south (about 2200 km) relative to Ancestral North America and moved to its present latitude between the Permian and Jurassic (Richards et al., 1993). The setting of the Kootenay Terrane component of the Sylvester Complex is less clear. The rocks may have been deposited in an off-shelf, continental margin environment which may have included a volcanic-plutonic arc in the Late Devonian and Early Mississippian (Fig. 34). During a Late Devonian orogenic event the layered rocks were strongly tectonized, metamorphosed, and intruded by granodiorite and diorite plutons. Subsequently, perhaps during early Mesozoic time, they were juxtaposed with the oceanic Slide Mountain rocks.

Quesnellia

Mesozoic plutonic, volcanic, and sedimentary rocks between Thibert and Kutcho faults, between Hottah and Kutcho faults, and northeast of the confluence of Turnagain River and Kutcho Creek are assigned to Quesnellia. The terrane is characterized by the greatest variation in ages and compositions of plutonic rocks in the region.

Shonektaw Formation

Resistant volcanic rocks of the Shonektaw Formation (Watson and Mathews, 1944) underlie several prominent mountains north of Dease Lake and an extremely rugged terrain along the upper part of Tucho River. The most typical lithology is variably foliated, massive to weakly layered, dark green-weathering augite porphyry. In places augite crystals are more than 0.5 cm long. The augite porphyry, occurring as flows, breccias, and tuffs is intercalated with augite-feldspar porphyry and feldspar porphyry. Contacts between flows are rarely discernable. Some of the breccia fragments consist of maroon feldspar porphyry. Green-weathering, well bedded tuff is abundant locally and forms a unit on the north slope of Northwest Mountain more than 200 m thick. Chloritic schist and phyllite are present in the more highly deformed rocks. Thin sections of porphyries reveal phenocrysts of augite and plagioclase in a fine grained, dark green matrix consisting of actinolite, oligoclase, chlorite, epidote, and magnetite. Feldspar phenocrysts are partly altered to epidote and augite is partly to completely uralitized (Watson and Mathews, 1944).

Volcanic rocks of the Shonektaw Formation, as much as 800 m thick, are intimately associated with plutonic rocks, particularly with foliated hornblende diorite which occurs as small, irregular, unmapped bodies as well as the larger mapped plutons.

The rugged ridges flanking the upper reaches of Tucho River are underlain by well layered, crystal and lithic tuffs and vesicular flows and more massive feldspar and augite porphyries. The tuffs range from maroon to grey and green, with maroon types being particularly common. One kilometre to the east, on the ridge south of Tucho River, in Kechika map area the volcanics locally enclose a body of pyroxenite.

Nazcha Formation

Sedimentary rocks of the Nazcha Formation (Watson and Mathews, 1944) are exposed northeast of Thibert Fault from Ichthyosaur Mountain to beyond Red Ledge Mountain. The best exposures are found on Mount Defot where as much as 500 m of strata are present. Except near Thibert Fault the rocks are relatively fresh.

The lower part of the sequence on the northeast slope of Mount Defot consists of very well bedded pebble conglomerate, greywacke, slate, and shale. Clasts in conglomerate include a variety of volcanic rocks, commonly porphyritic, limestone, and argillite. Significantly, no chert clasts have been observed. The greywacke, in beds from 1 m to several metres thick, generally weathers green-grey and consists predominantly of lithic fragments, mainly of volcanic origin. Graded bedding is well developed in some units. Laminated shale, slate, and argillite form the matrix of mixtites which are characterized by clasts of limestone. Common, synsedimentary slump structures in the argillaceous rocks suggest a southwestward paleoslope (Fig. 35). Some blocks of mixtite in a laminated shale matrix are more than 5 m long. Near the crest of Mount Defot and on the west slope of the ridge, the Nazcha Formation consists dominantly of interbedded greywacke, siltstone, and slate (Table 3). A coarse conglomerate

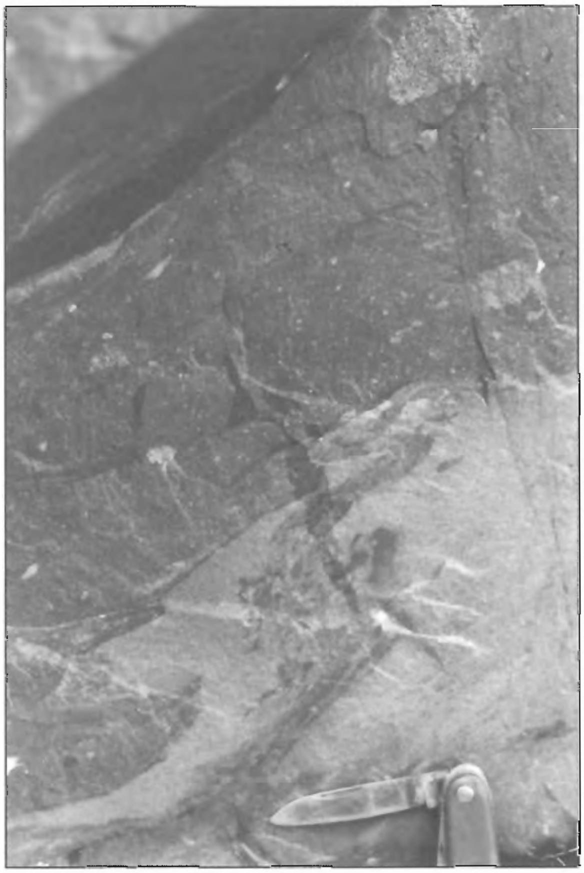


Figure 35. Slump folds in greywacke and pebble conglomerate of Nazcha Formation east of the confluence of Adsit and Canyon creeks. Photograph by J.O. Wheeler. GSC 1996-125JJ

Table 3. Modal analyses of greywacke in Nazcha and Cache Creek–Kedahda formations.

Sample number	Plagioclase	Orthoclase	Quartz	Matrix	Opaque minerals	Volcanics	Chert	Sediments	Mafic minerals	Carbonate	Fragments (unknown)
NAZCHA											
GA-29-6-56-2	24.2	5.6	4.0	10.6	3.2	3.6	0.8	1.4	15.4	9.4	21.8
CACHE CREEK-KEDAHDA											
GAB-29-6-56	3.3	0.9	3.3	18.2	8.7	6.3	7.7	9.4	3.3	7.7	31.0
GAB-22-6-56-4	2.2	0.0	1.5	12.2	3.3	4.3	5.0	6.9	13.2	3.9	47.5
GAB-10-6-8	7.6	0.0	8.2	19.6	3.5	5.0	4.6	9.2	17.9	4.1	20.3
GAB-23-6-56-5	8.2	0.9	8.0	10.5	3.8	7.0	9.2	24.2	2.1	10.6	15.5
GAB-30-6-56	14.4	5.0	14.0	10.2	2.7	7.9	4.0	2.4	6.5	22.5	10.4

on the ridge crest consists of boulders and cobbles of limestone and felsic volcanics in a greywacke matrix. Limestone clasts are up to 0.5 m long whereas volcanic clasts, commonly well rounded, range from 5 to 10 cm in diameter. Crossbedding is conspicuous in some of the siltstone members. Pebble conglomerate is locally abundant in the upper part of the assemblage.

On the eastern slope of Ichthyosaur Mountain, a steeply dipping band of limestone about 50 m wide and more than 1 km long is intimately associated with conglomerate. The limestone is strongly recrystallized. In places the member consists of intraformational limestone conglomerate and one band of coarse conglomerate, about 10 m thick, appears to be interbedded with the limestone. Immediately to the west is a unit of strongly cleaved, slaty shale. In view of the ages of the conglomerate and limestone, discussed below, it seems possible that the limestone unit is an olistolith. Across the valley to the east is another limestone unit, a few tens of metres thick. It dips steeply to the west and is bordered to the east by volcanic rocks of the Shonektaw Formation and to the west by conglomerate and siltstone of the Nazcha Formation.

Plutonic rocks

Plutonic rocks, ranging greatly in composition, structure, and age, are the most abundant rocks in Quesnellia. The oldest and most deformed plutons are intimately associated with volcanic rocks of the Shonektaw Formation but the younger ones have no obvious volcanic counterparts.

Cow Lakes Pluton

This pluton extends southeastward from Cow Lakes and Spike Mountain to the valley of Eaglehead Lake, underlying an area of about 370 km^2. At its northwestern end it includes an area of quartzose metamorphic rocks but relationships between the two lithologies is uncertain. The most abundant lithology of the pluton is a foliated, medium- to coarse-grained, hornblende-quartz diorite. Fresh, prismatic crystals of hornblende are commonly more than 1 cm long. Typical thin sections contain about 40% to 45% of strongly sericitized plagioclase, 10% potassium feldspar, locally megacrystic, and up to 25% quartz and 20% hornblende. Epidote is conspicuous in some samples. Where the rocks are in contact with mafic volcanic rocks they may be strongly melanocratic and generally finer grained than elsewhere. Some varieties have biotite but, in a few cases at least, this may be a metamorphic mineral. Other varieties are rich in hornblende, locally constituting amphibolite and hornblendite.

Rocks of the pluton have been intruded by pink-weathering granodiorite of possible Middle Jurassic age and by Early Cretaceous granite. Contacts with the Cassiar batholith and rocks to the southwest are faults. The area underlain by strata assigned to Ancestral North America and bounded by rocks of the Cow Lakes Pluton on the southwest may be a structural window.

Granitic rocks east of Spike Mountain

A body of mesocratic, medium grained diorite east of Spike Mountain is heterogeneous in composition with local concentrations of hornblende-rich varieties. The rock is massive and well jointed. Inclusions of fine grained, metavolcanic rock in which hornblende is generally strongly chloritized are common. In coarser grained lithologies, hornblende, in part chloritized, ranges from 30% to 50% and imparts a green colour to outcrops.

Granitic rocks northwest of Dease River

Granitic rocks in this area may comprise several separate plutons but their relationships are obscure. Strongly foliated hornblende diorite or granodiorite underlies the southwest slope of Northwest Mountain and may be continuous with similar rocks south of Canyon Creek. Near the contact with volcanic rocks the diorite is epidotized. In thin section the rocks are relatively fresh and consist of about 60% andesine and 35% hornblende. Chlorite alteration is minor. Along and south of Canyon Creek granitic rocks are highly sheared and foliated. Commonly, they are pink- or dark green-weathering because of alteration. Watson and Mathews (1944) described the rocks on the east side of Mount Coulahan as dark grey, medium grained, fresh gabbro consisting of labradorite, hypersthene, augite, and hornblende. The rocks are heterogeneous and light or dark coloured varieties, depending on the content of mafic minerals, may predominate locally. Biotite, magnetite, and quartz occur in small amounts and apatite is an accessory mineral.

Eaglehead Pluton

A wedge-shaped body of granitic rock extends southeastward from Eaglehead Lake to south of Turnagain River southwest of Flat Creek. The southeastern part of the body consists of nonfoliated, medium grained, hornblende-quartz diorite to granodiorite which locally contains a few megacrysts of potassium feldspar. It is cut by numerous aplite dykes and pegmatites consisting of potassium feldspar and quartz. The dykes may be related to a biotite granite which intrudes the granodiorite along its northern margin immediately southeast of Turnagain River. Northwest of the river, biotite is an important mineral and the rocks contain sparse megacrysts of potassium feldspar as much as 2 cm long. This granodiorite continues to the northwest where biotite and hornblende are present in about equal amounts. Locally, feldspar porphyry and aplite dykes are numerous.

The petrology, chemistry, and alteration of the Eaglehead Pluton have been studied in some detail around the Eaglehead porphyry copper prospect about 6 km southeast of Eaglehead Lake (Caulfield, 1982). There, the pluton consists of three phases. A narrow band of porphyritic to equigranular, medium grained, hornblende quartz diorite is flanked to the northeast by a dyke-like body, about 500 m wide, of biotite granodiorite. The bulk of the pluton, lying farther northeast, consists of biotite quartz granodiorite, locally containing rare K-feldspar megacrysts. All three phases are soda-rich and calc-alkaline. Propylitic, chloritic, and sericitic alteration are overprinted on an early K-feldspar replacement

The rock is foliated only along its southwest side where it is in fault contact with strata of the Kutcho Formation. In this respect, along with the conspicuous content of biotite, it contrasts markedly with granitic rocks of the Cow Lakes Pluton northwest of Eaglehead Lake.

Granitic rocks near Tucho River

Hornblende-quartz diorite underlies areas northeast of the Kutcho Fault both east and west of Tucho River. The rocks are weakly foliated except near the fault where chloritic shear surfaces are prevalent. Hornblende forms prisms as much as 1 cm long but varies considerably in grain size as does the host rock. The body east of Tucho River is part of the Pitman batholith which underlies a large area in southeastern Cry Lake and adjacent Kechika and Toodoggone River map areas (Gabrielse, 1962c; Gabrielse et al., 1977)

The body is variable in composition but a typical lithology is a leucocratic, medium grained, equigranular quartz diorite or granodiorite characterized by prismatic hornblende. Thin sections reveal the presence of 60% calcic oligoclase, as much as 10% potassium feldspar, 15% quartz, 10% or more hornblende, and 5% accessory minerals. Chlorite and epidote are common alteration products. In places the rock is distinctly foliated and has a protoclastic sugary texture.

Turnagain ultramafic body

The Turnagain ultramafic body is a typical, Alaskan-type, zoned ultramafic intrusion which underlies a northwesterly trending elongate area of about 25 km^2 crossing the Turnagain River just northeast of the Kutcho Fault. The body is characterized by sparse vegetation or lack of vegetation and dun to orange-brown weathering. The rocks are relatively fresh with serpentine occurring only locally along or near faults (Fig. 36).

Distinctive, dun-weathering dunite with local enrichment of chromite forms the central core of the body (Clark, 1980; Fig. 37). It is flanked to the northwest and southeast by a zone of wehrlite, olivine clinopyroxenite, clinopyroxenite, and rare hornblendite and plagioclase-hornblende rock. Small scale layering appears to have been folded and is commonly steeply dipping. Layering is expressed in the central dunite by chromite-rich bands as much as 8 m long and 8 cm wide gradational into enclosing dunite. Northwest of the central dunite, distinct layers of wehrlite and olivine pyroxenite range from a few centimetres to tens of metres wide. In places the central dunite clearly has intruded the bordering wehrlite.

Analyses of 60 olivine crystals shows a change in atomic per cent Mg from 96.6 in the dunite core to 80.2 in a band of olivine clinopyroxenite at the southeast end of the intrusion (Clark, 1980). Nickel is most abundant in the olivine with a high atomic percentage of Mg. The clinopyroxene is diopside.

Hornblendite, as much as 1 m thick, occurs along the northwest contact of the ultramafic body. Tongues of the hornblendite, up to a few centimetres thick in the metasedimentary rocks, locally truncate stratification. Drill core near the southwest end of the body reveal numerous sheets of hornblende- and plagioclase-bearing rock interlayered with clinopyroxenite and wehrlite. On the ridge southeast of the main ultramafic body southeast of Turnagain River, several pods of wehrlite have well developed aureoles of metamorphic rocks. There, amphibolite has formed by metasomatic reaction along the contact with ultramafic rock (N. Irvine, pers. comm., 1979). Where enclosed in graphitic schist, the zonation is from ultramafic rock to amphibolite, feldspar amphibolite, quartz-sericite-hornblende rock to sericitic schist. Where the bordering rocks are rich in carbonate, the zonation is from ultramafic rock through amphibolite, garnet amphibolite, feldspar-hornblende-garnet rock to carbonate.

Primary sulphide minerals have not been found in the central dunite core but occur at several localities in the flanking wehrlite and clinopyroxenite, particularly near Turnagain River (Clark, 1980). They occur as disseminated blebs, interconnected blebs and massive bands a few centimetres thick. The main minerals are pyrrhotite (commonly more than 95%), pentlandite, chalcopyrite, and bornite.

The main part of the Turnagain ultramafic body is bounded by faults along its northern, eastern, and southeastern boundary. The pods of ultramafic rock farther southeast appear to have intruded graphitic schist and calcareous strata.

Age and correlation of rocks in Quesnellia

Lithostratigraphic and lithodemic rocks assigned to Quesnellia in Cry Lake and Dease Lake map areas are mainly, or entirely, of Mesozoic age. Although fossil and isotopic ages are sparse they suggest a history extending only from Middle or Late Triassic to Middle Jurassic time.

Volcanic rocks

Volcanic rocks of the Shonektaw Formation are cut by granitic plutons and are overlain by the Nazcha Formation. Two of these plutons, one on the south flank of Northwest Mountain and one that crosses Eagle River have given Late Triassic zircon and K-Ar isotopic ages (see below). Overlying strata of the Nazcha Formation contain Late Triassic and probable Early Jurassic fossils.

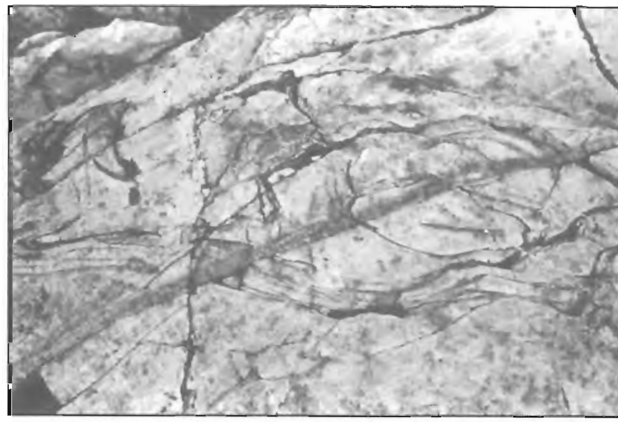


Figure 36. *Soft sediment deformation of chromite layers cut by wehrlite dyke in dunite of the Turnagain ultramafic body. Photograph courtesy of G. Nixon, British Columbia Department of Energy, Mines and Petroleum Resources.*

Sedimentary rocks

Limestone on the east flank of Ichthyosaur Mountain, described herein with the Nazcha Formation, contains caudal vertebrae identified by C.M. Sternberg as suggestive of the ichthyosaur *Delphinosaurus perrini* Merriam (Watson and Mathews, 1944). This fossil occurs in the Upper Triassic Hosselkus Limestone of California. The limestone is intercalated with conglomerate which contains clasts of the limestone and volcanic rocks of the Shonektaw Formation. As noted above, the limestone may be an olistolith in a conglomerate succession which may be of Early Jurassic age. A collection of bivalves from the Nazcha Formation, 2 km east-northeast of Ichthyosaur Mountain, includes "*Frenguelliella*" sp. which T.P. Poulton (pers. comm., 1982) indicated is of probable pre-Middle Toarcian and very likely of Sinemurian age. Conglomerate on Mount Defot contains limestone clasts of Late Triassic (late Karnian and Norian) age (Orchard, 1992).

Plutonic rocks

Foliated diorite on the south flank of Northwest Mountain has a U-Pb isotopic age on zircon of 228 ± 3 Ma (P. van der Heyden, pers. comm., 1988). Coarse grained hornblende-quartz diorite and granodiorite from the Cow Lakes Pluton which crosses Eagle River and extends to Eaglehead Lake has K-Ar isotopic ages on hornblende of 214.1 ± 3.2 and 206 ± 11 Ma (Hunt and Roddick, 1987). Mesocratic, hornblende-bearing, commonly foliated plutons on the east side of Mount Coulahan and southwest of the lower part of Canyon Creek are probably also of Late Triassic age. An isotopic K-Ar age of 186 ± 7 Ma was obtained on biotite from biotite-hornblende granodiorite to quartz monzonite of the Eaglehead Pluton (R.W. Oddy,

Figure 37. *Wehrlite dykes with clinopyroxene margins cutting dunite in the Turnagain ultramafic body. Photograph by G. Nixon, British Columbia Department of Energy, Mines and Petroleum Resources.*

pers. comm., 1972). Foliated diorite northeast of the Kutcho Fault and west of Tucho River are intimately associated with volcanics and are probably of Late Triassic age. The large pluton east of Tutcho River may include rocks of Late Triassic age but K-Ar hornblende ages on samples collected 30 km to the southeast near the Pitman Lineament in the Kechika map area indicate an Early Jurassic age (182 ± 13 Ma, 181 ± 13 Ma, Stevens et al., 1982a; 200.1 ± 3 Ma, Hunt and Roddick, 1987).

Pink-weathering biotite-hornblende granodiorite that intrudes hornblende diorite east of Eagle River yields discordant K-Ar ages. Hornblende ages range from 137 to 157 Ma whereas biotite ages cluster around 107 Ma (Hunt and Roddick, 1987). It is clear that the biotite ages have been reset by the emplacement of Early Cretaceous plutons. Whether or not the hornblende ages have been reset is unknown.

The Shonektaw and Nazcha formations can be mapped northwestward into their type localities in the Jennings River map area (Watson and Mathews, 1944). To the southeast they are correlated with volcanic rocks of the Takla Group and overlying Lower Jurassic rocks, respectively, which lie east of the Finlay River and Ingenika faults (Richards, 1976; Monger, 1977).

The Turnagain ultramafic body is similar to those which have been isotopically dated as Late Triassic in Quesnellia in the Toodoggone River, McConnell Creek, and Mesilinka map areas to the southeast (Nixon, 1990 and references therein). The complex association of plutonic rocks assigned to Quesnellia in the Cry Lake area is similar to that in the map areas noted above and also farther southeast in the Manson River map area (G.J. Woodsworth, pers. comm., 1989).

Tectonic setting of Quesnellia

The volcanic, plutonic, and sedimentary rocks of Quesnellia suggest an island arc setting during Late Triassic to possibly Late Jurassic time. One possibility is that the Nazcha Formation was deposited in a forearc environment coeval with formation of the Inklin Formation farther southwest as an accretionary wedge above a northward dipping, Early Jurassic subduction zone (Fig. 38). Polarity of the Late Triassic subduction zone is unknown. In the Dease Lake and Cry Lake map areas there is no convincing evidence as to the basement of the Shonektaw-Nazcha arc. To the northwest in Jennings River map area plutons similar to the Eaglehead Pluton (southeast of Eaglehead Lake) in composition and age have intruded upper Paleozoic rocks of uncertain terrane affinity. Evidence for oceanic sedimentation in the Slide Mountain Terrane during Triassic time is lacking. By Middle Jurassic time the Sylvester Allochthon and possibly Quesnellia had been emplaced onto Ancestral North America.

Rocks of uncertain terrane assignment

A panel of rocks about 2 km wide southeast of Turnagain River and northeast of Flat and Blick creeks includes lithologies which do not allow unique assignment to any of the major terranes in the region. The strata, possibly more than 200 m thick, are tightly folded but well layered and comprise black, phyllitic, pyritic slate, chloritic, foliated greenstone, creamy weathering, in part flow-banded, quartz-eye, schistose volcanics, local ribbon chert, and minor pods and lenses of carbonate. The felsic volcanics closely resemble those of the Kutcho Formation in the Cache Creek Terrane. The chert suggests either Slide Mountain or Cache Creek terrane affinity whereas the greenstone could be assigned to either of the above terranes or to Quesnellia. The rocks are bounded to the southwest by the Kutcho Fault but the nature of the eastern boundary is uncertain.

Cache Creek Terrane

The Cache Creek Terrane is bounded by the Thibert, Kutcho, and King Salmon faults and consists of three assemblages, two of which may be overlap assemblages. The oldest, or Cache Creek Complex, consists of radiolarian chert, argillite,

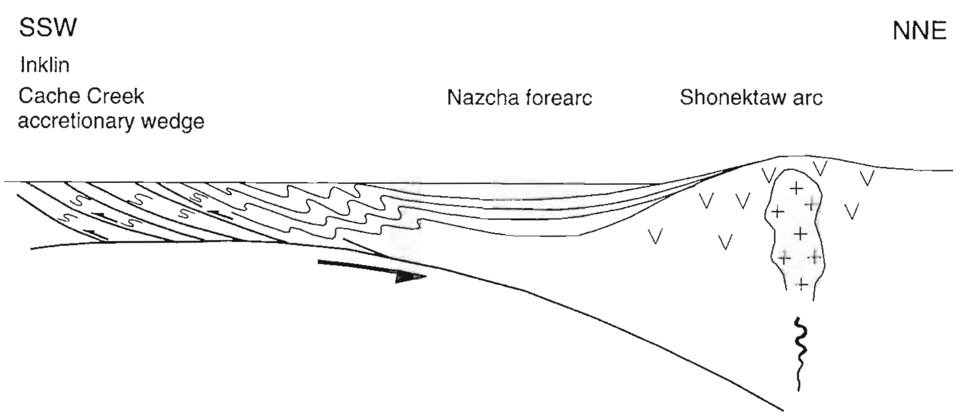


Figure 38. Diagram showing hypothetical relationships in Late Triassic and Early Jurassic time between Shonektaw, Nazcha, and Cache Creek rocks in northeastern Dease Lake map area. For legend see Figure 34.

limestone, mafic volcanics, diorite, gabbro, and ultramafic rocks of Early Mississippian to Permian age and, in the upper part, greywacke interbedded with chert of Late Triassic age. In the southeastern part of the area the complex is succeeded by a Triassic, dominantly volcanic assemblage named the Kutcho Formation. It comprises distinctly bimodal, calc-alkaline, mostly volcaniclastic basalt or basaltic andesite and rhyodacite or rhyolite with some sills of trondhjemite and gabbro. The youngest assemblage includes an Upper Triassic limestone (Sinwa Formation) overlain by thick greywacke, shale, and conglomerate of the Lower Jurassic Inklin Formation.

In this report rocks between the Nahlin and King Salmon faults are included in the Cache Creek Terrane because of the spatial relationship of typical oceanic lithologies, including ribbon chert and ultramafic rocks, with rocks of the Kutcho, Sinwa, and Inklin formations in southeastern Cry Lake map area. Nonetheless, it can be argued that the Kutcho, Inklin, and oceanic rocks between the two regional faults comprise a separate terrane of unknown correlation. It is also possible that the Inklin Formation is an overlap assemblage representing distal parts of the roughly coeval Nazcha Formation of Quesnellia and/or the Takwahoni Formation of Stikinia (Souther, 1971).

Cache Creek Complex

Definition of the term 'Cache Creek Group' and its regional correlation has been discussed in detail by Monger (1975). It is proposed in this report to refer to the Cache Creek rocks as a 'Complex' so as to emphasize the penetrative and extensive structural dislocations exhibited by these rocks. In this respect the sequence is analogous to the Sylvester Complex of the Slide Mountain Terrane except that the Cache Creek rocks are even more strongly deformed and dislocated. Stratigraphic relationships are further complicated by the strongly diachronous contacts between the carbonate, clastic, and volcanic rocks. Rocks of the Kutcho, Sinwa, and Inklin formations generally have a simpler structural style than those of the underlying Cache Creek and are not included in the complex.

Kedahda Formation

The Kedahda Formation (Watson and Mathews, 1944; Monger, 1969, 1975) is a generally recessive, dominantly sedimentary succession and is the thickest and most widespread unit in the Cache Creek Complex west of Eagle and Little Eagle rivers. By far the most complete and best exposed sections occur in the canyon of Dease Creek but the rocks are well exposed also locally in deep stream cuts on the north slope of the French Range, north of Thibert Creek and along the northern part of Dease Lake. Fairly continuous exposures occur along Metahag Creek west of Tuya River and in places along the Nahlin and Kushin rivers. The formation is represented by discontinuous lenses in the southeastern part of the region. Some of these, for example between the headwaters of Little Greenrock and Greenrock creeks, near the head of Two Mile Creek and near King Mountain, include considerable thicknesses of sedimentary rocks.

The characteristic lithologies of the Kedahda Formation are thinly bedded cherty pelite and pelitic chert with beds ranging from less than 1 cm to several centimetres thick (Fig. 39). The pelitic rocks are commonly phyllitic and dark grey weathering and in many places are stained with iron oxide. Where more highly metamorphosed, phyllitic rocks have a silver-grey sheen. Some are distinctly graphitic. East of Wheaton Creek muscovite is locally abundant. Bedded chert, ranging in colour from dark grey to medium grey and green to white is generally strongly recrystallized and has the texture of fine grained quartzite. Along Dease Creek manganese staining is common and, particularly in the lower reaches of the creek, stilpnomelane is abundant on bedding surfaces. Red jasper near the top of the formation near and on Mount Rath contains recrystallized radiolaria tests.

Discontinuous limestone, dolomitic limestone, and dolostone units occur in the Kedahda Formation, particularly around the French Range where they appear to be most abundant near the top of the formation. Along Dease Creek a number of dark grey, crystalline limestone members range from boudins 8 m long and 1 m thick to a coarsely crystalline unit as much as 60 m thick. The latter outcrops on the north

Figure 39. *Typical tight fold in chert of the Kedahda Formation along Kedahda River in southwestern Jennings River map area. Photograph by J.W.H. Monger. GSC 1996-125GG*

side of Dease Creek between the junctions of Buck and Lyons gulches and eastward across Lyons Gulch. It is dark grey, in part argillaceous and, in places, brecciated. Small pods and lenses of fine grained dolomitic limestone is interbedded with red jasper at the top of the Kedahda Formation on Mount Rath. In places these carbonate bodies contain silicified fusulinids. About 4.8 km south of Mount Rath, just east of Quartz Creek, buff-, yellow-, and white-weathering, locally tuffaceous, bioclastic limestone contains abundant fusulinids, crinoid columnals, and brachiopods (Monger, 1969).

Volcanic sandstone or greywacke is an important constituent of the Kedahda Formation in a belt up to 10 km wide along the north side of the Cache Creek Complex extending from northwest of Tuya River to the north end of Dease Lake. These rocks are, as far as is known, the youngest in the complex and consist of weakly to moderately foliated, relatively massive greywacke interbedded with phyllitic slate and ribbon chert. The coarser sediments comprise volcanic fragments, chert, and lesser amounts of plagioclase, mafic minerals, argillite chips, and quartz (Table 3). Slate fragments up to 4 cm long are conspicuous in almost all outcrops. Locally, brick red chert grains have been noted. The sedimentary rocks are ungraded and weather grey or greenish grey to shades of brown. Sorting is poor or absent and most grains are angular. Beds range from several centimetres to several metres thick.

Thicknesses of the Kedahda Formation are almost impossible to determine because of penetrative deformation and generally incomplete exposure. The rocks exposed along Dease Creek may be more than 1500 m thick and elsewhere sections several hundred metres thick can be observed. Contacts with ultramafic rocks are invariably faulted but the formation appears to grade, locally, into the overlying French Range Formation. Indeed, the two formations may be in part lateral equivalents.

The relationships between the greywacke-chert member of the Kedahda Formation and the succession exposed farther south in the French Range is enigmatic. The rocks may be separated by an unrecognized fault downthrown to the northeast. On the other hand, the present distribution of these rocks may have resulted from their paleogeographic evolution. In this scenario the French Range Formation strata, interpreted as representing a volcanic plateau upon which Permian, shallow water limestone was deposited, were succeeded to the northeast by deep water sediments which escaped significant erosion during a falling sea level in late Permian time. Thus, the younger rocks to the northeast may be part of a dominantly deep water succession which never included much volcanic or carbonate strata. Only on the flanks of the French Range plateau would an unconformity be evident. Some evidence for this hypothesis can be found between Thibert Creek and the headwaters of Canyon Creek where slate-chip greywacke directly overlies a thin unit of Permian limestone.

Northwest of the Dease Lake map area the upper part of the Kedahda Formation rests unconformably on the Horsefeed Formation (see below).

French Range Formation

The dominantly volcanic French Range Formation (Monger, 1969) is best exposed in the French Range where it forms resistant, dark-weathering outcrops (Fig. 5). Good exposures can be observed along Metahag Creek west of Tuya River. The easternmost outcrops assigned to the formation occur southeast of Halfmoon Lake and west of Eagle River where they underlie a prominent knoll.

The French Range Formation consists of about equal amounts of altered flow rocks and pyroclastic rocks, with minor diabasic intrusive equivalents, and intercalated chert and argillite (Monger, 1969). The flow rocks weather grey-green to dark brown and, in a few localities, maroon. Some are locally pillowed with interstitial chert, jasper, or reddish, crystalline limestone. Most are metabasalts but some feldspar porphyries are present. In places, for example, underlying the knoll 5 km southeast of Halfmoon Lake, massive, siliceous, fine grained, green basalt is dominant. Pyroclastic rocks range from coarse to fine agglomerate and cherty tuff. In thin sections the rocks can be seen to have been strongly altered. Plagioclase has been saussuritized and mafic minerals have been replaced by chlorite and actinolite. A few samples of least altered rocks contain relict crystals of diopsidic augite. Carbonate and quartz fill amygdules and form veinlets with chlorite and albite. At a few localities the rocks contain pumpellyite and epidote. Crossite-quartz schist and lawsonite-bearing altered greenstone are present locally. Sphene is an abundant accessory mineral as reflected in the relatively high titanium content of the volcanic rocks (see Table 4).

In the French Range, the French Range Formation may be as much as 600 m thick but throughout the region its thickness varies markedly.

Contacts of the French Range Formation with the underlying part of the Kedahda Formation are conformable, gradational, and diachronous (Monger, 1969). The contact with the overlying Teslin Formation is also conformable and locally gradational through a sequence of calcareous tuff and brown- to buff-weathering tuffaceous limestone. In a few places rocks of the French Range Formation appear to overlie limestone of the Teslin Formation. In these cases it is not known whether the relationships are structural or stratigraphic.

Teslin Formation

Northwest-trending ribs of the light grey-weathering, resistant limestone of the Teslin Formation (Watson and Mathews, 1944) are conspicuous in the French Range and in the lower lying areas to the northwest. The easternmost, fossiliferous body outcrops near Moose Lakes in Cry Lake map area.

The formation is generally massive and consists of fine grained limestone, limestone breccia, tuffaceous limestone (mainly at the base) and rare, coarse, bioclastic limestone. The most common lithology is hard, splintery, fetid, extremely fine grained, very dark grey limestone or dolomitic limestone which weathers pale grey (Monger, 1969). Laminations are clearly seen in some beds (Fig. 40). These laminations as well as mound-like structures may be of algal origin. A few structures resemble mudcracks. Fusulinids are abundant locally and poorly preserved brachiopods, corals, and bryozoa have been collected on the north side of Mount Rath in the French Range (Kerr, 1925).

The Teslin Formation gradationally overlies the French Range Formation and fossil evidence indicates that the contact is markedly diachronous. The relationship between the Teslin Formation and the Upper Triassic, volcanic sandstone member of the Kedahda Formation was described above.

The Teslin Formation varies greatly in thickness. Estimates for exposures in the French Range are between 300 and 600 m. Considerably thinner successions are present elsewhere but in few cases can depositional contacts be observed. Between the headwaters of Canyon and Thibert creeks the formation is probably no more than 15 m thick.

Horsefeed Formation

Limestone northeast of the junction of Dudidontu and Nahlin rivers and north of Sheslay have been included in the Horsefeed Formation (Monger, 1975). In its type area to the northwest in the Atlin map area the lower part of the formation consists of a basal, massive, pale grey-weathering calcarenite overlain by a thick succession of pale grey, porcellanous, crinoidal, and foraminiferal calc-arenite. This member grades upwards into dark grey, very fine grained detrital limestone and dolomitic limestone. The uppermost member of the Horsefeed Formation is an aggregate of foraminiferal calc-arenite and, in the upper part, locally breccia. Between Koshin and Nahlin rivers the most common lithology is pale grey, unsorted, massive limestone breccia (Monger, 1975).

The Horsefeed Formation regionally overlies Upper Mississippian tuff, argillite, and chert containing limestone pods. These rocks are included in the Kedahda Formation as are lithologies that overlie the Horsefeed Formation consisting of basal limestone breccia overlain by siltstone, argillite,

Table 4. Chemical analyses of volcanic rocks in the French Range Formation. (Monger, 1969).

Sample No.	1	2	3	4	5	6
SiO_2 %	44.8	46.3	46.6	42.8	47.0	49.6
TiO_2 %	2.31	1.65	1.35	1.62	4.47	1.35
Al_2O_3 %	13.1	15.2	16.2	14.7	15.4	16.4
Fe_2O_3 %	0.7	3.8	2.3	3.1	0.5	0.6
FeO %	11.2	7.0	7.9	9.2	10.1	8.8
MnO %	0.19	0.18	0.22	0.18	0.15	0.14
MgO %	6.1	8.5	6.8	8.8	7.6	4.8
CaO %	8.9	8.8	11.4	9.7	4.8	8.6
Na_2O %	4.3	3.4	2.1	2.9	3.3	4.0
K_2O %	0.01	0.7	2.4	0.2	1.0	0.9
H_2O %	3.7	4.2	0.6	5.1	5.4	3.0
CO_2 %	2.5	0.1	0.2	0.01	0.3	0.01
P_2O_5 %	0.22	0.14	0.12	0.12	0.73	0.10
Totals	98.03	99.97	98.19	98.43	100.75	98.30

Comments:
1. From southwest side, Johnson Knolls.
2. From north side, southeastern end of prominent greenstone ridge south of Slate Creek.
3. From north side, prominent greenstone ridge south of Slate Creek and 1.6 km southeast of peak of elevation 1889 m.
4. From east side, summit of Mount Rath.
5. From greenstone knoll, 2.4 km south of summit of Mount Rath.
6. From 3.2 km southeast of westernmost lake at head of Cody Creek.

* Analyses done by the rapid method by S. Courville in the laboratories of the Geological Survey of Canada.

Figure 40. *Laminated limestone of the Teslin Formation in the French Range. Photograph by J.W.H. Monger. GSC 1996-125FF*

and chert. The contact at the base of the upper Kedahda Formation is considered to be a regional unconformity (Monger, 1975).

In its type area the Horsefeed Formation is at least 1500 m thick but in the western part of the Dease Lake map area it may be considerably thinner because of bounding faults.

Ultramafic and mafic plutonic rocks

Two of the largest ultramafic bodies in the western Canadian Cordillera are exposed in the hanging wall of the Nahlin Fault. One is a continuation of a body that extends northwesterly through the northeastern corner of the Tulsequah map area (Souther, 1971) and into the Atlin map area (Aitken, 1959), and the other underlies the area trending southeasterly across south-central Cry Lake map area.

The southeast end of the Nahlin ultramafic body crosses the Nahlin River just upstream from its confluence with the Dudidontu River. Three ultramafic bodies, each about 8 km^2 occur in the Tachilta Lakes area west of Tuya River. A low-lying area just west of the settlement of Dease Lake is underlain by serpentinite, and Tanzilla Butte, 10 km southeast of Dease Lake consists mainly of ultramafic rocks. A large area extending southeastward from south of Eagle River to the Kutcho Fault is underlain by several large ultramafic bodies, which are in fault contact with innumerable smaller bodies of sedimentary and volcanic rocks. Many small serpentinite lenses outcrop along the King Salmon, Nahlin, and Thibert faults. Associated with the ultramafic rocks are units of diorite and gabbro which in turn are closely associated with volcanic rocks. The ultramafic rocks are characterized by reddish-brown- to grass-green-weathering surfaces and by lack of vegetation.

The Nahlin ultramafic body has been described by Aitken (1959) and Souther (1971). The most abundant rock is dark green to black peridotite consisting of partly serpentinized olivine, 10 to 20% orthopyroxene, minor augite, and traces of chrome spinel. Layers defined by concentrations of pyroxene between 1 cm and 15 cm thick are abundant in the central part of the peridotite body. Souther (1971) has interpreted the layers as pyroxene replacements of olivine along incipient fracture or shear planes. Eight kilometres west of Tedideech Lake and 9.6 km southeast of the junction of Chastot Creek and Nahlin River, serpentinite is in fault contact with Lower Permian carbonate. Along the fault, highly fractured rock is locally opalized and contains the nickel mineral millerite (Smith, 1957).

Ultramafic bodies in the Tachilta Lakes area are brown weathering and not generally strongly serpentinized. They have been intruded by granitic rocks and some of the dunite may be regenerated from serpentinite. Pyroxene layers, from one to three centimetres thick, like those in the Nahlin body, are locally conspicuous with cream-weathering pyroxene crystals in a brown to dark green matrix. The north end of the southeastern body locally contains numerous cross fibre chrysotile veinlets.

Poorly exposed serpentinite along the King Salmon Fault southwest of Dease Lake is generally highly slickensided and dark green-weathering. The outcrops may represent individual lenses rather than one large body. Along the fault the rocks have been strongly carbonatized and silicified.

Peridotite and serpentinite on a ridge 15 km west of the south end of Eaglehead Lake appears to form a northerly dipping sheet in the hanging wall of the Nahlin Fault overlain by fine grained volcanics and hornblende gabbro. In places the hornblende gabbro has crystals of hornblende up to 1 cm long. The rock locally forms pegmatitic segregations in the fine grained volcanics. At the contact with volcanic rocks the ultramafics consist of dun-brown- to orange-weathering dunite and pyroxenite forming a band from 30 to 35 m thick. Underlying these relatively fresh rocks is highly slickensided serpentinite which locally grades into less serpentinized peridotite, locally with well developed layers of pyroxenite. Pods of highly recrystallized limestone occur within the serpentinite. Zones of talcose and quartz-carbonate alteration (listwanite) mark the fault zone between the ultramafics and the footwall greywacke and phyllitic shale of the Inklin Formation.

Figure 41.

View to northwest, east of Turnagain River and west of Two Mile Creek to resistant, dark-weathering peak of pyroxenite and peridotite in shallow fault contact with structurally underlying light-weathering fish-scale serpentinite. GSC 1996-125E

Ultramafic rocks northwest and southeast of Serpentine Lakes consist of dun-brown- to reddish-brown-weathering dunite and peridotite with large area of highly slickensided, grass-green, fish-scale serpentinite. Pyroxenite layers composed of cream-weathering orthopyroxene concentrations from 1 cm to 6 cm thick occur here and there. Thin layers of chromite occur in widely scattered localities. One fresh diabase dyke, trending almost north cuts the ultramafic rocks and other bodies of highly altered diabase (rodingite) were noted locally. East of Serpentine Lakes several pods and lenses of jade (nephrite), ranging up to 30 m in length and 15 m in width, have been mined. Associated with the ultramafics are heterogeneous bodies of foliated greenstone and hornblende diorite or gabbro. Southeast of the south end of Serpentine Lakes a slice of fine grained, locally vesicular volcanic rock with foliated gabbro and another slice, farther south, of Inklin Formation greywacke and slate are faulted between serpentinite sheets within the fault zone in the hanging wall of the Nahlin Fault.

The structural stacking of ultramafic and mafic volcanics southeast of the mouth of Tumble Creek is similar to that on the ridge 15 km west of the south end of Eaglehead Lake. The crest of the ridge is underlain by northward dipping, fine grained volcanic rocks associated with medium- to locally coarse-grained gabbro. This unit is underlain by a unit of reddish-brown-weathering pyroxenite about 15 m thick which is, in turn, underlain by grass-green, fish-scale serpentinite (Fig. 41). The fault zone separating the pyroxenite from the serpentinite contains minor, rather brittle chrysotile asbestos. On the east side of the valley to the east the fault is marked by a zone of talc-quartz-carbonate rock (listwanite). From there it can be traced to the southeast into the valley of Two Mile Creek where it merges with other faults bounding northerly dipping slices.

On King Mountain serpentinized peridotite and pyroxenite is overlain along a gently dipping contact by a volcanic and gabbroic complex. Volcanic rocks are fine grained and dark green-weathering whereas the gabbroic rocks are medium- to coarse-grained and mesocratic. In a cirque on the northeast side of the mountain at the head of Ferry Creek, the retreat of a glacier has left fresh exposures of the gabbro which here shows spectacular banding on a scale of a few centimetres to perhaps 25 cm (Fig. 42). The layers consist of mafic-rich and mafic-poor lithologies which locally contain structures similar to cross-stratification in sedimentary rocks. In thin section the rocks show almost complete alteration of the mafic minerals to actinolite and feldspar to albite. Layered gabbro, strongly foliated, occurs as pods and lenses ranging up to a few kilometres long and hundreds of metres thick throughout the King Mountain area.

The large serpentinized ultramafic body northeast of Letain Lake contains a chrysotile asbestos deposit which has been extensively explored. The ultramafics are bordered to the northeast by a complex of metadiorite and/or metagabbro and volcanic rocks (Fig. 43). In these complexes grain size varies markedly from place to place and contacts between coarse grained plutonic rocks and fine grained volcanics are subtle.

In many places the ultramafic rocks have been altered to assemblages of talc, carbonate, and quartz characterized by buff-brown weathering. These alteration products, called listwanite, appear to mark fault zones, particularly within ultramafic bodies and along their contacts. They are particularly abundant in the area between Turnagain River and Letain Lake. Two northwest-trending zones of listwanite, each more

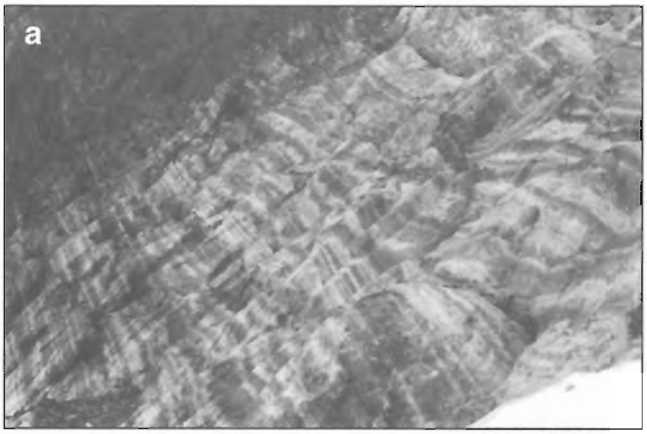


***Figure 42. a)** Layered gabbro at snout of glacier on north side of King Mountain. Section in centre of photograph about 6 m thick. GSC 1996-125DD **b)** View west to glacier on northeast side of King Mountain. GSC 1996-125CC. Layered gabbroic rocks of Figure 42a are light coloured exposures to left of the snout of the glacier.*

Figure 43.

View north, northeast of Letain Lake, to asbestos-bearing serpentinite. Dark-weathering gabbroic peaks are in right distance. GSC 1996-125BB

than 3 km long and as much as 30 m wide outcrop between Wheaton and Ferry creeks. The one nearest Wheaton Creek contains abundant mariposite. The other is heavily veined with quartz which occurs along well defined fracture sets. This zone separates volcanics to the southwest from siliceous sedimentary rocks to the northeast. A conspicuous quartz-carbonate alteration zone associated with lenses of serpentinite marks the Thibert Fault along Thibert Creek and along the southwest sides of Mount Defot and Red Ledge Mountain. Other well defined alteration zones occur along Eaglehead Fault southeast of Eaglehead Lake and Kutcho Fault along the southeast end of the Cache Creek Complex.

White rock bodies (rodingite) occur locally in highly sheared serpentinite as tabular, lenticular, and irregular masses. A spectacular block of rodingite about 6 m high and 4 m across and in contact with serpentinite occurs near the mouth of Delure Creek west of the north end of Dease Lake. The bodies consist of varying amounts of calc-silicate minerals including hydrogarnet, albite, prehnite, zoisite, diopside, and, in places, vesuvianite. Relict textures suggest most, if not all, of these rocks are altered gabbro or diabase.

Jade (nephrite) is an important alteration product associated with the serpentinized peridotite, particularly along contacts with metavolcanic or metasedimentary rocks (Fig. 44). It forms lenses and pods as much as 35 m long and 2 to 3 m wide best exposed in the mountains east of Provencher Lake although a number of occurrences are known in the belt extending southeastward from west of Eaglehead Lake to Kutcho Creek. Because of its resistance, jade readily forms boulders and these have been the target of much prospecting. Jade has also been found east of Serpentine Lakes and northwest of Stake and Porter Landing mountains east of the north end of Dease Lake. A pebble of jadeite was recovered in the lower part of Thibert Creek and represents one of the few occurrences of this high-pressure mineral known in the Canadian Cordillera.

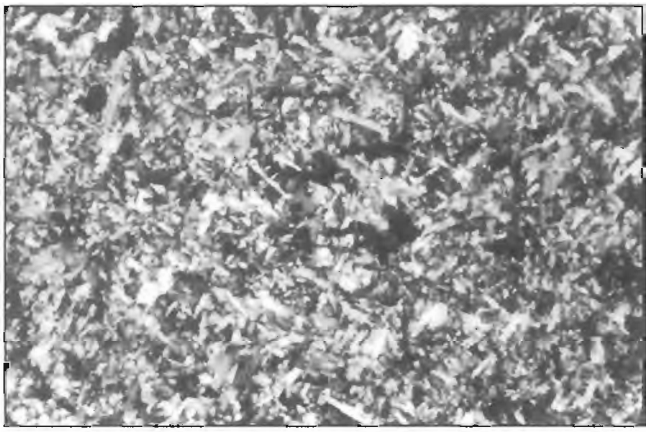


Figure 44. *Photomicrograph of amphibole jade showing the interlocking, hornfelsic texture. Width of photograph represents about 2 mm. GSC 1996-125AA*

Age and correlation of Cache Creek Complex

Age ranges for carbonate units in the Cache Creek Complex have been determined mainly from fusulinids and, locally for the Kedahda Formation, on foraminifera. Radiolaria have been used to date the upper part of the Kedahda Formation. The dominantly carbonate Horsefeed Formation contains fossils of late Mississippian, mid- and late Pennsylvanian, and Early and Late Permian ages (Monger, 1975). The Kedahda Formation contains early and late Mississippian, Pennsylvanian, Early Permian, and Middle to Late Triassic fossils (Monger, 1969, 1975; F. Cordey, pers. comm., 1989). The Teslin Formation contains an abundant Early and Late Permian fauna and the French Range Formation is of Early to possibly early Late Permian age. Because all contacts of ultramafic rocks appear to be faults there is no stratigraphic evidence for their age. No isotopic ages are available on the associated gabbro and diorite.

Rocks correlative with the Cache Creek Complex can be traced discontinuously from southwestern Yukon Territory to south-central British Columbia (Monger, 1975). The longest gap in exposures occurs where the complex has been faulted along Kutcho, Finlay River, and Ingenika faults (Gabrielse, 1985).

Kutcho Formation

The Kutcho Formation is a dominantly volcanic unit consisting of a distinctive bimodal suite of calc-alkaline basalt or basaltic andesite and rhyodacite or rhyolite (Bridge et al., 1986; Thorstad and Gabrielse, 1986). Its type section is exposed east of Kutcho Creek in the southeastern part of the Cache Creek Terrane. Much thinner volcaniclastic equivalents occur along the Nahlin Fault east and west of Dease Lake, along the King Salmon Fault east of Dease Lake and along the Thibert Fault southeast of Eaglehead Lake. The Kutcho Formation is host to a large, Kuroko-type, stratabound sulphide deposit east of Kutcho Creek.

In the type area the basal unit of the Kutcho Formation consists of dark grey- to green-weathering, basaltic to dacitic tuff and breccia. It comprises massive tuff, feldspar, augite and hornblende crystal tuff, and medium to coarse chaotic breccias with fragments from 1 to 35 cm long. The rocks are generally well foliated, but show little evidence of layering. Rare lenses of acidic tuff intercalated with thin argillite members are found throughout the sequence. These rocks are commonly quartz- and/or plagioclase-bearing and in places occur in successive graded cycles (Bridge et al., 1986). Epidote is widespread and locally forms small and large (1-20 cm diameter) subspherical clots of radiating crystals. The tuff has been altered considerably to epidote and carbonate and lesser sericite and chlorite. The unit may be as much as 215 m thick.

Feldspar quartz-eye sericite schist, quartz-eye sericite schist, and sericite schist enclose the massive sulphide deposit and are up to 565 m thick. From north to south there is a distinct facies change from lapilli crystal tuff to quartz feldspar crystal tuff (Bridge et al., 1986). Dolomite lenses from 10 to 20 cm long have been flattened in the plane of foliation. The footwall felsic schist also contains a lens of chlorite schist from 1 to 61 m thick. In thin section the chlorite schist comprises chlorite, epidote, and fine grained feldspar with minor amounts of sericite and tremolite-actinolite. Dolomite rhombs are common.

Overlying the member enclosing the sulphide deposit are units of breccias consisting of quartz-eye sericite schist fragments, basic schist similar to mafic rocks of the basal member, and an upper unit gradational from tuff and argillite to conglomerate totalling from 400 to 500 m in thickness. Tuff and argillite, ranging from 1 to 400 m thick (thickest in the eastern part of the area), include very fine grained quartz feldspar sericite schist, fine grained chloritic feldspar schist, black to green shale and siltstone with calcareous lenses, and grey to green sericite schist and greywacke. Disseminated pyrite and pyrrhotite and limonitic boxwork after pyrite are common (Thorstad and Gabrielse, 1986). The conglomerate, which ranges in thickness from 10 to 100 m, contains clasts from 0.5 to 12 cm long of quartz-eye sericite schist, sericite schist, quartz-eye feldspar sericite schist, and lesser chlorite schist, carbonate, and quartzite. Limestone lenses are present throughout.

In the southeastern part of the type area, a body of medium grained trondhjemite consisting of quartz, plagioclase, and chloritized mafic minerals is more than 5 km long and 1 km wide (Pearson and Panteleyev, 1975). The borders are foliated and, in places, brecciated. Locally coarse grained and porphyritic phases contain quartz phenocrysts as much as 1 cm in diameter. Another elongate body about 4.5 km long and 0.25 km wide occurs about 1.5 km north of the body described above. It has the mineralogy and texture of an altered diorite or gabbro. These bodies may be sills related to the Kutcho volcanism.

In the area of the sulphide deposit, the Kutcho Formation appears to be greater than 2 km thick. This accumulation must represent proximity to a volcanic centre because both the coarseness of fragments and thickness of the formation decrease markedly to the west.

The Kutcho Formation is well exposed in the mountains west of Kutcho Creek to Kehlechoa River. There it consists of intercalated assemblages of green-weathering, cherty, chloritic, fine grained volcanics including much tuff and creamy buff-weathering quartz-eye sericite schist. Similar rocks are exposed intermittently to beyond Turnagain Lake. Northwest of Wade Lake the formation includes considerable thicknesses of sheared augite porphyry and quartz hornblende porphyry.

West of Turnagain Lake green, chloritic volcanics in the hanging wall of the King Salmon Fault locally have strongly flattened, maroon-weathering clasts. These rocks are locally intercalated with quartz-eye schists noted as far west as Tanzilla Butte.

On Little Eagle River south of its confluence with Squaw Creek is a sequence of chlorite schist, quartz-eye sericite schist, argillite, conglomerate, and limestone. The schists are locally marked by gossan and pyrite is ubiquitous. As elsewhere these rocks seem to have elements of Kutcho, Sinwa, and Inklin lithologies.

Tuff, conglomerate, and argillite outcrop in the immediate footwall of the Nahlin Fault from north of Swinton Lake to the head of Little Dease Creek. These rocks are identical to those of the upper member of the Kutcho Formation in the type area. The rocks are very well bedded and, in places, graded (Fig. 45). At the head of Little Dease Creek, units of distinctive diamictite, tens of metres thick, consist of angular to well rounded cobbles to 10 cm long of quartz-eye porphyry in an argillaceous or tuffaceous matrix. They have a pervasive cleavage like that in the overlying Inklin Formation. Similar rocks occur stratigraphically at the base of typical Inklin rocks southeast of Eaglehead Lake along the Thibert Fault. Characteristic of all the Kutcho-type rocks is the prevalence of pyrite and perhaps pyrrhotite.

The well layered strata which occur at the base of the Inklin Formation southeast of Eaglehead Lake appear to grade upward into typical greywacke, conglomerate, and phyllitic slate of the Inklin Formation, in places with an intervening

Figure 45. *Well layered strata assigned to the Kutcho Formation north of Swinton Lake in western Cry Lake map area. Light coloured bands may be quartz-feldspar tuff. Section shown in photograph is about 7 m thick. GSC 1996-125Z*

limestone unit, presumably of the Sinwa Formation. The Kutcho rocks consist of quartz and feldspar porphyry, well layered tuff, and massive, flow banded felsic volcanics. Phenocrysts range from less than 1 mm to 5 mm in diameter. The volcanics are intimately associated with carbonate, which occurs as lenses or beds as much as 2 m thick, greywacke, shale, and conglomerate. The sedimentary rocks are typical of the Inklin Formation and, at least locally, separation of the Kutcho and Inklin rocks is arbitrary.

Conglomerate in the type Kutcho area seems to be overlain by limestone of the Sinwa Formation. Elsewhere, there is a gradation of typical Kutcho volcanic lithologies through bedded limestone of the Sinwa Formation into limestone conglomerate and finally into conglomerate with Kutcho and Sinwa clasts, greywacke, and shale of the Inklin Formation. In places, the Sinwa Formation is missing entirely because of erosion at the base of the Inklin Formation.

Age and correlation of the Kutcho Formation

If the Sinwa limestone stratigraphically overlies the Kutcho conglomerate, then the Kutcho Formation must be either Late Norian or older (Souther, 1971). Uranium-lead zircon determinations of 249 ± 13 Ma and 249 ± 7 Ma (Childe and Thompson, 1995) suggest an earliest Triassic or possibly latest Permian age. A Rb-Sr isochron calculated for rocks of the Kutcho Formation gives an age of 210 ± 10 Ma and an initial $^{87}Sr/^{86}Sr$ ratio of 0.7042 (Thorstad and Gabrielse, 1986). The isochron is, however, not closely constrained. Hence, the zircon ages are probably the most reliable.

Volcanic rocks of similar stratigraphic position and lithology are unknown in northern British Columbia. In central British Columbia, east of the Takla Fault, possible correlative rocks are included in the Sitlika Assemblage (Monger et al., 1978). Possibly the Kutcho Formation has been offset from the Sitlika Assemblage by a system of dextral transcurrent faults effecting an offset of almost 300 km (Monger et al., 1978; Gabrielse, 1985).

Sinwa Formation

Light grey-weathering, commonly massive limestone of the Sinwa Formation (Souther, 1971 and reference to F.A. Kerr therein) forms conspicuous exposures in the immediate hanging wall of the King Salmon Fault and occur either as olistoliths in the overlying Inklin Formation or in structural culminations within the Inklin Formation. The westernmost outcrops form prominent bluffs just west of the settlement of Dease Lake. A low ridge at the head of Little Eagle River is underlain by Sinwa limestone. The formation is particularly well exposed near Wade Lake southeast of Turnagain Lake (Fig. 46).

West of Dease Lake the Sinwa Formation is predominantly massive, recrystallized, strongly fractured limestone which weathers light grey. In places the rock is distinctly laminated and locally bedding is defined by alternating layers of massive and oolitic limestone. Detrital quartz, generally in angular grains are evident in some units. Poorly preserved corals are present locally but generally the rock is unfossiliferous.

On the east side of Highway 37 southeast of the settlement of Dease Lake, limestone in the hanging wall of the King Salmon Fault is strongly brecciated, fractured, and silicified. It weathers a distinct rusty buff but is medium to dark grey on the fresh surface.

A ridge at the head of Little Eagle River is underlain by limestone which, when viewed from a distance, gives the impression of defining an open syncline. The rocks are generally massive and coarsely crystalline. In places the limestone occurs as limestone cobble conglomerate with angular clasts. The clasts show well defined bedding and lamination whereas the host limestone shows very little evidence of bedding.

About 7.5 km east of the north end of Turnagain Lake well bedded limestone is exposed in an inlier surrounded by strata of the Inklin Formation. The rock is grey to dark grey, fetid, and crystalline. The stratigraphically lowest rocks are buff weathering and include sandy limestone which is locally crossbedded. A few well preserved pelecypods are the only fossils recovered.

Northwest and southeast of Wade Lake spectacular exposures of Sinwa Formation consist of tightly folded, light grey-weathering, well bedded to massive, crystalline limestone (Fig. 46). Cherty, laminated, in part fetid limestone east of Kehlechoa River locally contains crinoid columnals and possibly fragmentary corals. Near the King Salmon Fault, limestone breccia is yellow-buff-, brick red-, and rust-brown-weathering.

Coarse, recrystallized limestone with calcite crystals as much as several centimetres in diameter forms the basal unit of a klippe 4 km south-southeast of Wade Lake. The limestone is assigned to the Sinwa Formation because the overlying rocks are clearly Inklin Formation which everywhere in the Cache Creek Terrane overlies the Sinwa Formation.

Limestone in the Kutcho Creek area is crystalline and grey weathering. West of the creek, laminated limestone is locally dolomitic.

Thicknesses of the Sinwa Formation are variable and tight folding has undoubtedly led to marked thickening and thinning. In the Wade Lake area the formation may be as much as 75 m thick. West of Kutcho Creek about 25 m of limestone is present. The inlier 7.5 miles east of the north end of Turnagain Lake reveals at least 20 m of section with the base unexposed. Near the head of Little Eagle River estimates of thickness range from 20 to 30 m.

Age and correlation of Sinwa Formation

Remarkably few fossils have been recovered from the Sinwa Formation. A specimen of the Late Triassic hexacoral *Isastrea vancouverensis* was collected by F.A. Kerr southwest of Dease Lake (see Appendix 2). Late Norian fossils were collected by J.G. Souther from the Sinwa Formation in the Tulsequah map area (Souther, 1971). Probable Triassic fossils identified by E.T. Tozer were obtained from limestone east of Kehlechoa River.

Figure 46.

Tightly folded Sinwa Formation southeast of Wade Lake. The dark-weathering rocks to the right are stratigraphically underlying Kutcho Formation. GSC 1996-125Y

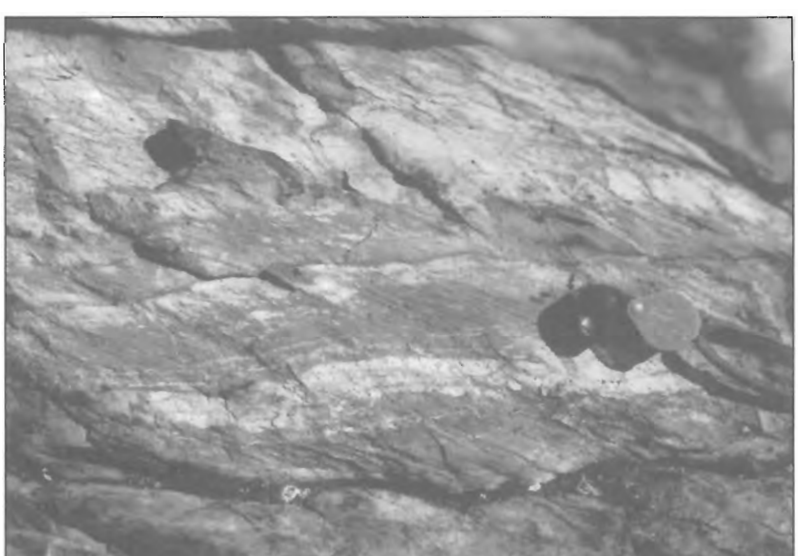


Figure 47.

Interbedded, light-weathering greywacke and dark-weathering argillite of the Inklin Formation showing the typical, strongly developed cleavage. Photograph by L.E. Thorstad. GSC 1996-125X

The Sinwa Formation is best exposed in its type area in the Tulsequah map area where it occurs in the hanging wall of the King Salmon Fault (Souther, 1971). Other Upper Triassic limestone units occur in nearby terranes but their lithologies and ages make correlation with the Sinwa Formation equivocal.

Inklin Formation

A thick succession of greywacke, conglomerate, shale, and phyllitic slate which overlies the Sinwa Formation underlies extensive areas in the Cache Creek Terrane. The strata are continuous with those of the type Inklin Formation in the Tulsequah map area (Souther, 1971). They are extremely well exposed in the canyon of the Dudidontu River in Dease Lake map area and in the mountains between Dome Mountain and Tumble Creek in Cry Lake map area. As with the Cache Creek Complex there is a marked increase in the development of cleavage in the Inklin Formation from northwest to southeast (Fig. 47) so that the rocks exposed to the northwest are much more amenable to sedimentological studies than those in the southeastern part of the region.

In the canyon of the Dudidontu River the Inklin Formation is very well bedded and consists of about equal amounts of interbedded, grey-green, generally calcareous greywacke and silty, grey to dark grey shale. Beds are up to several metres thick but many are less than 1 m. Woody fragments are abundant and some coaly layers are up to 4 cm wide and 40 cm long. Slate chips are locally abundant. Limestone clasts to cobble size are commonly well rounded and occur in a fine grained silty to shaly matrix. Calcareous septarian concretions have been noted in a few places. Crossbedding and flute and load casts appear to be well developed (Fig. 48).

East of Tuya River the basal units of the Inklin Formation include much conglomerate particularly well exposed west of the headwaters of Little Dease Creek, northwest of Swinton Lake, along the headwaters of Little Eagle River, along Squaw Creek, near the head of Zuback Creek, on Dome Mountain, and southeast of Eaglehead Lake. Near the King Salmon Fault the conglomerate is strongly sheared and the clasts are markedly flattened (Fig. 49, 50). Clasts consist mainly of limestone and cream-white-weathering quartz-eye porphyry. The limestone has been deformed into elongate cobbles or flat plates a few centimetres thick. Porphyry forms ellipsoidal pebbles and cobbles. The conglomerate grades upwards into greywacke and phyllitic slate. Conglomerate members in the Dome Mountain area and farther southeast are much less strained and include many fragments of slate chips in addition to limestone and porphyry. Northwest of Swinton Lake conglomeratic beds occur in an extremely well bedded succession of greywacke, siltstone, and phyllitic slate. The coarser grained beds weather cream-white and consist dominantly of quartz-eye feldspar porphyry clasts generally ranging up to pebble size. Some of these units may be water-lain tuffs and part of the Kutcho Formation (Fig. 45). A similar section can be seen in the basal beds of the Inklin Formation southeast of Eaglehead Lake.

Conglomerate exposed in the mountains 5 km west of the south end of Serpentine Lake includes a diamictite facies with angular granules, pebbles, and cobbles of limestone and slate in a fine grained, calcareous, argillaceous or silty matrix. Some of the cobbles are dark grey fetid limestones with poorly preserved pelecypods suggesting derivation from Sinwa Formation limestone.

Southeast of Eaglehead Lake, conglomerate includes angular to rounded, little deformed cobbles of hornblende-feldspar porphyry, very fine grained feldspar porphyry, chloritic, quartz and feldspar porphyry or tuff, sericitic tuff, greywacke, argillite, and minor carbonate. At least locally, the argillaceous components appear to be hornfelsed.

Thick successions of well bedded greywacke and phyllitic slate are characteristically strongly cleaved. Greywacke is typically grey-green- to olive-grey-weathering, medium grained and poorly sorted. It is commonly calcareous and contains slate chips and ubiquitous limonite specks. The latter may have been derived from widespread pyrite in the underlying Kutcho Formation. Plagioclase is locally abundant but potassium feldspar has not been recognized

Figure 48.

Sole markings in siltstone and greywacke of the Inklin Formation in the canyon of the Dudidontu River. GSC 1996-125W

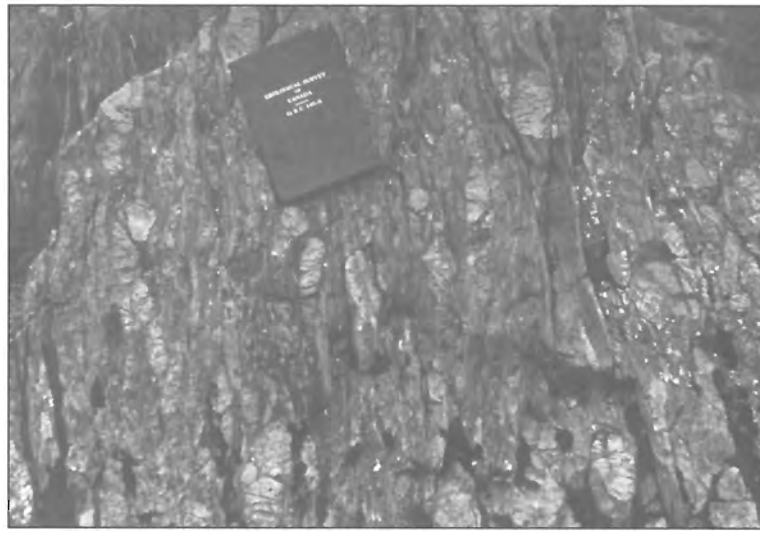


Figure 49.

Flattened quartz-feldspar porphyry (light weathering) and limestone clasts in Inklin strata in the hanging wall of the King Salmon Fault at the headwaters of Zuback Creek.

(Table 5). Slate, in part well laminated, generally has a phyllitic sheen and also contains abundant limonite specks presumably from the oxidation of pyrite. Graded bedding is common. Load casts, ripple marks, and channel fillings were noted locally. Greywacke beds range from 20 cm to more than 50 cm thick whereas slate interbeds are usually somewhat thinner to much thinner. A well exposed section of phyllitic slate, about 40 m thick, was noted in a stream cut southeast of Eaglehead Lake.

Southeast of Dome Mountain the Inklin Formation may be more than 1500 m thick. Elsewhere, deformation and poor exposure preclude useful estimates. In the Tulsequah map area a thickness of more than 2000 m has been measured (Souther, 1971).

The Inklin Formation appears to lie unconformably on the Upper Triassic Sinwa Formation. Erosion of Sinwa and Kutcho lithologies clearly produced much sediment during Inklin deposition. No younger sedimentary rocks are in contact with the Inklin Formation.

Age and correlation of the Inklin Formation

The age of the Inklin Formation is very poorly constrained. In the Tulsequah area J.G. Souther (1971) collected a single specimen of *Arnioceras*(?) sp., reportedly from the formation, indicating an Early Jurassic, Sinemurian age. J.G. Souther (pers. comm., 1990) now considers these rocks to be part of the Takwahoni Formation because of their lithology and position south of the King Salmon Fault. Farther northwest, along Atlin Lake in the Atlin map area, fossils of possibly Hettangian but certainly Early Sinemurian to Late Toarcian ages have been identified (H.W. Tipper, pers. comm., 1990). These fossils provide the only information on the age range of the Inklin Formation between Atlin Lake and the Kutcho Fault in Cry Lake map area.

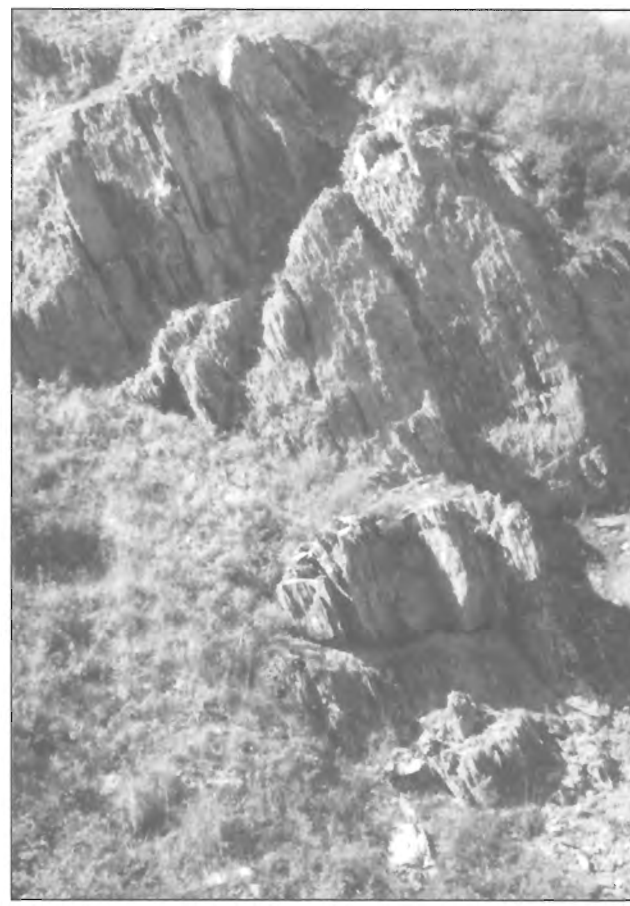


Figure 50. *Strongly foliated, cobble conglomerate with flattened clasts of limestone and quartz-feldspar porphyry along Squaw Creek. Photograph by C.J. Godwin. GSC 1996-125U*

Table 5. Modal analyses of greywacke from Takwahoni and Inklin formations.

Sample number	Plagioclase	Orthoclase	Quartz	Matrix	Opaque minerals	Volcanics	Chert	Sediments	Mafic minerals	Carbonate	Fragments (unknown)
TAKWAHONI											
GAH-19-7-56-10	44.9	2.2	6.4	11.9	1.3	22.4	0.0	0.9	0.8	5.6	3.6
GAB-19-7-56-2	34.0	2.9	5.7	18.1	1.5	33.7	0.0	0.5	0.8	1.2	1.6
GA-6-8-56	27.8	2.9	2.8	28.0	1.6	22.6	1.4	0.4	2.9	2.2	7.4
GA-21-7-56-6	26.9	7.1	7.1	15.5	3.4	28.5	1.9	5.7	0.9	0.0	3.0
GA-21-7-56-6	30.9	5.5	4.4	9.1	1.1	18.2	1.5	2.8	6.2	15.5	4.8
GA-19-7-56-5	23.5	4.1	5.2	43.1	5.1	11.1	1.2	1.2	1.1	0.3	3.8
GA-19-7-56-3	25.1	2.3	8.4	25.5	2.3	25.5	1.5	1.4	0.8	2.9	3.3
GA-6-8-56-2	34.4	11.6	8.6	16.4	1.8	6.2	3.5	3.7	5.3	1.2	7.3
INKLIN											
GAB-4-6-56-4	20.7	0.0	5.8	19.8	3.4	4.0	4.3	6.5	2.4	2.9	30.2
GAH-23-7-56-2	3.8	0.0	3.6	18.7	5.0	11.4	4.6	3.2	9.8	6.0	33.9

Inklin strata in the Atlin map area have been included in the Laberge Group (Aitken, 1959) which can be mapped farther northwest into the Whitehorse map area (Wheeler, 1961). There, the separation of the Inklin Formation of the Cache Creek Terrane and the Takwahoni Formation of Stikinia is difficult.

Tectonic setting of the Cache Creek Terrane

Four distinct assemblages comprise the Cache Creek Terrane and each reflects a different tectonic environment. The Cache Creek Complex clearly indicates an oceanic environment which persisted, at least locally, from the Early Mississippian to Late Triassic. The central facies belt (Monger, 1977) remained a predominantly deep water succession throughout its history. The flanking facies belts developed platformal sequences of limestone, probably on volcanic plateaus. Important changes took place in the Late Triassic with an influx of greywacke along the northern margin of the complex and, earlier in the Triassic, with the building of the calc-alkaline, Kutcho volcanic arc. Subduction related to the arc presumably led to the demise of the oceanic environment in the latest Triassic or earliest Jurassic. The Sinwa Formation may have formed as a fringing reef on Upper Triassic volcanic islands. Finally, the end of the oceanic regime was completed with the accumulation of thick Inklin greywacke during the Early Jurassic.

Future sedimentological, paleontological, and stratigraphic studies will determine whether the Inklin Formation is a distal facies of the Takwahoni Formation derived from Stikinia (Souther, 1971) or whether it was derived from a dominantly northerly source, possibly Quesnellia (Fig. 34). Clearly, much detritus in the Inklin Formation was derived from uplifted Kutcho and Sinwa formation rocks. Furthermore, additional work may show whether the formation represents backarc or forearc deposits. Contraction during the late Early to Middle Jurassic imbricated the Cache Creek Terrane and juxtaposed lithologies of the various environments including sheets of ultramafic rocks from the oceanic crust.

Stikinia

The area south of the King Salmon Fault is underlain by the northern part of Stikinia, the largest of the accreted terranes in the Canadian Cordillera. The terrane in the project area is underlain by sedimentary, volcanic, and plutonic rocks ranging in age from Permian or older through Late Jurassic. The rocks have been studied in some detail along Stikine River and southeast of Tanzilla River (Read, 1983, 1984), in and around the Hotailuh batholith (Anderson, 1983) and, locally, east of McBride River (Tipper, 1978). In the southwestern part of the Dease Lake map area only reconnaissance mapping has been carried out.

Permian rocks

Relatively small areas are underlain by Permian carbonate, argillaceous, and volcanic strata. The rocks are exposed along and near Sheslay River in the southwestern part of Dease Lake map area and along Stikine River and in the Hotailuh Range in southeastern Dease Lake map area. The most prominent units of the Permian assemblages are light grey to grey, generally massive, locally cherty limestones. Limestone along the Stikine River about 3 km east of its junction with Tanzilla River contains Early Permian fusulinids. It is a minimum of 350 to 400 m thick and is underlain by grey phyllite and overlain by Triassic volcanics (P.B. Read, pers. comm., 1991). Similar strata outcrop southeast of Tanzilla

River and as isolated patches around the Tanzilla and Pallen Creek plutons. Dark green, phyllitic greenstone occurs near the confluence of Stikine and Klastline rivers and is associated with Permian limestone and minor grey phyllite and chert along the Klastline River. Permian strata south of Stikine River and east of the confluence of Tanzilla and Stikine rivers include a member of fine grained gypsum (alabaster) about 50 m thick (Read, 1983). North and south of Stikine River in southwestern Cry Lake map area undated, massive light grey limestone separates structurally overlying, basic volcanic rocks and associated green phyllite from underlying grey phyllite. All of these rocks could be older than Permian (Read, 1990).

A thick unit of massive limestone is exposed in an east-trending anticline which crosses Sheslay River. Farther west another unit of limestone trends northerly and, like the one along Sheslay River, is flanked by grey phyllite and ribbon chert which may be of Permian or Triassic age.

Age and correlation of Permian rocks

Conodonts collected by P.B. Read (1983) from limestone in the Stikine-Tanzilla area and identified by Orchard (1992, 1993) are mainly of Early Permian age (including Sakmarian and Artinskian). Most of the conodont collections from Permian limestone in the northwestern part of Stikinia in the Iskut, Telegraph Creek, and Tulsequah areas are also of Early Permian age (Orchard, 1992, 1993).

Triassic rocks, Stuhini Group

A thick succession of Triassic volcanic and lesser sedimentary rocks underlies much of Stikinia in the project area. Detailed mapping in the Hotailuh and Three Sisters ranges and in the northwestern part of Spatsizi map area has led to a threefold subdivision which consists of a lower, sedimentary unit overlain by volcanics, a middle sedimentary unit, and an upper, dominantly volcanic unit (Anderson, 1983; Read, 1983, 1984, 1990). Where sediments are not exposed, separation of the volcanic units is difficult.

Read (1984) proposed the informal name "Tsaybahe Group" for the lower two units of the Triassic rocks based on rocks exposed in the northwestern part of Spatsizi map area. Because of the similarity of volcanic rocks in the "Tsaybahe Group" to those in the overlying volcanics, however, it is difficult or impossible to assign large tracts of these rocks to either the lower or upper volcanic units. The problem is compounded by the general recessive nature of the middle sedimentary unit which provides the only stratigraphic marker separating the two volcanic assemblages. Hence, all the Triassic volcanic and clastic sedimentary rocks are herein included in the Stuhini Group. It may be useful, eventually, to formalize the term "Tsaybahe" as a formation within the Stuhini Group. This would emphasize the distinctive character of its sedimentary facies and would not restrict the term "Stuhini" to only those rocks whose stratigraphic position within the Triassic assemblage is known.

Lower sedimentary unit

The lower sedimentary unit is exposed southeast of the Tanzilla Fault south of Stikine River (Read, 1983, 1984). There, a succession of green and grey phyllite and argillite and minor chert as much as 250 m thick directly overlies massive Permian limestone. The sedimentary rocks are overlain by meta-andesite and meta-basalt, augite porphyry flows, breccia, and tuff. Southwest of the Caribou Meadows Pluton volcanic rocks of the basal Triassic unit are overlain by a well bedded sequence of grey argillite; siliceous argillite; phyllite; tuffaceous greywacke; massive, olive, tuffaceous argillite with rare chert; and dark grey limestone. These rocks outcrop south and southeast of Tanzilla Pluton and occur locally along Stikine River. They also outcrop south of Thenatlodi Mountain and near Highway 37 near Upper and Lower Gnat lakes.

Middle sedimentary unit

The best exposed sections of the dominantly sedimentary middle part of the Stuhini Group occur in a northerly dipping, homoclinal sequence in the hanging wall of the Hotailuh Fault. Sections have been measured along an abandoned railway grade between Upper and Lower Gnat lakes and on the south slope of the mountain, elevation 2089 m, east of Gnat lakes. The rocks are well exposed east of Tanzilla River to southwest of Glacial Lake where, apparently, they are truncated by the Hotailuh Fault.

In weathered exposures the sedimentary rocks, generally recessive, are characterized by rusty colours. Laminated siltstone, in places pyritic, siliceous argillite, and greywacke are the dominant lithologies (Fig. 51). In places, medium- to coarse-grained, green-grey greywacke in beds to 20 cm thick overlies tan-grey siltstone with well developed flame structures at the contact. Load casts and ball-and-pillow structures are also present (Anderson, 1983). Greywacke, most abundant in the lower part of the unit, is marked by recessive weathering concretions from 0.5 to 1 cm in diameter. Some of the massive greywacke beds contain distinctive thin, discontinuous, wispy siltstone laminae which may be tuff (Anderson, 1983).

Plagioclase is the most abundant constituent of the greywacke and occurs as grains from 1 to 3 mm long. Locally, augite grains are conspicuous. Many greywacke beds are graded over widths of 10 to 20 cm and indicate that the sequence is upright. Some of the siltstone contains angular rip-up clasts of laminated siltstone up to 20 cm long and 10 cm wide. Other clasts, also angular, include siliceous argillite and medium- to coarse-grained greywacke.

A section measured on the railway grade is about 165 m thick with neither the top nor base exposed. To the north the sediments are overlain structurally by coarse, feldspar porphyry agglomerate and to the south they are underlain structurally by buff- to cream-weathering Lower Jurassic calcareous greywacke, locally conglomeratic, calcareous shale, and argillaceous limestone. On the south slope of the mountain, elevation 2089 m, a section measured by Anderson (1983) is about 285 m thick. There, massive greywacke and pyritiferous, laminated siltstone are cut by augite porphyry and plagioclase porphyry dykes presumably related to the

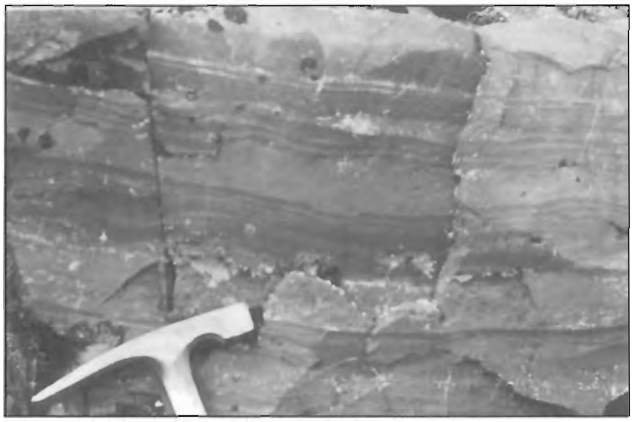


Figure 51. *Interbedded greywacke and argillite of the lower part of the Stuhini Group exposed in a cut along the abandoned railroad grade northwest of the north end of Lower Gnat Lake. Local lenses and beds of pyroxene-augite greywacke are present in this succession. GSC 1996-125R*

overlying volcanic rocks. In the lower part of the section, a unit of pyroxene porphyry about 23 m thick forms a distinct resistant rib on the hillside. Whether the porphyry is a sill or flow is uncertain. Underlying the sequence is a member of coarse volcanic breccia, about 55 m thick, consisting of angular and rounded fragments of felsic, hornblende-plagioclase porphyry from 1 to 10 cm in diameter in a matrix of grey, plagioclase porphyry.

Upper volcanic unit

Exposures of massive to thick layered augite and plagioclase porphyry flows, agglomerate, and breccia are widespread from near McBride River to the western border of Dease Lake map area. The volcanic rocks underlie rugged topography southwest of Tahltan and Sheslay rivers and in the Three Sisters Range. Sedimentary rocks, dominantly volcaniclastic, are important locally.

The two most characteristic lithologies of the Stuhini Group in northern and eastern Stikinia are augite porphyry and coarse-bladed plagioclase porphyry. In the Hotailuh and Three Sisters ranges the basal units consists of dark green, locally pillowed augite porphyry with augite crystals up to 1 cm long but generally about 0.5 cm long. In places these rocks are amygdaloidal. The flows grade into volcanic conglomerate with fragments of augite porphyry. In most places the rocks are variably epidotized and saussuritized. In thin section augite phenocrysts are relatively fresh whereas the smaller plagioclase phenocrysts and the fine grained matrix is strongly altered.

On the south slope of the mountain, elevation 2089 m, east of Gnat Pass, sediments at the base of the augite porphyry member are highly contorted suggesting they were not completely lithified when the volcanics were extruded. The basal units of the underlying sedimentary units contain dykes of augite porphyry and coarse-bladed feldspar porphyry (Anderson, 1983). Southwest of Horn Mountain and south-southwest of Glacial Mountain basal volcanics of the upper volcanic unit of the Stuhini Group contain rounded and angular boulders of granitic rock, as much as 150 cm across, derived from the Cake Hill Pluton (Anderson, 1983). In places the augite porphyry member is more than 300 m thick. Coarse-bladed feldspar porphyry flows, in part pillowed, generally overlie augite porphyry and are well exposed along the north side of the Cake Hill Pluton where they are several hundreds of metres thick. Commonly, plagioclase phenocrysts, as much as 3 cm long, show pronounced trachytic texture (Fig. 52). The phenocrysts occur in a fine grained, green to maroon matrix. Where broken, the pillowed lava occurs as fragments in a green-grey, graded greywacke. Thin sections show that the feldspar, of andesine composition, is commonly strongly sericitized and partly replaced by epidote. Fine grained feldspar laths in the groundmass generally have a pronounced trachytic texture. Chlorite, magnetite, and in maroon-weathering varieties, hematite are abundant.

In addition to the augite and bladed feldspar volcanics the Stuhini Group includes considerable thicknesses of augite-feldspar porphyry, fine grained feldspar porphyry, crystal tuff, and a variety of volcaniclastic rocks. Volcanic conglomerate and breccia is common on the north side of the Hotailuh batholith. Some breccia includes abundant rectangular clasts of rhyolite which, in a few cases, exhibit flow textures. Greywacke and greywacke conglomerate with a variety of volcanic clasts are intercalated locally with volcanic flows. East of Klastline River and southwest of Mount Meehaus a thick succession of grey-green, vaguely bedded, tuffaceous argillite with some greywacke is intercalated with minor aphyric, grey-green and maroon meta-andesite flows and rare augite porphyry flows (Read, 1983).

Massive outcrops of augite porphyry, augite-feldspar porphyry, fine grained feldspar porphyry, and dark green, aphanitic volcanics occur southwest of Dease Lake on both sides of Tanzilla River and along and southwest of Tahltan and Hackett rivers. In places they have been sheared and pyritized. Epidote is an ubiquitous alteration mineral. Where the volcanics are intimately related to granitic rocks they contain chalcopyrite and pyrite (Gnat Pass, Hluey Lakes, and Kaketsa areas).

Chemical analyses of the Stuhini volcanic rocks suggest a calc-alkaline to tholeiitic affinity and a close relationship with spatially related, coeval ultramafic and granitic rocks (Anderson, 1983).

Upper Triassic limestone

Massive, fine grained to cryptograined limestone outcrops in a ravine about 8 km southwest of Wade Lake east of McBride River. The limestone is at least 50 m thick and contains smooth shelled pelecypods and poorly preserved corals. The base is not exposed but the rocks are overlain unconformably by a thick, Early Jurassic (Sinemurian) conglomerate.

Upper Triassic and/or Lower Jurassic volcanics

In the Three Sisters Range the volcanic rocks of the Stuhini Group described above are overlain, apparently gradationally, by a thick succession of maroon-weathering flows and volcanics. Maroon-weathering volcanics are present elsewhere also, for example, along the lower reaches of Beatty Creek, 2 km east of Thenatlodi Mountain and east of the headwaters of McBride River. They consist mainly of well layered, green and red flows and volcaniclastics as much as 700 m thick. Fine grained plagioclase porphyry is abundant, both as flows and as clasts in volcanic conglomerate. One of the most completely exposed sections, about 684 m thick, occurs on a ridge west of the headwaters of McBride River, 11 km southwest of Turnagain Lake (Anderson, 1983). There, the lower part consists of grey to maroon, massive to vesicular, andesite flows and brick red siltstone and fine grained sandstone. Most of the section consists of grey to maroon, feldspar porphyry flows in which individual units are in the order of tens of metres thick. The upper part of the section comprises about equal amounts of plagioclase porphyry flows and maroon volcanic conglomerate and breccia. The conglomerate and breccia unit is typical of the upper part of the volcanic sequence as far west as Highway 37.

Chemical analyses of Upper Triassic and\or Lower Jurassic volcanic rocks suggests calc-alkaline to alkaline, tholeiitic affinity (Anderson, 1983).

Age and correlation of Triassic and/or Lower Jurassic rocks

Conodont collections by P.B. Read (1983, 1984) in the Hotailuh Range have established a Late Early and Middle Triassic age for the middle, sedimentary unit of the Triassic sequence. The overlying, dominantly volcanic assemblage (Stuhini Group) is undated except that it overlies the sedimentary sequence and the Cake Hill Pluton which, on the basis of U-Pb zircon dating, is Late Triassic (R.G. Anderson, pers. comm., 1991). The age of the maroon-weathering volcanic rocks which overly the Upper Triassic part of the Stuhini Group is enigmatic but the succession is unconformably overlain by Sinemurian sedimentary rocks east of McBride River. If the volcanics are indeed conformable with rocks assigned to the Stuhini Group, they eventually may be included in the Stuhini Group. This would result in a consistent nomenclature throughout the northern part of Stikinia. In the Tulsequah area a succession of augite porphyry and overlying maroon-weathering volcanics of the Stuhini Group is overlain by Norian limestone (H.W. Tipper and J.W.H. Monger, pers. comm., 1981).

Volcanic and lesser sedimentary rocks of Triassic age are widespread along the Stikine Arch in Tulsequah (Souther, 1971) and Telegraph Creek (Souther, 1972) map areas. They are also well developed in Toodoggone River (Gabrielse et al., 1977) and McConnell Creek (Richards, 1976; Monger, 1977) map areas on the northeast and eastern sides of Stikinia. In all of these localities the succession of augite porphyry overlain by coarse-bladed plagioclase porphyry and, finally, maroon-weathering volcanics is similar.

Late Triassic plutons

Seven plutons, the Kaketsa, Mansfield Creek, Cariboo Meadows, Latham Creek, Gnat Lakes, Cake Hill, and Beggerlay Creek are included in the Stikine Plutonic Suite. With the Stikine Pluton in northwestern Toodoggone River map area they

Figure 52. *Coarse bladed, plagioclase porphyry with trachytic texture in the upper part of the Stuhini Group northwest of Lower Gnat Lake. GSC 1996-125S*

define the Stikine Arch, a region topographically elevated in the Early Jurassic. A common feature of these rocks is the presence of hornblende as the dominant mafic mineral. Commonly the hornblende has cores of augitic pyroxene. Pink, potassic alteration is abundant. The Latham Creek, Gnat Lakes, and Cake Hill plutons are strongly foliated.

Kaketsa Pluton

The Kaketsa Pluton underlies an area of about 30 km^2 on Kaketsa Mountain south of Sheslay. The pluton consists mainly of fine- to medium-grained diorite but can be crudely subdivided into several phases (McMillan et al., 1975). Biotite-hornblende diorite forms an internal zone flanked by a discontinuous border zone of hornblende diorite. In the western part of the internal zone hornblende is dominant whereas in the eastern part biotite is the main mafic mineral. Biotite-pyroxene diorite occurs as a lens on the north side of the southern border zone. Quartz may constitute as much as 10% of the rock. Propylite, accompanied by potassic alteration, occurs along fractures with epidote, quartz, and pink zeolite (laumontite). Volcanic rocks along the contact are recrystallized and cut by dyke stockworks and dyke swarms.

Mansfield Creek Pluton

The poorly exposed Mansfield Creek Pluton underlies an area of about 20 km^2 along and northwest of Mansfield Creek near its junction with Little Tuya River. Most of the body consists of medium- to coarse-grained hornblende diorite generally much altered to clay minerals. One leucocratic dyke, possibly an aplite, is about 7 m wide and is almost completely altered to kaolinite. The borders contain jasper veinlets as much as 1 cm wide along fractures parallel with the contacts. A border phase exposed along Mansfield Creek near the western side of the pluton consists of coarse grained hornblendite. Volcanic rocks along the contact have been strongly fractured and silicified.

Cariboo Meadows Pluton

The Cariboo Meadows Pluton, about 11 km^2 in extent, outcrops just northeast of the junction of Tanzilla and Stikine rivers (Read, 1983). It consists of olivine-augite metagabbro. Small bodies of similar composition occur south of the confluence of the rivers and southwest of Mount Meehaus. The Cariboo Meadows Pluton intrudes Middle Triassic sedimentary strata and the bodies south of Stikine River occur in part as sill-like bodies in Upper Triassic tuffaceous and volcanic rocks.

Latham Creek Pluton

The Latham Creek Pluton is a pervasively foliated, hornblende-rich, hornblende quartz diorite and monzodiorite underlying an area of possibly 15 to 20 km^2 along and near Latham Creek and Stikine River. Leucocratic phases of the pluton resemble those of the Cake Hill Pluton. Along the Stikine River the rock contains inclusions of mafic volcanic rocks and salmon-pink-weathering apophyses cut the volcanics. Middle Triassic sedimentary strata have been hornfelsed near contacts with the Latham Creek Pluton.

Gnat Lakes Ultramafite

The Gnat Lake Ultramafite is a dark green-weathering body of clinopyroxenite about 3 km^2 which outcrops along the abandoned railway grade and along and west of Highway 37 a few kilometres south of Upper Gnat Lake (Anderson, 1983). The body is strongly foliated in places and locally has a schistose structure. Hornblende is common as a replacement of pyroxene and some phases are essentially hornblendite in which relict cores of clinopyroxene have been preserved in hornblende crystals. Apatite, titanite, and plagioclase are ubiquitous accessory minerals. A body of similar lithology occurs within the Three Sisters Pluton about 14 km to the south-southeast. The pluton is cut by augite and coarse-bladed, feldspar porphyry dykes and by the Three Sisters Pluton. Hornblendic marginal phases of the Gnat Lake Ultramafite have been intruded by apophyses of the potassic marginal phase of the Three Sisters Pluton.

Cake Hill Pluton

The Cake Hill Pluton underlies about one-third of the Hotailuh batholith, the two main parts separated by the potassic marginal phase of the Three Sisters Pluton (Anderson, 1983). Smaller bodies occur as inclusions within the Three Sisters Pluton. The southern large body may be gradational with the more mafic Latham Creek Pluton. The dominant lithology is a well foliated, leucocratic, medium- to coarse-grained, equigranular, quartz monzodiorite to monzodiorite. Euhedral, tabular hornblende is the sole mafic mineral in most outcrops. Titanite and less common magnetite are widespread accessory minerals. Foliation is defined by the planar orientation of hornblende crystals and, with only a few exceptions, trends consistently to the northwest. Very minor equigranular, hornblende gabbro occurs in one locality and inclusions of hornblendite, hornblende diorite, and greenstone are widespread but volumetrically insignificant in the northern part of the pluton. The Cake Hill Pluton is overlain nonconformably by Upper Triassic and younger rocks.

Beggerlay Creek Pluton

The east-west elongated Beggerlay Creek Pluton occupies the southern margin of the Hotailuh batholith bordered to the north by the Cake Hill Pluton and to the south by Triassic volcanic rocks (Anderson, 1983). Mafic, biotite-hornblende gabbro and more leucocratic biotite-hornblende diorite are the dominant lithologies. The leucocratic phase is most common along the southern and western margins of the pluton. Pyroxenite and foliated hornblende diorite occur along the northern contact. Elsewhere the rocks are massive, equigranular, and medium- to coarse-grained. The pluton has intruded and included rocks of the Cake Hill Pluton and along its southern contact Triassic volcanic rocks appear to be metamorphosed. Augite porphyry dykes locally cut the Beggerlay Creek Pluton.

Age and correlation of Triassic plutonic rocks

Data on stratigraphic constraints on ages of Triassic plutonic rocks has been given above. They appear to cut Lower and Middle Triassic rocks but, at least locally, they are overlain nonconformably by Upper Triassic rocks. The Kaketsa Pluton has been dated by the K-Ar method on hornblende and biotite with ages of 222 ± 8 Ma and 218 ± 6 Ma, respectively (Panteleyev, 1975). Mansfield Creek and Cariboo Meadows plutons have not been dated by isotope methods. Read (1983) suggested possible correlation of the Cariboo Meadows Pluton with the Gnat Lakes Ultramafite. The latter has given K-Ar dates of 227 ± 14 Ma and 230 ± 10 Ma (Anderson in Stevens et al., 1982a). Many K-Ar dates have been obtained from the Cake Hill Pluton (Anderson, 1983) but perhaps the most reliable age date is an U-Pb determination on zircon of 218.5 ± 0.5 Ma (M.L. Bevier, pers. comm. to R.G. Anderson, 1991). A K-Ar age for the Beggerlay Creek Pluton, determined on hornblende is 218 ± 29 Ma (Anderson, 1983).

The Late Triassic Stikine Pluton in northwestern Toodoggone River map area is similar in many respects to the Cake Hill Pluton. It and the Middle to Late Triassic plutons in southern Cry Lake and Dease Lake map areas described above define the east-southeast-trending Stikine Arch in this region.

Lower Jurassic sedimentary and volcanic rocks

A belt of Lower Jurassic sedimentary and volcanic rocks extends across the project area from the headwaters of Dudidontu River to the headwaters of Kehlechoa River. The dominantly sedimentary members are assigned to the Takwahoni Formation whereas a unit of maroon-weathering volcanics southeast of McBride River is tentatively correlated with the Cold Fish Volcanics of the Spatsizi map area to the south (Thorkelson, 1988). The rocks generally are not well exposed so that thicknesses and stratigraphic relationships are, in part, conjectural. The best documented stratigraphy occurs east of McBride River but there, also, limited exposure and numerous faults make interpretations of the stratigraphy difficult. Two narrow strips of Lower Jurassic strata occur in the footwalls of thrust faults along the northwest and east sides of the Hotailuh batholith.

The base of the Lower Jurassic succession is exposed about 8 km south-southwest of Wade Lake east of McBride River. There, a polymictic conglomerate, apparently a few hundred metres thick, unconformably overlies Upper Triassic limestone (Tipper, 1978). The base of the conglomerate contains boulders of limestone as much as 1 m in diameter. Overlying conglomerate has clasts of feldspar porphyry, coarse grained, leucocratic granitic rocks, chert, and argillite. To the southwest the conglomerate wedges out into a thick, shale-tuff sequence which is black to dark grey, massive, brittle, and in part, finely laminated. Overlying the conglomerate is a unit of green, andesitic to basaltic coarse breccia, minor tuff, and rare pebble conglomerate at the base. A rich ammonite fauna dates these rocks as Sinemurian (see Appendix 2).

The next youngest member of the Takwahoni Formation consists of a monotonous succession of interbedded greywacke and shale with rare lenses of pebble conglomerate. These rocks, more than 400 m thick, are the most widespread of the Lower Jurassic sediments and are locally well exposed between Turnagain Lake and Highway 37. Beds of greywacke range up to 1 m in thickness whereas well laminated siltstone and shale are generally less than 15 cm thick. The rocks are extremely fresh and well indurated with colours ranging from light grey to black. Woody fragments are abundant. Graded bedding, scour structures, and sole markings are common. In places synsedimentary faults offset beds as much as 10 cm. Plagioclase and lithic volcanic fragments are the dominant components of the greywackes. Other grains include quartz, orthoclase, carbonate, hornblende, and minor chert (Table 5). The greywacke succession has yielded fossils of Pliensbachian age (Tipper, 1978). All observed contacts appear to be faults.

Toarcian rocks east of McBride River comprise coarse conglomerate, grey, tuffaceous shale, and cream rhyolitic tuff. Conglomerate, wedging out from east to west, contains large clasts of limestone and a variety of rock fragments. To the west these rocks seem to lie unconformably on Triassic volcanics. In most places they are bounded by faults. Early Toarcian ammonites have been collected from this sequence (Tipper, 1978).

On the lower part of the south slope of the mountain, elevation 2089 m, east of Lower Gnat Lake, a buff-weathering section of Late Pliensbachian (?) to Early Toarcian age, in the footwall to a thrust fault, is about 175 m thick (Henderson and Perry, 1981). A basal unit of fine grained, massive sandstone with rare hornblende grains unconformably overlies granitic rocks of the Cake Hill Pluton. Overlying strata are fine- to coarse-grained, graded and crossbedded sandstone, as well as fossiliferous, arenaceous carbonate and rhyolitic crystal tuff and volcanic breccia. The carbonate units contain a varied fauna of bryozoans, algae, echinoderms, pelecypods, foraminifers, gastropods, ostracodes, ammonites, sponge spicules, radiolarians, corals, fish, and wood (Henderson and Perry, 1981). The rocks can be mapped westward beyond the abandoned railway grade along Highway 37 and a few isolated patches occur farther east along the north side of the Cake Hill Pluton. A thicker sequence of similar lithologies, including hornfels and calc-silicate assemblages, outcrops along the eastern margin of the Three Sisters Pluton.

Interbedded greywacke and siliceous shale are well exposed in glacial stream channels on the north side of the Cake Hill Pluton east of Tanzilla River (Fig. 53) and along Zuback and Dalby creeks. Similar strata have been hornfelsed west of Dease Lake by the Snow Peak Granite. Scattered outcrops occur along the headwaters of the Dudidontu River south of the King Salmon Fault. Fragments of ammonites have been collected in the Snow Peak area but the age of the Takwahoni rocks west of Dease Lake is poorly constrained.

A distinctive succession of maroon, well layered epiclastic sandstone, pyroclastic volcanic rocks, agglomerate, and flows, at least 750 m thick, underlies a fault-bounded, triangular area east of McBride River along the southern boundary of the Cry Lake map area (Fig. 54). The lower part, about 200 m thick, is maroon-weathering, epiclastic sandstone, fine grained tuff, and volcanic breccia containing clasts of purple, vesicular volcanics. It is overlain by about 100 m of blocky, orange-grey-weathering flows characterized by salmon-pink feldspar phenocrysts. The overlying units comprise 200 m of blocky, grey-weathering, massive tuff succeeded by more than 150 m of volcanic breccia with clasts of spherulitic rhyolite and maroon fragmental rocks. The uppermost unit consists of maroon siltstone intercalated with vesicular volcanics and pebble conglomerate. Epiclastic sandstone forms cliffs in which beds of red and green, fine grained sediments range in thickness form 3 mm to 8 cm. Porphyritic flows and porphyry fragments in agglomerate locally show marked flow banding resulting from a trachytic texture of feldspar (calcic andesine). In places, fine- to coarse-grained epiclastic sandstone and breccia shows excellent graded bedding in beds 5 to 20 cm thick.

Thin sections studied by Erdman (1978) show that the epiclastic sandstones contain large fragments of fine grained feldspar porphyry but are generally made up of grains of volcanic rock containing feldspar microlites. Alteration has been extensive resulting in completely epidotized feldspars and chloritized matrix. The volcanic flows consist almost entirely of randomly oriented feldspar phenocrysts and microlites with rare, euhedral crystals of augite. Vesicles contain an amygdaloidal filling of well crystallized calcite, quartz, and chlorite. Some of the flows contain up to 15% hematite in the matrix which produces the distinctive maroon cast. Spherulitic rhyolite is characterized by oval to round areas of well crystallized quartz locally surrounded by radiating hematite-stained needles of quartz and feldspar. Medium grained tuffs consist of about 88% euhedral plagioclase and augite crystals and as much as 12% disseminated hematite. Plagioclase has been strongly altered to epidote, sericite, and albite and augite has been weakly altered to epidote.

Chemical and petrographic analyses of typical volcanic rocks in the succession (Table 6; Fig. 55) indicate that they are iron-rich, magnesia-depleted, calc-alkaline andesites (Erdman, 1978).

The volcanic sequence described above, more than 750 m thick, is bounded on the northwest by a fault. The volcanics are overlain unconformably by conglomerate of the Bowser Lake Group.

Figure 53. *Interbedded, blocky greywacke and recessive argillite of the Takwahoni Formation east of Tanzilla River. The bases of greywacke beds show well developed scour- and fill-structures . GSC 1996-125R*

Age and correlation of Lower Jurassic sedimentary and volcanic rocks

Fossil collections east of McBride River have established the age of strata assigned to the Takwahoni Formation as ranging from Sinemurian to Toarcian (see Appendix 2). The basal coarse conglomerate which grades rapidly westward into a shale-tuff sequence is of Sinemurian age. This succession includes a feldspathic, andesitic to basaltic, breccia member in the upper part of possible Sinemurian age (Tipper, 1978). The thick, widespread greywacke and shale member appears to be entirely of Pliensbachian age. A second coarse conglomerate is Early Toarcian. Marked unconformities occur at the base of Sinemurian and Toarcian conglomerates and an unconformity is probable at the base of Pliensbachian strata.

A Rb-Sr isochron obtained by Erdman (1978) on the volcanic rocks gives an age of 191 ± 9 Ma with an initial $^{87}Sr/^{86}Sr$ of 0.7036 ± 1, suggesting a Pliensbachian to

Figure 54.

Well layered, coarse agglomerate of the Lower Jurassic volcanic sequence along the southern margin of the Cry Lake map area east of McBride River. These rocks are distinctly maroon- and green-weathering. GSC 1996-125Q

Table 6. Chemical analyses from Lower Jurassic volcanic suite east of McBride River (Erdman, 1978).

Sample Name	110	117C	118B	119B	SphRhy
Lithology	fine grained aphanitic volcanic	maroon feldspar porphyry	feldspar porphyry	maroon feldspar porphyry	spherulitic rhyolite
SiO_2	53.94	64.49	55.01	52.48	76.75
FeO	5.10	4.12	5.70	6.88	1.64
CaO	8.92	2.70	6.95	8.92	0.52
TiO_2	0.95	0.38	0.92	0.85	0.12
Na_2O	3.01	5.25	4.21	3.11	1.53
Al_2O_3	18.45	15.44	17.30	18.14	12.03
MgO	4.55	0.51	3.77	4.64	0.30
K_2O	1.64	3.15	2.55	1.51	5.73
Fe_2O_3	3.23	2.67	3.61	4.36	1.57
P_2O_5	0.17	0.16	0.17	0.17	0.14
Totals (weight %)	99.96	98.96	100.19	101.06	100.33

Analyst: L.R. Erdman.
Analyses by XRF.

Aalenian age. Thus the rocks could be correlative with either the Cold Fish Volcanics in the Spatsizi map area to the south (Thorkelson, 1988) or to the Toarcian volcanics exposed on Mount Brock in northwestern Spatsizi map area (H.W. Tipper, pers. comm., 1983; Read, 1990). They may be at least partly correlative, also, with the Toodoggone Volcanics in the Toodoggone River map area (Diakow et al., 1992). Lower Jurassic strata of the Takwahoni Formation are best exposed in the Tulsequah map area (Souther, 1971) and are correlative with part of the Laberge Group in Whitehorse map area (Wheeler, 1961).

Early and Middle Jurassic plutonic rocks

Early and Middle Jurassic plutons underlie large areas in the Hotailuh and Three Sisters ranges. Some of the plutons are poorly dated and their inclusion in Stikinia rather than as part of overlap assemblages is arbitrary. The emplacement of the Three Sisters Pluton, in particular, may have coincided with the amalgamation of Stikinia with the terranes to the north and the initiation of the Bowser Basin.

Tahltan Pluton

This pluton is a zoned ultrabasic body underlying an area about 15 km^2 southwest of the village of Tahltan along the Telegraph Creek Road and Stikine River on the southern boundary of the Dease Lake map area. It has a border zone of pyroxenite containing abundant magnetite and apatite grading through pyroxenite-syenite agmatite and pyroxene syenite to a core of altered leucocratic syenite (Morgan, 1976). The pyroxenite is composed of diopsidic augite, magnetite, biotite, hornblende, apatite, and altered plagioclase. On the eastern side of the body the pyroxenite zone is as much as 600 m wide but narrows to about 150 m on the north side. The rock is cut by numerous orthoclase and epidote veins. The syenite core consists mainly of albite and antiperthite with diopsidic augite and minor hornblende. Magnetite, apatite, and sphene are common accessory minerals. The rocks are cut by pegmatitic veins of pink feldspar and diorite.

McBride River Pluton

The McBride River Pluton, forming the southeastern part of the Hotailuh batholith, is a white-weathering, massive, equigranular, medium grained granodiorite or quartz granodiorite characterized by abundant quartz, euhedral biotite, and hornblende and a general lack of inclusions (Anderson, 1983). The widespread but few inclusions are mafic-rich and range from rounded to elongate with no preferred orientation. Its relationship to the Three Sisters Pluton is unknown but the pluton cuts Upper Triassic volcanic rocks and appears to have metamorphosed Jurassic sedimentary rocks east of McBride River.

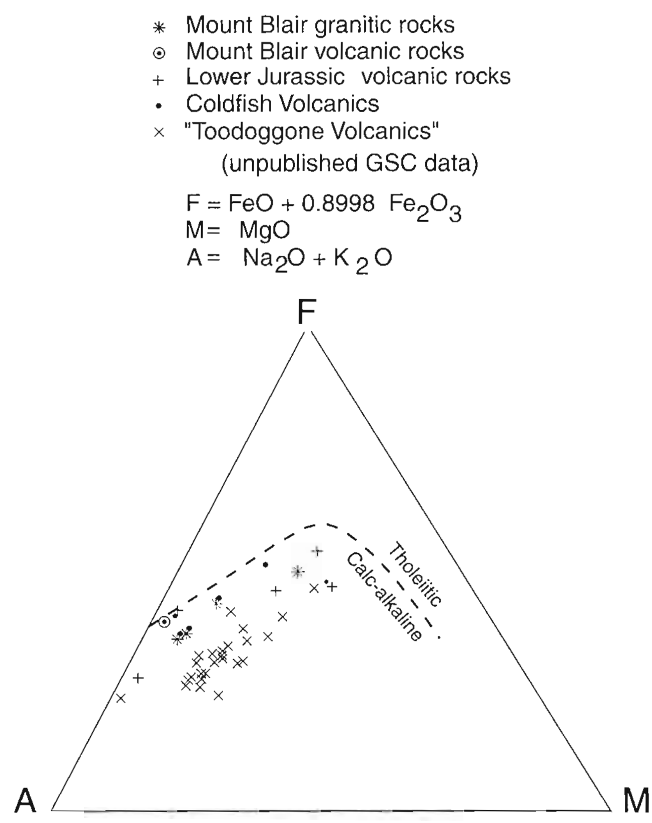


Figure 55. AFM plot for Lower Jurassic volcanic rocks (Fig. 54) compared with analyses of granitic and volcanic rocks near Mount Blair, the Toodoggone Volcanics, and the Coldfish Volcanics. Data from Erdman (1978) and unpublished GSC analyses (for Toodoggone Volcanics).

Tanzilla, Pallen Creek, and related plutons

These plutons, relatively recessive-weathering in comparison with surrounding Triassic volcanic rocks, occur in the Hotailuh Range. The Pallen Creek Pluton is a distinctive, homogeneous and massive, biotite-hornblende monzodiorite to quartz monzodiorite with K-feldspar megacrysts (Anderson, 1980). Near its northeast end a small body of equigranular hornblende gabbro and biotite-hornblende monzodiorite is intruded by equigranular monzodiorite. Thin, irregular, hornblende-biotite syenite dykes cut the rocks noted above. All phases of the Pallen Creek Pluton cut Triassic augite porphyry and underlying sedimentary rocks.

The Tanzilla Pluton, underlying an area of about 20 km^2 southeast of Tanzilla River is more mafic than the Pallen Creek Pluton and consists of fresh, homogeneous, hornblende-biotite quartz monzodiorite with abundant sphene (Anderson, 1980). The body is marked by a strong joint pattern resulting from roughly orthogonal vertical and horizontal joints. The pluton is locally cut by a stockwork of syenitic dykes. Along its northern margin the body has intruded augite porphyry.

A number of small granitic plutons in the Hotailuh Range and in the area between Tuya and Tanzilla rivers are included in the Three Sisters Plutonic Suite although no isotopic age dates are available. A body northwest of Hluey Lakes is essentially a biotite-hornblende granodiorite in its northern part and a syenite and syenite porphyry in its southern part. Others range in composition from quartz monzodiorite to quartz monzonite. East of Tuya River near the head of Ross Creek a pluton about 4 km long and 1 km wide consists of leucocratic, medium grained, locally porphyritic, biotite quartz diorite. In thin section many small quartz crystals impart a buckshot texture. Plagioclase (calcic oligoclase) has been intensely sericitized. The body is enclosed by hornfelsed greywacke and slate of the Lower Jurassic Takwahoni Formation.

Three Sisters Pluton

The Three Sisters Pluton is the largest and most heterogeneous body of the plutonic suite that bears its name (Anderson, 1983). The largest part of the pluton underlies much of the eastern Hotailuh batholith and is joined to a north-northwest-trending, western prong by a narrow band that bisects the Cake Hill Pluton. The main phases of the body in decreasing order of abundance are: a central phase consisting of biotite-hornblende quartz monzodiorite, monzodiorite, and quartz monzonite; a potassic marginal phase consisting of biotite-hornblende quartz monzonite, granite, quartz syenite, and syenite; a leucocratic phase, restricted to the southeast part of the pluton and consisting of clinopyroxene-hornblende granodiorite and quartz monzodiorite; a mafic phase of biotite-hornblende quartz diorite, diorite, and gabbro; and a fine grained phase of clinopyroxene-biotite-hornblende quartz diorite, diorite, and quartz monzodiorite.

The central phase of the Three Sisters Pluton is light grey-weathering and massive and ranges from fine- to medium-grained. The potassic marginal phase, on the other hand, is characterized by pink weathering resulting from the high content of alkali feldspar. It is mainly medium grained and relatively homogeneous. The leucocratic phase is homogeneous, white weathering, and equigranular and contains little K-feldspar and only minor mafic minerals. Textural heterogeneity is typical of the mafic phase which includes acicular hornblende diorite, equant hornblende porphyry diorite and equigranular hornblende gabbro. The fine grained phase is homogeneous, massive, and devoid of inclusions.

The Three Sisters Pluton generally lacks a structural fabric but, in places, inclusions in the mafic and central phases show linear and planar structure. Intrusive relationships within the pluton indicate a succession of emplacement from the fine grained phase to the mafic phase to the central phase to the potassic marginal phase to the leucocratic phase. The pluton has intruded and metamorphosed granitic rocks of the Cake Hill Pluton and Triassic and Lower Jurassic volcanic and sedimentary rocks.

Age and correlation of the Early and Middle Jurassic plutons

A K-Ar age on biotite from pyroxenite of the Tahltan Pluton is 202 ± 7 Ma (Stevens et al., 1982a). A U-Pb age on zircon from the McBride Pluton is 184 ± 8 Ma (Anderson and Bevier, 1992). Potassium-argon ages for the Tanzilla Pluton are 188 ± 4 Ma on biotite and 171 ± 14 Ma on hornblende (Anderson in Stevens et al., 1982a, b). Hornblende from the Pallen Creek Pluton has given K-Ar ages of 197 ± 18 and 165 ± 8 Ma and biotite has given 145 ± 7 Ma (Wanless et al., 1972; Stevens et al., 1982b). Many K-Ar ages are available for the Three Sisters Pluton (Anderson in Stevens et al., 1982b). They range rather widely but a significant age, obtained by the U-Pb method on zircon from the western apophyses of the potassic marginal phase, was about 170 Ma (Anderson et al., 1982).

Tectonic setting of Stikinia

The most diagnostic lithology in Permian sequences of Stikinia is thick bedded to massive, commonly thick, limestone. These rocks are continuous with a widespread Permian limestone along the northwestern margin of Stikinia (Monger, 1977) and suggest deposition on a relatively stable platform. A distinct contrast in structural style and metamorphic grade between the Permian rocks and overlying upper Lower Triassic strata near the Stikine River indicates an episode of deformation and metamorphism in latest Permian or earliest Triassic time.

Middle Triassic to Middle Jurassic volcanic, sedimentary, and plutonic rocks were the products of an island-arc environment which initiated the Stikine Arch in Late Triassic time. Unconformities on the arch and marked differences in stratigraphic successions bounded by faults on the north side of the arch reflect Early Jurassic tectonic activity, perhaps related to the interaction between Stikinia and the Cache Creek Terrane (Fig. 56).

Tectonism along the northern margin of Stikinia culminated in Middle and Late Jurassic time with deformation, plutonism, and overthrusting of the terrane by the Cache Creek Terrane.

Overlap assemblages and post-accretionary plutons

The rocks described below were deposited or emplaced after the major terranes either had been amalgamated or were sufficiently close that their geological evolution reflected similar processes. It is possible that the Upper Triassic greywacke and the Inklin Formation assigned to the Cache Creek Terrane were derived in part from Quesnellia but it is the Middle Jurassic rocks that provide the first clear evidence of terrane linkage.

Bowser Lake Group

A thick succession of marine to nonmarine clastic sedimentary rocks and associated andesitic volcanics are assigned to the Bowser Lake Group. They underlie most of southeastern Cry Lake map area and are best exposed in the mountains about 10 km south-southwest of Wade Lake and east of Tucho River.

A fault-bounded area southwest of Wade Lake is underlain by interbedded marine shale and greenish breccia, siltstone, and tuffaceous shale. This succession yields a Middle Bajocian fauna (Tipper, 1978). Overlying units consist of thick-bedded, chert-pebble conglomerate with interbedded slate and greywacke. The massif immediately to the southeast is composed of at least 700 m of pebble to cobble conglomerate with clasts of green and red radiolarian chert, limestone with fusulinids, aphanitic to porphyritic volcanics, and cream-white-weathering volcanics. All clasts were clearly derived from the Cache Creek Terrane to the north (see also, Currie, 1984). Clasts encompass a complete range from angular to well rounded. These rocks are interbedded with grit, sandstone, siltstone, and shale locally containing woody fragments. Farther south the conglomeratic succession unconformably overlies Lower Jurassic volcanic rocks (Fig. 57) and the basal units show trough crossbeds indicating southerly sedimentary transport. Similar rocks occur to the east beyond the Kehlechoa River and in places are intercalated with pink- to purple- and green-weathering volcanic tuff and flows.

Between Kehlechoa and Tucho rivers resistant ribs of conglomerate as much as a few tens of metres thick are intercalated with tuff which shows well developed bedding on a scale of centimetres. The tuffs and associated siltstone and some shale weather maroon and green to grey. North of the creek which flows eastward into Tucho River about 6 km north of its confluence with Pitman River the sequence is dominantly sedimentary. Sandstones show abundant crossbedding, some grading, and scour-and-fill structures. Shale ranges from carbonaceous and black to maroon weathering. Siltstone contains abundant woody fragments in some sections. Thin, well laminated tuffaceous beds occur locally.

South of the aforementioned creek and east of Tucho River sequences of volcanic rocks, probably more than 600 m thick, dominate (Erdman, 1978). They include aphanitic, dark green volcanics intercalated with agglomerate and purple to pink feldspar porphyry and well layered and laminated pink-, purple-, and maroon-weathering tuff. The volcanics are intercalated with at least two prominent sedimentary units which comprise chert-pebble conglomerate, gritty sandstone, siltstone, and dark, carbonaceous shale. Lavas, the most abundant volcanic rocks, are commonly dark grey- to mauve- and maroon-weathering and generally contain pink feldspar phenocrysts from 1 to 7 mm long. Augite phenocrysts are sparsely distributed. Vesicles may be filled with either calcite or chlorite.

Thin sections of the volcanic rocks show the preponderance of plagioclase as phenocrysts and microlites commonly altered to albite, epidote, and sericite. Microlites show well

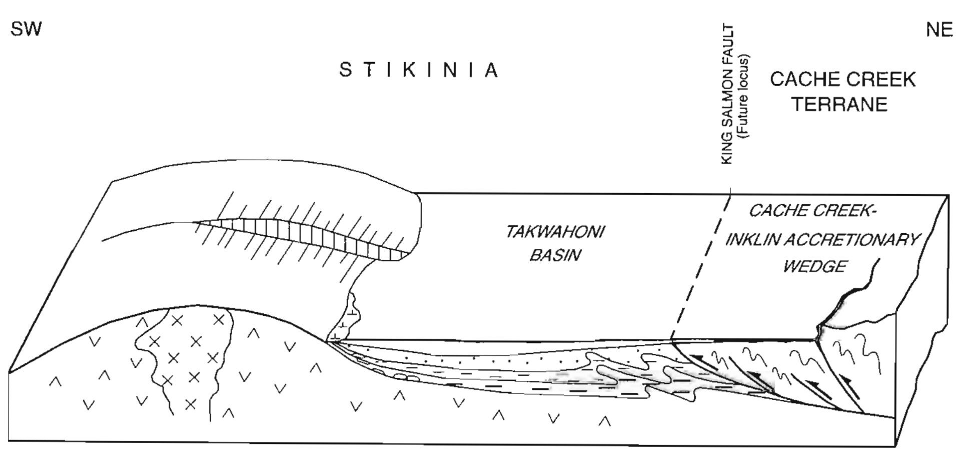


Figure 56. *Hypothetical relationship between Stikinia and the Cache Creek Terrane in Early Jurassic time.*

Figure 57.

Ledge of basal Bowser Lake Group sediments unconformably overlying Lower Jurassic volcanics along the southern margin of the Cry Lake map area east of McBride River. GSC 1996-125P

defined trachytic texture. In addition to calcite and chlorite, amygdules contain minor quartz and potassium feldspar. Clinozoisite is abundant in the groundmass of some samples.

Near the west end of a pluton southeast of Mount Blair a volcanic breccia pipe cuts the granitic rocks (Erdman, 1978). The pipe, possibly more than 100 m in diameter, consists of brecciated, microcrystalline to porphyritic grey-, green-, and red-weathering volcanic clasts in a finely crystalline dark grey matrix. Local bleaching and silicification of the granitic rocks is evident near contacts of the pipe and numerous feldspar porphyry dykes cut the pluton. The dykes are also brecciated in part.

Except for the lowermost unit south-southwest of Wade Lake, the sedimentary rocks and associated volcanics are believed to be of nonmarine origin.

Age and correlation of Bowser Lake Group

The basal member of the sequence assigned to the Bowser Lake Group is Middle Bajocian (Tipper, 1978). The conglomeratic and volcanic succession which overlies these sediments is poorly dated. It is Bajocian or younger and is older than the pluton southeast of Mount Blair dated by the K-Ar method on hornblende as 159 ± 6 Ma (Erdman, 1978). A dacite boulder from a Callovian sequence of strata in the northern Bowser Basin has been dated by the U-Pb zircon method at 160.7 ± 0.7 Ma (Ricketts and Parrish, 1992). A probable source for the boulder is the volcanic succession assigned to the Bowser Lake Group in southeastern Cry Lake map area. Thus, an age range between Bajocian and Callovian is suggested for the Bowser Lake Group in the Cry Lake map area.

Middle Jurassic plutons

A suite of leucocratic plutons of mainly Middle Jurassic but in part of Early Jurassic age occur in a broad belt from Tachilta Lakes in the northwest to north of Pitman River in the southeast. In contrast to the Late Triassic Stikine Plutonic Suite, the rocks are little foliated and contain substantial biotite. In addition, they occur in Quesnellia and in the Cache Creek Terrane as well as in Stikinia.

Tachilta Lakes and Granite Lake plutons

Three, roughly equidimensional plutons outcrop in the area around Tachilta and Granite lakes. The Tachilta Lakes Pluton, underlying an area of about 50 km^2 in the southern part of the Tachilta Lakes area consists of even grained, medium- to coarse-grained, largely unstrained granodiorite to monzodiorite consisting of zoned plagioclase feldspar (An_{30}), quartz, biotite, hornblende, and minor K-feldspar, sphene, and zircon. The rocks intrude and hornfels sediments and ultramafic rocks of the Cache Creek Complex. The Granite Lake Pluton, also about 50 km^2 in area, is similar in composition to the Tachilta Lakes Pluton. The unnamed pluton east-northeast of Tachilta Lakes Pluton and west of Tuya River is light grey- to buff-weathering granodiorite cut by dykes of biotite leucogranite.

Snowdrift Creek Pluton

Five granitic bodies separated by overburden occur near the headwaters of Snowdrift Creek north of the Hotailuh batholith. They may constitute one pluton underlying an area of more than 100 km^2 but evidence is lacking. The northwestern outcrops consist of incipiently foliated, medium grained, equigranular granodiorite containing 40% andesine, 20% K-feldspar, 25% quartz, 10% biotite, and 5% hornblende. Rocks in the southeastern bodies contain more hornblende but otherwise are similar in composition. Mineral foliation and schlieren define steeply northwestward- and southeastward-dipping margins for the pluton at the level of erosion (Anderson, 1983). A small body west of Horn Mountain is of similar lithology.

The Snowdrift Creek Pluton has intruded and metamorphosed rocks as young as Early Jurassic (Pliensbachian).

Plutons east of Kehlechoa River and southeast of Mount Blair

A small body of strongly fractured, greenish grey-weathering, epidotized, pink hornblende quartz diorite outcrops on a ridge east of Kehlechoa River and south of the King Salmon Fault. Contacts were not observed but the body probably intruded the surrounding Lower Jurassic greywacke.

The pluton southeast of Mount Blair and north of Pitman River ranges in composition from syenite to diorite and locally includes quartz monzonite and granodiorite (Erdman, 1978). The syenite weathers light to dark pink and is composed of inequigranular, medium grained, potassium feldspar with minor plagioclase, hornblende, and local biotite. These rocks are cut by discontinuous, bright pink, fine grained dykes. Quartz monzonite and monzonite range from fine- to medium-grained. Lath-shaped hornblende is the primary mafic mineral constituting about 3-5% of the rock. Granodiorite and diorite weathers dark to light green and contains from 5 to 8% hornblende which is strongly chloritized. The monzonite phase is cut by a volcanic breccia pipe described above.

The granitic rocks have intruded volcanics of the Bowser Lake Group and are cut by the breccia pipe suggesting that the volcanics and pluton are roughly coeval.

Pluton at the headwaters of Four Mile River

In this area pink-weathering, hornblende quartz monzonite underlies an area of about 30 km^2. The rock is relatively fresh, medium grained, and contains megacrysts of K-feldspar. It consists of 35% plagioclase (An_{34}) which is partly replaced by sericite, 35% K-feldspar, and 10% hornblende, in places much altered to chlorite but in others completely fresh. Sphene is abundant. Small, irregular bodies of similar lithology occur farther northwest but have not been mapped separately.

The quartz monzonite is cut by east-trending faults and its west side is marked by a breccia zone as much as 30 m wide. Unlike the Late Triassic plutonic rocks it intrudes, the pluton is unfoliated.

Ages of Middle and Late Jurassic plutons

A K-Ar age on biotite from the granitic body near Tachilta Lakes is 173 ± 4 Ma (Stevens et al., 1982a). Hornblende from the same sample gives an age of 160 ± 20 Ma. The biotite measurement is preferred because of its higher percentage of potassium and radiogenic argon (Stevens et al., 1982a). Biotite from the northwestern part of the Snowdrift Creek Pluton has been dated by the K-Ar method at 147 ± 5 Ma (Stevens et al., 1982b). The southeastern part of the pluton has given concordant K-Ar ages on biotite and hornblende of 157.8 ± 2.4 Ma and 160.8 ± 2.5 Ma, respectively (Hunt and Roddick, 1987). Erdman (1978) obtained a K-Ar age on hornblende from the pluton southeast of Mount Blair of 159 ± 6 Ma. K-Ar ages for samples of the pluton at the head of Four Mile River are markedly discordant and range from 137 to 157 Ma (Stevens et al., 1982b; Hunt and Roddick, 1987).

On the basis of the disparate isotopic age determinations for the various plutons it is impossible to give a well constrained age range for the plutonism. Coupled with the stratigraphic evidence, however, the isotopic ages suggest a broadly Middle Jurassic episode of magmatism.

Late Early Cretaceous Cassiar Plutonic Suite

Rocks of the Cassiar Plutonic Suite occur in Quesnellia and Ancestral North America. More than 2500 km^2 is underlain by the Cassiar batholith which continues beyond the Cry Lake map area to the northwest and east and is the largest Cretaceous pluton in the Canadian Cordillera. An isolated body about 24 km^2 in extent occurs northwest of the confluence of Cassiar and Turnagain rivers. Two bodies are in Quesnellia, one southeast of Dease River (Beady Range Pluton) and the other northeast of Kutcho Fault and south of Hottah Fault.

Cassiar batholith

The Cassiar batholith is characterized by rugged topography extending diagonally across the Cry Lake map area from northwest of Dease River to north of Hottah Lake (Fig. 58). It is typically a light grey, blocky-weathering, medium- to coarse-grained, megacrystic, hornblende-biotite granite containing about equal amounts of K-feldspar, plagioclase, and quartz. Megacrysts of K-feldspar as much as 1.5 cm long are particularly abundant along the northeastern margin of the pluton near and southeast of Meek Lake but are common almost everywhere. Muscovite is present locally particularly near screens or pendants of schistose, metasedimentary rocks. Zircon and apatite are common accessory minerals. Pegmatite is present in a few localities but is nowhere abundant. Micaceous, strongly foliated, metasedimentary inclusions are widespread and are especially conspicuous in the southwestern part of the pluton from near Dease River to beyond Cry Lake.

Chemical analyses of Early Cretaceous granitic rocks, mainly in Quesnellia (Table 7), emphasize the relatively high silica and potassium content of these rocks and their probable derivation from continental basement.

Turnagain Pluton

The semicircular body northwest of the mouth of Cassiar River, about 40 km^2 in area, is a strongly jointed, (Fig. 59), light grey-weathering, medium- to coarse-grained, leucocratic granite with about 25-30% quartz, 35-40% K-feldspar, 15-25% plagioclase, and 7% biotite. Muscovite is ubiquitous but minor, and zircon is common. Muscovite-quartz-feldspar pegmatite occupies some of the joints. In places the quartz is distinctly smoky, an unusual characteristic for the Cretaceous granites. K-feldspar shows very strong microcline twinning and perthite was observed in a few thin sections.

Figure 58.

Terrain underlain by the Cassiar batholith northeast of Kutcho Creek. View is to the northeast. GSC 1996-1250

Table 7. Chemical analyses of selected granitic rocks in Cry Lake and Dease Lake map areas.

Suite	Cassiar						Middle Jurassic(?)		Early Triassic
Sample No.	GA-67 102A	GAD-81 67C	GAD-81 45-1	GAB-81 57	GAB-81 57-1	GAEn-81 12	GAD-81 42	GAD-81 43	GAD-81 10d
Lithology	granite	quartz monzonite	pegmatite	granite	granite	granodiorite	granodiorite	granodiorite	diorite
Location	58°42'45"N 128°42'55"W	58°00'30"N 127°34'30"W	58°49'50"N 129°40'09"W	58°46'30"N 129°37'30"W	58°46'30"N 129°37'30"W	58°53'00"N 130°01'00"W	58°44'15"N 129°37'45"W	58°44'30"N 129°37'00"W	58°44'30"N 129°37'00"W
SiO_2 %	66.4	64.9	66.5	68.8	63.0	59.5	71.6	62.5	48.1
TiO_2 %	0.58	0.44	0.61	0.18	0.74	0.78	0.28	0.73	0.70
Al_2O_3 %	15.7	15.6	15.8	16.6	17.2	16.5	14.2	15.5	16.8
FeO %	3.5	1.7	2.8	0.7	3.0	5.0	1.0	3.5	6.1
Fe_2O_3 %	0.9	2.3	1.5	0.8	1.1	2.4	0.6	1.4	2.3
MnO %	0.11	0.1	0.04	0.06	0.09	0.17	0.03	0.11	0.17
MgO %	1.9	1.47	1.60	0.44	2.14	2.94	0.82	3.13	9.35
CaO %	2.2	3.70	0.70	2.04	4.88	6.66	2.22	5.79	12.4
Na_2O %	4.4	4.0	0.8	4.7	4.1	2.9	4.0	3.0	1.1
K_2O %	3.8	3.81	5.62	4.01	2.32	1.22	2.74	1.72	0.22
H_2O_T %	0.7	0.3	2.0	0.3	0.4	0.5	0.2	0.5	1.5
CO_2 %	0.2	0.1	0.4	0.3	0.2	0.0	0.2	0.1	0.6
P_2O_5 %	0.12	0.23	0.07	0.09	0.01	0.16	0.15	0.18	0.02
Ba %	–	0.161	0.176	0.229	0.156	0.035	0.218	0.174	0.012
Ni %	–	0.009	0.008	0.010	0.009	0.007	0.007	0.008	0.016
Rb %	–	0.010	0.018	0.010	0.007	0.004	0.082	0.004	
Sr %	–	0.105	0.016	0.119	0.041	0.27	0.082	0.064	0.020
Zn %	–	0.007	0.008	0.005	0.006	0.006	0.006	0.007	0.007
Zr %	–	0.015	0.016	0.010	0.029	0.015	0.013	0.014	0.004
Total	100.5	99.0	98.8	99.4	99.7	98.8	98.5	98.5	99.6

Analyst, R.M. Rousseau, GSC Ottawa.
All analyses by XRF except FeO, H_2O_T, and CO_2 by rapid chemical methods.
– not analyzed

Figure 59.

Well developed joints in the Turnagain Pluton. View is to the west. GSC 1996-125N

Beady Creek Pluton

Distinctly pink-weathering, fine- to medium-grained granite underlies an area of about 70 km^2 north of Beady Creek. Near the mouth of Packer Tom Creek and west of Dease River the body is more heterogeneous and possibly these phases represent a separate pluton or plutons. North of Beady Creek the rock is well jointed, homogeneous, and biotite-bearing. In the canyon of Packer Tom Creek pink-weathering granite contains about 15% hornblende plus biotite. About 1.3 km to the north on the east side of Highway 37 foliated granodiorite cut by pink aplite veinlets contains about 20-25% combined hornblende and biotite. These lithologies contain inclusions of green, partly epidotized volcanics. Along and north of Canyon Creek west of Highway 37 granitic rocks range from leucocratic, medium grained, biotite-hornblende granite to mesocratic and melanocratic hornblende quartz diorite. K-feldspar content varies from absent in hornblende diorite to about 35% in granite.

Fresh biotite-granite exposed along the upper reaches of Swamp Creek and the lower reaches of Thibert Creek are assigned to the Cassiar Plutonic Suite although their age is unknown. The rocks are medium grained and pink weathering.

Along the northeast side of the Kutcho Fault east of Kutcho Creek a small undated body of rusty- to reddish-weathering biotite granite contains quartz in crystals locally more than 1 cm in diameter. In places the granite is cut by aplite dykes.

The southwestern boundary of the Cassiar batholith from Hard Lake northwest to the northwest corner of the Cry Lake map area is marked by the Kutcho Fault, a zone of intense foliation and mylonitization. Elsewhere, granitic rocks of the Cassiar Plutonic Suite clearly have intruded country rock with the development of conspicuous contact metamorphic aureoles.

Age and correlation of Cassiar Plutonic Suite

Potassium-argon ages of widely distributed samples from the Cassiar batholith range from about 100 Ma to 116 Ma with a majority between 105 and 110 Ma (Table 8). Potassium-argon ages for granitic rocks in Quesnellia near Highway 37 are discordant but suggest ages as old as 127 Ma (Table 8). It seems likely that there the mid-Cretaceous magmatism has resulted in resetting to some degree of K-Ar systems related to an older episode or episodes of plutonism.

Mid-Cretaceous granitic rocks are characteristic of the Omineca Belt throughout the length of the Canadian Cordillera. In general they are more potassic and quartzose than plutons which occur in terranes west of Quesnellia.

Sustut Group

The Sustut Group (Eisbacher, 1974) underlies an elongate area extending from near Takla Lake in the southeast to the Grand Canyon of Stikine River in the northwest. It ranges from 300 to 2300 m thick and consists of dominantly, or entirely, nonmarine, well bedded, sedimentary strata with tuff beds in its uppermost (Brothers Peak) formation. Only the lower, Tango Creek Formation is present in Dease Lake map area.

Tango Creek Formation

Sedimentary rocks of the Tango Creek Formation are well exposed in the Grand Canyon of the Stikine River and on Mount Meehaus (Read, 1983; Fig. 60). They also form scattered outcrops in the forested area of the Klastline Plateau. The succession has been described by Read as follows:

"In the southeastern quarter (104J/2E and 104J/1W map areas), the Tango Creek Formation consists of a gently southwesterly dipping succession of thin lenses, up to 15 m thick, of chert and quartz pebble conglomerate at the base of a sequence of interbedded sandstone, shale and carbonaceous shale less than 250 m thick. These rocks underlie an upper chert pebble conglomerate which is more than 300 m thick. This sequence, magnificently exposed on the south walls of the Grand Canyon, onlaps the northern margin of the Sustut basin so that 5 km to the north of the canyon the upper pebble conglomerate lies directly on rocks of the Stuhini Group. Structure contours on the base of the Sustut Group show that the northern margin of the basin slopes from 5 to 27° southwards and has southerly trending ridges and valleys carved into it. The slopes were sufficiently steep locally to generate basal mudflow deposits immediately above the unconformity."

Sustut Group strata lie with marked unconformity on Triassic rocks and folded Sustut rocks have been intruded by an Eocene granitic pluton on Mount Meehaus.

Age and correlation of Sustut Group

The Tango Creek Formation of the Sustut Group contains late Early Cretaceous to possibly Early Cenomanian palynomorphs (Read, 1983; identifications by A.R. Sweet). Similar ages have been obtained for the formation in the Spatsizi River area (Read, 1990). The Sustut Group exposed in the southeastern part of Dease Lake map area define the northwestern limit of the Sustut Basin which extends southeastward along the eastern margin of the Bowser Basin for at least 250 km (Eisbacher, 1974).

Table 8. Potassium-argon ages for granitic rocks of the Cassiar Plutonic Suite.

K-Ar/ GSC Number	Mineral	Latitude	Longitude	Pluton	Age (Ma)	Ref. GSC Paper
GSC 67-15	(b)	58°49'N	129°52'W	Beady Range	107.6 ± 5	69-2A
K-Ar 3577	(b)	58°53'30"N	130°01'W	Beady Range	108.7 ± 1.7	87-2
K-Ar 3946	(b)	58°54'15"N	130°03'20"W	Beady Range?	116 ± 3	89-2
K-Ar 3947	(h)	58°54'15"N	130°03'20"W	Beady Range?	128 ± 3	89-2
K-Ar 3563	(b)	58°49'N	129°40'W	Pegmatite-Kutcho Fault zone	104.6 ± 1.6	87-2
K-Ar 3585	(b)	58°46'30"N	129°37'30"W	Irregular pluton west of Kutcho Fault	107.4 ± 1.6	87-2
K-Ar 3579	(b)	58°44'30"N	129°37'W	Irregular pluton west of Kutcho Fault	111.2 ± 1.7	87-2
K-Ar 4061	(b)	58°41'00"N	128°10'36"W	Turnagain	116.5 ± 1.6	90-2
GSC 70-35	(b)	58°42'30"N	128°43'30"W	Cassiar batholith	104.5 ± 5	71-2
GSC 76-72	(b)	58°30'30"N	128°45'30"W	Cassiar batholith	98.0 ± 3.7	77-2
GSC 76-73	(h)	58°30'30"N	128°45'30"W	Cassiar batholith	107 ± 5	77-2
K-Ar 4058	(b)	58°24'20"N	128°22'20"W	Cassiar batholith	114.1 ± 1.6	90-2
K-Ar 4059	(b)	58°32'45"N	128°06'00"W	Cassiar batholith	110.1 ± 1.8	90-2
K-Ar 4060	(m)	58°32'45"N	128 06'00"W	Cassiar batholith	109.3 ± 1.5	90-2
K-Ar 4063	(b)	58°53'00"N	129 21'00"W	Cassiar batholith	107.2 ± 2.2	90-2
K-Ar 4062	(b)	58°42'22"N	129°04'00"W	Cassiar batholith	108.8 ± 1.9	90-2
K-Ar 3805	(b)	59°02'00"N	129°46'30"W	Cassiar batholith	103 ± 2	89-2
K-Ar 3803	(b)	59°02'00"N	129°46'30"W	Cassiar batholith	103 ± 3	89-2
K-Ar 3804	(h)	59°02'00"N	129°46'30"W	Cassiar batholith	110 ± 3	89-2
K-Ar 3806	(m)	59°01'00"N	129°47'30"W	Cassiar batholith	100 ± 2	89-2

b = biotite
m = muscovite
h = hornblende

Late Cretaceous granitic rocks

Two Late Cretaceous granitic plutons have been identified. One cuts rocks assigned to Stikinia whereas the other occurs in the Cache Creek Terrane. Regionally, similar rocks are known to occur in all terranes represented in the project area.

Snow Peak Granite

This pluton underlies an area of about 15 km^2 on the eastern side of the Snow Peak massif about 22 km west of the settlement of Dease Lake. It is a leucocratic, fine- to medium-grained, biotite-hornblende granite containing 30% K-feldspar (locally zoned), 30% plagioclase (partly sericitized and strongly zoned), 30% quartz, 5% biotite, and 5% hornblende. Commonly, euhedral crystals of beta quartz occur with phenocrysts of plagioclase in a finer grained matrix. Many dykes, presumably related to the pluton, cut sediments on the main north-trending ridge of Snow Peak.

The Snow Peak Granite is responsible for a conspicuous, rusty-weathering metamorphic aureole in greywacke and slate of the Lower Jurassic Takwahoni Formation.

Little Eagle Pluton

The Little Eagle Pluton, more than 15 km^2, in area, lies between Eagle and Little Eagle rivers and is a blocky, leucocratic, medium grained, miarolitic, biotite granite. It comprises about 40% K-feldspar (patch perthite), 25-30% quartz, less than 25% plagioclase (oligoclase-andesine), and 5% quartz. In some samples hornblende is evident. Quartz is generally smoky.

Like the Snow Peak Granite, the Little Eagle Pluton has a well developed contact metamorphic aureole.

Age and correlation of Late Cretaceous plutons

A K-Ar age on hornblende from the Snow Peak Granite is 73.5 ± 4.2 Ma (Stevens et al., 1982b) and on biotite from the Little Eagle Pluton is 78.4 ± 1.7 Ma (Stevens et al., 1982b). These plutons are part of a suite of high-level, nonfoliated, commonly equidimensional plutons that are widespread in northern British Columbia. The Needlepoint Pluton in the McDame map area (Panteleyev, 1980) and the Surprise Lake Pluton in the Atlin map area (Aitken, 1959; Ballantyne and Littlejohn, 1982) are two of the largest.

Upper Cretaceous(?) to Lower Tertiary sedimentary rocks

There is no confirmed record of Upper Cretaceous rocks in either the Dease Lake or Cry Lake map areas although strata along the Kechika Fault may include some rocks of this age (Gabrielse, 1962c). Eocene strata, on the other hand are well documented.

Figure 60. *Gently-dipping, light-weathering strata of the Tango Creek Formation of the Sustut Group unconformably overlying dark-weathering rocks of the Stuhini Group in the Grand Canyon of the Stikine . GSC 1996-125M*

Tanzilla Canyon Formation

Thick sedimentary breccia, pebble to cobble conglomerate, with local sandstone, shale, and carbonaceous shale, outcrop along Tuya River, in the canyon of Tanzilla River, on the northwest side of Stikine River downstream from the mouth of Tanzilla River (Fig. 61), and along Classy Creek, Mansfield Creek, and Little Tuya River. No single locality can be designated as the type locality but the lower part of the formation is well exposed along Tanzilla River and the upper, or perhaps in part more distal, part of the formation is best exposed along the lower reaches of Tuya and Little Tuya rivers.

Strata of the Tanzilla Canyon Formation, which underlie an area of about 250 km^2, are as much as 200 m thick along Tanzilla River but probably less than 150 m thick farther north. Similar rocks occur along Tahltan River near Hartz Creek, along Nahlin, and Koshin rivers in the northwestern part of Dease Lake map area, and north of Sheslay on the west side of the Level Mountain massif. Coarse conglomerate with sandstone is exposed southwest of the Kechika Fault in easternmost Cry Lake map area. In general, clasts in the clastic sediments reflect the composition of nearby underlying bedrock.

Along Tanzilla River the rocks are tightly folded along northeast-trending axes and the angularity and coarseness of the sedimentary rocks suggests fanglomeratic deposition along a fault scarp. In places the rocks weather to mauve and cream. Well rounded chert pebbles are the dominant clasts in nonfanglomeratic facies. The rocks exposed along Tuya River and its tributaries locally contain seems of bituminous coal. One seam, presumably near the mouth of Mansfield Creek, is almost 12 m thick and another, less than a kilometre to the south, is almost 8 m thick (Featherstonhaugh, 1904). It is underlain by a bed of clay and shale and overlain by conglomerate. An abundance of shale has led to slumping into Tuya River.

Poorly consolidated outcrops of shale, sandstone, and lignitic coal occur near river level along Tahltan River near the mouth of Hartz Creek (Smitheringale, 1953). These rocks are overlain by thick deposits of recent unconsolidated gravel and clay.

Figure 61. Light-weathering strata of the Tanzilla Canyon Formation separated from the underlying, steeply dipping Permian limestone and volcanics by the West Fault. View to west near mouth of the Tanzilla River . GSC 1996-125L

Lacustrine sandstone, siltstone, conglomerate, and tuff containing coalified wood occur in gently dipping beds along Koshin and Nahlin rivers. The age of these rocks is not known but they are similar in lithology and induration to those along the lower reaches of the Tuya River.

Rocks in northeastern Cry Lake map area

A clastic sequence containing very coarse conglomerate underlies a dark-weathering ridge on the west side of the Kechika Fault southeast of Blue Sheep Creek. Boulders in the conglomerate, generally fairly well rounded, are up to 0.5 m in diameter and consist of carbonate, volcanic, and ultramafic rock. Dun-weathering, serpentinized ultramafic rocks are common and some contain cross fibre veinlets of chrysotile asbestos. The next most abundant clast lithology is a maroon-weathering, green, aphanitic volcanic. In places blue-grey-weathering limestone clasts are conspicuous. Black slate fragments are rare. The conglomerate is very poorly sorted and clasts range from boulders to the coarse grained, green sandstone matrix. This succession, more than 150 m thick, unconformably overlies dark grey-weathering limestone (probably Espee Formation) on its west side and is truncated by the Kechika Fault on the east.

Age and correlation of Upper Cretaceous(?) to Lower Tertiary sedimentary rocks

Palynomorphs from rocks exposed along the Tuya River have been identified by A.R. Sweet and suggest an age of no older than Eocene (Read, 1983 and A.R. Sweet, pers. comm., 1995). In the Canadian Cordillera rocks of this lithology and age commonly occur along regional faults. Those in the Tuya basin appear to have been deposited synchronously with movement on a fault on their southeast side (Read, 1983). Lack of exposed contacts precludes an interpretation of the setting of strata in the Nahlin-Koshin basin. The conglomerate along the Kechika Fault is correlated tentatively with the numerous nonmarine deposits of Upper Cretaceous(?) to Eocene age which are found along the major transcurrent faults in the Cassiar and Omineca mountains (Gabrielse, 1985).

Eocene volcanic rocks

Sloko Group

Mildly deformed, varicoloured volcanic rocks outcrop in three areas north of Sheslay (Hamilton, 1981). They are as much as 152 m thick and comprise green and purple flows of pyroxene andesite and pyroxene-hornblende andesite. Similar rocks form dykes from 1 to 3 m wide. In the central outcrop area these rocks are overlain by fine grained basaltic andesite, rhyodacite, and rhyolite breccia. Basaltic andesite locally weathers to shades of grey, red, and brown. Chemical analyses indicate that the volcanics are calc-alkaline in composition (Hamilton, 1981). The rocks have been metamorphosed to zeolite facies.

The volcanic succession described above lies on an erosion surface which truncates Permian, Triassic, and Lower Jurassic strata.

Other occurrences

Volcanic rocks northeast of the Kechika Fault are cream-white-weathering, white, light pink, and grey rhyolite flows, rhyolite tuffs, and breccias (Hedley and Holland, 1941). The most common lithology is light coloured, highly quartzose breccia with kaolinized feldspar and clear, glassy quartz. In places spherulitic texture is well developed. Judging from their distribution the volcanics must be at least 200 m thick.

Rhyolitic porphyry occurs with basaltic dykes in a cataclastic zone within the Cassiar batholith just north of the Beady Range fault zone between Eagle and Four Mile rivers. The age of these rocks is unknown.

A few scattered exposures of quartz-latite porphyry outcrop south of Stikine River northeast of Mount Meehaus (P.B. Read, pers. comm., 1995). At one locality a sill of the porphyry has been emplaced into sediments of the Lower Cretaceous Tango Creek Formation. The latite is otherwise undated.

Age and correlation of Eocene volcanic rocks

Volcanic rocks north of Sheslay have been correlated with the Sloko Group exposed to the west in the Tulsequah map area (Souther, 1971; Hamilton, 1981). There, volcanic rocks and associated plutons have been dated by the K-Ar method as Eocene (J.G. Souther and J. Nelson, pers. comm., 1990). Volcanic rocks northeast of the Kechika Fault have given a K-Ar whole rock age of 45.3 ± 2.3 Ma (Stevens et al., 1982a). This age is the same as that for volcanics in and near the Northern Rocky Mountain Trench in the Ware (west half) map area (Wanless et al., 1978).

Eocene plutonic rocks

Major Hart Pluton

Blocky, light grey-weathering, leucocratic, miarolitic granite with smoky quartz outcrops along the headwaters of the Major Hart River and extends for about 13 km to the northwest (Fig. 62). The pluton underlies an area of approximately 120 km^2. Thin sections reveal the presence of about 60% perthitic K-feldspar which contains inclusions of plagioclase feldspar, 15% strongly twinned calcic oligoclase, 20% quartz, and 5% biotite. Zircon is an abundant accessory mineral. Fluorite has been noted in these rocks along their northeastern contact with ultramafic rocks. Intrusive contacts with surrounding rocks of the Sylvester Allochthon range from steeply dipping to a more common gentle dip.

Meehaus Pluton

A body of fine- to medium-grained biotite-augite granodiorite, less than 1 km^2 in area has intruded strata of the Tango Creek Formation on the west slope of Mount Meehaus in south-central Dease Lake map area. The intruded rocks show a distinct metamorphic aureole and were folded and faulted prior to intrusion.

Other occurrences

Five kilometres north of the mouth of the creek flowing eastward from Beale Lake, a body of rusty-weathering, quartz-feldspar porphyry, less than 300 m long, has intruded diorite of the Sylvester Allochthon. Euhedral feldspar crystals to 2 mm long have been strongly kaolinized. Quartz occurs in crystals as much as 1.5 mm in diameter and is distinctly smoky. Pyrite and blue cryptocrystalline quartz are common. The age of the pluton is unknown.

A small stock of leucocratic biotite, quartz, and feldspar porphyry southeast of Blue Sheep Lake has intruded limestone of the Cambrian Rosella Formation. A distinctive skarn borders the pluton. Its age has not been determined.

Figure 62.

Distinctive, strong jointing in the Major Hart Pluton. View to north 4 km north of Turnagain River. GSC 1996-125K

A number of dykes up to several metres wide cut rocks of the Kutcho Formation and Cache Creek Complex east of the headwaters of Kutcho Creek. The rocks are fresh, unfoliated, and medium- to fine grained. They contain about 65-70% plagioclase (An_{40}) showing well developed trachytic texture. Augite is the dominant mafic mineral and is commonly rimmed with hornblende which is in turn partly replaced by biotite. Apatite, sphene, and magnetite are abundant.

Age and correlation of Eocene plutonic rocks

Only three K-Ar determinations are available for Eocene plutonic rocks in the area. Biotite from the Major Hart Pluton has given an age of 48.52 ± 0.77 Ma (Hunt and Roddick, 1987). A K-Ar date on biotite from the Meehaus Pluton is 52 ± 2 Ma (Read, 1983). Hornblende from a dyke east of the divide at the head of Kutcho Creek has been dated at 55.4 ± 3.0 Ma (J.C. Roddick, pers. comm., 1984).

The Eocene was a time of widespread plutonism in the Cordillera which, in the Omineca Belt, is represented by a host of discordant, high-level granitic intrusions. These bodies are accompanied in some areas by coeval volcanic rocks. Many of the bodies are relatively small dykes and sills but others, like the Major Hart Pluton in the project area and the Balourdet Pluton in the Toodoggone River and Ware (west half) map areas (Evenchick, 1988) are of substantial size. The Eocene witnessed the last major plutonic episode in the western Cordillera.

Miocene to Recent volcanic rocks

Tuya Formation

Miocene to Recent volcanic rocks underlie some of the most distinctive landforms in the region. Black-weathering basaltic cones extend in a broad belt from the headwaters of Teslin River to Snowdrift Creek. Many small outcrops of columnar basalt extend as far east as the southwest end of Cry Lake and east of Turnagain Lake. The volcanic rocks are particularly abundant in the western part of the Dease Lake map area dominated by the Level Mountain shield volcano and the Heart Peaks massif.

Kawdy Mountain in northwestern Dease Lake map area is the largest of the cinder cones. It is deeply dissected on its northern and eastern flanks which facilitates observation of its general structure. The mountains consists of layered agglomerate, tuff, and ash dipping from 5 to 10° outward from a central cirque area. Near the top of the mountain buff-brown-weathering ash and tuff are cut by vertically dipping basaltic dykes as much as 1 m wide. One gulley on the north slope of the mountain exposes basalt with vertically dipping columns flanked by a unit with horizontally dipping columns. The latter overlies basalt with well developed pillows as much as 1 m across. Agglomerate, the most common lithology, consists of fragments of vesicular, black, aphanitic basalt as much as 12 cm long but perhaps averaging 2.5 cm. Pillows consist of an outer frothy glass layer less than 1 cm thick with an underlying layer of grey, aphanitic rock slightly more than 1 cm thick. This is succeeded inward by a frothy layer from 0.5 to 1.5 cm thick consisting of tubular vesicles oriented perpendicular to the exterior of the pillow. The cores of the pillows are grey, aphanitic basalt.

The volcanic edifice 10 km northeast of Kawdy Mountain is a typical tuya described by Mathews (1970). The lower part of the mountain consists of layered, buff-weathering agglomerate dipping at angles of 15 to 30°. This material is capped by a layer of columnar-jointed, flat-lying lava flows, in places up to 100 m thick, which form vertical cliffs around the top of the mountain. The edifice is assumed to have formed with eruption into a lake thawed from an ice sheet.

Cinder cones east and southeast of Dease Lake comprise varying proportions of ash, agglomerate, and dyke material. Most of the flows are vesicular and scoriaceous near the base. Dykes are dark, aphanitic, and locally porphyritic with small phenocrysts of olivine. Volcanic bombs are found intermingled with fragmental rocks near the central conduits of the volcanoes. Between Eaglehead Lake and Spike Mountain steeply dipping basaltic dykes ranging form about 10 to 20 cm wide are fairly common. They form two sets, one trending approximately east, and another north. Most are aphanitic and massive but some have vesicular borders. They are thought to be part of the Tuya Formation.

Numerous exposures of flat-lying basalt flows occur on the Tanzilla Plateau and in the southwestern part of the Cassiar Mountains. They range from a few metres to more than 5 m thick and commonly have well developed columnar structure. The rocks are grey to black and most have yellowish-green olivine and amber-coloured plagioclase (labradorite) phenocrysts. A frothy grey flow on the north side of Cry Lake near its southwest end contains abundant plagioclase microlites in an aphanitic matrix. Augite and pigeonite have been reported from the groundmass of flows on the northwestern part of the Tanzilla Plateau (Watson and Mathews, 1944). Lherzolite nodules and partly fused clasts of granitic rocks were observed locally. In some places, for example on Mount McLeod, and in the Hotailuh Range, the lavas form conspicuous buttes whereas in many places they have been localized by stream valleys as along Dease and Canyon creeks.

A spectacular succession of flows is exposed along the Stikine River below its confluence with the Tahltan River. There, as many as four flows have been superimposed in the old river valley (Fig. 63). Across from the mouth of the Tahltan River a flow has filled a stream channel in river gravel with the columns in the basal part oriented perpendicular to the walls of the channel. In other places stream valleys cut into basalt were later filled with younger flows. Olivine basalt flows along the lower reaches of the Klastline River are intercalated with fluviatile sand and gravel (Read, 1983).

By far the greatest volume of Miocene to Recent volcanic rocks in the map areas occurs in the Heart Peaks and Level Mountain massifs. The Level Mountain Range volcanic plateau, more than 2400 km^2 in extent, consists of up to four sequences of alkali basalt and ankaramite flows and tuffs with a total thickness of as much as 1000 m (Hamilton, 1981). The basal flows of the volcanic plateau are well exposed along Beatty Creek and in the canyon of Little Tahltan River. In both

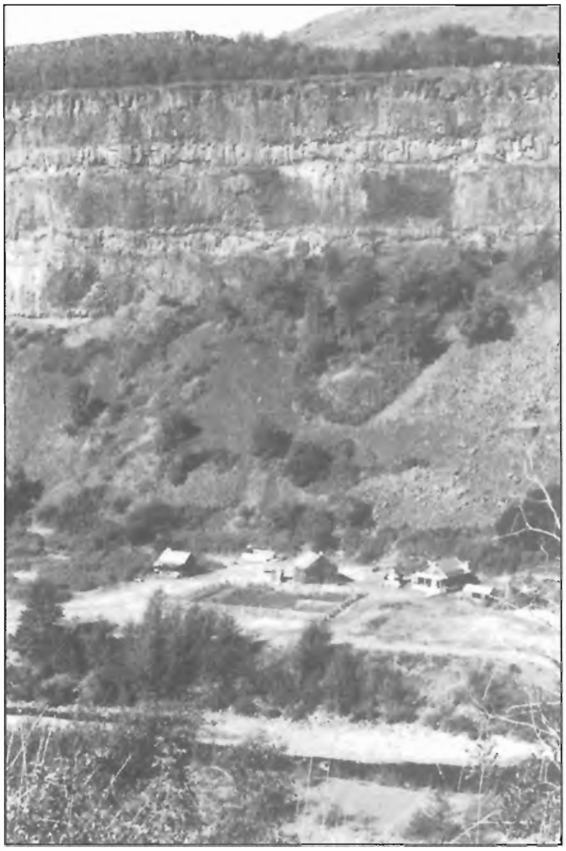


Figure 63. *View northwest over Tahltan to a succession of three Pleistocene lava flows. Note well developed columns along upper and lower surfaces. GSC 1996-125J*

places the lavas rest on coarse, poorly sorted agglomerate and basaltic stream conglomerate which, along Beatty Creek, is underlain by cream-weathering, kaolinized, carbonaceous, flat-lying feldspathic sandstone and pebble conglomerate. On Beatty Creek lake silts locally overlie volcanic conglomerate. Similar conglomerate outcrops along Megatushon Creek on the northeast side of Level Mountain Range (Ostensoe, 1960). The basal lavas consist of massive ankaramite (Hamilton, 1981). These rocks typically contain from 10 to 30% olivine, 15 to 30% augite, and 35 to 50% labradorite. Each of the four major plateau units comprises as many as eight cooling units, each of which is made up of one or more flows. In some places a series of flows, erupted in a short time, cooled as a single unit with pervasive columnar joints. The cooling units are commonly separated by a thin layer of brick red, scoriaceous flow breccia.

Above the widespread basal unit of ankaramite flows, tuff, and agglomerate is another extensive unit of alkali basalt flows, pillow basalt, and plagionite tuff which, at the head of Kakachuya Creek, include a member of comendite, trachyte, and phonolite flows and dykes. The central and highest parts of the Level Mountain Range massif are underlain by alkaline basalt, comendite, rhyolite, trachyte, peralkaline trachyte, and phonolite flows and tuff. Tristanite (intermediate in composition between trachyandesite and trachyte) forms a north-trending belt of dykes and domes on the high ridge 7 km south-southeast of Meszah Peak. The youngest volcanic rocks of the volcano are hawaiite, mugearite, and trachybasalt flows, agglomerate, bombs, and spatter cones. They outcrop on and near Meszah Peak and on the ridges 10 km south-southwest of the peak and 14 km southeast of the peak, respectively (Hamilton, 1981).

Trachytes are the most abundant lithologies in the strato-cone and contain, in decreasing order of abundance, phenocrysts of alkali feldspar, plagioclase, sodic clinopyroxene, fayalitic olivine, aenigmatite, Fe-Ti oxides and, rarely, biotite. Chemical analyses show that many of these rocks contain more than 10% combined K_2O and Na_2O (Hamilton, 1981). The total thickness of volcanic rocks in the central part of the Level Mountain Range may be more than 1000 m. Like the individual volcanic centres to the north on Tanzilla Plateau, the Level Mountain lavas probably were erupted on a mature erosion surface.

The Heart Peaks massif, along the western boundary of the Dease Lake map area is underlain by a succession of alkali basalt flows more than 450 m thick. The rocks probably represent a western extension of the Level Mountain volcanics. At least 25 cooling units, each exhibiting excellent columnar structure, are evident. They are mostly dark grey to black, fine grained, equigranular basalts (Souther, 1971). The units are separated by red-weathering, scoriaceous, flow breccia. The thicker flows are in part porphyritic with honey-yellow labradorite laths up to 0.75 cm across. Thin sections reveal a modal composition of about 50% labradorite, 30% augite, 10% olivine, and 10% basaltic glass, ores, and a trace of opatite (Souther, 1971).

Alkali olivine basalt in several areas south of Kennicott Lake and south of Tahltan River may also be extensions of the Level Mountain volcanic pile. If so, the volcanics could originally have underlain an area of more than 6000 km^2.

Age of Tuya Formation. Potassium-argon, whole rock ages for the Level Mountain volcanics range from 14.9 Ma on ankaramite near the base of the succession to 5.3 Ma on phonolite at Meszah Peak (T. Hamilton, pers. comm., 1984). Basalt flows southeast of Thenatlodi Mountain have been dated by the whole rock, K-Ar method at 4.8 and 5.4 Ma (Read, 1983), and a flow farther southeast, southwest of Beggerlay Creek at 4.3 Ma (Hunt and Roddick, 1992). A small knoll of vesicular basalt on the north side of the southwest end of Cry Lake yielded a K-Ar whole rock age of 0.73 Ma (Hunt and Roddick, 1992). Alkali olivine basalt flows along the Klastline River, forming buttes about 100 m above the valley floor, have been dated by the K-Ar method on whole rock at 0.43 ± 0.15 Ma (Read, 1983). Recent, unglaciated flows which occur locally along Klastline River have been dated by the ^{14}C method on burnt wood at 8610 ± 80 years BP (Read, 1983).

Except for the volcanics on the Klastline River and minor volcanic vents on Level Mountain Range, most of the volcanic edifices in the area have been glaciated. Some edifices near the headwaters of the Teslin River and farther east, however, show little modification by ice movement although they rest directly on strongly grooved surfaces (Fig. 10). They include two typical tuyas which may have been emplaced into an ice sheet during the waning stages of glaciation so that the flat-lying basaltic caps were not significantly modified.

The cones east of Dease Lake are elliptical in shape and oriented parallel with the direction of ice flow. Glacial erratics occur near the summits of many. Johnston (1925) noted the presence of glaciated granitic boulders in well bedded tuff east of Little Eagle River and concluded that volcanism there may have been of early Pleistocene age. Sedimentary and granitic rocks at the base of some of the cinder cones are fresh and unweathered suggesting that the volcanics were erupted on a glaciated surface (Hanson and McNaughton, 1936).

Flows and cinder cones on the Tanzilla Plateau in Dease Lake map area have not been dated but a basalt flow to the north, south of Little Rancheria River in Jennings River map area, has a whole rock, K-Ar age of 4.3 Ma (Hunt and Roddick, 1992). Flows along the Alaska Highway range in age from 0.232 to 0.765 Ma. They are considered to be, in part at least, intra-Pleistocene in age (Klassen, 1987).

STRUCTURAL GEOLOGY

Each terrane in the map areas has a characteristic structural style reflecting not only its particular lithologies but also its peculiar history and environment of deformation. Some of the structures predate the accretion of terranes and are specific to a particular terrane. Most, however, are the result of accretionary and postaccretionary deformations. Folds and thrust faults are typical structures in the well stratified rocks of Ancestral North America. Complex structural imbrication has resulted in the stack of nested thrust sheets comprising the Slide Mountain and Kootenay (?) terranes. The general competency of rocks in Quesnellia is expressed in common homoclinal dips. Intense foliation, fragmentation, and tight folding are observed in the Cache Creek Terrane and the rocks are further complicated by faults which bound blocks of more competent rock types. Moderately to gently dipping thrust sheets are common in sequences underlain by ultramafic rocks. Homoclinal dips are general in Stikinia but block faults have disrupted the continuity of units along the Stikine Arch and thrust faults are locally important.

The three northwest-trending, dextral, transcurrent faults Kechika, Kutcho, and Thibert postdate all but the easterly trending sinistral faults and the folding south of Stikine River in Dease Lake map area. On the other hand, the Klinkit, King Salmon, and Nahlin thrust faults appear to be closely related in origin to deformation in the bordering terranes, presumably the result of terrane amalgamations.

Schematic structural cross-sections of the terranes on a scale of 1:100 000 are included in the pocket (Fig. 64). The following discussion deals with the typical structural styles in more detail.

Ancestral North America

Rocks assigned to Ancestral North America occur in four regional structures. Northeast of Kechika Fault they form the southwest limb of a complicated anticlinorium. Southwest of Kechika Fault is a westward-overturned to recumbent anticline in the hanging wall of a gently dipping thrust fault succeeded to the southwest by a synclinorium continuous with the McDame Synclinorium to the north (Gabrielse, 1963). Southwest of the synclinorium is an anticlinorium occupied mainly by the Cassiar batholith. The westernmost exposures of Ancestral North American strata lie along the southwest limb of this structure.

Northeast of Kechika Fault

Stratigraphic units northeast of the Kechika Fault are commonly steeply dipping and northwest trending. At least locally, along the eastern margin of the main belt of Silurian and Devonian strata, the rocks are slightly overturned to the southwest. In a few places east of the lower reaches of Blue Sheep Creek, complex, tight folds are defined by resistant carbonate beds. Argillaceous beds of the Kechika Formation are strongly cleaved and generally the cleavage is near vertical or steeply inclined to the southwest. Gently dipping carbonate strata north of Major Hart River in the extreme northeast corner of Cry Lake map area are in the same structural domain as those in southeastern McDame map area. They are cut by northwest- and north-trending, steep faults which fragment the competent units into numerous blocks.

Southwest of Kechika Fault and northeast of the Cassiar batholith

Between the Kechika Fault and the southeastern end of the Sylvester Allochthon the structural style is dominated by southwesterly verging folds and related thrust faults. Cleavage is well developed in the argillaceous rocks, particularly those of the Kechika Formation, and generally dips moderately to the northeast. The west flank of the Four Brothers Range is composed of a gently dipping, overturned panel of Upper Proterozoic and Cambrian rocks, the Four Brothers Nappe, in the hanging wall of the Four Brothers Fault (Fig. 64, 65). It is flanked to the southwest by a faulted synclinal region with numerous southwesterly verging folds (Fig. 66, 26). North of Major Hart River the recumbent panel of the Four Brothers Nappe is transitional into a steeply dipping but still overturned succession. On its northeast flank the Four Brothers Nappe is truncated by the Kechika Fault. Silurian and Devonian strata in the synclinal area along the southeast part of the Sylvester Allochthon are cut by numerous southwest-directed thrust faults with displacements of tens of metres (Fig. 67). These faults merge into the basal fault of the allochthon (Harms, 1986). Within about 100 m of the sole fault of the Sylvester Allochthon, well bedded carbonate rocks have been deformed into eastward verging chevron folds with amplitudes of 5 to 10 m (Fig. 68).

Southeast of Blue Sheep Creek the structure is broadly anticlinal and relatively gentle dips predominate. Local relationships, however, suggest that interformational, shallow-dipping faults with hanging walls displaced relatively to the southwest are important (Mansy, 1986). In particular, the base of the Espee Formation is commonly marked

Figure 65.

View to north along the west side of the Four Brothers Range showing the overturned panel of lower Paleozoic strata in the hanging wall of the Four Brothers Fault. Light-weathering rocks in the left distance are part of the Kechika Formation (ЄOK). They are overlain structurally by resistant carbonates of the Rosella Formation (ЄR) above and below forested patch, in turn overlain structurally by resistant quartzite of the Boya Formation, not visible on the far side of the mountain in the right centre of the photograph. GSC 1996-125I

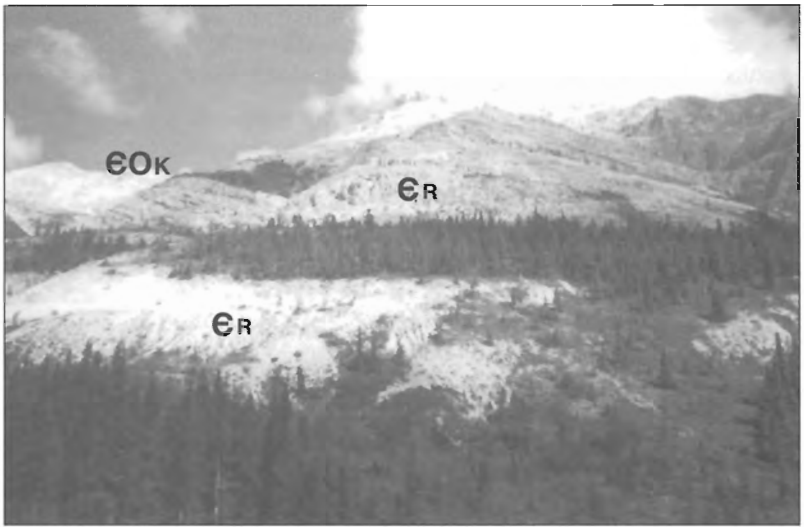
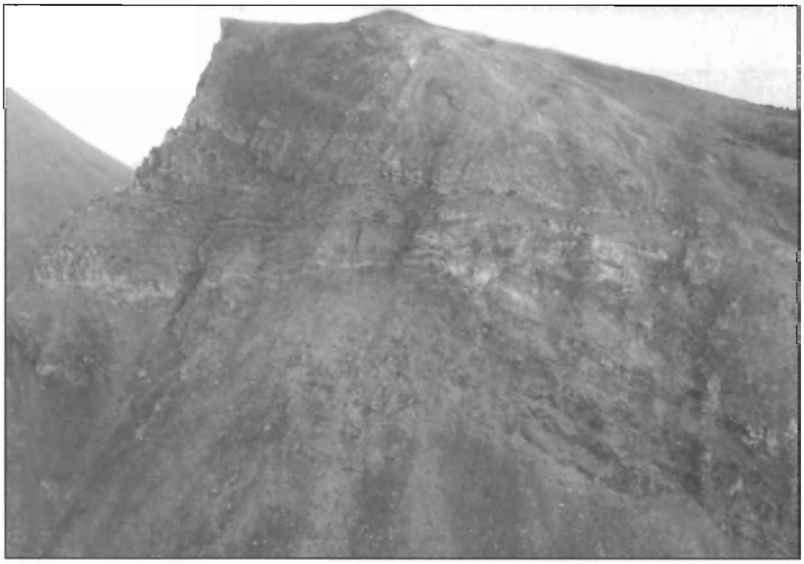


Figure 66.

Westerly verging folds outlined by Ramhorn and McDame formations. View is to north over Major Hart River. GSC 1996-125H

Figure 67.

Ramp in westerly directed thrust fault and related minor faults in strata of the McDame Formation southeast of Major Hart River. The Sylvester Fault is just out of the photo to the right. Photograph by T.A. Harms. GSC 1996-125G



by a fault. Several steeply dipping, northwest-trending faults have been recognized northeast of the Turnagain Pluton but no consistent pattern of displacement has been determined.

South of Turnagain River and west of Cassiar River is a broadly synclinal region much complicated by interformational, thrust and normal faults. In contrast to the areas farther northeast, the map pattern is strongly influenced by easterly directed thrust faults. One important southwest-dipping fault has placed Kechika Formation rocks on the southwest against strata of the Ramhorn Formation on the northeast (Fig. 69). The extent to which the distribution of Kechika and Ramhorn strata are the result of faulting and/or isoclinal folding, however, is not known. A possible continuation on this fault across Turnagain River coincides with an abrupt change in facies of Lower Devonian rocks from fine grained clastics to the west to sandstone and dolomite to the northeast. A few kilometres to the west another west-dipping fault has brought Espee and older strata against younger rocks to the northeast. The fault is assumed to swing west-northwestward near Turnagain River where stratigraphic separation is as much as 1000 m. Farther west the continuation of the structure is obscured by a prong of the Cassiar batholith which may have been emplaced along the locus of a southwest-trending tear fault. To the southeast, strata in the hanging wall of the thrust fault are truncated abruptly by a northeast-trending fault apparently downthrown to the northwest.

Flat to gently dipping faults which truncate underlying units mark the bases of most of the competent formations (Mansy, 1980). Southwest-verging, recumbent folds on scales of from 10 cm to 10 m are abundant and mylonite is common in rocks of the Stelkuz Formation 20 km west of Cassiar River. Incompetent rocks of the Tsaydiz, Stelkuz, Kechika, and Road River successions are disharmonically folded and vary greatly in thickness.

Three phases of deformation can be recognized in the Major Hart and Turnagain River areas (Mansy, 1980). The first, and most important in terms of map expression in the northeastern part of the area, is represented by the southwestward verging folds and related thrust faults. This was followed by the formation of broad synclinoria and anticlinoria,

Figure 68.

View south near the head of Ramhorn Creek to easterly verging kink folds in platy limestone of the upper member of the McDame Formation. Cliffs in upper right are underlain by rocks of the Sylvester Complex. GSC 1996-125F

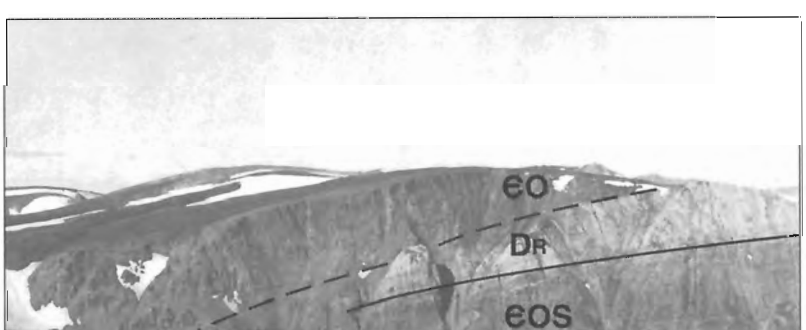


Figure 69.

Easterly directed thrust fault and/or reumbent syncline placing strata of the Kechika Formation (ЄO, dark weathering) and undivided Kechika and Road River formations (ЄOS) above and below Ramhorn Formation DR on ridge 12 km west of the mouth of Cassiar River. Photograph by J.L. Mansy. GSC 1996-125E for example the McDame Synclinorium, and, finally, small-scale kink folding about east-southeast axes. In the enclave within the Cassiar batholith south of Turnagain River, however, northeasterly directed thrust faults are important but their age, other than predating emplacement of the granitic rocks, is uncertain. The structures may have been contemporaneous with the formation of easterly verging folds that occur just below the eastern margin of the Sylvester Allochthon.

Northeast-verging, isoclinal folds are defined by Silurian(?) and Devonian carbonate rocks in the roof pendant southeast of Cry Lake. The folds have amplitudes of as much as 500 m and axial surfaces, parallel with cleavage, that dip moderately to the southwest. A roof pendant northwest of the lake probably has the same structural style as the one noted above but no fold closures have been observed.

Area southwest of the Cassiar batholith

Between Hard Lake and Rainbow Lakes a generally homoclinal succession dips southwestward away from the Cassiar batholith. Folds with amplitudes on a scale of tens of metres have axial surfaces dipping steeply to the southwest and short limbs dipping northeast. They suggest that the homoclinal succession represents the southwest limb of a major anticline. Steeply dipping north-northwest- to north-trending faults offset the strata and fold axes. These structures, which also cut the bordering granitic rocks, do not occur southwest of the Kutcho Fault. One of the faults was examined northeast of Kutcho Creek where a shear zone in granite, 3 to 4 m wide, trends north and has been eroded into a conspicuous gulley. Strong fractures with little alteration are spaced at about 1 cm intervals and are parallel with the trend of the fault zone. Strongly chloritized fractures, concave to the southeast, swing into the zone from the east where they trend a little north of east. The curvilinear fractures extend into the granitic rock for several metres from the main fracture zone.

Eagle River

The structure of the micaceous quartzite along Eagle River is not well understood because of poor exposure. It is clear, however, that the rocks have undergone intense, polyphase deformation. A well developed foliation trends east-southeast and dips gently to the north. Axial surfaces of first phase, tight, in places recumbent, isoclinal folds with amplitudes of up to 1 m are parallel with the foliation. In places, rootless folds and boudinage are prevalent. Second phase folds have axes which trend northwest and plunge gently. These folds are open and have gently dipping limbs. Conjugate sets of kink bands are present locally.

Dease River area

Rocks tentatively assigned to Ancestral North America lie between the Kutcho and Klinkit faults near the northern boundaries of Dease Lake and Cry Lake map areas. The rocks are strongly foliated and, locally, lineated. Southwest of Goathorn Creek, foliations dip consistently to the southwest with dips decreasing generally from steep to moderate towards the Klinkit Fault. Well developed lineation, marked by streaky elongation of chlorite and possibly amphibole trends southeast and plunges between nearly horizontal to about 40°. Northeast of Goathorn Creek, foliation dips mainly steeply to the northeast and lineation plunges southeast from near horizontal along the Kutcho Fault to about 30° farther southwest.

No large scale folds have been recognized in these rocks but local changes in dip and the presence of folds with amplitudes of a few metres and reversals in dips of foliation suggest that the succession is not a simple homocline. Superimposed on the bedding and foliation is a conspicuous fracture pattern which consists of steeply dipping joints and/or faults (Fig. 70). The dominant fractures trend north-northwest at an acute angle to the Kutcho Fault whereas the subordinate ones

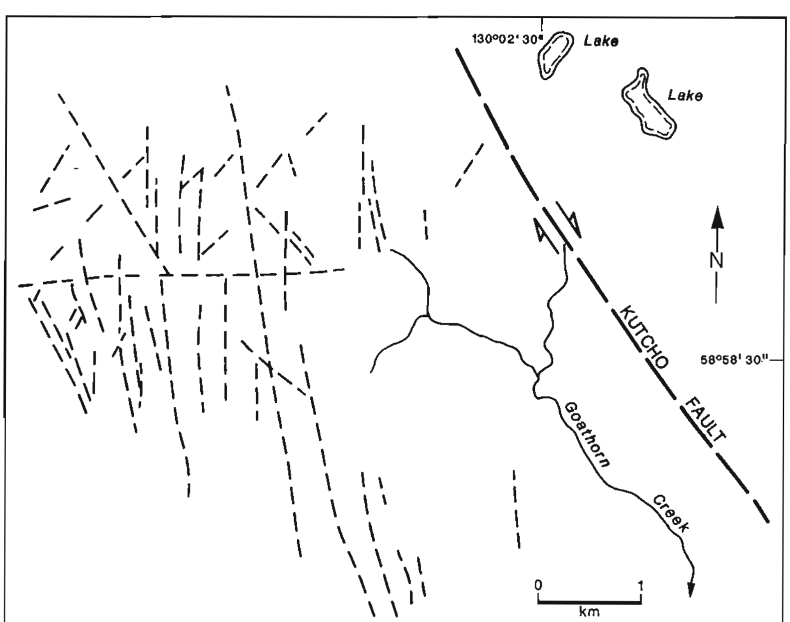


Figure 70.

Clearly defined fracture pattern southwest of the Kutcho Fault and north of Dease River trend northeast and northwest parallel with the fault. Thus, the trend of the dominant fractures bisects the acute angle between the two subordinate sets suggesting that it represents a tensional direction related to north-south compression. If so, the direction of compressive stress could have been generated with dextral movement on the Kutcho Fault.

Slide Mountain and Kootenay terranes

The Sylvester Allochthon is characterized by a nested stack of lithotectonic slices which are bounded by subhorizontal, layer-parallel faults (Harms, 1986; Harms et al., 1988). The slices are tabular and lensoidal and range in thickness from a few hundred metres to more than 2000 m and in length from several kilometres to as much as 30 km. The base of the allochthon is a broadly synclinal, gently dipping surface (Sylvester Fault) on which the Sylvester rocks have been emplaced onto Ancestral North America (Fig. 71). Various criteria define the positions of faults within the allochthon. Some are marked by serpentinite lenses and zones of foliated rocks. Others have classic older over younger stratigraphic relationships with easily recognized associated drag folds as, for example, the fault which juxtaposes Pennsylvanian and Permian strata along the northern boundary of the Cry Lake map area northwest of Rapid River. Finally, some faults have little structural expression but are indicated by stratigraphic successions in which units spanning two or three geological periods are repeated in upright sections.

Bedding in argillaceous rocks has been generally transposed by ubiquitous cleavage; pencil cleavage, resulting from intersecting cleavages, is common (Harms, 1986; Fig. 72). Banded chert is commonly crumpled and, in places, forms spectacular fold train with amplitudes of 2 to 10 m. A salmon-pink and green chert member at the base of the allochthon south of Major Hart River is tightly folded into nearly isoclinal, recumbent folds with amplitudes of up to 75 m (Fig. 73). In some places mullions are well developed. No consistent vergence of small scale structures has been recognized although cleavage dominantly tends northwest and is subvertical (Fig. 72). One or more units of siliceous tectonite are strongly foliated and weakly lineated (Fig. 30). Locally, the rocks have a mylonitic fabric. Their deformation is significantly more penetrative and ductile than that in other units, probably resulting from a period of tectonism and metamorphism independent in time and place from that which affected most of the Sylvester Complex.

The basal fault of the Sylvester Allochthon (Sylvester Fault) shows remarkably little expression on outcrop scale. Commonly it marks a distinct break in structural style between units above and below. Harms (1986) noted a pronounced, streaky, northeast-trending lineation locally in carbonate rocks of the footwall. South of Major Hart River northeast-verging chevron folds have been superimposed on regional southwest-verging folds in the footwall near the base of the allochthon. The Sylvester Fault serves as the roof fault of minor, west-verging thrust faults around the southeastern end of the allochthon.

Quesnellia

Structural styles in Quesnellia reflect contrasting competencies of sedimentary and volcanic rocks and the various ages of granitic rocks. Well bedded, sedimentary rocks of the Nazcha Formation possess a well developed cleavage which commonly dips vertically or steeply to the southwest (Fig. 74). Bedding dips uniformly and moderately to the southwest except on the northeast limbs of folds. The only significant fold observed is exposed on the east flank of Mount Defot. It has an amplitude of tens of metres and a chevron form with the long limb dipping southwest, suggesting it is a drag fold on the southwest limb of an anticline.

Volcanic rocks of the Shonektaw Formation are generally weakly foliated except in the hanging wall of the Klinkit Fault, near Kutcho Fault and along several strong shear zones. On the northwest slope of Northwest Mountain tuffaceous strata are intensely foliated. The foliation surfaces dip gently to moderately south-southwest and contain a fine lineation which plunges between 5° and 35° southeast. Southeast of Pyramid Mountain highly sheared augite porphyry has a steeply dipping to vertical foliation and gently dipping

Figure 71.

View to north-northwest from ridge directly south of Blue Sheep Lake to south end of the Sylvester Allochthon (dark-weathering rocks) resting on Devonian carbonate strata of Ancestral North America. The Sylvester Fault follows a recessive, dark-weathering, thin unit of Earn Group clastics which overlie the carbonates. GSC 1996-125D lineation parallel with the Kutcho Fault. Northeast of the Kutcho Fault and south of Grey and Hottah lakes, volcanics of the Shonektaw Formation are relatively massive and blocky weathering. About 15 km southeast of Hottah Lake in Kechika map area similar rocks have a steeply dipping, west-northwest-trending foliation.

Late Triassic plutons have a pronounced foliation associated, in many cases, with cataclastic structure. In particular, granitic rocks of presumed Late Triassic age between Canyon Creek and east of Slough Mountain to Dease Lake are strongly sheared. Generally, the foliation dips moderately to steeply and trends northwest but many exceptions occur.

The Early Jurassic Eaglehead Pluton southeast of Eaglehead Lake is, for the most part, unfoliated except along its faulted, southwestern contact. There, the rocks range from mildly foliated to schistose and mylonitic with abundant evidence of cataclasis. Foliation surfaces dip steeply and trend roughly parallel with the contact. Hornfelsed strata of the Kutcho Formation to the southwest suggest the possibility that strike-slip movement along the fault zone was not great. On the other hand, it is possible that the metamorphic rocks were related to another pluton far to the southeast and subsequently displaced from that pluton along a dextral fault.

Middle Jurassic(?) plutons are foliated only locally adjacent to shear zones and mid-Cretaceous granitic rocks are nonfoliated. In this respect they contrast to the markedly foliated, Late Triassic plutons.

The granitic rocks and volcanic rocks are strongly sheared and, in places, altered along east-trending, subvertical fault zones. One of these zones, the Beady Range Fault east of the Beady Range and Eagle River, is the locus of an apparent sinistral offset. Lineations on the east-trending vertical foliation indicate that the latest movement was south-side-up steeply to the east. Along Eagle River strongly foliated, and locally mylonitic, granitic rocks structurally overlie metamorphosed clastic rocks assigned to Ancestral North America along their northeastern contact. Near the contact, foliation in both assemblages dips gently to moderately northeast. The southwestern contact of the metasedimentary rocks is so poorly exposed that the relationships with Quesnellia rocks could not be determined. It is possible that the Ancestral North American assemblage is an inlier beneath an overthrust sheet of volcanic and granitic rocks.

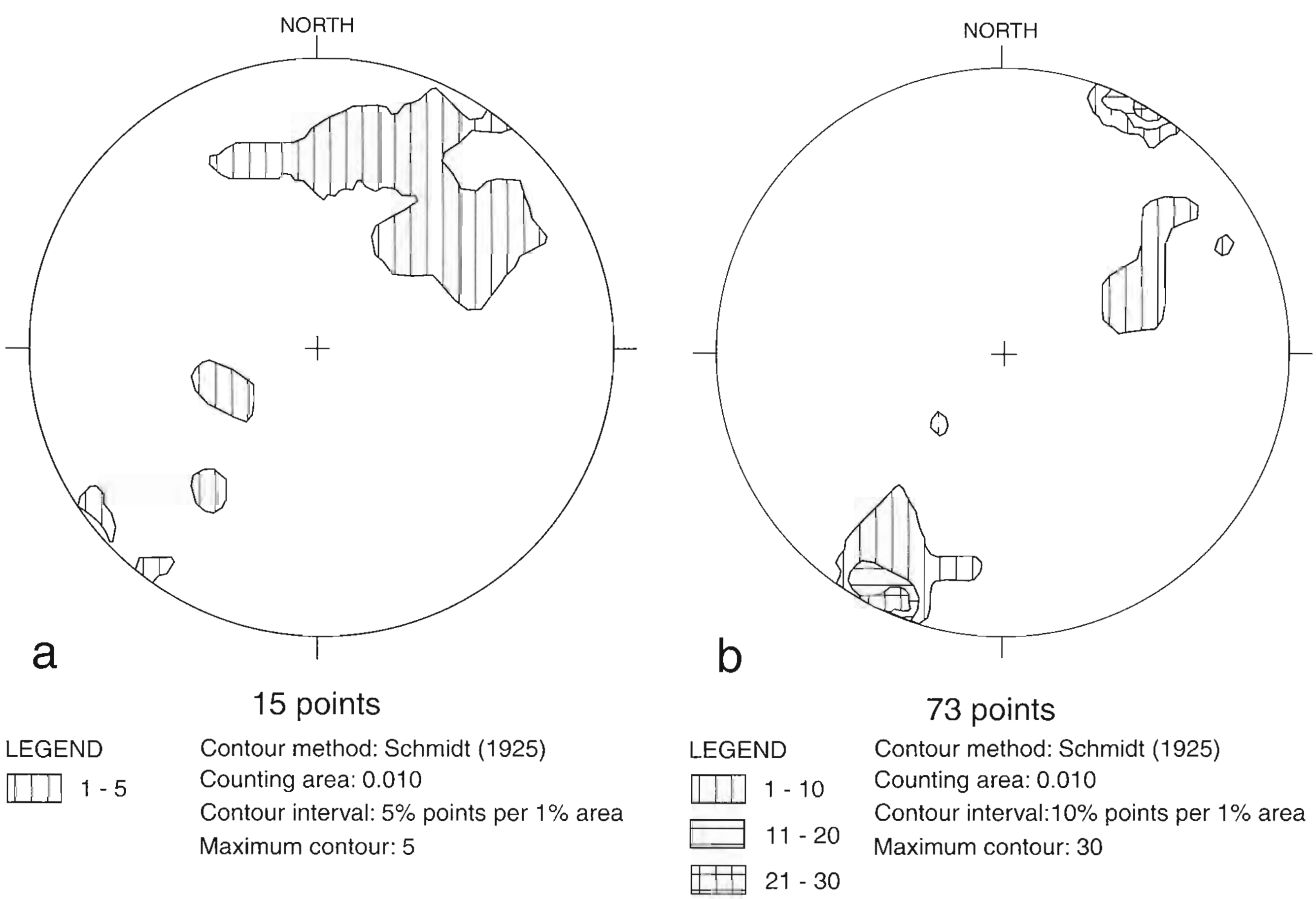


Figure 72. *Plots of poles to* ***a)*** *bedding and* ***b)*** *cleavage attitudes in rocks of the Sylvester Complex.*

Figure 73.

Folded chert of Pennsylvanian age at base of Sylvester Allochthon 2.5 km southeast of Major Hart River. Exposure is about 10 m high. GSC 1996-125C

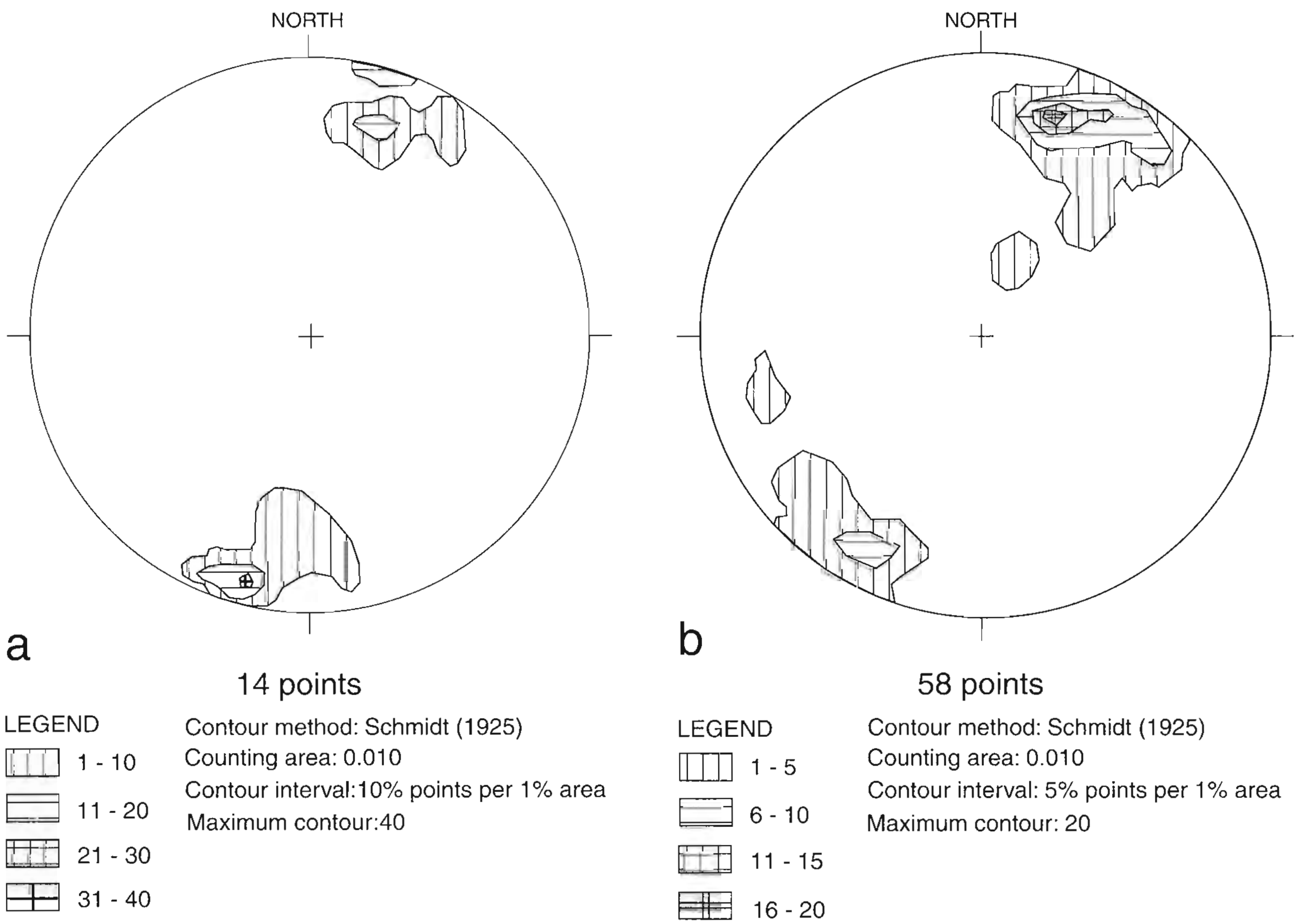


Figure 74. *Plots of poles to* ***a)*** *bedding and* ***b)*** *cleavage attitudes in rocks of Quesnellia northwest of Dease River.*

Terrane of undefined affinity northeast of Kutcho Fault

Upper Paleozoic and or Triassic rocks of doubtful terrane assignment northeast of Kutcho Fault and southeast of Turnagain River are structurally complex. They are tightly folded and strongly cleaved. Poles to bedding form a north-northeasterly trending girdle with no obvious concentration of dip directions, whereas cleavage trends uniformly northwest and commonly dips steeply southwest (Fig. 75). In many exposures the rocks show a well defined lineation plunging gently to the northwest (Fig. 75). These rocks structurally overlie strata assigned to Ancestral North America but no fault between the two assemblages could be defined.

Cache Creek Terrane

Structural styles in Cache Creek rocks can be best observed in the French Range (Monger, 1969), between Nahlin and King Salmon faults southeast of Dome Mountain (Thorstad and Gabrielse, 1986) and between Nahlin and Kutcho faults southeast of Little Eagle River. Continuous exposures revealing structures in the Inklin Formation are also well exposed along the canyon of the Dudidontu River.

In the French Range an early deformation accompanied by regional metamorphism resulted in bedding parallel foliation and isoclinal folds (Monger, 1969; Fig. 76). Clasts in pyroclastic rocks have been markedly flattened and, commonly, muscovite and chlorite have been strongly segregated in phyllites. The presence of minerals including crossite and lawsonite, indicate that the early deformation and metamorphism took place in a low temperature, high pressure environment. A later deformation, reflected in the present distribution of map units, is characterized by the development of irregular, northwest-trending folds and steep faults. The folds generally have horizontal fold axes trending N70°W and N55°W. Minor folds are irregular and asymmetrical and their form suggests a general sense of vergence towards the southwest.

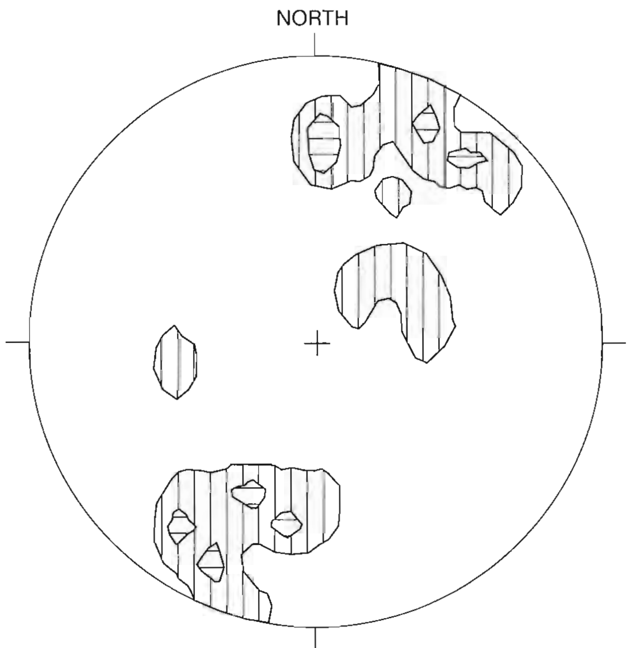
Near the south end of Dease Lake northeast-trending faults are roughly parallel with faults along the Tanzilla River farther southwest. One of these faults, northwest of Swinton Lake, has effected a well documented sinistral offset of the Nahlin Fault of about 3 km. Tight, steeply plunging folds occur along the southeast side of the structure.

Well exposed strata of the Inklin Formation southeast of Dome Mountain have been folded into structures along both westerly and northerly trending axes which locally plunge as much as 35° northerly. A strong axial plane foliation, generally dipping moderately to steeply north, accompanies the dominant, westerly trending folds which have amplitudes of as much as 100 m (Fig. 77). Typically, the southern limb of these folds is steeply dipping to the south or overturned whereas the northern limb is generally shallow dipping. Interference of the two fold trends results in distinct dome-and-basin structures.

Conglomerate in the Inklin Formation shows a marked change in structural style southward from Dome Mountain to the King Salmon Fault. On Dome Mountain, poorly sorted conglomerate containing angular to subangular pebbles and cobbles of limestone, slate, quartz-feldspar porphyry, and volcanic rock show little preferred orientation of the clasts except for a general elongation parallel with bedding. In the Squaw Creek area, near the headwaters of Zuback Creek and northeast of Settea Creek, however, clasts have been greatly flattened and elongated (Fig. 49, 50). In these areas buff- and brown-weathering conglomerate in exposures up to 18 m thick contain pebbles and cobbles of limestone, quartz feldspar porphyry, and porphyritic volcanic rocks ranging from less than a centimetre to as much as 65 cm long in a highly sheared, calcareous and sericitic greywacke matrix (Godwin, 1962). The fragments in these rocks are typically ellipsoidal and have been flattened parallel with the dip of the beds; most are elongate down dip. The common orientation of pebbles and cobbles, therefore, is that with the minor axes perpendicular to the dip, the intermediate axes parallel with the foliation, and the long axes parallel with the dip. One polished specimen shows sericitic cleavage diverging about a feldspar porphyry cobble with conjugate calcite filled fractures which are 2 to 3 mm wide and subtend an average angle of about 33° to the major axis of the cobble. Less competent limestone wraps around the quartz feldspar porphyry cobble. One ellipsoidal, feldspar quartz porphyry cobble, about 65 cm long, is traversed by parallel fractures along which there have been offsets of as much as 2.5 cm in the direction of the long axis. The fractures, which are slickensided, subtend an angle of about 35° to the plane containing the major and intermediated ellipsoidal axes. In all cases it is evident that the matrix has been intensely strained and has flowed around the fragments. Tentatively, it is assumed that the strong deformation of the conglomerate in these rocks has resulted from intense shearing related to southerly directed thrust movement along the King Salmon Fault.

Farther southeast, in the Kutcho Creek area, deformation has been much more severe with a marked increase in fold amplitude and a concomitant decrease in wave length (Thorstad and Gabrielse, 1986). Cleavage is strongly developed and, commonly, steeply dipping to the southwest (Fig. 78). East of Kutcho Creek outcrops of Sinwa Formation limestone define a large, south vergent, west-plunging anticline with smaller parasitic folds on its southern limb. Strong, axial plane cleavage dips steeply north but flattens somewhat near the sole of the King Salmon thrust fault. Near the fault, limestone of the Sinwa Formation is isoclinally folded with axial surfaces dipping moderately north to northeast (Fig. 46, 79). Flattened clasts of volcanics in the Kutcho Formation and of limestone in the Inklin Formation are ubiquitous. Thin sections of the volcanic clasts indicate extreme cataclasis with the development of augen-shaped quartz and feldspar crystals in a comminuted matrix.

Southeast of Little Eagle River, between Nahlin and Kutcho faults, the structure of Cache Creek rocks is exceedingly complex. Most contacts between mappable geological units are faults and marker horizons are rare or so discontinuous that they give little clue to structural style. The most



a

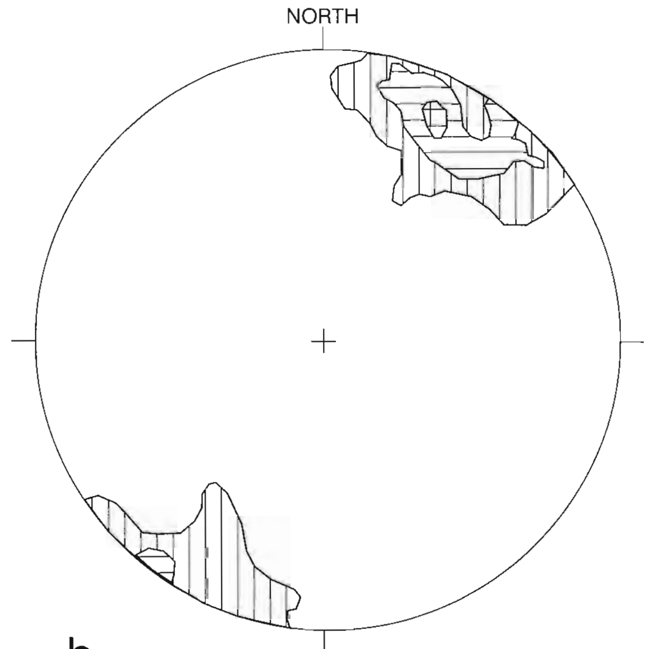
21 points

LEGEND

1 - 5

6 - 10

Contour method: Schmidt (1925)
Counting area: 0.010
Contour interval: 5% points per 1% area
Maximum contour: 10



b

69 points

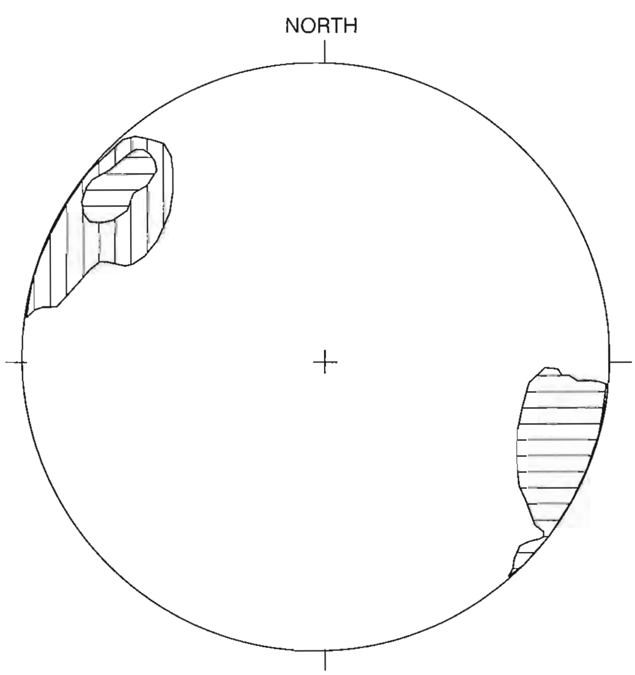
LEGEND

1 - 5

6 - 10

11 - 15

Contour method: Schmidt (1925)
Counting area: 0.010
Contour interval: 5% points per 1% area
Maximum contour: 15



c

21 points

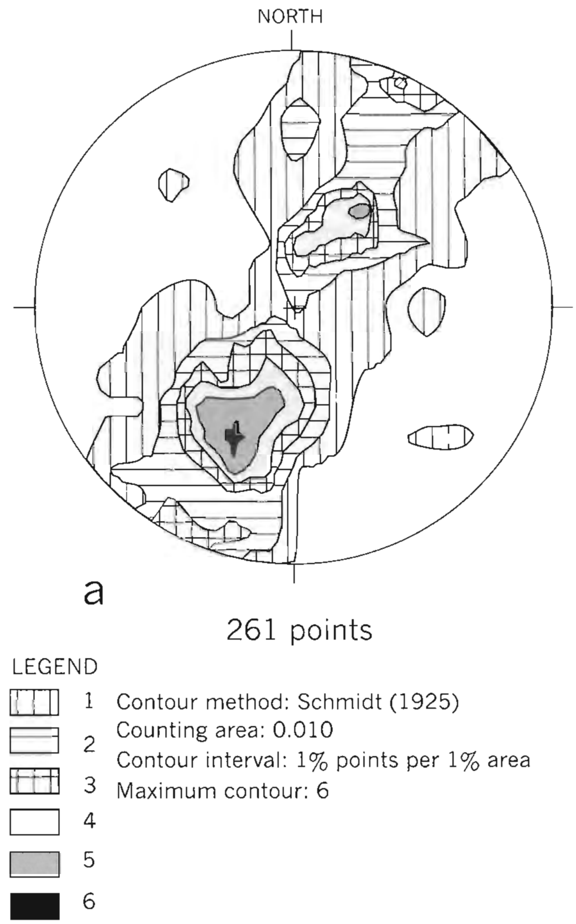
LEGEND

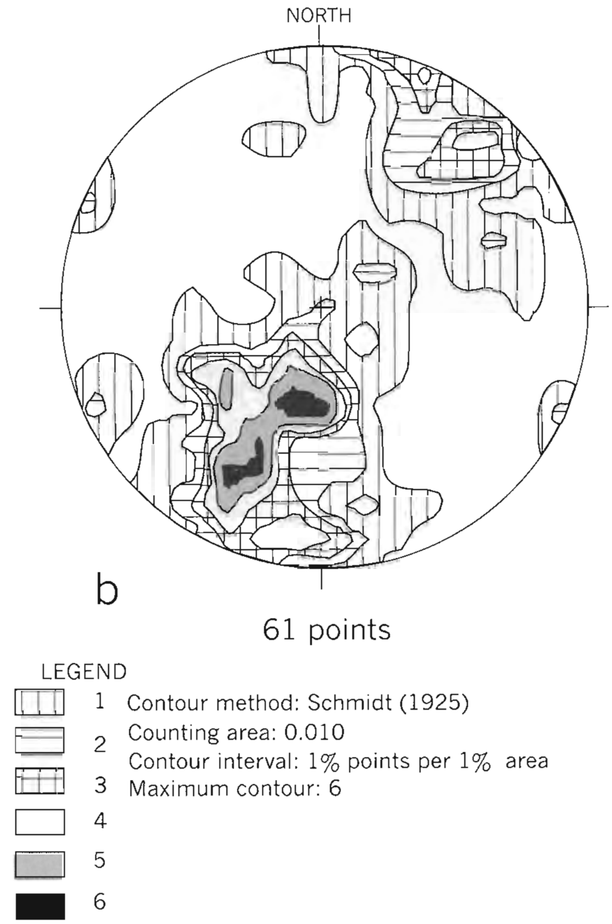
1 - 5

6 - 20

Contour method: Schmidt (1925)
Counting area: 0.010
Contour interval: 5% points per 1% area
Maximum contour: 20

Figure 75. *Plots of poles to **a)** bedding and **b)** cleavage, and **c)** lineation in rocks of uncertain terrane affinity northeast of Kutcho Fault and southeast of Turnagain River. Lineations are mainly fold axes on minor folds and crenulations.*





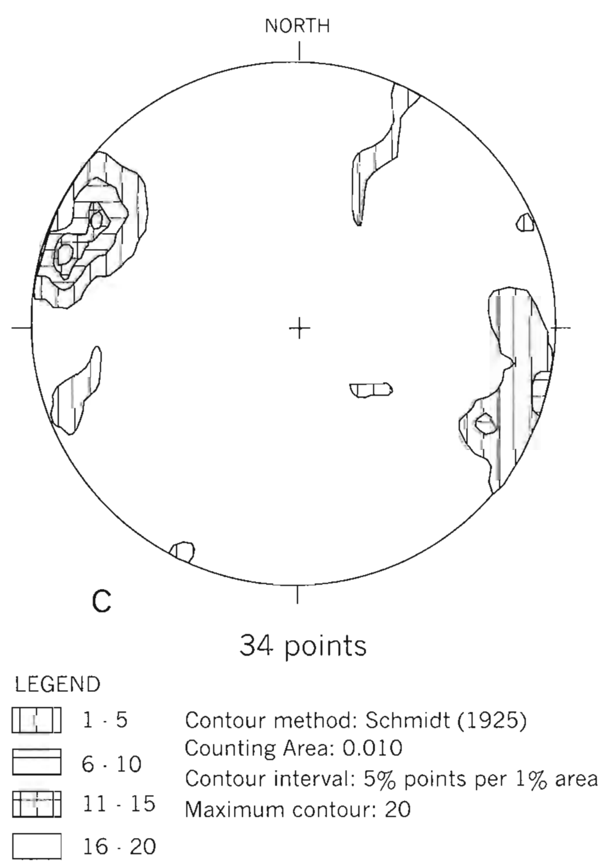


***Figure 76.** Plots of poles to **a)** bedding, and **b)** cleavage, and **c)** lineation in rocks of the Cache Creek Complex west of Dease Lake. Lineations are dominantly fold axes of minor crenulations.*

obvious large scale structures are gently dipping faults which bound ultramafic bodies. They are marked by the development of fish-scale serpentinite and zones of listwanite.

The structural style of the Cache Creek Complex with its gentle to moderately dipping ultramafic slices between Eaglehead and Nahlin faults, coupled with the general southwesterly facing of the Inklin and Kutcho formations northeast of Eaglehead Fault, suggests that the Eaglehead Fault intersects the Nahlin Fault near and southeast of Eaglehead Lake with relative uplift of rocks to the southwest. Thus the Nahlin Fault could represent the sole fault of an allochthon which closes to the northwest near the Little Eagle Pluton. The Eaglehead Fault could be a splay off the Thibert Fault. If so, lateral displacement may not have been large because the Inklin, Sinwa, and Kutcho formation rocks northeast of the fault more closely resemble those directly to the south in the footwall of the Nahlin Fault than those in the Kutcho Creek area to the southeast.

Locally, for example east of Serpentine Lake, isoclinal folds are outlined by a limestone unit. Small scale structures are abundant and include at least two intersecting sets of cleavages, refolded isoclinal folds, and recrystallization of limestone units. As in the French Range, the earlier cleavage is mainly parallel with bedding surfaces and probably axial planar to the minor isoclinal folds. The latest cleavage is pervasive and similar to the one that involves rocks of the Inklin and Kutcho formations. Rootless, isoclinal folds are common in cherty, phyllitic rocks and along with pod-shaped bodies of competent rocks suggests intense boudinaging of the Cache Creek Complex. A conspicuous limestone member 10 km southeast of Little Eagle Pluton consists almost entirely of strongly oriented, fibrous to coarsely acicular crystals of calcite. A similar texture was noted in limestone north of the Nahlin Fault just east of Highway 37 and, locally, along Metahag Creek east of Nuthinaw Mountain. In localities east of Dease Lake the elongation of crystals seems to be essentially perpendicular to bedding.

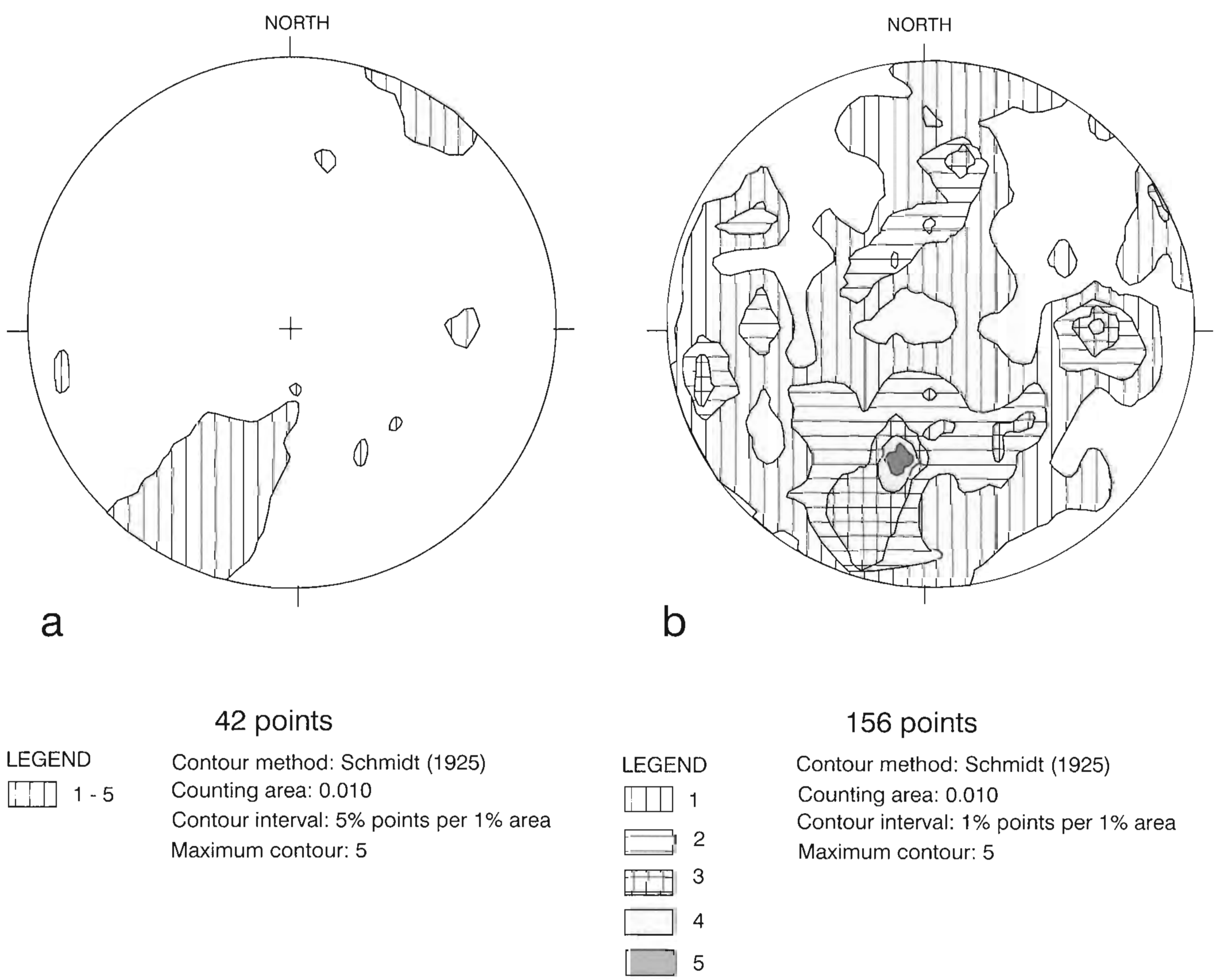
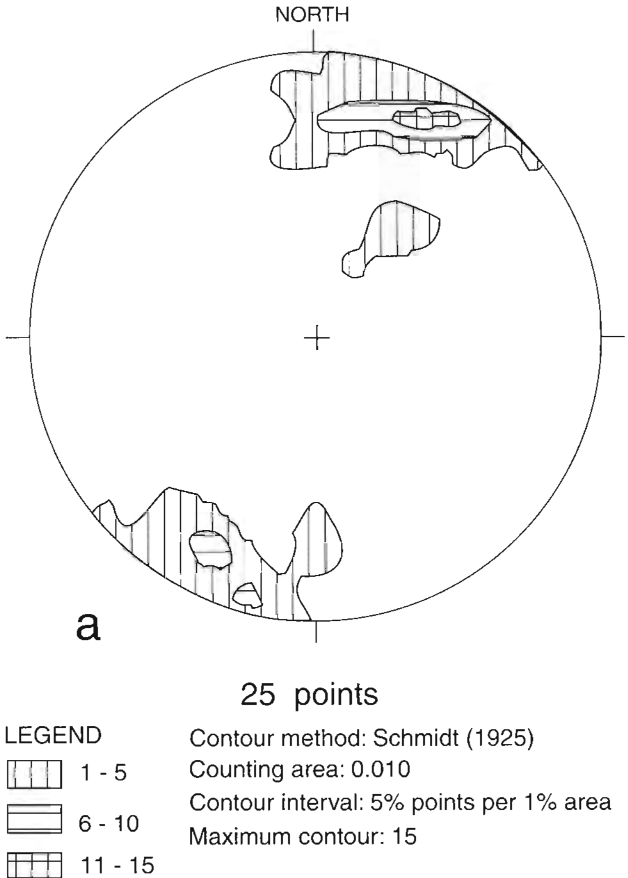
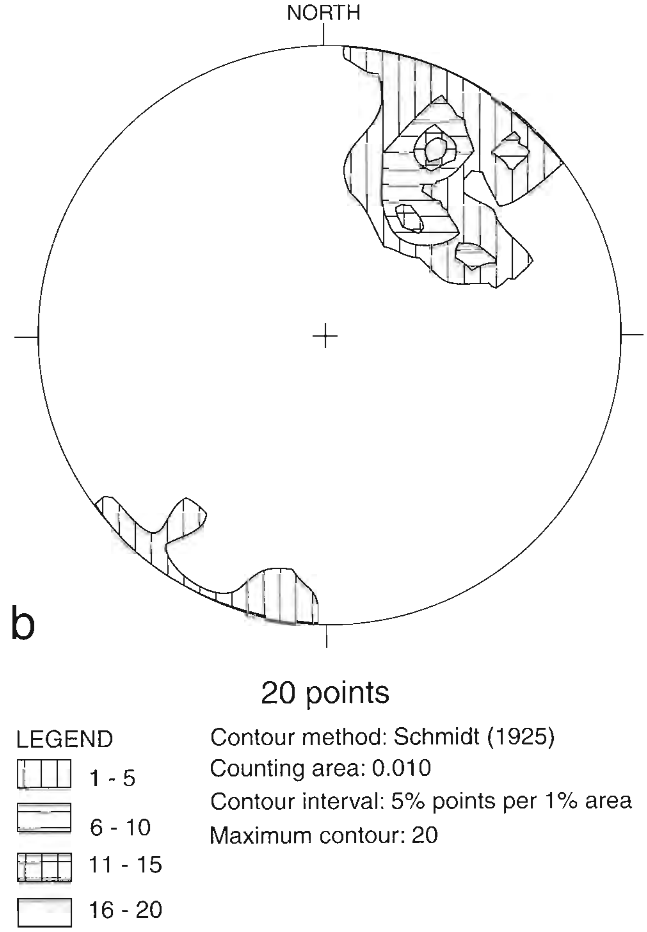


Figure 77. *Plots of poles to **a)** bedding, and **b)** cleavage in strata of the Inklin Formation between Dease Lake and Turnagain Lake.*





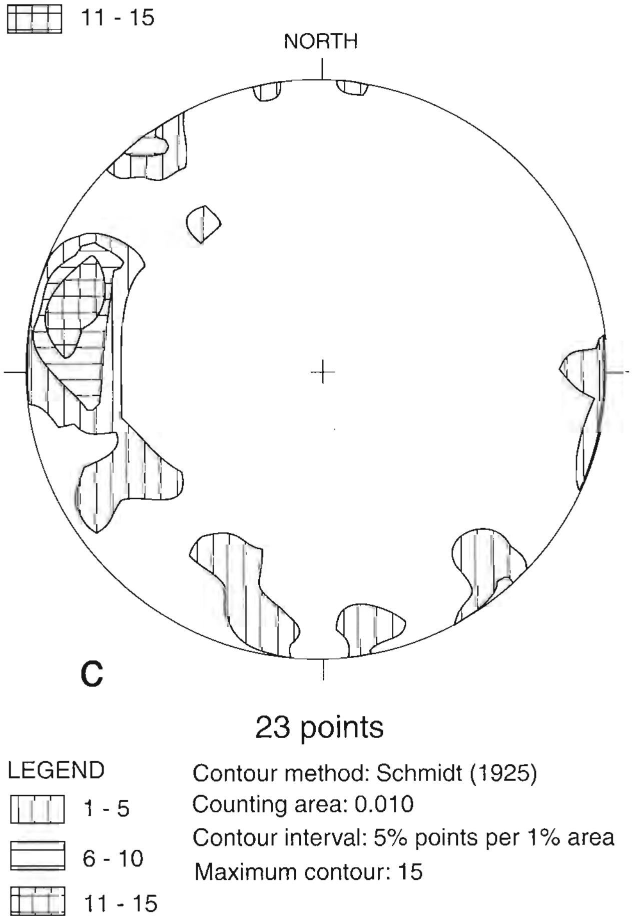


***Figure 78.** Plots of poles to **a)** bedding, and **b)** cleavage, and **c)** lineation in rocks of the Cache Creek Complex southeast of Dease Lake. Lineations are mainly axes of minor folds and crenulations.*

Figure 79.

Limestone of the Sinwa Formation in the hanging wall of the King Salmon Fault southeast of Wade Lake. The structural base of the limestone in this area is marked by rusty-weathering, limestone breccia. GSC 1996-125B

Inklin strata exposed along the deep gorge of Dudidontu River have been chevron folded and cut by numerous faults. One large and one small ultramafic body east of the river may be klippen related to the Nahlin Fault. To the southeast, near the headwaters of Little Dease Creek, Inklin Formation strata are much more penetratively foliated resulting in a well defined, uniformly northerly dipping cleavage (Fig. 80).

Stikinia

Structural styles in Stikinia in western Dease Lake map area are poorly understood, not only because of the reconnaissance nature of the mapping, but also because of the widespread distribution of massive volcanic and plutonic rocks. Permian carbonate strata along the western border of the map area west of Sheslay River are folded along northerly and north-northeasterly trends, a continuation of the structures mapped in Tulsequah map area (Souther, 1971). Just to the east, on either side of Sheslay River, similar rocks are exposed in a east-northeast- to east-trending anticline. Farther north, rocks of the Stuhini and Takwahoni formations are moderately to steeply dipping, commonly to the north.

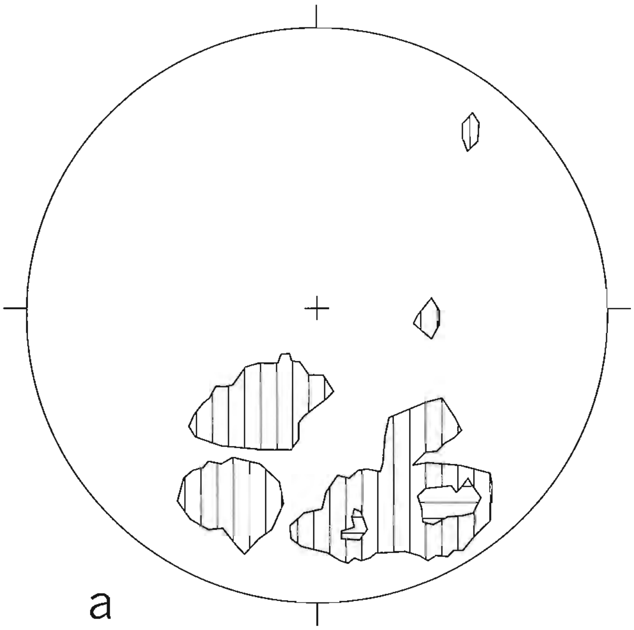
East of Tuya River and northwest of Tanzilla River greywacke and shale of the Takwahoni Formation generally dip moderately to steeply northeast and display a distinct northeasterly dipping cleavage (Fig. 81). Trends are parallel with the trace of the King Salmon Fault. These structures appear to be cut by a set of northeasterly trending faults which parallel Tanzilla River and are well exposed southeast of the river (Read, 1983).

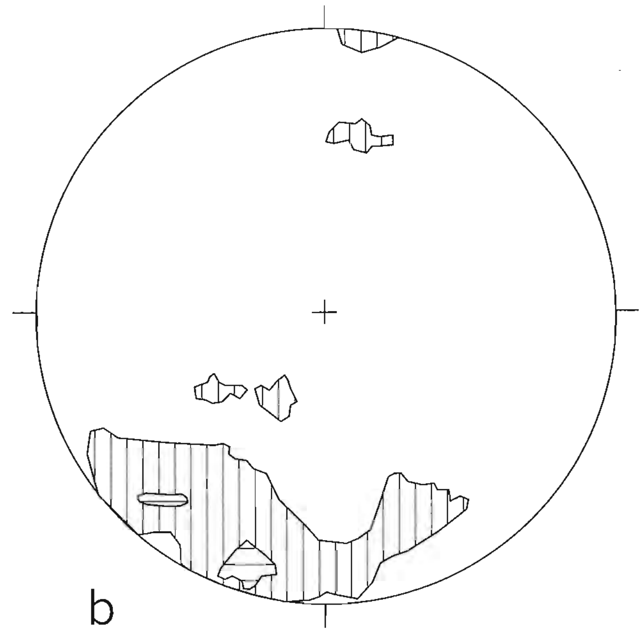
The best exposed folds southeast of Tanzilla and Stikine rivers occur on Mount Meehaus. There, a northwest-trending anticline and adjoining syncline in the Sustut Group have a wave length of about 1 km and an amplitude of more than 150 m. The beds are moderately dipping and on the southwest have been clearly deflected around the Meehaus Pluton. Evenchick (1991) has suggested that these structures represent a northeastern expression of the Skeena fold belt which dominates the structural style in the Bowser Basin to the south. Elsewhere, in the Stikine-Tanzilla region, fairly open folds commonly trend northeast.

Several faults southeast of Tanzilla River parallel the river. The Bend and West faults appear to be normal faults downdropped to the northwest. They bound Eocene sediments including fanglomerates derived from the fault scarps. The Tanzilla Fault, on the other hand, seems to be a folded thrust fault (Read, 1983). Another folded thrust fault is exposed along Stikine River about 2 km west of the south end of the Blamey Fault. It dips very gently and on the south side of the river is truncated by late Lower Cretaceous Tango Creek Formation. Some steep faults, like the Junction and Creek faults, which trend northwest, are interpreted as being dextral whereas the Meehaus Fault, which trends northeast, appears to have had sinistral movement along it.

North and northeast of the Hotailuh batholith, volcanic and lesser sedimentary rocks of the Stuhini Formation dip gently to moderately north to northeast. The overlying sedimentary strata of the Takwahoni Formation have been deformed into open to tight folds roughly parallel with the trace of the King Salmon Fault (Fig. 81). These structures are well exposed on the mountain 7 km west of Turnagain Lake and have been documented by detailed mapping in the mountains southwest of Wade Lake.

The Hotailuh Fault is a south-southwestward directed thrust fault which crosses Highway 37 about 1.5 km north of Lower Gnat Lake. Farther east the fault is separated from the Hotailuh batholith by a narrow belt of Lower Jurassic (Toarcian/Pliensbachian) strata which, in turn, unconformably overlie the batholith. The fault is truncated by the Three Sisters Pluton but its probable continuation appears to the southeast west of McBride River. If this is so, the emplacement of the Three Sisters Pluton may have been responsible for doming the structure. East of McBride River it may be represented by the Kehlechoa Fault which bounds the north side of Bowser Lake Group strata although this would necessitate a marked upward cutting of the fault in the hanging wall. The





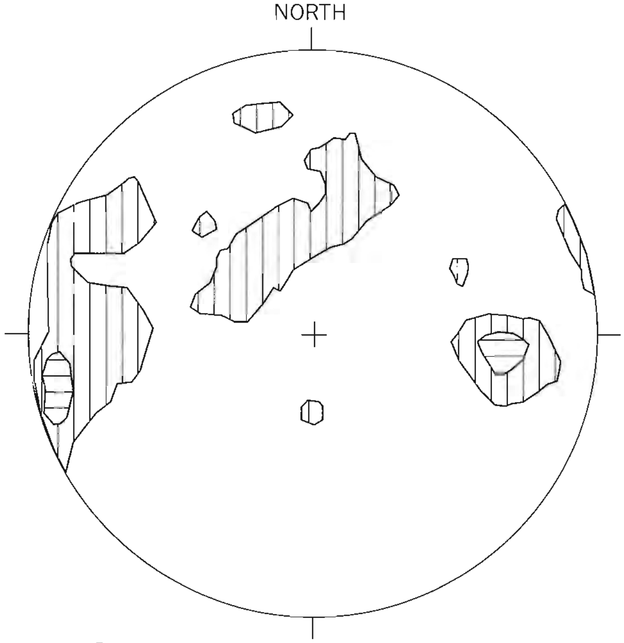


Figure 80. *Plots of* ***a)*** *bedding,* ***b)*** *cleavage, and* ***c)*** *lineation in strata of the Inklin Formation west of Dease Lake. Lineations include cleavage and bedding intersections and axes of minor folds and crenulations.*

Hotailuh Fault cannot be traced west of the Gnat Pass Fault, a northwest-trending structure with relative uplift on its southwest side. Whether this apparent displacement is the result of dextral movement or of normal faulting is not known. Along the west side of the Cake Hill Pluton and the east side of the Gnat Lakes ultramafic body, rocks have been intensely sheared. The fault has been cut by the Three Sisters Pluton but probably continues to the south along the west side of the Cake Hill Pluton east of the lower reaches of Tees Creek. The Gnat Pass Fault projects to the north towards the south end of Dease Lake where it cuts the northeasterly trending belt of Stuhini volcanic rocks.

Several low angle thrust faults directed south-southwest cut Lower Jurassic strata southwest of Wade Lake. South-southeast of Wade Lake a klippe is floored by coarsely crystalline marble, presumably of the Sinwa Formation. Crystals in the carbonate are as much as 10 cm long. Overlying rocks of the Inklin Formation are cut by a pervasive cleavage dipping about 25-35° north and are, in places, overturned to the south.

A northeast-trending, steep fault juxtaposes volcanic rocks of the Stuhini Group with Lower Jurassic volcanics southeast of the McBride Pluton. Its extension to the northeast could account for the apparent difference in structural level between Lower Jurassic Takwahoni rocks to the west and the klippe to the east. Strata of the Bowser Lake Group occur in open, east-northeast-trending folds south of the King Salmon Fault. Their southern limit is marked by the Pitman Fault lying along a regional lineament which can be followed west almost to the north end of the Mount Edziza volcanic complex in Telegraph Creek map area (Souther, 1992a) and east to beyond Frog River in southern Kechika map area, a distance of more then 175 km. In the Kechika map area the fault shows a sinistral offset of about 4 km but the amount of vertical movement is not known. Along Pitman River in Cry Lake map area, rocks to the south may have been relatively uplifted but, alternatively, the apparent difference in structural level could have resulted from deep pre-Bowser erosion.

Regional faults

A number of important regional faults traverse Dease Lake and Cry Lake map areas. They are important in separating regions of contrasting stratigraphy and structural style. Kutcho, Thibert, and King Salmon faults are terrane-bounding structures. Nahlin Fault separates distinctly different assemblages in the Cache Creek Terrane. Kechika Fault juxtaposes regions of different facies in Ancestral North America.

Kechika Fault can be traced from near the northwest corner of McDame map area southeastward through Cry Lake and Kechika map areas and into Toodoggone map area where

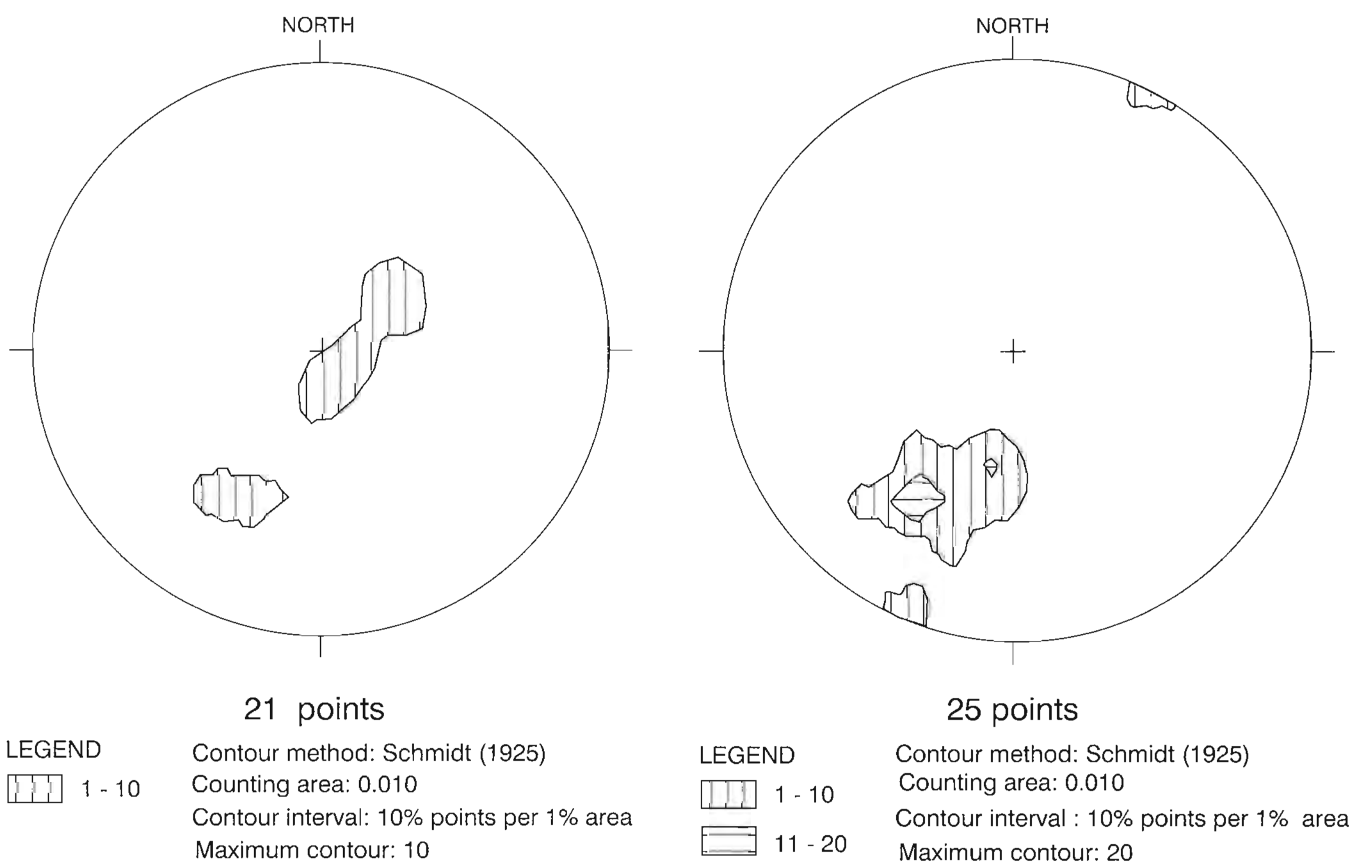


Figure 81. *Plots of poles to bedding in the Takwahoni Formation **a)** west and **b)** east of Dease Lake. GSC 1996-125A*

it joins the Northern Rocky Mountain Trench. It is assumed to be a dextral transcurrent fault with displacement of as much as 280 km (Gabrielse, 1985; Evenchick, 1988). The fault is not exposed in Cry Lake map area but its effect on the geology is obvious. As in areas to the northwest and southeast the fault is marked by the occurrence of Eocene volcanic and sedimentary rocks. Great stratigraphic separation across the fault is demonstrated by the occurrence of Upper Devonian/ Mississippian strata on the northeast and Upper Proterozoic strata on the southwest. Lower Silurian carbonates of the Sandpile Formation northeast of the structure are replaced by graptolitic rocks of the Road River Formation to the southwest.

Kutcho Fault diagonally bisects Cry Lake map area from northwest to southeast. In the southeast it sharply truncates easterly trending structures of strata in Stikinia, Quesnellia, and the Cache Creek Terrane. Farther northwest it separates Quesnellian rocks from the Cassiar batholith and a wedge of rocks which, in part, is of Ancestral North American affinity and, in part, of uncertain terrane affinity. In the northwestern corner of Cry Lake map area it marks the contact between the Cassiar batholith and assumed Ancestral North American rocks to the southwest.

In southeast Cry Lake map area Kutcho Fault lies in a drift-filled valley but its continuation in Kechika map area to the southeast is documented by a broad zone of highly sheared and rust stained granitic rocks along the southwest side of an extensive Early Jurassic granodiorite pluton. East of Kutcho Creek the fault lies along a zone of carbonatized ultramafic rocks and strongly fractured granodiorite. From Kutcho Creek northwest to near Eagle River, Kutcho Fault lies in broad valleys. Near Eagle River it is offset about 5 km by the Beady Range sinistral fault. Northwest and southeast of the Beady Range Fault, Kutcho Fault is well exposed and is characterized by steeply dipping foliation, horizontal to gently plunging stretching lineation, and zones of mylonite. Good examples of mylonite can be seen in Early Cretaceous granitic rocks on the southwest flanks of Anvil and Sphinx mountains. A canyon along the lower part of Pyramid Creek exposes a fault zone, as much as 150 m wide, consisting of siliceous and calcareous mylonite with well developed, gently plunging to horizontal stretching lineation on steeply dipping foliation surfaces. Muscovite is well developed on these surfaces. Locally, folds with amplitudes of several centimetres and wave lengths of up to 20 cm have steeply plunging axes in the plane of foliation. They and S/C fabrics noted in thin sections of oriented samples indicate a dextral sense of displacement along the Kutcho Fault.

The sinistral Beady Range Fault near Eagle River lies along a prominent lineament east of the river. Along the north side of the lineament granitic rocks of the Cassiar batholith are strongly foliated parallel with the lineament and these steeply dipping structures have been superimposed on earlier northwest-trending foliations related to the Kutcho Fault. Minor structures indicate upward and eastward latest movement of rocks to the south. Faults of similar trend cut rocks of Quesnellia between Kutcho and Thibert faults.

An analysis of possible offsets along the Kutcho Fault based on a study of the Omineca and Cassiar regions suggests dextral movement of as much as 100 km (Gabrielse, 1985). Restoration by this amount would bring together Quesnellia rocks in the Beady Range with those south of Hottah Lake and Late Triassic and Early Jurassic granodiorite southeast of the Beady Range with those in southeastern Cry Lake map area and adjacent Kechika and Toodoggone map areas.

Thibert Fault everywhere forms the northeast boundary of the Cache Creek Terrane. It is best exposed in northeastern Dease Lake map area where it is delineated by a zone of listwanite and highly sheared serpentinite bodies. At least locally it coincides with a mélange of serpentinite, greenstone, phyllite, chert, and limestone, with all lithologies forming lensoid masses of widely ranging dimensions. It is strongly marked by a zone of buff-brown- to maroon-weathering carbonatized and silicified rocks from northeast of Adsit Lake to southwest of Porcupine Lake. Southeast of Eaglehead Lake, Thibert Fault and Eaglehead Fault bound a panel of Inklin and Kutcho formation rocks. The Eaglehead Fault zone consists of silicified and carbonatized rocks which weather a brilliant orange to maroon and brown. On a fresh surface the rocks, ranging from phyllitic to massive ultramafics, are bluish-green. Locally, fuchsite is conspicuous.

The relationship of the Eaglehead Fault to Inklin and Kutcho formation rocks to the northeast is similar to that of the Nahlin Fault with similar rocks to the southwest and it is possible that they represent a single fault which has placed an allochthon of Cache Creek Complex on the Mesozoic strata. This structural style would be consistent with the gently dipping faults bounding ultramafic bodies southeast of Wheaton Creek.

Steeply dipping foliation is parallel with Thibert Fault along the southwest side of Eaglehead Pluton southeast of Eaglehead Lake. Displacement there, however, may not have been significant because rocks southwest of the fault have been hornfelsed, perhaps by the adjacent Eaglehead Pluton. On the other hand, the hornfels may be related to another pluton from which it subsequently has been displaced. A further possibility is that much of the movement on the Thibert Fault took place before emplacement of the Eaglehead Pluton which has been dated at 186 Ma. Dextral displacement along Thibert Fault is estimated at about 75 km. Restoration would place the granodiorite body southeast of Cow Lakes beside a body of similar lithology near Kedahda Lake in Jennings River map area (Christmas Creek batholith; Watson and Mathews, 1944; Gabrielse, 1985). It should be emphasized, however, that the nature and extent of movements on the Eaglehead and Thibert faults is still far from clear.

Nahlin Fault trends west-northwest across Cry Lake and Dease Lake map areas and beyond to the Atlin Lake area, a distance of more than 350 km. Throughout, it separates strata of the Lower Jurassic Inklin Formation to the south-southwest from ultramafic and related rocks of the Cache Creek Complex to the north-northeast. Commonly the fault dips gently to moderately north and evinces relative southward thrust movement of the hanging wall rocks. Ultramafic rocks along the fault are generally fish-scale serpentinites. Where the fault trends northwest instead of west, for example southwest of King Mountain, it is fairly steep and minor folds with steeply dipping axes suggest a component of dextral displacement. From near Swinton Lake west to south of Dease Creek rocks in the footwall of the Nahlin Fault include lithologies typical of the Kutcho Formation. These are, in part, diamictites in which clasts of quartz-feldspar porphyry are little deformed. A pronounced cleavage in strata south of the fault dips steeply south. The relationship of ultramafic bodies to rocks of the Inklin Formation east of Dudidontu River is unclear. As noted above, they may be klippen related to the Nahlin Fault or simply uplifted blocks within the Cache Creek Complex. The possibility that the Nahlin and Eaglehead faults represent the same structure has been noted above.

As with the Nahlin Fault the King Salmon Fault can be traced west-northwest across the Intermontane Belt of northern British Columbia for more than 350 km. It forms the southern boundary of the Cache Creek Terrane characterized by intensely foliated and discontinuous rock units and the northern boundary of Stikinia with its much less foliated and altered lithologies. The structure is clearly a south-southwestward directed thrust fault with low to moderate north dip.

The King Salmon Fault is well exposed in a creek canyon just west of its confluence with Tucho River (Fig. 82). There, penetratively foliated green, gritty volcanics of the Kutcho Formation and phyllite of the Kutcho Formation or Cache Creek Complex are in contact with kaolinized volcanics of the Bowser Lake Group along a zone of intense deformation at least 70 m wide. The Bowser Lake rocks are foliated in the immediate footwall of the fault but are little deformed farther south. In places, phyllite in the hanging wall has been deformed into tight chevron folds with amplitudes of about 1 m and axes plunging about 20° west. Crenulations on foliation surfaces commonly plunge moderately north-northeast.

Southeast of Wade Lake, Sinwa Formation limestone in the hanging wall of the King Salmon Fault occurs in tight, isoclinal folds with axial surfaces dipping steeply northeast (Fig. 79, 46). Farther northwest the limestone is strongly brecciated where it is in fault contact with relatively fresh greywacke of the Takwahoni Formation.

Strata of the Sinwa and Inklin formations occur in the hanging wall of a fault, probably the King Salmon Fault, in a klippe 4 km south-southeast of Wade Lake. There, the Sinwa Formation limestone is coarsely recrystallized and the Inklin Formation strata strongly foliated.

Structures in the hanging wall of the fault along and near Squaw Creek and along the headwaters of Zuback Creek were described earlier in the section concerning structural style of the Cache Creek Terrane. Just east of Highway 37, limestone, probably of the Sinwa Formation, in the hanging wall of the King Salmon Fault is strongly shattered, recrystallized, and pyritized.

Ages of deformation

Within Dease Lake and Cry Lake map areas the oldest record of deformation is found in the rocks of the Sylvester Allochthon. The siliceous tectonite unit and Late Devonian/Early Mississippian plutons provide evidence for Late Devonian tectonism. The clearest demonstration of deformation, metamorphism, plutonism, and volcanism at this time occurs in the southern part of the McDame map area west of Four Mile River (Harms et al., 1993), where, in one locality, a Late Devonian pluton cuts the structural fabric of mylonitic and highly sheared rocks and is itself strongly deformed. A later deformation of rocks in the Sylvester Complex is shown by the truncation of thrust faults, which juxtapose Carboniferous strata, by an Early Permian pluton (Harms, 1986). The Permian Meek Creek Pluton is undeformed and clearly was not involved in the penetrative deformation that affected the siliceous tectonite unit.

The broad synclinorium which contains the Sylvester Complex is one of a number of regional structures in north-central British Columbia believed to be of Early Cretaceous age (Sketchley et al., 1986; Gabrielse, 1991). This synclinorium and the adjacent anticlinorium to the southwest, predate the emplacement of the Cassiar Plutonic Suite but postdate the Mesozoic contractional structures.

Figure 82.

Intensely deformed rocks, possibly of the Kutcho Formation in the hanging wall of the King Salmon Fault about 3 km west of Tucho River.

The King Salmon Fault, Nahlin Fault, possibly Thibert Fault, and related structures are as old as late Early Jurassic (Gabrielse, 1991; Ricketts et al., 1992). These structures, recording the collision of Stikinia with the Cache Creek Terrane, may be roughly the same age as the earliest contractional structures in Ancestral North American rocks (Fig. 83). Locally, the dominant, southwest-verging folds and associated thrust faults southwest of Kechika Fault have been deformed by northeast-verging structures all of which predate formation of the McDame Synclinorium in Early Cretaceous time (Gabrielse, 1963, 1991; Fig. 83).

The abrupt changes in Lower Jurassic stratigraphic sequences coupled with numerous unconformities suggests marked instability of the region northeast of the Hotailuh batholith during the Early Jurassic. North-northeast-trending faults may have been active during this time (Fig. 56).

Throughout the region, the Early Jurassic plutons are much less foliated than those of Late Triassic age. For example, the Cow Lakes Pluton is pervasively foliated whereas the Eaglehead Pluton lacks foliation except near the Thibert Fault. Similarly, the strongly foliated Cake Hill Pluton contrasts markedly with the essentially massive McBride River Pluton. This evidence, in addition to conspicuous unconformities at the base of Lower Jurassic strata as old as Sinemurian, point to an important episode of tectonism in latest Triassic or earliest Jurassic time. It is difficult, however, to find evidence for this tectonism in the Triassic Shonektaw and Stuhini formations because of their general lack of well defined structural fabric.

The mélange of strongly foliated rocks in the Cache Creek Terrane may have formed over a considerable period of time related to subduction which resulted in closure of the Cache Creek oceanic basin.

Structures associated with the emplacement of Quesnellia and the Slide Mountain Terrane onto North America could, in part, have predated the emplacement of Early Jurassic plutons of Quesnellia thereby accounting for the structural contrast between the Late Triassic and Early Jurassic plutons.

Contraction of late Early Cretaceous rocks of the Tango Creek Formation southwest of Stikine River was of latest Cretaceous or Early Tertiary age (Evenchick, 1991). Folds produced in this deformation are cut by the Eocene Meehaus Pluton. The Tanzilla Fault and the one farther east along Stikine River are older. Locally, they are truncated by the unconformity at the base of the late Early Cretaceous Tango Creek Formation. Thus, there is evidence for three episodes of deformation in the Tanzilla-Stikine rivers area. The oldest is represented by the pre-late Early Cretaceous, northeast-trending, Tanzilla Fault and similar structures which suggest contraction in a northwest-southeast direction. The age of this structure, perhaps also reflected in the northeast trends of the Pallen Creek and McBride River plutons may have been Early Jurassic. This was followed by the northeast-southwest contraction of Late Cretaceous or Early Tertiary (pre-Meehaus Pluton) age which resulted in the Mount Meehaus folds. Finally, the region was cut by northeast-trending Eocene faults. These structures may have been related to the deformation associated with the Mount Meehaus folds or could have been later.

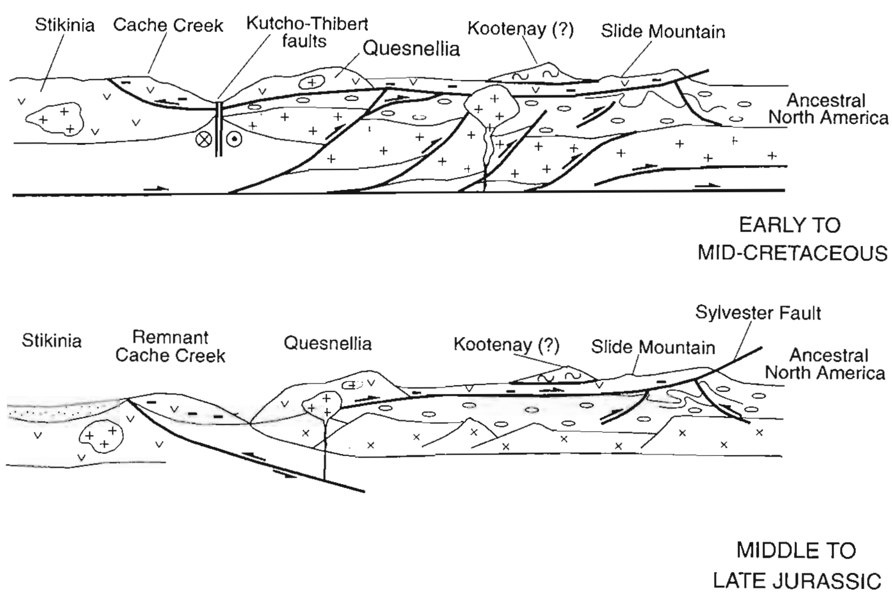


Figure 83. *Diagram showing hypothetical structural relationships of the various terranes following their amalgamation in Early Jurassic time (see Fig. 34). Symbols on Kutcho-Thibert faults indicate dextral, transcurrent displacement. For legend see Figure 34.*

Displacements on Kechika, Thibert, and Kutcho faults took place in the late Early Cretaceous judging by the deformation of Early Cretaceous plutons and the development of muscovite along foliation surfaces in the fault zones at that time (Gabrielse, 1985). Earlier, pre-Cretaceous movement on the Kutcho and Thibert faults is not precluded. The Kechika Fault was active in the Eocene and possibly during the Late Cretaceous when it was the locus for nonmarine sedimentation and felsic volcanism.

The Pitman and Beady Range sinistral faults truncate or bound Early Cretaceous plutons so are of mid-Cretaceous or younger age. Eocene faulting is demonstrated by the relationship between faults parallel with Tanzilla River and fanglomerates to the northwest.

METAMORPHISM

Each of the terranes has a characteristic type of metamorphism determined by its lithologies and tectonic history. In Ancestral North America the grade of metamorphism is related to stratigraphic depth and proximity to plutons. Metamorphic facies range from subgreenschist to amphibolite. Rocks in the Sylvester Allochthon, and assigned to the Slide Mountain Terrane, are mainly or entirely in greenschist facies. The Kootenay(?) Terrane, also in the Sylvester Allochthon, is clearly of higher grade than the Slide Mountain Terrane but probably still mainly within greenschist facies. Quesnellia and Stikinia are underlain by rocks in subgreenschist to local amphibolite facies. Much of the Cache Creek Terrane west of Dease Lake is in subgreenschist facies with local areas of blueschist in the French Range and perhaps along Thibert Creek. East of Dease Lake the terrane is represented by greenschist facies rocks.

Ancestral North America

Miogeoclinal strata in Ancestral North America range from prehnite-pumpellyite to amphibolite facies. The lowest grade are the lower Paleozoic rocks remote from the large granitic plutons. In the Four Brothers Range there is a transition into greenschist facies and strata of the Espee, Tsaydiz, and Swannell formations contain fine grained garnet, abundant chlorite and, in the lower beds, considerable mica. The increase of metamorphic grade with depth is typical of Proterozoic rocks in the Cassiar and Omineca mountains (Mansy, 1986). In places, south of Turnagain River, the Lower Cambrian Boya Formation also contains metamorphic mineral assemblages, including much biotite and red garnets about 0.5 mm in diameter. Elsewhere, the effects of thermal metamorphism related to granitic plutons is marked. A roof pendant in the Cassiar batholith south of the Beady Range Fault and east of Four Mile River contains assemblages of grossularite, diopside, olivine, wollastonite, and hercynite and of cordierite and sillimanite. Mansy (1986) has suggested that peak temperatures during metamorphism may have ranged between 650° and 750°C at pressures in the order of 5 to 6 kbar. Northwest and southeast of Cry Lake, assemblages of garnet, diopside, tremolite, and olivine and sillimanite, muscovite, andalusite, and garnet suggest peak temperatures between 550° and 650°C and pressures between 2 and 3.5 kbar respectively (Mansy,1986).

In the sedimentary enclave within the Cassiar batholith south of Turnagain River and west of Cassiar River and along the southwest side of the batholith near Turnagain River, an increase in metamorphic grade towards the pluton is represented successively by the minerals biotite, garnet, and andalusite. West of Cassiar River, chloritoid and biotite are conspicuous in the rocks of lower grade but near the batholith these minerals are replaced by a second generation of biotite and by andalusite. In places the andalusite is replaced by muscovite, in turn replaced by fibrolite and prismatic sillimanite. Vesuvianite and sphene are present in some of the recrystallized carbonate rocks.

The roof pendant north of Hottah Lake is characterized by assemblages of muscovite, staurolite, sillimanite, and garnet. Sillimanite has partly replaced staurolite and it is possible that metamorphic minerals formed in response to thermal metamorphism by the Cassiar batholith have overprinted minerals formed during an earlier regional metamorphism.

The window(?) of rocks assigned to Ancestral North America south of the Beady Range Fault is in greenschist facies, locally within the garnet zone. Along and northwest of Dease River, strata of the same terrane contain abundant chlorite and porphyroblastic albite.

It is clear that thermal metamorphism in Ancestral North America reached a peak during emplacement of the Early Cretaceous granitic plutons. The nature and timing of any earlier metamorphism generally has been obscured by the Early Cretaceous event. The foliation which accompanied the first recognized deformation contains synkinematic chloritoid, biotite, and locally, garnet (Mansy, 1986). Progressive or later deformation coincided with the crystallization of garnet, andalusite, staurolite, and sillimanite. The structural and metamorphic styles in Ancestral North American rocks are similar to those in the Cassiar and Omineca mountains to the south (Mansy, 1986) and it is likely that in the Cry Lake map area a regional metamorphism, probably of Middle and Late Jurassic age, was followed by a thermal metamorphism during Early Cretaceous time.

Kootenay(?) Terrane

Siliceous tectonite and associated rocks in the Sylvester Allochthon probably range from greenschist to amphibolite facies. Fine grained garnet is common in these rocks and volcanic members typically consist of albite, chlorite, actinolite, and zoisite. Chlorite and muscovite are ubiquitous on foliation surfaces. Correlative rocks east of Four Mile River in the McDame map area contain assemblages of staurolite, garnet, zoisite, muscovite, quartz, and feldspar (Harms et al., 1993). A contact metamorphic zone around the pluton 8 km east of the north end of Cry Lake is well defined. There, as the contact is approached the bedded rocks become strongly recrystallized and near the pluton unoriented blocks of amphibolite are prevalent. Garnet reaches a diameter of 5 mm.

Based upon intrusive relationships in the southern part of the McDame map area it is evident that significant deformation and metamorphism took place in the Late Devonian or Early Mississippian (Harms et al., 1993). Neither the degree of tectonism or the grade of metamorphism are present in rocks of the adjacent Slide Mountain lithologies.

Slide Mountain

Greenschist facies are dominant in the Slide Mountain lithologies. Locally, colour alteration indices of conodont fossils range as high as 6 to 7 perhaps equivalent to the transition between chlorite and biotite and garnet zones (Greenwood et al., 1992). Typical mineral assemblages in volcanic rocks include chlorite, actinolite, albite, zoisite, and clinozoisite. In places the rocks are less altered and some relict pyroxene and plagioclase have been preserved. Prehnite is present locally and some of the rocks may be in prehnite-pumpellyite facies. Rodingite bodies in some of the ultramafic rocks contain tremolite-actinolite, grossular garnet, and zoisite. Nowhere in the Sylvester rocks have minerals representing high pressure and low temperature conditions of metamorphism been noted.

The lower grade regional metamorphism of the Slide Mountain rocks, largely of prehnite-pumpellyite facies, probably took place during the initial emplacement of the volcanic rocks and their reaction with seawater. The greenschist metamorphism was in part related to the emplacement of granitic plutons. This pattern of alteration is well documented in the McDame map area (Gabrielse, 1963; Nelson and Bradford, 1993).

Quesnellia

Metamorphic facies in Quesnellia are much like those in the Slide Mountain Terrane although perhaps generally of slightly lower grade. Colour alteration indices of conodonts obtained from limestone clasts in the Nazcha Formation are lower than those from any other terrane in the region (M.J. Orchard, pers. comm., 1992). Porphyry from Coulahan Mountain consists of phenocrysts of plagioclase and augite in a fine grained, dark green matrix containing actinolite, oligoclase, chlorite, epidote, and magnetite. The feldspar phenocrysts are partly altered to epidote and augite is partly to completely uralitized (Watson and Mathews, 1944).

Although the ultramafic body along Turnagain River is of Alaskan type no significant contact metamorphic aureole is present. This may be attributed, at least in part, to contacts being faulted. At the southeast end of the body, amphibolite and muscovite-bearing rocks may represent contact effects.

Metamorphism of the rocks in Quesnellia was related mainly to the volcanic and plutonic events during their formation. Thermal metamorphism accompanying the emplacement of the Beady Range Pluton in late Early Cretaceous time is not conspicuous because of the lithologies of the bordering volcanic and plutonic rocks.

Cache Creek

In Dease Lake and Cry Lake map areas the Cache Creek Complex is mainly in prehnite-pumpellyite facies west of Little Eagle River and in greenschist facies to the east. These regions represent different structural levels with higher levels occurring to the west. Rocks of the Kedahda Formation along Dease Creek are the most highly altered of the western area and consist of chlorite, muscovite, and albite with common stilpnomelane (Monger, 1969). Greenstones of the French Range Formation contain chlorite, epidote, actinolite stilpnomelane, pumpellyite, and feldspar. Crossite, riebeckite, and lawsonite are present in places and suggest a high pressure-low temperature grade of metamorphism (lawsonite blue schist facies). Monger (1969) related the metamorphism generally to an earlier phase of deformation involving the Cache Creek Complex.

A cobble of jadeite has been recovered from the lower stretches of Thibert Creek but its source location is not known. A possible source may be one of the masses of rodingite that occur along Thibert and Delure creeks. It is almost certain, however, that the clast was derived from the Cache Creek Complex and gives further evidence for high pressure-low temperature metamorphism.

In the region east of Little Eagle River stilpnomelane and muscovite are common in Cache Creek rocks. The best studied rocks include those of the Kutcho Formation which are in greenschist facies (Thorstad and Gabrielse, 1986). The mafic volcanic rocks have been altered to assemblages of epidote/clinozoisite, chlorite, calcite, biotite (or stilpnomelane), albite, white mica, and minor quartz. Felsic volcanic rocks consist of assemblages of white mica, potassium feldspar, quartz, chlorite, plagioclase, and calcite. Metamorphism was synkinematic with the development of penetrative foliation and folding in the Kutcho Formation, presumably of late Early Jurassic and/or Middle Jurassic age.

Metamorphism of the Inklin Formation also accompanied the strong development of foliation. The presence of a distinct, sericitic, phyllitic sheen on foliation surfaces is characteristic of these rocks. Conodonts from limestone clasts in the Inklin Formation have distinctly higher colour alteration indices that those in the Nazcha Formation in Quesnellia (about 5 as opposed to 3-3.5; M.J. Orchard, pers. comm., 1992).

Ultramafic rocks in the Cache Creek Complex show an interesting succession of metamorphic events. Serpentinization of the original ultramafics was followed by recrystallization of the serpentine resulting in a felted mass of reticulated, feathery antigorite. Finally, nephrite which mimics the texture of the antigorite was developed. This sequence and the formation of rodingite indicate the effects of increasing pressure, temperature, and metasomatism, perhaps in an accretionary prism setting (Gabrielse, 1991).

Subgreenschist facies metamorphism of the volcanic rocks in the Cache Creek Complex may be the result of reaction with seawater at the time of volcanism. The somewhat higher grade of metamorphism noted in the lower structural levels can be attributed to deeper burial in an accretionary prism which culminated locally in the formation of the high pressure, blueschist facies.

Stikinia

Rocks in Stikinia range from prehnite-pumpellyite to amphibolite facies. In general, the stratigraphically oldest rocks (mainly Permian) have typical greenschist mineral assemblages. The younger rocks are, for the most part, of somewhat lower grade although lower greenschist rocks occur in Lower Jurassic volcanics and Middle Jurassic volcanics of the Bowser Lake Group (Erdman, 1978). Amphibolite facies metamorphism took place within a few hundred metres of some of the larger plutons (Anderson, 1983).

Lower Jurassic sedimentary rocks along the east side of the Three Sisters Pluton west of McBride River are hornfelsed and carbonate strata contain wollastonite and garnet. Mauve, rusty-weathering hornfelses are conspicuous in metasedimentary rocks northwest of the Snowdrift Creek Pluton and in an extensive area near the Snow Peak Granite. In the latter area, part of the metamorphism appears to be related to the Snow Peak Granite but some may be older and related to a swarm of Jurassic(?) granitic dykes. Sericitization, uralitization, and saussuritization with local potassium feldspar alteration has affected the volcanic rocks near the Cake Hill and Three Sisters plutons. Next to the contacts amphibolite is a common metamorphic product (Anderson, 1983).

Rocks from the Lower Jurassic volcanic suite east of McBride River and the Middle Jurassic volcanic suite in the Tucho River area have secondary mineral assemblages typical of greenschist facies metamorphism (Erdman, 1978). These include albite with relict phenocryst plagioclase, chlorite, zoisite/clinozoisite, actinolite, and quartz. Prehnite and clinozoisite coexist locally. In summary, the most significant metamorphism in rocks of Stikinia can be ascribed to the emplacement of volcanic rocks and the intrusion of Late Triassic and Jurassic plutons in an island arc environment.

Overlap assemblages

The Tango Creek Formation and Eocene rocks in the Dease Lake map area have been altered to zeolite facies mineral assemblages (Read, 1983). Eocene rocks along the Kechika Fault likewise are in zeolite facies. Volcanic rocks of the Tuya Formation have undergone no alteration except that coeval with their emplacement.

MINERAL DEPOSITS

Cry Lake and Dease Lake map areas contain a wide variety of mineral occurrences reflecting the diversity of tectonic environments represented by the various terranes. Carbonate-rich strata of the miogeocline (Ancestral North America) are host to tungsten skarn deposits near contacts with Early Cretaceous granitic rocks. Lead and zinc minerals also occur locally. Oceanic rocks of the Slide Mountain and Cache Creek terranes have nephrite jade and chrysotile asbestos deposits and appear to have been the source rocks for placer gold. Barite-quartz veins in one locality contain gold, silver, zinc, and lead. Volcanic-plutonic complexes within Stikinia and Quesnellia contain numerous copper and molybdenum showings and two significant porphyry copper deposits. The volcanic Kutcho Formation, formed on a Cache Creek basement, is host to two important copper and zinc, volcanogenic, massive sulphide deposits. Late Cretaceous and Eocene granitic rocks are associated with molybdenum, copper, and fluorite. Minor amounts of nickel and chromium occur in ultramafic rocks of the Slide Mountain and Cache Creek terranes and nickel is present in an Alaskan-type ultrabasic body within Quesnellia.

Few mineral occurrences in the map areas have been extensively explored and only placer gold and alluvial and lode jade have been mined. Accounts of the occurrences can be found in annual reports of the British Columbia Ministry of Mines and Petroleum Resources and in assessment reports filed with the Ministry. Summaries of these reports are given in a mineral inventory file (MINFILE) and in Table 9. Locations of mineral showings are shown on the 1:100 000 scale geological maps (Fig. 14, in pocket) and on Figures 84 and 85. The following discussion deals only with some of the more significant deposits and deposit types referenced by numbers on Figures 84 and 85.

Ancestral North America

Where they have been intruded and metamorphosed by granitic rocks, carbonate strata of the miogeocline, particularly those of Early Cambrian or older age, are prospective targets for tungsten deposits. Good examples are the scheelite deposits in skarn along the north side of an apophysis of the Cassiar batholith north of Turnagain River (Fig. 85, location 25). There, skarns with garnet and vesuvianite form bands in carbonate strata. Nearby, to the west, minor galena and sphalerite are present locally in veins within highly kaolinized granite (Fig. 85, location 31). Similar occurrences have been noted south of Turnagain River along the west side of the apophysis (Fig. 85, locations 24, 35).

Just southeast of Blue Sheep Lake a stock of leucocratic biotite, quartz, feldspar porphyry of unknown but possibly Eocene age cuts limestone of the Rosella Formation. Skarn, developed along the contact, consists of fine grained diopside and garnet in a silicified matrix. Magnetite, galena, and sphalerite with some pyrite are localized within the skarn (Fig. 85, location 40). Minor scheelite and molybdenite occur locally within quartz filled joints.

North of Wolverine Lake, near Bullion Creek, galena has been found in quartz-carbonate veins in intensely sericitized rock in a metamorphosed succession along the southwest side of the Cassiar batholith (Fig. 85, location 90). The stratigraphic position of the showing is uncertain. It is either in the lower part of the Earn Group or the upper part of the underlying Road River Formation.

Table 9. Summary of mineral occurrences in Dease Lake (104J) and Cry Lake (104I) map areas. See Figures 84 and 85. CJES, Canadian Journal of Earth Sciences; CIMM, Canadian Institute of Mining and Metallurgy; W. Miner, Western Miner; N. Miner, Northern Miner; BCDM MMAR, British Columbia Department of Mines and Petroleum Resources, Minister of Mines Annual Report; BCDM Gem, British Columbia Department of Mines Geology, Exploration and Mining; BCMI, British Columbia Mineral Inventory; EMR MRB, Energy, Mines and Resources, Minerals Resource Branch; EMR MRD, Department of Energy, Mines and Resources, Mineral Resources Division; GCNL, George Cross Newsletter

DEASE LAKE MAP AREA							
No.	**Commodity**	**Name**	**Deposit type**	**Host rock**	**Map sheet**	**Comment**	**Bibliography**
1	Ni	Opal Lake Nickel, Beaver	Disseminated replacement	Fault zone	104J/13		BCDM MMAR 1957-5; BCDM Prop. File, Sketch Map; GSC Map 1962-21; EMR MRD Corpfile (Canadian Explorers Ltd., Moneta Porcupine Mines Ltd.); BCDM Open File (sketch map); EMR MRB Invest. Rept. No. MD 3186, 1957.
2	Cu	Ace, Ace 1-16	Porphyry	Cache Creek sediments	104J/13		BCDM MMAR 1958-75; BCDM Asses. Rept. 220.
3	Asbestos	Tuya, Tack, Tachilta	Vein	Serpentinized peridotite	104J/10		BCDM MMAR 1960-119, 126; BCDM Asses. Rept. 293, 316, 3772; GSC Paper Info Circular No. 2; GSC Map 1962-21.
4	Cu	Kid, Grizzly	Porphyry	Upper Triassic volcanic rocks, Kaketsa stock	104J/4		BCDM MMAR 1961-117, 1962-7,135; BCDM Gem 1970-31, 1972-547, 1974-349; BCDM Asses. Rept. 349, 2605, 3990, 428, 3991, 5040, 5231; GSC Map 1962-21.
5	Cu	Go, Callison Copper, Copper Creek	Porphyry	Triassic rhyolite to basalt, granodiorite, diorite, monzonite	104J/4		BCDM Open File (Skyline-Polar Creek); BCDM MMAR 1955-13, 1956-14; BCDM Gem 1969-38, 1970-32, 1971-48, 1977-E235; BCDM Asses. Rept. 2061, 2805; GSC Map 1962-21; BCDM Asses. Rept. 12430.
6	Au	Defot Creek	Placer	Gravel	104J/16		BCDM Bull. 1-27, 19-7, 28-57; GSC Summ. Rept. 1925A-40; GSC Ann. Rept. 1887-138.
7	Au Pt	Thibert Creek	Placer	Gravel	104J/16		BCDM Open File; BCDM Bull. 1-27, 2-27, 28-60; GSC Map 1962-21; GSC Summ. Rept. 1925A-67.
8	Au	Dease Creek	Placer	Preglacial channel	104J/9		BCDM Open File; BCDM Bull. 1-27, 28-58; BCDM Prop. File; GSC Summ. Rept. 1925A-56.
9	Au	Tahltan River	Placer	Gravel	104J/2		BCDM MMAR 1933-62; BCDM Bull. 28-59, 19-48.
10	Cu Ag Au Ti Cd	Pinto	Vein	Granite	104J/3		BCDM Gem 1970-48.
11	Asbestos	NW	Vein	Serpentine	104J/13		BCDM MMAR 1958-75; BCDM Asses. Rept. 221; EMR MRB MRF 216 68.
12	Au	Keystone	Vein	Quartz porphyry	104J/16	9.25 g/t Au reported	BCDM MMAR 1931-53, 1933-63.
13	Cu Mo	Hu	Porphyry	Triassic tuff, lava sediments, syenite dyke, diorite feldspar porphyry	104J/8		BCDM Gem 1969-44, 1970-37, 1972-551, 1973-513; BCDM Asses. Rept. 4399, 3737; BCDM Prop. files; GSC Map 1962-21.
14	Mo Cu W	Mac, Snow Peak	Disseminated porphyry	Quartz monzonite, quartz feldspar porphyry	104J/8		BCDM Gem 1969-44, 1970-37, 1971-49, 1972-551; BCDM Prop. Files; BCDM Asses. Rept. 3207, 3848, 6354, 7657; BCDM Expl. in BC 1977-E236, 1979-292.
15	Cu Au Ag	Pat	Vein, disseminated	Altered volcanics	104J/4		BCDM Open File (Skyline-Polar Creek); BCDM Gem 1970-32; BCDM Asses. Rept. 2554, 2061, 6835; BCDM Expl. in BC 1977-E234, 1979-291.
16	Cu	Grizzly 4, 13	Porphyry	Upper Triassic volcanic rocks, Kaketsa stock	104J/4		BCDM Gem 1970-31, 1972-547, 1974-349; BCDM Asses. Rept. 2605, 3990, 3991, 5040, 5231.
17	Ni	Al	Replacement disseminated	Serpentine	104J/13		GSC Map 1962-21.
18	Cu	Go, Car, East Kaketsa, Pyrrhotite Cr	Porphyry	Stuhini volcanics, Kaketsa diorite, granodiorite, syenite	104J/4		BCDM Gem 1970-32, 1971-48, 1972-547; BCDM Asses. Rept. 2805, 3514, 3515, 3516; BCDM Prop. File 1973 Gembard Ella; BCDM Asses. Rept. 12430.

Table 9. (cont.)

No.	Commodity	Name	Deposit type	Host rock	Map sheet	Comment	Bibliography
				DEASE LAKE MAP AREA			
19	Cu Mo	Disco, Chopper	Porphyry	Granodiorite volcanic rocks	104J/1		CDM Asses. Rept. 3169 (Geophys., Geochem.); BCDM 1970, p. 48; 1971, p. 48.
20	Cu	G	Porphyry	Andesitic volcanics, monzonite-syenite	104J/4		BCDM Gem 1970-32; BCDM Asses. Rept. 3514, 3515, 3295; BCDM Asses. Rept. 12430.
21	Cu	Oh	Disseminated	Diorite, andesite	104J/4		BCDM Asses. Rept. 3514, 3296.
22	Mo Cu	Jim, Duck	Vein	Quartz veins in granite, quartz monzonite	104J/16		BCDM Gem 1972-552; BCDM Asses. Rept. 3424.
23	Cu Pb Zn	Ho	Vein	Quartz-carbonate veins, Kaketsa pluton, Stuhini volcanics	104J/4		BCDM Asses. Rept. 3514.
24	Cu	West Kaketsa	Porphyry	Stuhini volcanics, Kaketsa pluton	104J/4		BCDM Asses. Rept. 3514.
25	Cu	Pet, Mineral Hill	Porphyry	Syenite, andesitic volcanics	104J/5		BCDM Gem 1971-49; BCDM Asses. Rept. 3695, 4095.
26	Cu	Vi	Porphyry	Intrusive bodies	104J/4		BCDM Gem 1972-546; BCDM Asses. Rept. 3972.
27	Mo Cu	Shield	Porphyry	Quartz monzonite, Cassiar batholith	104J/16		BCDM Asses. Rept. 6887, 3433; BCDM Gem 1971-50, 1972-552; BCDM Asses. Rept. 3423; BCDM Expl. in BC 1978-E266.
28	Cu	Pet Creek	Porphyry	Syenite, andesitic volcanics	104J/5		BCDM Gem 1971-49, 1972-549, 1973-512; BCDM Asses. Rept. 3695, 4095.
29	Asbestos Jade	Dease Lake	Vein	Serpentine	104J/16		GSC Paper 78-19, p. 32; GSC Ann. Rept. 1887-88, Part 1, p. B78; GSC Ann. Rept. 1887-88, Part 1, p. B78; GSC Map 1957-9, 1962-21; GSC Summ. Rept. 1925A-84,99; GSC Map 1957-9, 1962-21.
30	Asbestos	Dudidontu River	Vein	Serpentine	104J/12		BCDM MMAR 1960-131; GSC Summ. Rept. 1925A-28; GSC Map 1952-21.
31	Cu	Bud	Vein	Stuhini andesite	104J/1		BCDM Gem 1971-48.
32	Asbestos	Bak, WP	Vein	Peridotite	104J/9		BCDM Gem 1971-451.
33	Cu	Disco 74, 76	Porphyry	Stuhini volcanics, Pallen Creek pluton	104J/1		BCDM Asses. Rept. 8505.
34	Cu Au Ag	Star	Porphyry	Kaketsa diorite, Stuhini volcanics	104J/4		GCNL 06/08/77; BCDM Gem 1976-E193, 1977-E234; BCDM Fieldwork 1974-63, 1975-77; BCDM Asses. Rept. 8882; BCDM Asses. Rept. 11395; BCDM Asses. Rept. 12430.
35	Cu	Tan, Zilla	Vein	Stuhini Group	104J/8		BCDM Asses. Rept. 6422; BCDM Expl. in BC 1977-E235, 1978-E265.
36	Cu	Zero	Residual surficial	Shonektaw volcaniclastics	104J/16		Prospectus, Oremont Mines Ltd., 1970, report by F.L. Croteau
37	Coal	Thundercloud	Stratabound sedimentary	Eocene sediments	104J/7		BCDM Coal Asses. Rept. 242, 243, 244; BCDM Paper 1986-5, p. 26.
38	Coal	Tuya River	Stratabound sedimentary	Eocene sediments	104J/7	214 Mt reserves	BCDM Coal Asses. Rept. 245, 246; BCDM Paper 1986-5, p. 26.
39	Coal	Tahltan River	Stratabound sedimentary	Eocene sediments	104J/2-3		BCDM Coal Asses. Report 24

CRY LAKE MAP AREA							
No.	Commodity	Name	Deposit Type	Host Rock	Map Sheet	Comment	Bibliography
1	Cu Au	Gnat Lake June Stikine Hill Zone	Porphyry Cu Au stockwork	Andesitic greenstones	104I/4	22.7 Mt reserves @ 0.44% Cu; 0.31 g/t Au	BCDM MMAR 1966-19, Fig. 2, 1965-15, 1967-27, 1968-36; BCDM Asses. Rept. 660; GSC Map 1962-29; EMR MRB Corpfile (Lytton Minerals Ltd., The Patino Mining Corp., Dease Lake Mines Ltd.); EMR Min. Res. Br. File (Stikine); EMR Reserves File (Moss); GCNL 75/Res.; Canadian Mines Handbook 1972, 1973 Res.; Mining Review, 1992.
2	Au	Goldpan Creek TNA	Placer	Glacial gravels	104I/5		BCDM MMAR 1962-134, 1965-16; BCDM Asses. Rept. 437.
3	Cu Au Ag Ba As	Dalvenie Big Chief	Fault replacement	Porphyritic andesite chert, argillite, quartzite	104I/4		BCDM MMAR 1924-76, 1925-111, 1926-102, 1927-108, 1928-121, 1953-6; GSC Mem. 194-7,16; BCDM Bull. 28-59; GSC Summ. Rept. 1925-A.
4	Au Jade Cr	Wheaton Creek	Placer	Tertiary gravels	104I/7		GSC Paper 72, p. 46, 48-49; BCDM Open File; BCDM MMAR 1933-70, 1939-104, 1961-124; BCDM Bull. 2, 28-61, 12-48; GSC Mem. 194, p. 14.
5	Au	Alice Creek	Placer	Glacial gravels	104I/7		BCDM MMAR 1933-70, 1939-104, 1961-124; BCDM Bull. 2.
6	Asbestos	Kutcho Creek Letain	Vein	Serpentinized peridotite	104I/7	15.7 Mt reserves @ 4.7%	N. Miner 08/23/79; W. Miner 1979, Feb., p. 15; BCDM Asses. Rept. 1975, 1076, 6470, 7028; BCDM Asses. Rept. 825, 1075, 1076, 6470; BCDM Expl. in B.C. 1977-E248, 1978-E282; BCDM Gem 1970-486, 1977-E248, 1978-; BCDM Asses. Rept. 825, 1075, 1076, 6470; EMR MRB Corpfile (Cassiar Asbestos Corp. Ltd., Kutcho Creek Asbestos Co. Ltd.).
7	Au	Faulkner Creek Palmer Creek	Placer	Glacial drift	104I/7		BCDM MMAR 1933-72.
8	Cu Mo Ag Au	Eaglehead Joy Eagle	Porphyry Cu Mo	Cassiar batholith, Lower Jurassic sedimentary rocks	104I/6	30.0 Mt reserves @ 0.41% Cu; 2.71 g/t Ag; 0.2 g/t Au	N. Miner, 09/20/79, p. A27 res.; GCNL 09/15/76; BCDM MMAR 1963-6, 1964-11,174, 1965-16; BCDM Gem 1971-45, 1972-540, 1973-511, 1974-349, 1975-E190, 1976-E192; BCDM Asses. Rept. 585, 3476, 4256, 5353, 6086, 6192, 7826; GSC Map 381A, 1962-29; GCNL 08/26 and 09/15/76; BCDM Expl. in BC 1979-288; BCDM Asses. Rept. 8754.
9	Cu Zn	Ant	Vein	Quartz veins, limestone; replacement	104I/2		BCDM MMAR 1962-134, 1965-16; BCDM Asses. Rept. 437.
10	Cu	Bee Group	Vein	Quartz vein	104I/2		BCDM MMAR 1962-135; BCDM Asses. Rept. 434, 438, 439; BCDM Asses. Rept. 9339.
11	Au	Bullion Creek	Placer	Postglacial gravels	104I/7		BCDM MMAR 1933-71; BCDM Bull. 28-58.
12	Cu	TNA	Vein	Quartz vein, limestone, andesite	104I/2		BCDM MMAR 1963-7, 1965-16.
13	Cu	June, Stikine Creek zone, September, Moss	Porphyry	Andesitic greenstones	104I/4		BCDM MMAR 1965-15, 1966-19, Fig. 2, 1967-27, 1968-36; EMR MRB Corpfile (Lytton Minerals Ltd., The Patino Mining Corp.).
14	Cu Ni	Turn, Cobalt, Pyrrhotite	Magmatic, disseminated	Serpentinized peridotite-dunite	104I/7		BCDM MMAR 1966-22, 1967-28; BCDM Gem 1969-49, 1970-40, 1971-46, 1972-544, 1973-512; BCDM Asses. Rept. 2056, 3735; CJES 1980-744; Clark, 1980.
15	Cu	HC, Bold, McBride River	Fracture fillings, disseminated	Tuff, shear zones	104I/3		BCDM Gem 1969-47, 1971-43; BCDM Asses. Rept. 1963, 3203; GSC 68-1-27; BCDM Asses. Rept. 12292.

Table 9. (cont.)

CRY LAKE MAP AREA							
No.	Commodity	Name	Deposit Type	Host Rock	Map Sheet	Comment	Bibliography
16	Cu	CM, Bonus, Boldex, Ride	Disseminated	Stuhini lavas shear zone	104I/2-3		BCDM Gem 1969-47, 1971-43; BCDM Asses. Rept. 1963, 3237, 3203; GSC Map 1957-9; BCDM Asses. Rept. 12292.
17	Asbestos	Eye, Emile 16, J	Vein	Serpentine	104I/12		BCDM MMAR 1960-119; BCDM Gem 1971-451; BCDM Asses. Rept. 315, 1649, 3082, 3363.
18	Asbestos	Jay, Emile 6	Vein	Serpentinized peridotite	104I/12		BCDM Gem 1971-451; BCDM Asses. Rept. 315, 1649, 3363, 3082
19	Cu Ag Au	Winco	Replacement	Lower Cambrian limestone, dolomite, chert, quartzite, and schist; shear zone	104I/16		BCDM Open File; BCDM Gem 1969-49; BCDM Asses. Rept. 2342.
20	Cu W	Mac	Skarn	Limestone, granodiorite-quartz, monzonite intrusion	104I/12		BCDM MMAR 1967-28, 1968-38; BCDM Gem 1969-43, 1976-E193; BCDM Asses. Rept. 1105, 2546.
21	Cu	Joy 94, Bow	Fissure filling	Triassic-Jurassic feldspar porphyry	104I/2		GSC Paper 68-1, p. 27; BCDM Gem 1969-47, 1971-43.
22	Ag Cu	Falcon	Vein stockwork	Sinwa limestone	104I/6		BCDM Asses. Rept. 14954.
23	Mo	Owl	Porphyry(?)	Quartz-diorite, Triassic-Jurassic granodiorite volcanic rocks	104I/5		BCDM Gem 1970-38, 1971-45, 1972-539, 1973-511; BCDM Asses. Rept. 3292, 4644, 4645, 4659, 4660, 4661, 4662, 5769; BCDM Expl. in BC 1975-E190, 1979-287.
24	W	Wolf, Kid, Winkle	Vein skarn	Quartzite, limestone skarn	104I/9		BCDM Gem 1969-48, 1970-41, 1972-544; BCDM Asses. Rept. 2643, 6952, 7680, 7786; BCDM Expl. in BC 1978-E264, 1979-288.
25	W	Ewe, Ram, Sheep	Skarn	Granite, limestone skarn	104I/9		BCDM MMAR 1967-28, 1968-38; BCDM Gem 1967-48, 1970-41; BCDM Asses. Rept. 5473, 5781, 6507, 6755, 7510, 7672; GSC Map 1962-29; BC & Yukon Chamber of Mines, Mining Dev. Review 1970-12; BCDM Expl. in BC 1979-290; BCDM Asses. Rept. 8409.
26	Cu	Kay, Kim, King	Disseminated	Metavolcanic rocks	104I/5		BCDM Open File; BCDM Gem 1969-45, 1970-38, 1971-45, 1972-538; BCDM Asses. Rept. 2622, 2766, 3372, 3973, 2152, 2767, 3204, 3205.
27	Cu	Star	Fracture filling	Upper Triassic volcanics, syenite	104I/3		BCDM Gem 1969-46; BCDM Asses. Rept. 2154.
28	Cu Ag Ni Fe	WT	Replacement along dyke	Serpentinized peridotite	104I/7		BCDM Gem 1969-49, 1970-40, 1971-46, 1975-E190; BCDM Asses. Rept. 2131, 5656.
29	Cu	Moss	Disseminated along contacts	Stuhini basalt flows	104I/5		BCDM MMAR 1966-19, Fig. 2, 1965-15, 1967-27; BCDM Asses. Rept. 1106, 845; GSC Map 1962-29; EMR MRB Corpfiles (Lytton Minerals Ltd., The Patino Mining Corp., Dease Lake Mines Ltd.).
30	Cu Ni	GB	Magmatic	Serpentinite peridotite	104I/15		BCDM Gem 1970-39; BCDM Asses. Rept. 2580, 2797, 2796.
31	Ag Pb Zn	Herb	Vein	Granite	104I/9		BCDM Gem 1970-40, 1972-544.
32	Zn Pb Sb Cu	Niz	Vein fracture filling	Siliceous metasediments	104I/14-15		BCDM Gem 1971-47, 1972-545; BCDM Asses. Rept. 2789, 3404, 4096, 7818; BCDM Expl. in BC 1979-290; 1993, p. 29.
33	Cu	Bell	Disseminated	Stuhini volcanics	104I/4		BCDM Gem 1971-44; BCDM Asses. Rept. 2889.

CRY LAKE MAP AREA							
No.	Commodity	Name	Deposit Type	Host Rock	Map Sheet	Comment	Bibliography
34	Cu Pb Zn	Mat	Disseminated	Gneiss, pyroxenite, gabbro	104I/4		BCDM Gem 1971-43; BCDM Asses. Rept. 3028.
35	W	Rye	Skarn	Metasediments, quartz monzonite, granodiorite	104I/9		BCDM Gem 1971-47; BCDM Asses. Rept. 3213.
36	Cu Mo	Rin, Rin 88	Vein	Quartz monzonite	104I/1		BCDM Asses. Rept. 3215.
37	Cu	Kay 19	Disseminated	Upper Triassic volcanic sediments	104I/5		BCDM Gem 1969-45, 1970-38, 1971-45, 1972-538; BCDM Asses. Rept. 2622, 2766, 3973, 3372, 2152, 2767, 3204, 3205.
38	Cu	Agnes	Disseminated	Upper Triassic ultrabasic rocks	104I/7		BCDM Gem 1971-46; BCDM Asses. Rept. 3206.
39	Cr	JJR	Disseminated	Serpentinized peridotite	104I/6		BCDM Gem 1972-540; BCDM Asses. Rept. 3530; BCDM Asses. Rept. 9286.
40	Ag Pb Zn	Johnny 2	Replacement	Porphyry, Lower Cambrian limestone contact	104I/16		BCDM Gem 1972-546; BCDM Asses. Rept. 3539.
41	Fe	Johnny 1	Replacement skarn	Porphyry limestone	104I/16		BCDM Gem 1972-546; BCDM Asses. Rept. 3539.
42	Asbestos	J, Wind	Vein	Serpentinized peridotite	104I/2		BCDM Gem 1971-450; BCDM Asses. Rept. 3628.
43	Cu Mo	Pat	Disseminated	Hotailuh batholith	104I/3		BCDM Gem 1972-537, 1977-E232; BCDM Asses. Rept. 3963, 6323.
44	Cu Ab	ASB 8	Disseminated vein	Serpentinized peridotite	104I/6		BCDM Gem 1972-540; BCDM Asses. Rept. 3992.
45	Asbestos	ASB 4	Vein	Peridotite	104I/6		BCDM Gem 1972-540; BCDM Asses. Rept. 3992.
46	Cu	Crown	Disseminated porphyry	Volcanic rocks, monzonite intrusion	104I/4		BCDM Gem 1971-44, 1972-538; BCDM Asses. Rept. 3422.
47	Ni	Lux	Disseminated	Serpentinized peridotite	104I/6		BCDM Gem 1970-39; BCDM Asses. Rept. 2808.
48	Asbestos	Occurrence	Vein	Serpentinized peridotite	104I/2		BCDM Gem 1960-131; GSC Map 1957-9, 1962-29.
49	Mo Cu	Joyce, Horn Mountain	Disseminated	Granodiorite	104I/5		BCDM MMAR 1967-28.
50	Cu Mo	May	Disseminated	Andesite, basalt, diorite	104I/5		BCDM MMAR 1929-116, 1965-16, 1968-37; BCDM Asses. Rept. 771, 1820, 1891.
51	Ni Cu	Flat	Magmatic(?)	Gabbro to peridotite	104I/7		BCDM MMAR 1967-28; BCDM Asses. Rept. 1077; BCDM Asses. Rept. 8055.
52	Cu Zn Ag Au	Kutcho Creek	Vein	Quartz vein	104I/2		A. Panteleyev, pers. comm., 1980.
53	Asbestos	B	Vein	Serpentinized peridotite	104I/7		BCDM Asses. Rept. 825, 1076.
54	Cu	Louise	Disseminated	Migmatite	104I/4		BCDM Gem 1972-537; BCDM Asses. Rept. 3964.
55	Cu	Cop	Vein	Quartz veins, Cache Creek Complex	104I/12		BCDM Gem 1972-545; BCDM Asses. Rept. 4093.
56	Cu	Wolf	Vein	Triassic-Jurassic andesite, basalt	104I/6		BCDM Gem 1972-537; BCDM Asses. Rept. 4498.

Table 9. (cont.)

CRY LAKE MAP AREA							
No.	**Commodity**	**Name**	**Deposit Type**	**Host Rock**	**Map Sheet**	**Comment**	**Bibliography**
57	Ag Cu	Erna	Vein	Quartz vein	104I/16		BCDM letter to Dept. (Hennel, H.) 08/15/73.
58	Ag Cu	Norma	Vein	Quartz vein	104I/16		BCDM letter to Dept. (Hennel, H.) 08/15/73.
59	Cu Mo Pb Zn	Nup, Snowdrift	Vein	Triassic andesite, granodiorite, quartz monzonite	104I/5		BCDM Gem 1973-511; BCDM Expl. in BC 1975-E190, 1976-E191, 1978-E262; BCDM Asses. Rept. 4644, 4645, 4659, 4660, 4661, 4662, 5769; BCDM Geological Fieldwork 1976-P69.
60	Cu Zn Fe	SMRB, Kutcho	Volcanogenic massive sulphide (Kuroko type)	Muscovite quartz schist	104I/1	1986 reserve estimate: 17 000 000 tonnes @ 1.62% Cu, 2.3% Zn, 0.3 g/t Au, 29.2 g/t Ag, 0.06% Pb	EMR MRD Corpfile (Sumitomo Metal Mining Canada Ltd., Sumac Mines Ltd.); BCDM Expl. in BC 1978-E260; BCDM Gem 1973-510, 1974-348; BCDM Asses. Rept. 4863, 5120, 5475, 5778, 6025, 6026, 6038, 6039; BCDM Geol. 1975; BCDM Expl. in BC 1975-E189, 1976-E190, 1977-E231, 1978-E261; BCDM Expl. in BC 1979-286; BCDM Asses. Rept. 13132; CIMM spec v. 37, 1986, p. 115-128.
61	Cu Zn	Sumac West, Esso West	Volcanogenic massive sulphide (Kuroko type)	Quartz sericite schist	104I/1	1986 reserve estimate: 10 000 000 tonnes @ 1% Cu, 1.2% Zn; 1 000 000-1 500 000 tonnes @ about 2% Cu, 2.4% Zn	EMR MRD Corpfile (Sumitomo Metal Mining Canada Ltd., Sumac Mines Ltd., Imperial Oil Limited); BCDM Expl. in BC 1978-E260; N. Miner 03/18/76, 09/28/78; BCDM Gem 1973-510, 1974-343; BCDM Asses. Rept. 5138, 5147, 5253, 5294, 5652, 5552, 5591, 5599, 5641, 5652, 5986, 5987, 6273, 6343, 6373, 7024, 7433, 7437, 7537, 7599; BCDM Expl. in BC 1975-E188, 1976-E189, 1977-E230, 1978-E260, 1979-287; GSC Bull. v. 86, no. 2, 1975, p. 257; CJES, v. 8, 1971-523; BCDM Asses. Rept. 7914, 8273, 8381, 8395; BCDM Asses. Rept. 11323; BCDM Asses. Rept. 13132.
62	Jade	CWA, Jade	Replacement	Serpentinized ultramafic	104I/2		GSC Paper 72-53, p. 46, 48, 49; GSC Paper 78-19; BCDM Gem 1974-381; BCDM Asses. Rept. 5100, 7542, 7582; BCDM Expl. in BC 1979-335.
63	Jade	CWL	Replacement	Serpentinized ultramafic	104I/2-7		GSC Paper 72-53, p. 46, 48, 49; GSC Paper 78-19; BCDM Gem 1974-381; BCDM Asses. Rept. 4801, 5100, 7542, 7582; BCDM Expl. in BC 1979-335.
64	Jade	NCW, CWL	Replacement	Serpentinized peridotite	104I/7		GSC Paper 72-53, p. 46, 48, 49; GSC Paper 78-19; BCDM Gem 1974-381; BCDM Asses. Rept. 4801, 4802, 7542, 7582; BCDM Expl. in BC 1979-335.
65	Jade	Jade	Replacement	Serpentinized peridotite	104I/7		GSC Paper 72-53:33; GSC Paper 78-19; BCDM Gem 1974-381, 1976-E204; BCDM Asses. Rept. 5100, 5815.
66	Jade	JW	Surficial boulders	Talus boulders	104I/7		GSC Paper 72-53:33; GSC Paper 78-19; BCDM Asses. Rept. 5100, 6008; BCDM Gem 1974-381, 1976-E204.
67	Jade	King Kong	Replacement	Serpentinized peridotite	104I/7		GSC Paper 72-53:33; GSC Paper 78-19; BCDM Gem 1974-381; BCDM Asses. Rept. 5100, 7542; BCDM Expl. in BC 1979-334; BCDM Asses. Rept. 8659.
68	Cu Zn Pb Mo	BCR, SS	Fracture filling	Hotailuh batholith, Upper Triassic volcanics	104I/4		BCDM Gem 1974-348.
69	Mo	Bartle	Disseminated	Granodiorite	104I/14		BCDM MMAR 1966-22.
70	W	May	Skarn	Dolostone, Cassiar batholith	104I/9		BCDM Asses. Rept. 5473, 5781, 6455, 6507, 6755, 7510; BCDM Expl. in BC 1975-E190, 1977-E233, 1979-289.
71	Cu	Bow	Vein	Quartzite	104I/2		BCDM Gem 1975-E189, 1976-E190; BCDM Asses. Rept. 5508, 5911.

CRY LAKE MAP AREA

No.	Commodity	Name	Deposit Type	Host Rock	Map Sheet	Comment	Bibliography
72	Cu	Kutcho prospect	Volcanogenic	Quartz-sericite schist	104I/2		W. Miner 02/79:15; W. Miner 06/70:50; BCDM Asses. Rept. 6210, 6374, 6375, 6686, 6916; BCDM Expl. in BC 1976-E191, 1977-E232, 1978-E262; BCDM Asses. Rept. 9170; BCDM Asses. Rept. 13-132.
73	Jade	Barb	Surficial boulders	Serpentinized ultramafic	104I/7		GSC Paper 72-53:33; GSC Paper 78-19; BCDM Gem 1976-E204; BCDM Asses. Rept. 5784.
74	Cu	Let, Tak, Tain Creek	Disseminated	Feldspar porphyry, chloritic volcanics	104I/7		BCDM Expl. 1976-192; GSC Map 1962-29; BCDM MMAR 1966-21; BCDM Gem 1977-E232, E233; BCDM Asses. Rept. 6406; BCDM Expl. 1970-E192.
75	Cu Zn	CK	Volcanogenic	Quartz-sericite schists	104I/1		BCDM Gem 1977-E230; BCDM Asses. Rept. 6630; Expl. Form 1977.
76	Cu	Sul	Magmatic(?)	Periodite	104I/7		BCDM Asses. Repts. 6459, 5656, 6406; BCDM Gem 1977-E233.
77	Cu Zn	Castle	Volcanogenic	Chlorite schist	104I/5		BCDM Ex. Form 1978; BCDM Asses. Rept. 6979; BCDM Expl. in BC 1978-E263.
78	Jade	Jadex	Replacement and boulders	Serpentinized ultramafic	104I/2	1989 reserve estimated: 5000 t	BCDM Expl. in BC 1978-E292; BCDM Expl. in BC 1979-335; BCDM Asses. Rept. 8659; GSC Paper 78-19.
79	Jade	PML 1711	Surficial boulders	Serpentinized ultramafic	104I/7		BCDM Asses. Rept. 7104.
80	Jade	PML 1710	Surficial boulders	Serpentinized ultramafic	104I/7		BCDM Asses. Rept. 7096; GSC Paper 78-19.
81	Cu Pb Zn Ag	Choa	Unclassified(?)	Kutcho Formation	104I/1		BCDM Asses. Rept. 13081.
82	Asbestos	Wheaton Creek	Vein	Serpentinized peridotite, Cache Creek Complex	104I/7		EMR MRB MRF 216/68.
83	Asbestos	(Occurrence)	Vein	Serpentinized peridotite, Cache Creek Complex	104I/6		EMR MRB MRF 216, 1968.
84	Asbestos	Serpentine Creek, Dease Lake	Vein	Serpentinized peridotite, Cache Creek Complex	104I/12		EMR MRB MRF 216, 1968.
85	Ni Cr	Garnierite	Replacement	Serpentinized peridotite, Cache Creek Complex	104I/7		BCDM Bull. 2-24.
86	Au Ag Cu	LU	Silicified fault zones	Cache Creek Complex	104I/5		BCDM Asses. Rept. 14136.
87	Jade	Eileen	Boulders	Serpentinized ultramafic	104I/2		BCDM Asses. Rept. 5100, 7258; GSC Paper 78-19.
88	Au Ag	D	Vein	Triassic-Jurassic volcanics	104I/3		BCDM Asses. Rept. 10699; BCDM Asses. Rept. 11279.
89	Pb	Turn	Replacement	Sinwa(?) limestone	104I/7		BCDM Asses. Rept. 13195; BCDM Expl. 1984-392.
90	Pb Zn	Dinah	Stratiform	Devonian(?) shale, limestone	104I/7		BCDM Asses. Rept. 9803, 10877; BCDM Expl. 1982-390.

The metamorphosed pendants of lower Paleozoic rocks northwest and southeast of Cry Lake are underlain by lower Paleozoic rocks which, in places, have a high pyrite content. Although no other sulphide minerals were seen, the geological setting of these rocks suggests they merit careful examination.

Slide Mountain and Kootenay(?) terranes

Few mineral showings have been reported from the Slide Mountain and Kootenay(?) terranes. Oceanic lithologies of the Slide Mountain have potential for jade and asbestos deposits in ultramafic and related rocks. Chalcopyrite and pyrite have been noted in the Beale Mountain area. East of the headwaters of Nizi Creek quartz-barite veins carry zinc, lead, gold, and silver (Fig. 85, location 32). The deposits occur in a potassic, rhyolitic tuff and are believed to be of epithermal origin (Wojdak et al., 1993).

In comparison with the McDame area the area near the eastern margin of the Cassiar batholith in the Cry Lake map area seems favourable for mineral occurrences. It lacks the abundant quartz veins, however, which are prominent in the gold-quartz vein deposits (e.g., the Erickson and Quartzrock Creek deposits) in the Sylvester Complex to the northwest. It also seems to lack the plutons of the Surprise Lake Plutonic Suite (ca. 70 Ma) that generate much of the tungsten, molybdenum, and zinc skarn and porphyry mineralization around Cassiar in the McDame map area. In general, neither of the Slide Mountain nor Kootenay(?) terranes appear to have been extensively prospected in the Cry Lake map area.

Quesnellia

Copper showings are fairly common in volcanic and plutonic rocks of Quesnellia, an important example of this is the porphyry copper deposit (Eaglehead) that has been explored southeast of Eaglehead Lake (Panteleyev, 1972; Caulfield, 1982; Fig. 85, location 8). There, pyrite, chalcopyrite, bornite, tetrahedrite, and molybdenite occur in strongly foliated and cataclastized granodiorite along the southwest margin of the Early Jurassic Eaglehead Pluton. Flanking strata to the southwest, in part hornfelsed, have been assigned to the Upper Triassic Kutcho Formation. The minerals form disseminated stockworks in three main mineralized zones that lie within a belt about 3 km long and as much as 500 m wide. Mineralization seems to have been largely restricted to a dyke-like body of biotite granodiorite which separates a narrow border phase of hornblende quartz diorite from biotite quartz granodiorite forming the bulk of the Eaglehead Pluton. Numerous feldspar porphyry dykes are present. The host rocks have been altered to quartz-chlorite-sericite schist, carbonate and epidote, and locally, potassic feldspar. Estimated reserves are about 30 000 000 tonnes averaging 0.41% Cu, 0.0216% Mo, 2.71 g/t Ag, and 0.20% Au.

Chalcopyrite and molybdenite occur as clusters in quartz veins in Early Jurassic granodiorite near the western margin of a large pluton north of Kutcho Fault and east of Tucho River (Fig. 85, location 36). The granodiorite is known to contain copper showings to the east in Kechika map area.

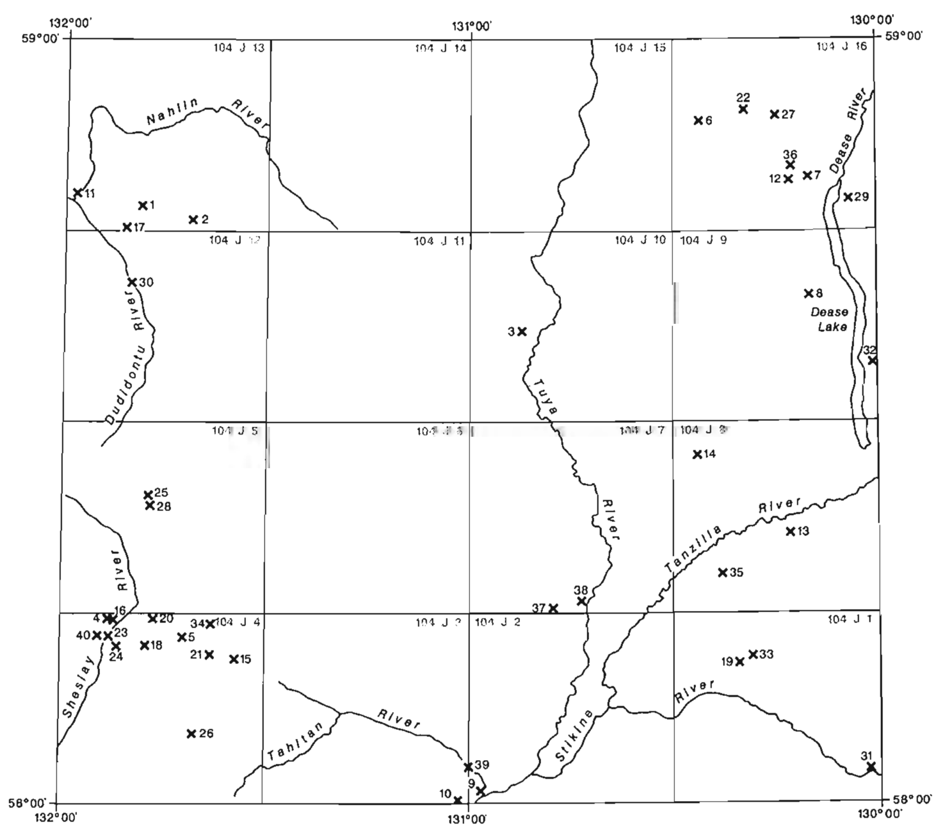


Figure 84.

Distribution of mineral occurrences in Dease Lake map area. See also Table 9.

An Alaskan-type ultramafic body in Quesnellia along Turnagain River is host to concentrations of copper and nickel in the minerals chalcopyrite, bornite, pentlandite, and pyrrhotite localized in wehrlite surrounding an unmineralized central core of relatively fresh dunite (Fig. 85, location 14). The sulphides form disseminated blebs, interconnecting blebs, and massive bands up to a few centimetres wide (Clark, 1975, 1980).

Cache Creek Terrane

Oceanic rocks of the Cache Creek Complex and island arc volcanic rocks of the Kutcho Formation are host to several important mineral deposits and numerous showings. Gold placer claims have been worked since the early 1870s and jade has been recovered from boulders and lode deposits in the Cry Lake map area since the 1960s. A significant chrysotile asbestos deposit was discovered east of Letain Lake in the 1950s (Fig. 85, location 6) and copper and zinc occurrences have been extensively explored in the Kutcho Formation since their discovery in the late 1960s (Fig. 85, locations 60, 61).

Placer gold

Placer gold mining has been carried out in the Cassiar region for more than 100 years and, at various times, has been the stimulus for the founding of settlements at Laketon, Porter Landing, and Dease Lake. The most productive creeks have been Dease (Fig. 84, location 8), Thibert (Fig. 84, location 7), Defot (Fig. 84, location 6), Goldpan (Fig. 85, location 2), and more recently, Wheaton (Fig. 85, location 4). The early history of placer mining in the Dease Lake area was summarized by G.M. Dawson (1889) and A.S. Trueman (1935). W.A. Johnston (1925) conducted the most detailed study of placer deposits on creeks near Dease Lake and S.S. Holland (1940) undertook a study of the Wheaton Creek placers with an analysis of the physiographic history of the immediate area.

As noted by Johnston, the placer gold deposits occur in three or four different settings. The most important occurrence of placer gold is in gravel resting on bedrock in the high level channels. These are commonly only a metre or less thick and are probably of preglacial age (late Tertiary). A second setting is in glacial and interglacial gravels partly filling stream channels and present valleys. In these gravels the gold is generally scattered and pay streaks are only slightly concentrated. A third type of occurrence, in postglacial sediments on low benches along present streams, can be rich locally where the stream has cut through old gold-bearing channels. Finally, for example along Settea Creek, and possibly along Eagle River, placer deposits have been preserved beneath volcanic flows.

Well defined rock benches flank Wheaton Creek and Holland (1940) concluded that a Tertiary drainage system was strongly incised prior to glaciation with downcutting proceeding up to the present. Deep weathering of source rocks and concentration of gold by Tertiary streams probably led to the initial localization of placer deposits which were later modified by glaciation and stream erosion. Holland (1940) noted evidence for at least two episodes of glaciation with

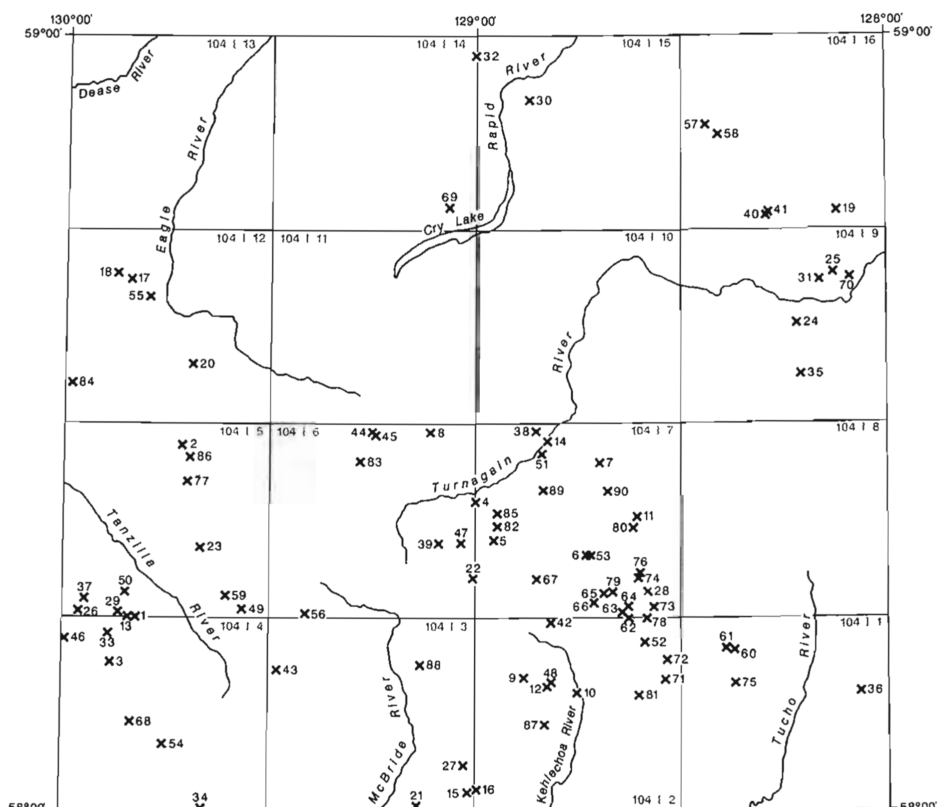


Figure 85.

Distribution of mineral occurrences in Cry Lake map area. See also Table 9.

consequent disruptions of drainage patterns. The physiographic history of the Wheaton Creek area can be applied to all of the major drainages in the Dease Lake region so that there is significant potential for unrecognized, drift filled, abandoned, gravel-bearing channels near the present stream courses.

The ultimate source for the placer gold in the Dease Lake and Cry Lake map areas is not well known. It is clear that the gold is closely associated with oceanic rocks of the Cache Creek Terrane but no lode deposits of significance have been found in either the ultramafic rocks or with related gabbroic, volcanic, and sedimentary lithologies. Some exploration attention has been given to quartz veins in conspicuous quartz-carbonate-mariposite alteration assemblages (listwanites) but notable concentrations of gold have not been reported. Nonetheless, streams draining areas underlain by oceanic rocks of the Cache Creek and Slide Mountain terranes have the best potential for placer gold occurrences. In particular, those streams in eastern Dease Lake map area and in Cry Lake map area that flow in roughly east-west courses are most likely to have stream gravels of preglacial or interglacial age preserved. These gravels of preglacial or interglacial age may have been less subject to glacial scour than those lying in channels parallel with ice movement.

Jade

Since the mid-1960s the Cry Lake area has been one of the world's leading producers of nephrite jade. Production has come from boulders and talus blocks generally near their source areas or from in situ lenses enclosed in serpentinite of the Cache Creek Complex (Leaming, 1978). The host rocks occur mainly in a belt of volcanic, sedimentary, ultramafic, and mafic plutonic rocks more than 80 km long and ranging from 6 to 15 km wide, extending from southwest of Eagle River to east of Kutcho Creek (Fig. 85, locations 62, 63, 64, 65, 67, 78). The belt is bounded to the north and east by the Thibert and Kutcho faults and to the south and west by the Nahlin Fault. Ultramafic rocks also occur in the hanging wall of the King Salmon Fault. They host some jade occurrences southeast of Wade Lake. The ultramafic rocks are readily recognized in the field by their dun brown- and serpentine green-weathering and general lack of vegetation. Jade lenses from 1 to 10 m wide and up to several tens of metres long are discontinuous and relatively rare. High quality material constitutes only a small part of a lens because of schistosity, resulting from deformation, postdating the formation of jade.

Several constraints on the environment of jade formation are provided by structural and petrological studies of the Cache Creek Complex. The distribution of the various lithologies suggests the style of a structural mélange. Many of the contacts between rock units are faults and all units are discontinuous over a wide range of scales. Where faults bound ultramafic bodies they are marked by zones of listwanite or highly sheared, fish-scale serpentinite. Attitudes of slickensides, the lensoid form of jade bodies, and pervasive foliation indicate the effects of rotation, boudinaging, and shearing. High pressure and possibly low temperature metamorphism within the Cache Creek Complex is shown by the local presence of riebeckite, crossite, and jadeite. Stilpnomelane is widespread and, in places, muscovite is conspicuous in metasedimentary rocks. Near jade occurrences serpentinite commonly consists of hornfelsic, feathery reticulated antigorite. This texture is identical to that of the fine grained jade suggesting the possibility that the jade formed from antigorite simply by the addition of calcium and perhaps silica in zones of metasomatism. In most, if not all cases, the metasomatism has taken place where the serpentinites were in contact with sedimentary or volcanic rocks.

Nephrite jade deposits are known in the ultramafic rocks within the Slide Mountain Terrane of the Sylvester Allochthon despite the fact that the Slide Mountain rocks lack the imprint of high pressure metamorphism noted in the Cache Creek Terrane.

Asbestos

Minor veinlets of cross fibre chrysotile asbestos can be found in many of serpentinite bodies within the Cache Creek and Sylvester complexes. An asbestos deposit northeast of Letain Lake (Fig. 85, location 6) is the only one of significance, however, so far found in the ultramafic rocks within the Dease Lake and Cry Lake map areas. The body occurs near the central part of a large, northwesterly elongate band of serpentinized peridotite and is about 1500 m long, 300 m wide, and extends down dip at least 200 m (McCammon, 1960). The host rock is flanked to the northeast by a volcanic-plutonic complex and to the southwest by sedimentary and volcanic rocks. Cross fibre chrysotile forms veins as much as 3 cm wide but central partings reduce fibre lengths to mostly less than 1 cm. The veins are related to two well defined fracture sets, one of which trends N50°E to N60°E and dips steeply northwest and the other which trends N30°W to N40°W and dips nearly vertically. Reserves have been estimated at 15.7 million tonnes grading 4.7% with a 3% cutoff (Cassiar Mining Corp. Prospectus, 1985).

Like the host serpentinite at the Cassiar mine in the McDame map area the serpentinite northeast of Letain Lake contains abundant feathery reticulated antigorite. This texture results from metamorphism of the original serpentinite and may be fundamental to the formation of chrysotile asbestos veinlets (Gabrielse, 1963) and, as mentioned above, to the formation of nephrite jade.

Copper, zinc, silver, gold

The Kutcho Formation is host to an important copper and zinc deposit explored by Esso Minerals Canada and Sumac Mines Limited east of the headwaters of Kutcho Creek in the southeastern Cry Lake map area (Fig. 85, locations 60, 61). Kuroko-type massive sulphides occur at one stratigraphic level in the highest volcanic cycle in the thickest and most felsic section of the bimodal volcanic Kutcho Formation. The host rocks are strongly sericitized and carbonatized. Pyrite, chalcopyrite, sphalerite, and bornite are the dominant minerals. The zone of mineralized rock can be traced for about 3.5 km. An excellent, detailed description of the lithology, sulphide minerals, and alteration is given by Bridge et al. (1986) and the regional setting is described by Thorstad and Gabrielse (1986).

Reserves in the easternmost, or Kutcho deposit, are estimated at 17 000 000 t grading 1.62% Cu, 2.32% Zn, 29.2 g/t Ag, and 0.3 g/t Au. The central, Sumac West deposit contains about 10 000 000 t grading 1.0% Cu and 1.2% Zn. The western, Esso West deposit, contains between 1 000 000 and 1.5 000 000 t with about twice the grade of the Kutcho deposit (Bridge et al., 1986). Volcanogenic rocks of the Kutcho Formation are relatively abundant as far west as Turnagain Lake and scattered outcrops are found northwestward to south of the French Range in Dease Lake map area. A narrow band of Kutcho Formation borders the southwest contact of the Eaglehead Pluton southeast of Eaglehead Lake. In many localities they have a significant pyrite content but large sulphide concentrations seem to be restricted to the thickest pile of volcanics which occurs in the Kutcho Creek area.

A stockwork of quartz veins and siliceous replacement zones in limestone of the Sinwa Formation, 9 km east of the north end of Turnagain Lake is mineralized with sphalerite, pyrite, tetrahedrite, and galena (Fig. 85, location 22). The deposit, which contains some silver, occurs just below a contact with rocks of the Inklin Formation. Quartz veins in the Sinwa Formation 5 km southeast of the south end of Wade Lake carry chalcopyrite and pyrite. The occurrence lies in the immediate hanging wall of the King Salmon Fault.

Other minerals

Minor pods of chromite are present locally in ultramafic rocks of the Cache Creek Complex but the mineral is more commonly present in only accessory amounts. On the shore of a small lake about 4.5 km west of Koshin River, nickel occurs in millerite within an opalized and pyritized, northwest-trending fault zone. The deposit appears to have little economic potential.

Stikinia

Many copper showings have been found in the volcanic and plutonic rocks of Stikinia but few have been extensively explored. Copper and molybdenum are closely associated with the northern and western margins of the Hotailuh batholith and with the Kaketsa Pluton. Chalcopyrite is ubiquitous in volcanic rocks in the area between Tanzilla River and the Grand Canyon of the Stikine River. Bornite and chalcocite occur in shear zones in Lower Jurassic tuff east of McBride River. Gold and silver are present in Upper Triassic or Lower Jurassic volcanic rocks near their contact with Lower Jurassic sedimentary rocks also east of McBride River.

Copper and molybdenum

Most of the copper occurrences in Stikinia have characteristics common to porphyry-type deposits. The dominant, primary minerals are pyrite and chalcopyrite but molybdenite is a common, though minor, component. They occur in shear zones or stockworks mainly in volcanic rocks of the Stuhini Group but, in places, within the adjacent plutonic rocks. Some appear to be feldspar phyric porphyries typical of porphyry-feldspar deposits (e.g., Fig. 84, locations 5, 18, 24, 26). The plutons range in composition from hornblende diorite to monzodiorite and syenite and in age from Late Triassic to Middle or Late Jurassic. In many localities a distinct pink alteration results from the introduction of potassium feldspar or the presence of finely disseminated hematite (e.g., several prospects in the Kaketsa Pluton area described by Panteleyev, 1972). Epidote, siderite, ankerite, sericite, and clay minerals are typical alteration minerals. North of the Hotailuh batholith spectacular gossans are associated with strongly bleached and pyritized volcanic rocks.

On Dudidontu River, between Ketchum and Camp lakes, chalcopyrite and hematite occur in highly fractured, potassium-rich plutonic rocks (Panteleyev, 1972). Specular hematite is abundant and ankerite is an abundant vein mineral. On the east side of Kaketsa Mountain, steep, northwesterly trending fracture zones in an enclave of Stuhini Group volcanic rocks contain pyrite and chalcopyrite (Panteleyev and Dudas, 1972). There, also, specular hematite is common.

Several copper showings have been investigated in the Hotailuh Range where they occur in Stuhini Group volcanic rocks near contacts with the Pallen Creek Pluton and a syenitic to dioritic pluton northwest of Hluey Lakes (Fig. 84, location 13). Small amounts of molybdenite accompanies chalcopyrite. Pink, potassium feldspar and green epidote are common alteration minerals. The potassic alteration is characteristic of the marginal phase of the Middle Jurassic Three Sisters Pluton.

One of the more extensively explored copper deposits lies just east of Highway 37 and Lower Gnat Lake (Fig. 85, location 1). There, along the northwest flank of the Late Triassic Cake Hill Pluton, in volcanic rocks of the Stuhini Group, chalcopyrite and bornite with pyrite and magnetite occur in a stockwork of veinlets. Alteration minerals include carbonate, sericite, chlorite, tourmaline, potassium feldspar, silica, and hematite. Reserves have been estimated at 22 700 000 t grading 0.44% Cu.

In volcanic rocks of the Stuhini Group near the northern margin of the Cake Hill Pluton a conspicuous gossan zone has resulted from the weathering of disseminated pyrite. The volcanics have been intruded by monzodiorite and numerous feldspar porphyry dykes of probable Middle or Late Jurassic age. Narrow quartz veinlets contain chalcopyrite and molybdenite. The country rock is strongly bleached and, in part, looks almost cherty. The bleaching results from a combination of silicification and sericitization.

Silicified shear zones in well layered, tuffaceous, Lower Jurassic volcanic rocks east of McBride River contain chalcocite and bornite (Fig. 85, locations 15, 16). To the west, feldspar porphyry along the southeast side of the McBride River Pluton is mineralized with chalcopyrite, magnetite, and hematite (Fig. 85, location 21). The deposits have many characteristics of porphyry copper occurrences.

Gold and silver

Gold and electrum are localized in quartz veins within Upper Triassic or Lower Jurassic volcanics east of McBride River about 12 km south of Turnagain Lake (Fig. 85, location 88). Parallel with the northeast-trending zone of quartz veins is a set of shear zones which contain minor amounts of galena and sphalerite.

Overlap assemblages

Some of the mineral deposits related to overlap assemblage plutons have been noted above, e.g., scheelite which occurs in skarn next to the Cassiar batholith. In this case the host rocks are clearly part of Ancestral North America. Elsewhere, chalcopyrite, molybdenite, and minor scheelite occur in veinlets occupying fractures in granite and feldspar porphyry of the Late Cretaceous Snow Peak Granite (Fig. 84, location 14). Massive pyrite and pyrrhotite, with some chalcopyrite, was noted at the southwest end of the Late Cretaceous Little Eagle Pluton where it is in contact with limestone of the Cache Creek Complex (Fig. 85, location 20). Fluorite occurs locally along the northeast margin of the Major Hart Pluton where it is in contact with ultramafic rocks.

No mineral occurrences have been reported from the Bowser Lake Group. In view of the gold occurrences related to the Cache Creek Group, the source rock for the Bowser sediments, there may be some potential for placer gold in old stream channels within the Bowser Lake Group or in modern streams that cut these rocks.

The Tanzilla Canyon Formation changes facies from coarse, fanglomeratic lithologies in the southeast along and near Tanzilla River to sandstone, claystone, siltstone, and minor conglomerate in the north and northwest. Along Mansfield Creek and nearby along Tuya River, coal seams occur in the lower part of a sequence of claystone, siltstone, and sandstone (Fig. 84, locations 37, 38). In the Mansfield Creek area as many as seven seams are present (Ryan, 1991 and references therein). The lowest and thickest seam ranges from 3.61 to 5.03 m in thickness and contains numerous carbonaceous claystone bands. An overlying seam is from 1.24 to 1.55 m thick. The remaining, thinner seams are separated by partings of mudstone from 5 to 28 m thick. Along Tuya River a lower seam is from 1.45 m thick in the northwest and is from 2 to 3 m thick in the Mansfield Creek area. It is separated from an overlying seam from 1.5 to 5 m thick by 1.2 m of mudstone. Both seams contain numerous mudstone partings. Several, thin seams occur higher in the sequence.

Analyses of coal from the Mansfield Creek area reveal 11.14% moisture, 24.25% ash, 29.09% volatile matter, 34.30% fixed carbon, 0.46% sulphur, and a calorific value of 4299 calories/g. Inferred coal resource potential is estimated to be as much as 600 million tonnes (Ryan, 1991) with a coalbed methane resource as much as 0.04 trillion cubic feet. Analyses of the Tuya River coal reveals 11.35 to 16.9% moisture, 5.1 to 9.92% ash, 28.36 to 35.6% fixed carbon, and 0.9 to 1.15% sulphur. The calorific value ranges from 9680 to 11 401 BTU per pound (Ryan, 1991). The coals are rated as high volatile sub-bituminous "B" to bituminous "C" in rank.

The coal measures are folded about north-trending axes and are cut by numerous northwest- and northeast-trending faults. Generally, beds dip from 20 to 30° to the east.

Coalified logs are present in the Eocene(?) rocks along Nahlin River but no significant coal seams have been reported.

TECTONIC SUMMARY

Reviews of tectonic evolution in the various terranes are given in the previous sections. This section deals with some of the implications of these data for regional syntheses and emphasizes problems resulting from either an equivocal interpretation of data or a lack of information.

Ancestral North America

The stratigraphy of Ancestral North America suggests that a miogeocline developed along the western, passive, rifted margin of the North American craton in the Late Precambrian. The abrupt westward thinning of most stratigraphic units and their change from platformal to off-shelf facies is well illustrated in northeastern Cry Lake map area (Fig. 27). Until accurate determinations can be made of displacements along Kechika and Burnt Rose faults (Gabrielse, 1963, 1985) and faults along the Northern Rocky Mountain Trench, however, a more comprehensive analysis of the miogeoclinal wedge in the northern Cordillera will not be possible.

The classic, continental margin deposition in Cry Lake and nearby map areas was brought to a close with tectonism that occurred the full length of the North American Cordillera in early Late Devonian time. The nature of this event is not fully understood although its effects in the miogeoclinal region are clear. In the western part of the northern Rocky Mountains the event is marked by the widespread deposition of black, in part baritic and pyritic shale, locally host to sedimentary exhalative lead-zinc deposits. These rocks are overlain by chert pebble conglomerate of western and northwestern derivation. In places there is a significant unconformity beneath the chert pebble facies. Locally, the clastic succession is overlain by limestone correlative with the Mississippian Prophet Formation which is widespread in the northern Rocky Mountains. Northeast of the Burnt Rose Fault (Gabrielse, 1963) the stratigraphy of the miogeoclinal rocks is much like that in the western, northern Rocky Mountains, including the presence of a Prophet Formation-like limestone unit. In the Cassiar Mountains the base of the limestone is a marked unconformity on Silurian siltstone. Between Burnt Rose and Kechika faults the stratigraphic succession contrasts with that to the northeast in having a well developed Silurian and Devonian carbonate platform facies. A significant unconformity beneath Devonian clastic rocks has not been observed. Finally, in transitional platform to off-shelf facies of Silurian and Devonian age southwest of Kechika Fault, pyritic black shale of early Late Devonian age conformably overlies early Late Devonian limestone. To the northwest, near the northern end of the McDame Synclinorium, a thick conglomerate of Late Devonian to Mississippian age was deposited on previously uplifted and karsted McDame Formation carbonates.

The stratigraphic relationships described above are similar to those in the Pelly Mountains (Gordey, 1981) and in Selwyn Basin (Gordey et al., 1987, 1992). They have been ascribed to extension along the western margin of the miogeocline. There is now abundant evidence, however, that farther west along the entire length of the Cordillera, tectonism, including intense deformation, plutonism, and metamorphism occurred at about the same time as extension in the miogeoclinal region. In the Cry Lake map area evidence for these events is contained in rocks assigned to the Kootenay(?) Terrane. Unfortunately, their paleogeographic position relative to Ancestral North America is unknown. They may have formed far to the south and have been transported northerly with the Slide Mountain Terrane between Permian and Jurassic time (Richards et al., 1993). Alternatively, they may represent a distal part of the miogeocline in the northern Cordillera juxtaposed with the Slide Mountain Terrane during Mesozoic contraction.

The Cassiar batholith, emplaced into Ancestral North American rocks has important tectonic significance for the evolution of the northern Cordillera. Extending from the Wolf Lake map area in southern Yukon Territory (Poole, 1956) into Kechika map area (Gabrielse, 1962a, 1963) it represents an enormous mass of sialic crust presumably derived from continental basement of the miogeocline. The batholith seems far removed from any possible subduction zone at the time of its formation in the Early Cretaceous and, therefore, was probably not directly related to subduction. More likely, it was derived from the melting of sialic basement greatly thickened during Mesozoic deformation.

Deformation of the miogeoclinal rocks in the Cry Lake area included the formation of important westerly verging structures exemplified by the Four Brothers Nappe. This structural style occurs throughout the Omineca Belt from at least southern Yukon Territory (Murphy, 1988) to the 49th Parallel. Nappe-like structures, implying considerable shortening are present southwest of Kechika Fault in Kechika map area (Mansy, 1986), in the Cariboo Mountains (Raush Nappe, Murphy, 1987), northern Selkirk Mountains (Scrip Nappe, Simony, 1992), and in the southern Kootenay Arc (Riondel Nappe, Fyles and Hoy, 1992). All of these structures were developed relatively early in the Mesozoic contraction of the western part of the miogeocline and are generally assumed to reflect the collision of Ancestral North America with terranes to the west. Based on relationships between regional metamorphism and structures in map areas to the southeast (Mansy, 1986) it seems probable that initial metamorphism of the miogeosynclinal rocks was of mid-Jurassic age, predating the contact metamorphism related to Early Cretaceous plutons.

Mineral occurrences in Ancestral North America are mainly related to the emplacement of sialic, plutonic rocks. No sedimentary exhalative deposits have been noted in the lower Paleozoic rocks of the Cry Lake map area.

Slide Mountain and Kootenay(?) terranes

The Sylvester Allochthon, comprised of the Slide Mountain and Kootenay(?) terranes was emplaced onto Ancestral North America probably in the Early to Middle Jurassic (Fig. 34). The Slide Mountain rocks are mainly of oceanic affinity but are of unknown paleogeographic origin. Local influxes of minor quartzose sandstone and pebble conglomerate indicate cratonal sources although whether they were nearby or distant is not known. Judging from the abundance of structurally superimposed stratigraphic units of different character, the width of the Slide Mountain ocean must have been considerable (Harms, 1986).

Intrusive and structural relationships in Cry Lake map area show that the oceanic Slide Mountain Terrane evolved into an island arc environment during the Pennsylvanian and Permian. In the McDame map area, calc-alkaline volcanics of these ages have been described from several localities by Nelson and Bradford (1993) who compared them with rocks assigned to the Harper Ranch subterrane in the southern Canadian Cordillera. In this report they are considered to be an integral part of an evolving Slide Mountain Terrane with which they are in intrusive and depositional contact.

In contrast to the relationship between oceanic and island arc rocks of the Slide Mountain Terrane is the faulted contact between the Slide Mountain and Kootenay(?) terranes. Rocks in these terranes reveal a markedly different tectonic history, shown by differences in structural style, plutonism, and metamorphism (Gabrielse et al., 1993; Harms et al., 1993). How the terranes were juxtaposed is unknown. An interpretation, placing Kootenay(?) rocks west of some Slide Mountain rocks before Mesozoic contraction (Fig. 34), is purely hypothetical. It seems equally possible that the Kootenay(?) rocks represent a distal facies of Ancestral North America which were thrust westward over Slide Mountain strata before the combined terranes were transported eastward over Ancestral North America.

A detailed study of the lithology, structure, metamorphism and plutonic history of the Kootenay(?) Terrane is warranted. In particular, the relationship of the ultramafic rocks to the adjacent rocks is poorly understood. Potassium-argon determinations on bordering amphibolite suggest an early Mississippian age (Gabrielse et al., 1993). For comparison, a gabbro-trondhjemite body associated with a large ultramafic complex in the Slide Mountain rocks at Zus Mountain in the McDame map area has yielded an Early Permian zircon age (Gabrielse et al.,1993). Possibly, the Cry Lake Kootenay(?) rocks represent a mixture of sediments distal to Ancestral North America and oceanic crust developed during spreading in a Late Devonian and an Early Mississippian ocean.

One of the great enigmas concerning the Slide Mountain Terrane is its palaeographic position relative to the oceanic Cache Creek Terrane. Perhaps they were once part of a single ocean, so large that it embraced different climatic zones reflected in the different faunas of the two terranes. Further paleomagnetic research, particularly on the rocks of the Kutcho Formation in the Cache Creek Terrane, might prove informative.

Quesnellia

The character of the basement to the island-arc, plutonic, and volcanic rocks of Quesnellia is unclear (Fig. 38). The composition of the plutonic rocks, showing increasing potassium and silica content with decreasing age culminating in the emplacement of granite in Early Cretaceous time, suggests an increasing contribution from underlying sialic crust. The Upper Triassic arc may have formed in an oceanic environment but as the rocks were emplaced onto Ancestral North America during Jurassic time, volcanism ceased and plutonic rocks became more and more sialic. Sedimentary rocks of the Nazcha Formation were derived from the uplifted arc in Early Jurassic time.

The Eaglehead Pluton, essentially unfoliated except along its southwestern boundary, is similar in age and composition to the Simpson Peak and Nome Lake batholiths and Plate Creek stock in Jennings River map area (Gabrielse, 1969). All of these Early Jurassic plutons were emplaced into previously deformed strata. Their undeformed texture contrasts to strongly foliated Late Triassic plutons suggesting an intervening episode of tectonism.

Rocks of uncertain terrane affinity between Flat and Faulkner creeks require detailed study to determine their age and structural relations. The Turnagain ultramafic body is most likely of Triassic age but it appears to be largely bounded by faults and may be part of a relatively small thrust sheet.

Emplacement of Quesnellia is assumed to have been roughly coeval with the emplacement of the Slide Mountain and Kootenay(?) terranes onto Ancestral North America (Fig. 34).

Cache Creek Terrane

The Cache Creek Terrane is bounded to the north by the Thibert Fault and to the south by the King Salmon Fault. Except for limestone in the French Range the strata are poorly dated. With the use of conodont and radiolarian biostratigraphy, careful sampling might clarify the age range of the pre-Kutcho Formation rocks within the terrane. Except for the Upper Triassic greywacke south of Thibert Fault in the Dease Lake map area, ages for the Cache Creek Complex, established mainly in Dease Lake map area and map areas farther northwest, range from Mississippian through Permian (Monger, 1975). This is comparable to that of the Sylvester Complex of the Slide Mountain Terrane which, however, seems to include little or no Upper Permian strata.

The regional distribution of Cache Creek rocks coupled with the relatively high heat flow in a borehole on the east side of the middle of Dease Lake (T. Lewis, pers. comm., 1970) probably reflecting the presence of underlying Stikinia plutons, suggests that the Cache Creek Terrane is preserved as an allochthon completely underlain by Stikinia. This supports a similar conclusion by studies in the Teslin map area of southern Yukon Territory by Gordey and Stevens (1994).

Recent work by Childe and Thompson (1995) suggests that the chemistry of the Kutcho Formation favours a rift or unusual volcanic island-arc origin in a Cache Creek oceanic environment. The assignment of the Inklin and Sinwa formations to the Cache Creek Terrane, however, is more debatable. If the Inklin Formation in Dease and Cry Lake map areas can be tied to the Takwahoni Formation, as suggested by Souther (1971), then it should be regarded as an overlap succession. Until that can be done its spatial relationship to the Cache Creek Terrane indicates that, at least, it was deposited on Cache Creek basement.

If, as seems likely, the Cache Creek and Slide Mountain terranes are completely allochthonous relative to their basements, the most probable candidate for a root zone is the Thibert Fault. Structures verge away from the fault so that those in Quesnellia and at the base of the Sylvester Allochthon verge to the northeast and those in the Cache Creek Terrane verge to the southwest.

Stikinia

The dominantly Triassic and Jurassic volcanic and plutonic, island-arc rocks, overlying upper Paleozoic strata, are characteristic of the northern and eastern margins of Stikinia. Uplift of Stikinia in earliest Jurassic time is documented by regional unconformity. The location of subduction zones during this time are unknown but the concept that they contributed to the diminution and final elimination of the Cache Creek ocean is compelling.

Structural and sedimentological data documenting the collision of Stikinia with the Cache Creek Terrane are abundant (Fig. 56). It is clear from structures along the King Salmon Fault that they formed as the result of relative north to south overthrusting of the Cache Creek Terrane onto Stikinia. Uplift of the Cache Creek rocks is recorded in the enormous volume of overlap, Middle and Upper Jurassic sediment deposited to the south in the Bowser Basin. The extent of sedimentary fill in the basin attests to the great contraction of Cache Creek strata that must have occurred during collision. The relative northerly movement of Stikinia lasted until latest Jurassic or earliest Cretaceous time (C.A. Evenchick, pers. comm., 1995).

Overlap assemblages

Overlap assemblages, including those of the Bowser Lake Group, record the change to nonmarine environments in the region. The Bowser Lake Group formed in response to uplift during the collision of Stikinia with the Cache Creek Terrane. The Sustut Group, on the other hand, documents uplift within the Omineca and Intermontane belts as the result of tectonic activity centred in the Coast and Insular belts far to the west (Evenchick, 1991). Eocene sedimentary and volcanic rocks clearly reflect local uplifts and depressions caused by faulting. The upper Cenozoic volcanic rocks were emplaced on peneplaned surfaces exemplified by the Kawdy Plateau. Their distribution has been attributed to regional strain related to the dextral displacement of the Pacific Plate relative to the North American Plate (Souther, 1992a, b).

The regional tectonics associated with Middle Jurassic to Eocene plutons is speculative to the extreme. Middle Jurassic plutons of the Three Sisters Suite are the oldest that clearly cut across terrane boundaries. They may be the youngest rocks directly related to subduction which eliminated the Cache Creek oceanic basin. The origin of the Early Cretaceous plutons was discussed above. Late Cretaceous plutons of the Surprise Lake Suite are widespread in northern British Columbia and southern Yukon Territory (Woodsworth et al., 1992). They occur in a northwest-trending belt in the Intermontane Belt and a north-northwest-trending belt along the east side of the Coast Belt. Only in the latter are they accompanied by volcanics. Their distribution may be related to plate interactions along the Pacific margin of the continent. Eocene volcanics and related plutons are commonly along or near faults suggesting regional dextral strain.

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APPENDIX 1

Stratigraphic sections in Dease Lake (104J) and Cry Lake (104I) map areas

Section 1.	Rosella Formation. North of Major Hart River; upper part 58°55'45"N, 128°26'45"W; upper middle part 58°55'30"N, 128°26'15"W; lower middle part 58°56'N, 128°26'45"W; lower part 58°56'15"N, 128°27'W; Measured by W.H. Fritz, 1977 (GSC Report 19-1979-WHF).

Unit	Description	Thickness (m)	Total from base (m)
	Kechika Formation		
17	Shale, fresh and weathered surface silvery medium light grey.	not measured	
16	Siltstone, medium rust-brown weathering, medium grey on fresh surface.	61 estimated	953.4
	Rosella Formation		
15	Limestone, medium blue-grey weathering, thick bedded, fresh surface medium grey, finely crystalline; changes laterally to dolostone, cream on weathered and fresh surfaces, thick bedded, finely crystalline.	53.6	892.2
14	Dolostone, interval 0-6.7 m light pink, cream weathering, medium- and thick-bedded, fresh surface medium dark grey, finely crystalline; 6.7-102.4 m light brownish-grey, pink, cream-orange weathering, thick to thin (6.7-46.0 m) and thick (46.0-102.4 m) bedded with possible bioherms just below 102.4 m level, fresh surface medium dark grey, finely crystalline. Some chert present above 29.3 m level; interval 102.4-161.5 m dull pinkish-orange, cream-grey weathering, thick bedded, fresh surface medium grey, medium crystalline, some white chert present as 0.32 cm thick blebs. At 120.4 m diabase sill, 1.8 m thick.	161.5	838.8
13	Dolostone, weathering surface dull light orange and medium brown, bedding thick and medium, partings wavy, fresh surface medium dark grey; finely crystalline and medium crystalline, recrystallized oölites (?) at 19.8 m, *Girvanella*? present in float. Also at 19.8 m is 1.5 m of limestone laterally grading to dolostone. Limestone is medium dark grey and medium brownish-grey, mottled, medium bedded, fresh surface medium dark grey, finely crystalline.	33.2	677.3
12	Limestone and shale. Limestone in interval 0-5.8 m and in 2/3 of interval 5.8-16.2 m, medium grey weathering, thin- to thick-bedded, partings orange mottled, fresh surface dark grey, finely crystalline; intervals 18.0-27.1 m and 32.6-46.6 m medium light grey weathering, thin to thick partings, planar laminated, fresh surface dark grey, finely crystalline, interval 46.6-54.3 m 1/3 medium grey weathering, bedding thin, wavy, medium dark grey on fresh surface, finely crystalline. Shale in interval 5.8-16.2 m (1/3), medium light grey, medium light brown weathering, medium light grey, fresh; interval 16.2-18.0 m orange to medium light brown, medium brown fresh; interval 27.1-32.6 m medium brown to light grey weathering, light grey fresh; 46.6-54.2 m (2/3) medium reddish-brown weathering and fresh silty, limy.	54.3	644.1
11	Mostly shale, intervals 0-8.2 m, 10.7-19.8 m light brown weathering and fresh, in plates 0.3 x 3.81 x 7.6 cm; interval 19.8-32.0 medium light grey, medium brown weathering, medium light grey fresh. Limestone present in interval 8.2-10.7 m, medium grey and orange weathering; bedding thick, irregular, fresh surface medium dark grey, finely crystalline. Minor interbedded limestone in intervals 10.7-19.8 m and 19.8-32.0 m, orange weathering, bedding thick to thin (10.7-19.8 m) and medium to thin plus thin lenses (19.8-32.0 m), fresh surface medium, dark grey, finely crystalline. *Olenellus* sp. (GSC loc. 95221) in middle of unit; *Olenellus* sp.? (GSC loc. 95222) near top of unit.	32.0	589.8

Unit	Description	Thickness (m)	Total from base (m)
10	Limestone, highly sheared, intervals 0-12.5 m, 21.6-28.7 m, 33.5-55.2 m medium light grey weathering, thick bedded; fresh surface medium grey to medium dark grey, finely crystalline; intervals 12.5-21.6 m and 28.7-55.2 m, mottled medium light grey and medium dark grey on weathered surface, medium bedded (? most bedding planes destroyed by shearing), fresh surface medium dark grey, finely crystalline. Dolostone in interval 55.2-67.3; light orange to cream weathering, medium and thick bedded, fresh surface medium light grey. Fault present at top of this unit, overlying shale unit removed by faulting, but visible a short distance NW of segment 1B and is present 0.53 km to SE in segment 1C. Diabase sill in subinterval 3.4-4.0 m.	67.3	557.8
9	Limestone, medium grey weathering, bedding medium and wavy (0-7.3 m) and thick (7.3-70.7 m); fresh surface medium dark grey, finely crystalline; above 30.5 m level to top of this section strata highly sheared. Interval 37.5-70.7 m medium light grey weathering, thick bedded, medium grey on fresh surface, finely crystalline.	70.7	490.5
8	Limestone, medium grey weathering; bedding thin, wavy parting thick, mottled with medium light grey dolostone blebs averaging 1.9 cm thick and roughly aligned parallel with bedding, fresh limestone and dolostone medium dark grey, finely crystalline; above 25.0 m level limestone locally replaced by dolostone, light orange to cream weathering, thick bedded, fresh surface light brown, medium dark grey, fine to coarse crystalline.	101.8	419.8
7	Limestone and shale. Interval 0-18.3 m limestone, medium grey weathering, thick (0-7.3 m) and thin to thick (7.3-18.3 m) bedded, fresh surface light brown, finely crystalline. Intervals 18.3-21.3 m, 38.1-42.0 m, and 53.0-59.4 m shale, greenish-grey weathering and fresh. Interval 21.3-25.9 m 1/2 limestone, medium grey weathering, thin bedded, wavy fresh surface light grey, and 1/2 limy siltstone, light orange weathering, light grey fresh. Interval 42.1-53.0 m limestone, light grey weathering and fresh argillaceous and limestone, light orange weathering thin bedded, thick parting. Diabase present in 25.9-38.1 m and 59.4-69.5 m intervals.	69.5	318
6	Mainly siltstone and shale; interval 0-22.9 m siltstone, greenish-grey weathering *Olenellus*? sp. in lowermost beds; interval 29.9-37.5 m shale, rust to light grey weathering, light grey fresh; interval 39.0-42.7 m siltstone, rust to medium greenish-grey weathering, greenish-grey fresh, minor limestone interbeds, interval 0-22.9 m contains five per cent limestone, orange weathering, bedding thin, platy, fresh surface light grey, finely crystalline; interval 22.9-29.9 m dark grey weathering and fresh, bedding thin, finely crystalline; interval 37.5-39.0 m medium grey weathering, thick bedded. Diabase in 42.7-51.8 m interval. *Nevadella* sp. (GSC loc. 95219) in lowest beds. *Olenellus* sp.(?) (GSC loc. 95220) in float from immediately overlying beds.	51.8	248.5
5	Dolostone, light orange- and cream-weathering, fresh surface light grey; interval 0-14.0 m covered, medium bedded (?), finely crystalline; interval 14.0-33.8 m thick bedded, coarsely crystalline.	33.8	196.7
4	Limestone, medium light grey on weathered and fresh surfaces, thick bedded, some beds are planar laminated, finely crystalline, some beds irregular, possible mounds (?).	43.6	162.9
3	Dolostone, light orange weathering, thick bedded, medium light grey on fresh surface, medium crystalline. Interval 0-5.8 m 1/2 limestone, medium grey weathering, and 1/2 limestone as in 26.8-67.1 m subinterval below. Top 1.8 m interval consists of diabase sill.	26.2	119.3
2	Limestone, medium grey weathering, bedding thin and medium (avg. 7.6 cm) platy and broadly wavy, parting thin (0-17.4 m), thin to thick (17.4-26.8 m), thick (26.8-67.0 m); slump breccia in subintervals 6.1-7.3 m, 10.7-11.0 m, small slump folds at 26.8 m, 51.8 m, fresh surface medium dark grey finely crystalline, above 17.3 m weathering of beds alternate between medium light and medium dark grey; slump folds at 51.8 m. Subintervals 2.7-6.1 m, 7.3-9.1 m contain 1/2 limestone in thin lenses and 1/2 siltstone, medium orange-brown weathering, medium dark grey on fresh surface. *Holmiella*-like spines and *Chancelloria* sp. (GSC loc. 95217, 95218) in lowest beds.	67.1	93.1
1	Siltstone, light rust, light silvery grey weathering; also light greenish-grey weathering, medium light grey on fresh surface.	26.0	26.0
	Boya Formation		
	Siltstone, rust to medium light grey and medium brownish weathering; fresh surface medium dark grey; about 1/3 of the unit is quartzite, light brown weathering and fresh, bedding thick, planar laminated, very fine grained.	50.3	-50.3

Section 2.	Road River Formation. South of Turnagain River at 58°38'N, 128°17'W. Measured by B.S. Norford, 1979.

Unit	Description	Thickness (m)	Total from base (m)
	Ramhorn Formation		
15	Limestone, microcrystalline to very finely crystalline, dark grey, weathers dull light grey; bedding 5 to 30 cm. Interbedded with platy limestone (15%). GSC loc. C-83019 189 to 201 m (conodonts).	12	208
14	Platy limestone, dark grey, weathers grey and greyish orange.	10.5	196
13	Dolostone, limy, fine to medium crystalline, brownish olive-grey weathers dull light grey, recessive; bedding 30 cm. Unit largely a covered interval (183-187, 178 to 182.7 m).	7.5	185.5
12	Limestone, dolomitic, very finely crystalline with quartz silt and local layers of quartz sand; grey, weathers light grey and very light grey; bedding 3 to 30 cm. Interbedded calcareous quartz sandstone and quartzite, quartz sand very fine to coarse, subangular to rounded, weathers dull dark grey, thickly lichen covered; beds 10 to 30 cm, mostly laminated, rarely crosslaminated.	22	178
11	Limestone dolomitic with abundant very fine to fine quartz sand, light grey on weathered surface, light olive-grey on fresh surface, bedding 2 to 100 cm, many beds laminated. Lower 2/3 of unit poorly foliated subparallel with bedding (perhaps adjacent to a faulted basal contact). Sparse small nodules of quartz within limestone. Contact with Road River Formation not exposed, may be faulted, because basal sequence of rock unit differs laterally.	15	156
	Road River Formation		
10	Covered interval.	6	141
9	Shale, calcareous, greyish black, weathers greyish black, light olive-grey, and grey; very fissile, very poorly exposed as float and frost-heaved outcrop.	13	135
8	Covered interval.	5	122
7	Shale, graphitic, siliceous, dark grey, weathers dull dark grey, recessive; bedding 1 to 3 cm, mediocre cleavage parallel. Interbedded very fissile shales (10%). Calcareous shale in top third of unit, somewhat platy, bedding 1 to 5 cm, fissility poor, parallel. Unit poorly exposed with frost-heaved outcrops, covered intervals at 100 to 103.5 m, 99.5 to 99.75 m, 98 to 98.5 m. Graptolites throughout, sponge fragments at 108.5 m, (GSC loc. C-83018, 110.5 to 110.6 m; C-83016, 105.0 to 105.3 m; C-83015, 104.4 to 104.5 m, C-83014, 98.5 to 98.6 m; C-83017, float, 102 to 110 m).	19	117
6	Limestone, argillaceous, microcrystalline to very finely crystalline, dark grey, weathers dull dark grey; bedding 1 m, some lamination and somewhat platy weathering at top of unit. GSC loc. C-83013, 96 to 97 m (conodonts).	2	98
5	Covered interval.	15	96
4	Limestone, argillaceous, some with siliceous content, microcrystalline, dark grey, weathers dull olive-grey and dark grey, platy: bedding 5 to 50 cm, some beds laminated, cleavage poorly developed. Sparse shaly interbeds. Lamination reveals shearing and microfolds. Poorly preserved graptolites (GSC loc. C-83012, 75 to 81 m, conodonts; C-83011, float and rare outcrop, 70 to 81 m).	11	81
3	Interval mostly covered but with local float of shale and, at 57 to 59 m, outcrop of calcareous shale, graphitic, greyish-black, weathers dark grey, moderately fissile.	20	70
2	Quartz sandstone, argillaceous, very finely to finely crystalline, dark grey, weathers dull dark yellowish brown, dull olive-grey, off white, with abundant lichens; resistant; bedding 50 to 200 cm, poorly developed. Quartz veins and stringers.	12	50
1	Shale, some calcareous, some siliceous dark grey and greyish black, weathers dark bluish grey, dark grey, with dark yellowish orange stains, recessive; bedding 0.5 to 3 cm, cleavage moderate, parallel. Unit poorly exposed, covered intervals at 22 to 38 m, 14 to 18 m, 2 to 11 m, 0 to 1 m; contact with underlying rocks not exposed.	38	38
	Kechika Group (uppermost beds)		
	Mudstone, calcareous, dark grey, weathers dull grey and lustrous light olive-grey, recessive; thinly bedded. Locally folded.		

Section 3.	Section of undivided transitional facies equivalents of Sandpile (mainly) and Ramhorn formations along north-trending spur above Turnagain River at 58°52'30"N, 127°59'45"W. Kechika map area. Measured by H.H. Geldsetzer, 1983.

Unit	Description	Thickness (m)	Total from base (m)
	Fault zone.		
29	Dolomitic sandstone, brown-grey, thin bedded, platy, to fine sandstone.	94	564
28	Dolostone, brown-grey, bioturbated.	10	470
27	Dolostone, brown-grey, platy, silty.	14	460
26	Dolostone, nodular.	8	446
25	Limestone, light grey, thin bedded, with some silty, sandy interbeds, breccia near top.	28	438
24	Shale, yellow-brown, grey, calcareous, with limestone interbeds.	23	410
23	Limestone, dolostone, shale, medium grey, thin bedded, with calcareous shale interbeds.	37	387
22	Dolomitic shale, shaly dolostone, medium grey to yellow-grey, cherty in part, graptolites. GSC loc. C-95104.	26	350
21	Dolostone, very light grey, bioturbated, algal, some breccia.	13	324
20	Dolostone, pink, yellow, grey, shaly, graptolites.	6	311
19	Dolostone breccia, light grey.	7	305
18	Dolostone, dark grey, shale interbeds.	11	298
17	Dolostone, algal laminations.	38	287
16	Dolostone breccia.	13	249
15	Dolostone breccia, medium grey to light grey.	24	236
14	Dolostone, algal, initial brecciation of lamination.	22	212
13	Dolostone, light grey, finely laminated, algal mounds throughout.	67	190
12	Dolostone, dark grey, laminated, bioturbated.	14	123
11	Dolostone, light grey, laminated, to dark grey, bioturbated.	8	109
10	Dolostone, medium to dark grey, alternating bioturbated and laminated, breccia pockets.	36	101
9	Dolostone, medium grey, bioturbated with brachiopod fragments.	12	65
8	Dolostone, medium grey, nodular, silty, cherty, some breccia.	3	53
7	Dolostone, medium grey, fossiliferous, bioturbated.	16	50
6	Dolomitic sandstone, brown-grey.	2	34
5	Dolostone, medium grey, fossiliferous.	12	32
4	Dolomitic sandstone, yellow-brown, laminated.	4	20
3	Dolomitic sandstone, yellow to grey, bioturbated; separated from unit 2 by unconformity(?).	16	16
2	Dolostone, yellow-grey, bioturbated.	10	-10
1	Limestone, yellow-grey to light grey.	20	-50
	Base not exposed.		

Section 4.	Ramhorn and McDame formations hear headwaters of Ramhorn Creek. Upper part of composite section at 58°30'25"N, 128°22'00"W, lower part 3.2 km to southeast. Description modified from B.S. Norford, 1959.

Unit	Description	Thickness (m)	Total from base (m)
	McDAME FORMATION Upper Member		
4	Limestone, dark grey and light grey, finely crystalline to sublithographic; weathers light grey to grey forming well bedded resistant outcrops; beds 0.3 to 1.2 m thick with some thicker beds in lower part; upper part is thinner bedded, argillaceous and distinctly platy with local argillaceous partings; upper part contains brachiopods (GSC loc. 37269, 37272).	107	472
	Lower Member		
3	Dolostone, dark grey to black and earthy grey, finely to medium crystalline; weathers dark grey and grey; beading rarely conspicuous with beds 0.15 to 1 m thick; most lithologies distinctly fetid; laminated grey and dark grey dolostone common; sedimentary breccia abundant and locally fills channels several metres deep; "spaghetti stone" fairly common; locally abundant fossils e.g., GSC loc. 37267.	180	365
	RAMHORN FORMATION (type section) Upper Part		
2	Dolostone, light to dark grey, finely crystalline; weathers light creamy grey to grey; beds range from 0.15 to 1 m thick; locally distinctly laminated; unfossiliferous.	100	185
	Lower Part		
1	Dolostone and sandstone ranging from laminated, finely crystalline dolostone through sandy dolostone, and dolomitic sandstone to orthoquartzite. Dolostone is finely crystalline to sublithographic and weathers dark grey and light grey; beds are from 0.15 to 0.75 m thick. Orthoquartzite is dark grey to light grey, medium grained with siliceous cement; commonly has tapioca-like texture with rounded, translucent quartz grains, generally less than 1 mm in diameter in a siliceous or dolomitic matrix; beds are from 0.3 to 2 m thick and commonly strongly crossbedded with foreset thicknesses up to 0.5 m; planar crossbeds abundant; local well developed ripple marks; unfossiliferous.	85	85

Section 5.	Section of McDame Formation on north-trending spur along Turnagain River at 58°52'28"N, 127°59'50"W. Kechika map area. Measured by H.H. Geldsetzer, 1983.

Unit	Description	Thickness (m)	Total from base (m)
	McDame Formation		
14	Dolostone, dark grey, stromatoporid buns, amphiporids.	8	257
13	Talus.	19	249
12	Dolostone, medium to dark grey	5	230
11	Dolostone, light grey, laminated.	2	225
10	Dolostone, medium to dark grey, breccia pockets, *Stringocephalus* brachiopods.	30	223
9	Dolostone, dark grey to black, breccia pockets, generally vaguely laminated.	31	193
8	Talus.	13	162
7	Dolostone, light grey, crinoids, sandstone at base.	2	149
6	Dolostone, light grey to medium grey, fossiliferous, stromatoporid buns.	5	147
5	Talus.	24	142
4	Dolostone, medium grey to dark grey, alternating laminated and bioturbated.	18	118
3	Dolomitic sandstone, light grey, laminated.	4	100
2	Quartz sandstone, dark grey.	6	96
	Ramhorn Formation		
1	Dolomitic sandstone, alternating dark grey to yellow-grey, bioturbated, some shale at 71 m, with abundant fine terrigenous dark particles.	90	90

Section 6.	Sedimentary succession in lower part of Stuhini Group. West side of railway cut and west of Highway 37 at 58°16'30"N, 129°51'W. Measured by H. Gabrielse, 1984.

Unit	Description	Thickness (m)	Total from base (m)
	Top Unexposed		
6	Interbedded laminated limestone to dark grey siltstone and fine grained, massive green-grey siltstone-greywacke. Most of exposure shows excellent bedding, as grain size decreases bedding more obvious. Bedding at 69 m 350/47 at 86-90 m last exposure to NNW, on south side bedding 202/45, on north side bedding 038/60. Sharp offsets of as much as 2 cm of laminated beds, synsedimentary faults, do not cut overlying contact. No cleavage associated with fold.	11	90
5	Same green-grey siltstone and greywacke, mainly greywacke, even grained with a few beds of laminated medium to dark grey siltstone. Minor coarse grained clasts in greywacke to 2 cm. Bedding very uniform.	5	79
4	Interbedded laminated limestone to dark grey siltstone to very tough compact conchoidal fracturing argillite and fine grained green-grey massive greywacke, latter in beds to 1 m thick. Mostly argillite, 80%. Contact between greywacke and argillite in places markedly irregular and in others knife sharp, and parallel.	10	74
3	Continuous fresh exposures of mainly massive, poorly bedded, grey, medium- to coarse-grained greywacke. At 45 m conglomerate has clasts of laminated green-grey fine grained sandstone-greywacke to 20 cm x 10 cm, very blocky and angular. Clasts of medium to dark grey siltstone and green weathering greywacke and augite crystals and plagioclase grains. Smaller fragments average 1-2 cm long. At 59-60 cm bed contains chaotic fragments of dark grey siltstone to argillite in green-grey, even grained greywacke matrix - fragments sparse to packed, all angular and irregular shaped 1-15 cm long.	19	64
2	Sparse outcrop of well bedded, interbedded laminated dark grey siltstone to argillite with greenish grey, medium grained greywacke, greywacke in beds to 20 cm thick. Greywacke includes many clasts of shale and siltstone up to 6 cm long irregularly shaped. Some appear to be rip-up clasts. At 33 m, poorly preserved coral(?). Conical belemnoid shaped mold.	15	45
1	Exposures and float of poorly sorted greywacke conglomerate with dark grey-green laminated siltstone. Clasts of shale to 8 cm. In places to 10 cm. Clasts of laminated siltstone. Locally, blocks of fine grained grey massive siltstone to 20 cm x 10 cm, poorly sorted. Matrix even grained grey sandstone. Many grains of augite to 3 mm, euhedral. Rock locally weathers rusty tan but on fresh surface green-grey. Augite bearing rocks are poorly bedded and massive units as much as 2 m thick.	30	30
	Base Unexposed		

Section 7.	Middle, sedimentary succession and lower part, upper volcanic unit of Stuhini Group. South of facing slope of mountain, 5 km east of north end of Lower Gnat Lake at 58°15'00"N, 129°45'30"W. Measured by R.G. Anderson, 1983.

Unit	Description	Thickness (m)	Total from base (m)
12	Rusty, dun-brown-weathering, massive pyroxene porphyry; grades in and out of massive flows and pyroxene-fragment, volcanic conglomerate; minor, black plagioclase porphyry near top of unit.	181.5	466.5
11	Olive-grey and light grey, laminated to thin bedded siltstone.	13.5	285.0
10	Rusty brown, interbedded, fractured pyritiferous black shale and medium grained feldspathic greywacke with distinctive white, siltstone laminae (tuff?) marking the top of greywacke beds.	50.0	271.5
9	Greenish grey to rusty brown shale and sandstone; beds in shale 1-3 cm thick and in sandstone 5-10 cm thick.	9.0	221.5
8	Dark grey porcelainite, hornfelsed, thinly laminated siltstone cut by massive, monzodiorite sill; convolute laminae.	7.5	212.5
	Covered interval.	12.0	205.0
7	Greenish grey to rusty brown greywacke interbedded with fissile, pyritiferous, very fine grained greywacke or siltstone; interlayered, massive bluish-grey greywacke and laminated, black siltstone; rare, recessive weathering concretions.	22.5	193.0
	Covered interval.	34.5	170.5
6	Black and rusty brown sandstone in beds from 3 to 10 cm, 20 to 25 cm, and 60-150 cm thick; siltstone laminae 2 to 5 mm thick in beds 2 to 3 cm thick; load casts, ball-and-pillow and flame structures common.	31.5	136.0
5	Brownish grey, massive, well indurated, medium grained, blue-grey greywacke with rare, white, wispy siltstone (tuff?) laminae.	21.0	104.5
4	Light grey, black siltstone; breccia contains white rhyolite and plagioclase porphyry fragments.	3.5	83.5
3	Grey to black, massive, blue-grey greywacke overlain by black siltstone interlaminated with very thin, delicately layered white siltstone laminae.	24.0	80.0
2	Blue-grey to rusty brown pyroxene porphyry decreasing in grain size upward to fine grained at the top.	22.5	56.0
1	Brownish-grey, thinly laminated, siltstone and greenish-grey, medium grained, thin bedded greywacke, interbedded; convoluted siltstone beds beneath unit 2; greywacke has distinctive recessive weathering concretions 0.5 to 1 cm in diameter.	33.5	33.5
	Base Unexposed		

Section 8.	Unnamed Triassic/Jurassic volcanic succession on south face of ridge west of McBride River at 58°10'30"N, 128°04'45"W. Measured by R.G. Anderson, 1983.

Unit	Description	Thickness (m)	Total from base (m)
17	Grey, massive, fine- to medium-grained porphyry.	54.0	684.0
16	Maroon; basal, homogeneous plagioclase porphyry with 2-3% round plagioclase porphyry fragments grading up into volcanic conglomerate consisting of light and dark grey and maroon plagioclase porphyry fragments.	60.0	630.0
15	Reddish-brown, predominantly light to dark grey, plagioclase porphyry; fragments vesicular or amygdaloidal.	24.0	570.0
14	Maroon to grey, fine- to medium-grained plagioclase porphyry with 5-7% quartz and epidote-filled amygdules.	18.0	546.0
13	Maroon, predominantly grey, fine grained, plagioclase porphyry with minor, fine grained maroon siltstone fragments.	22.5	528.0
12	Light grey to grey, locally maroon, massive, locally moderately to highly vesicular, fine- to medium-grained plagioclase porphyry; thin breccia subunit with fine grained maroon volcanic matrix; plagioclase phenocrysts form 40% of rock at base and 15 to 20% at top of unit; minor lapilli breccia; vesicles more common at base of unit (10-15%) and almost absent at top.	118.5	505.5
11	Dark greenish-grey to maroon grey, chloritized, pyroxene(?)-plagioclase porphyry at base grading upward to fine grained plagioclase porphyry(?).	32.0	387.0
	Covered interval.	7.5	355.0
10	Dark grey to purplish-dark grey, pink alkali feldspar porphyry with 15 to 20% fine grained to medium grained alkali feldspar phenocrysts in dark, fine grained matrix.	127.5	347.5
9	Purplish-grey, massive, fine grained alkali feldspar porphyry.	21.5	220.0
8	Maroon to light grey, medium grained plagioclase porphyry; individual flow units distinguished by increase or decrease in plagioclase phenocryst content, physiographic expression or, less distinctly by groundmass colour; local vesicular intervals.	102.0	198.5
7	Maroon, laminated mudstone.	0.5	96.5
6	Grey to maroon, medium grained plagioclase porphyry.	39.0	96.0
5	Maroon to brick red, faintly bedded, fine grained siltstone to fine grained sandstone overlain by fine to medium grained, lithic crystal tuff or tuffaceous greywacke; scour structured in siltstone.	24.0	57.0
4	Maroon to light grey, medium grained plagioclase porphyry and maroon grey, fine grained andesite.	18.0	33.0
3	Amygdaloidal lava.	3	15.0
2	Maroon grey, massive tough, fine grained andesite.	7.5	12.0
1	Maroon, massive amygdaloidal lava.	4.5	4.5

Section 9.	Takwahoni Formation. Basal part east of McBride River; 129°00'W, 58°08'30"N. Measured by H.W. Tipper, 1977.

Unit	Description	Thickness (m)	Total from base (m)
	(Overlain by Pliensbachian rocks)		
	Fault.		
3	Cobble-pebble conglomerate with granitic clasts overlies limestone clast conglomerate with Triassic volcanic clasts, in turn overlies limestone pebble conglomerate, tuff breccia, and limestone clast conglomerate.	305-447	548-751
2	Shale, minor tuff, overlies tuff-shale unit, overlies tuff and laminated tuff-argillite.	91-152	243-304
1	Conglomerate with limestone clasts and Triassic volcanic clasts; tuff, minor shale.	152 ±	152
	Probable unconformity, not seen.		
	Presumably Triassic volcanics and volcanic sediments.		

Section 10.	Takwahoni Formation east of McBride River. Sinemurian rocks at 58°08'30"N, 128°58'W. Measured by H.W. Tipper, 1977.

Unit	Description	Thickness (m)	Total from base (m)
	(Overlain by Pliensbachian rocks)		
	Fault.		
5	Breccia and tuff, massive dark green to grey-black, andesitic to basaltic; age uncertain.	91+	761+
4	Shale, dark grey with rare interbedded greywacke beds; some beds tuffaceous but mainly shale (*Paltechioceras*).	213	670
3	Breccia, volcanic, tuff-shale, overlies limestone clast conglomerate, overlies 15 m thick breccia and limestone, breccia and conglomerate breccia.	305	457
2	Shale-tuff-breccia interbedded, shale predominates.	91+	152
1	Breccia, tuff conglomerate, limestone pebble conglomerate.	61	61
	Unconformity.		
	Upper Triassic limestone.		

Section 11.	Takwahoni Formation. On west side of ridge north to creek east of McBride River at 58°10'N, 129°02'W. Toarcian section on west side of central ridge, north to creek. Measured by H.W. Tipper, 1977.

Unit	Description	Thickness (m)	Total from base (m)
	Top not exposed.		
19	Black shale, sooty, with wood fragments, no banding.		802.5+
	Fault.		
18	Shale, 30-50 cm thick bands, interbedded with brown greywacke; (GSC loc. 95265) (shale).	50	802.5
17	Greywacke, massive, and tuff becoming more tuffaceous upward; a few rhyolite tuff bands, 20 cm thick, near top of unit.	130	752.5
16	Tuff-shale, crumbly, dark grey, weathers rusty.	30	622.5
15	Greywacke-tuff, massive beds of blue-grey tuff, weathers buff; 2 or 3 thin interbeds of black fissile shale.	91.5	592.5
14	Pebble conglomerate, clasts mainly volcanic; minor greywacke.	12	501
13	Sandstone-greywacke, interbedded, minor gritty conglomerate and rare thin shale; greywacke weathers brown, limy weathering with rough surface; beds may be tuffaceous.	55	489
12	Siltstone and minor greywacke dark grey, weathers rusty.	5	434
11	Greywacke, conglomerate and minor shale interbedded; greywacke is fine, brittle; conglomerate is mainly volcanic clasts, well-rounded and sparse, up to 7.5 cm in diameter with interbedded gritty sand.	10	429
10	Shale, grey, finely laminated with tuff silt interbeds, fossiliferous (GSC loc. 95264).	6	419
9	Conglomerate, coarse, limestone clasts and abundant volcanic clasts; top is a fine pebble conglomerate.	25	413
8	Shale, dark grey-black, recessive, fossiliferous (GSC loc. 95261).	15	388
7	Conglomerate with predominantly limestone clasts, some sandy beds closely interbedded.	35	373
6	Shale, crumbly, squeezed, sheared.	3?	338
5	Conglomerate band, as before, but limestone clasts are finer; one interbedded sand bed, 1 m thick.	10	335
4	Shale-siltstone-sand, finely banded dark grey, interbedded with shale-siltstone-sand laminae, fossiliferous (GSC loc. 95263).	5	325
3	Conglomerate, massive, coarsest at base to pebble conglomerate at top but generally poorly sorted; clasts mainly fine grained, grey massive limestone, generally not recrystallized, irregular shape, up to 1/2 m diameter, commonly the largest; granitic clasts are low mafic quartz diorite; volcanic clasts are rhyolite, andesite, reddish tuff; some chert, some greywacke; near top sandy beds grading to pebble conglomerate to sand; beds more massive downward.	100+	320
	Offset in section		
2	Shale-siltstone, brownish-grey, friable, sheared.	20+	220
1	Breccia-conglomerate, massive beds of greenish volcanic breccia with greenish clasts of andesite, porphyry, a few limestone clasts, a few chert pebbles, rare beds of pebble conglomerate and beds of shale, as much as 15 cm thick.	200+	200

Section 12.	Partial section of Bowser Lake Group east of Tucho River at 58°04'30"N, 128°08'W. Measured by H.W. Tipper, 1977.

Unit	Description	Thickness (m)	Total from base (m)
6	Pebble conglomerate and minor grit; closely packed, well rounded to subrounded pebbles, poorly sorted in a minor greywacke matrix, up to 3 cm in diameter, most <3 mm, totally disoriented; clasts are dark grey to blue-grey argillite or chert, grey-green acid volcanic or chert, grey chert, rare jasper, limestone clasts uncommon; well to poorly cemented grades downward into greenish coarse greywacke or fine grit.	9.1	66.25-80.75
5	Tuff, reddish brown, vuggy banded, fine grained.	3.05	67.15-71-65
4	Tuff, reddish, no banding but commonly with small, irregular grey limestone masses.	6.1	64.1-68.6
3	Flow or tuff, fine, reddish grey, heavy; may grade into fine tuff from a fine greywacke.	4.6-9.1	58-62.5
2	Tuff, darker than unit 3, fine, red-grey to grey.	22.9	53.4
1	Breccia or tuff, red-grey to grey, with fragments up to 2 or 3 cm in size.	30.5	30.5

APPENDIX 2

Fossil localities

Fossil localities listed below are mainly from Cry Lake and Dease Lake map areas but also include some unpublished localities from adjacent map areas which have a direct bearing on the geology described in this report.

Lower Cambrian

GSC loc. 28784 Approximately 16.1 km WSW of Deadwood Lake, at 58°59′50"N, 128°31′30"W.

Bonnia sp.
Kootenia sp. (7 spines)
Olenellus cf. *O. peurtobancoensis* (Lochman, 1952)
cf. *Pachyaspis* sp.
cf. *Palaeolenella* sp.
Zacanthopsis sp.

Strata just structurally above contact with lustrous slates contains the better preserved fauna consisting of numerous trilobite fragments. The collection indicates a high position within the Lower Cambrian *Bonnia-Olenellus* Zone. The dark grey, finely crystalline matrix is atypical for the Rosella Formation. However, the age indicates these strata are part of the mainly light grey Rosella Formation and below the unconformity separating the Rosella from the overlying Kechika Formation.
Age: Early Cambrian.
Identification and comments by W.H. Fritz

GSC loc. 28785 On ridge immediately northwest of Major Hart River at 58°55′00"N, 128°24′00"W.

archaeocyathids?
Olenellus sp.
Salterella? sp.
Wanneria-like pattern on fragment

The questionable presence of archaeocythids and *Salterella*, plus *Wanneria*-like pattern, suggests this collection is from the medial part of the *Bonnia-Olenellus* Zone.
Age: Early Cambrian.
Identification and comments by W.H. Fritz.

GSC loc. 95217 Ridge northwest of Major Hart River at 58°56′15"N, 128°27′00"W.

trilobite fragments including large, curved *Holmiella*-like spines

Age: Early Cambrian, *Nevadella* Zone
Identification by W.H. Fritz.

GSC loc. 95218 Same as GSC loc. 95217, but about 5 m higher stratigraphically.

Chancelloria sp.

Age: Early Cambrian, *Nevadella* Zone.
Identification by W.H. Fritz.

GSC loc. 95219 Same locality as GSC loc. 95217, about 170 m higher stratigraphically.

Nevadella sp.

Age: Early Cambrian, *Nevadella* Zone.
Identification by W.H. Fritz.

GSC loc. 95220 Same locality as GSC loc. 95217, about 175 m higher stratigraphically.

Olenellus? sp.

Age: Early Cambrian *Bonnia-Olenellus* Zone.
Identification by W.H. Fritz.

GSC loc. 95221 Ridge northwest of Major Hart River at 58°55′54"N, 128°26′15"W.

Olenellus sp.

Age: Early Cambrian *Bonnia-Olenellus* Zone.
Identification by W.H. Fritz.

GSC loc. 95222 Same locality as GSC loc. 95221, about 10 m higher stratigraphically.

Olenellus? sp.

Age: Early Cambrian *Bonnia-Olenellus* Zone.
Identification by W.H. Fritz.

Ordovician

GSC loc. 28827 Cry Lake map area immediately southeast of Major Hart River at 58°52′42"N, 128°24′36"W. Road River Formation.

Tetragraptus sp. indet.
Phyllograptus sp. indet.
?Didymograptus
?Oncograptus

A single faunal zone is apparently represented in this collection which is, however, fragmentary and poorly preserved. Without species determination a zonal correlation is impossible. Nevertheless, the generic determinations permit accurate correlation with the Lower Ordovician Arenig Series of the standard section (Canadian Series in terms of North American terminology).
Age: Lower Ordovician.
Identification and comments by R. Thorsteinsson.

GSC loc. C-72398 Cry Lake map area, about 200 m SE of GSC loc. 28827 at 58°52′10"N, 128°23′55"W. Road River Formation from talus below Ramhorn Formation.

goniograptid.
?*Cardiograptus* sp.
Isograptus sp.

Large *Isograptus* are common in the *Isograptus caduceus* Zone that is well known from the Glenogle and Cloudmaker formations elsewhere in British Columbia (note Davies, 1966).
Age: Ordovician, late Arenig to early Llanvirn.
Identification and comments by B.S. Norford.

GSC loc. 38289 Kechika map area. On southeast-trending ridge 4.0 km northwest of junction of Dall and Turnagain rivers at 58°47′30"N, 127°52′12"W. Above Kechika Formation and immediately below Sandpile Formation.

Cyrtolites sp.
Small orthid brachiopod
Small trilobite with smooth glabella and strong glabellar spine, cf. *Ampyx*
Cryptolithid trilobite, cf. *Tretaspis*
Diplograptus sp.

This sample consists of chips of rock of two interbedded lithologies. The denser black limestone produced fragmentary fossils but clearly indicate a Middle Ordovician age for the rock. A similar *Ampyx,* similar cryptolithid and similar *Diplograptus* occur at Gabrielse's GSC loc. 24193 southwest of Deadwood Lake in the McDame map area, a coincidence too great to be accidental. Thus these beds may be considered the same age.
Age: Middle Ordovician.
Identification and comments by G.W. Sinclair.

GSC loc. C-110088 McDame map area, 1 km NNW of peak, elev. 1910 m southeast of Sandpile Lakes at 59°03′45"N, 128°05′45"W. Road River Formation.

Climacograptus sp.
Dicellograptus sp.
Nemograptus cf. *N. gracilis* (Hall)
?*Orthograptus* sp.

This collection refines previous determinations of Middle Ordovician horizons below the Sandpile Formation in the upper part of dark shales referred to the Road River Formation. Its age is approximately coeval with those of the graptolites reported from near Dease River by Lapworth (in Dawson, 1889).
Age: Middle Ordovician, early Caradoc or latest Llandeilo, gracilis Zone.
Identification and comments by B.S. Norford.

The following Ordovician and Silurian collections were made by C.M. Henderson from Road River Formation strata directly below the Ramhorn Formation on the northeast limb of the McDame Synclinorium in the McDame map area.

GSC loc. C-76029 McDame map area, 20.9 km SE of Good Hope Lake, 59°09′55"N, 129°01′55"W.

inarticulate brachiopod
Diplograptid

Age: Early Ordovician to Early Silurian.
Identification by B.S. Norford.

GSC loc. C-76030 McDame map area, 20.9 km SE of Good Hope Lake, 59°09′55"N, 129°01′55"W.

Biserial graptolite.

Age: Early Ordovician to Early Silurian.
Identification by B.S. Norford.

GSC loc. C-76028 McDame map area, 20.9 km SE of Good Hope Lake, 59°09′55"N, 129°01′55"W.

?*Climacograptus* sp.

Age: Early Ordovician to Early Silurian.
Identification by B.S. Norford.

GSC loc. C-72399 McDame map area 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W.

sponge spicules
?*Orthograptus* sp.
Dicellograptus complanatus ornatus Elles and Wood

Age: latest Ordovician, Ashgill, *D. complanatus ornatus* Zone.
Identification and comments by B.S. Norford.

GSC loc. C-76024 McDame map area, 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W.

Climacograptus sp.
? *Orthograptus* sp.

Age: probably late Middle Ordovician (Caradoc) to Early Silurian.
Identification by B.S. Norford.

GSC loc. C-72397 McDame map-area, 20.9 km southeast of Good Hope Lake, in dolostone between Ordovician and Silurian graptolitic sequences at 59°00′N, 128°35′W.

Indeterminate solitary coral.

Age: Ordovician to Permian.
Identification and comments by B.S. Norford.

Silurian

GSC loc. C-76033 McDame map area, 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W. About 2 m above top of dolostone unit.

Monograptus ex gr. *M. spiralis* (Geinitz)
M. aff. *M. vomerinus* (Nicholson)
M. sp.
Retiolites sp.

Age: Early Silurian, latest Llandovery, *Monograptus spiralis* zone.
Identification and comments by B.S. Norford.

GSC loc. C-76027 McDame map area, 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W. About 3 m above GSC loc. C-76033 and about 5 m above top of dolostone unit.

?Cyrtograptus cf. *?C. canadensis* sp.
Mongraptus ex gr. *M. spiralis* (Geinitz)
M. aff. *M. vomerinus* (Nicholson)
M. sp.
Retiolites cf. *R. geinitzianus* (Barrande)

Age: Early Silurian, latest Llandovery, late *Monograptus spiralis* Zone.
Identification by B.S. Norford.

GSC loc. C-76026 McDame map area, 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W. About 6 m above top of dolostone unit.

Cyrtograptus cf. *C. canadensis* Jackson and Etherington
Monograptus 2 spp.
M. ex. gr. *M. spriralis* (Geinitz)
Monograptus or *Cyrtograptus* sp.

Age: Early Silurian, latest Llandovery, late *Monograptus spiralis* Zone.
Identification by B.S. Norford.

GSC loc. C-76025 McDame map area, 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W. About 8 m above top of dolostone unit.

Cyrtograptus cf. *C. canadensis* Jackson and Etherington
Monograptus 2 spp.
Monograptus or *Cyrtograptus* sp.

Age: Early Silurian, latest Llandovery (late *Monograptus spiralis* Zone) or earliest Wenlock.
Identification and comments by B.S. Norford.

GSC loc. C-76032 McDame map area, 20.9 km SE of Good Hope Lake at 59°09′55"N, 129°01′55"W. About 14 m above top of dolostone unit.

Cyrtograptus sp.
Monograptus sp.

Age: Early Silurian, latest Llandovery or Wenlock.
Identification and comments by B.S. Norford.

GSC loc. C-76031 McDame map area, 20.9 km SE of Good Hope Lake, 59°09′55"N, 129°01′55"W. About 18 m above top of dolostone unit.

Cyrtograptus sp.
?Monograptus sp.

Age: Early Silurian, latest Llandovery or Wenlock.
Identification by B.S. Norford.

GSC loc. C-72400 McDame map area, 20.9 km SE of Good Hope Lake, 59°09′55"N, 129°01′55"W. About 25 m above top of dolostone unit.

Monograptus sp.

Age: Silurian.
Identification by B.S. Norford.

GSC loc. C-95103 Head of Ramhorn Creek, 2.5 km SE of 1949 m peak at 58°48′54"N, 128°19′06"W.

Climacograptus sp.
?Glyptograptus sp.
Monograptus 3 sp.

The presence of monograptids with curved rhabdosomes and subtriangulate thecae indicates a probable Middle Llandovery age. The occurrence below the ?Devonian Ramhorn Formation, separated by a 20 m covered interval, indicates that the normal Sandpile Formation (mostly Late Llandovery) is absent. Perhaps the covered interval is underlain by Late Llandovery shales as in the McDame section 20.9 km southeast of Good Hope Lake.
Age: Early Silurian, Llandovery, probably Middle Llandovery.
Identification and comments by B.S. Norford.

The following collections were made and identified by B.S. Norford from a Road River Formation section on a south facing slope south of Turnagain River at 58°38′N, 128°17′W.

GSC loc. C-83011 Talus collection between 70-81 m above base.

?Protospongia sp.
Monograptus 2 spp.

Age: Early Silurian (Llandovery).

GSC loc. C-83014 Same locality as GSC loc. C-83011. Between 98.5 and 98.6 m above base.

Monograptus sp.
M. ex gr. *M. spiralis* or *Cyrtograptus* sp.
Retiolites sp.

Age: Early Silurian probably *Monograptus spiralis* Zone.

GSC loc. C-83015 Same locality as GSC loc. C-83011. Between 104.4 and 104.5 m above base.

Cyrtograptus cf. *C. canadensis* Jackson and Etherington
Monograptus spp.
M. ex gr. *M. spiralis* (Geinitz)
Retiolites sp.

Age: Early Silurian, *sakmaricus-laqueus* Zone.

GSC loc. C-83016 Same locality as GSC loc. C-83011. Between 105 and 105.3 m above base.

Cyrtograptus cf. *C. canadensis* Jackson and Etherington
Monograptus sp.

Age: Early Silurian, *sakmaricus-laqueus* Zone or early Middle Silurian.

GSC loc. C-83017 Same locality as GSC loc. C-83011. In talus between 102 and 110 m above base.

Cyrtograptus cf. *C. canadensis* Jackson and Etherington
Monograptus 2 spp.
Monograptus ex gr. *M. spiralis* (Geinitz)
Retiolites sp.

Age: Early Silurian, *sakmaricus-laqueus* Zone.

GSC loc. C-83018 Same locality as GSC loc. C-183011. Between 110.5 and 110.6 m above base.

Cyrtograptus cf. *C. laqueus* Jackson and Etherington
Monograptus sp.
Age: Early Silurian, *sakmaricus-laqueus* Zone.
B.S. Norford commented on the fossils collected from this Road River Formation section as follows: "The graptolite faunules from 98.5 to 110.6 m show close similarity to the sequence of faunules that spans the Llandovery-Wenlock boundary at Clearwater Creek, southern Mackenzie Mountains (Jackson and Etherington, 1969). All seem to belong to the latest Llandovery *sakmaricus-laqueus* Zone but the two highest could be Wenlock in that they do not contain *M.* ex gr. *M. spiralis*."

GSC loc. C-95104 Kechika map area east of Kechika Fault, 10 km NNW of mouth of Dall River at 324 m above the base in section at 58°52′30"N, 127°59′45"W.
Monograptus sp.
M. ex gr. *M. spiralis* (Geinitz)
?*Stomatograptus grandis* (Suess)
This is *spiralis* Zone which in central British Columbia is known from just above the fauna normally found in the coralline member of the Sandpile Formation. The presence of a thick, previously unrecognized unit above conventional Sandpile Formation and below the Ramhorn Formation, may represent a very local preservation of younger beds beneath the sub-Ramhorn unconformity or, more probably, the unit may be a facies equivalent of the Sandpile Formation.
Age: Early Silurian, Late Llandovery, *spiralis* zone.
Identification and comments by B.S. Norford.

GSC loc. C-70299 32.2 km NNW of Sharktooth Mountain at 58°53′00"N, 127°58′30"W.
Indeterminate cephalopod
Favositid coral
Age: Silurian or Devonian.
Identification by B.S. Norford.

Devonian

GSC loc. C-70300 Kechika Ranges, east of Kechika Fault at 58°52′30"N, 128°00′45"W.
Amphipora? sp. (recrystallized)
Undet. bulbous stromatoporoid
Coenites? sp.
Although fossil remains are abundant in the sample, the skeletal structures are coarsely recrystallized and in part silicified so that the finer details have been obliterated. The genus *Amphipora* ranges from the Silurian to Jurassic, but is exceedingly common in the carbonate rocks of the Devonian, particularly the Middle Devonian. The genus *Coenites* ranges from the Silurian to Devonian. The relatively large diameter is suggestive of a form common in rocks of Middle Devonian age.
Age: probably Middle Devonian.
Identification and comments by A.W. Norris.

GSC loc. 37267 Southeast end of ridge 3.2 km southeast of 1950 m mountain at 1554 m elevation near head of Ramhorn Creek. 58°48′45"N, 128°19′15"W. McDame Formation, Lower Member.
Talus collection
Rugose coral indet.
Coenites ? sp.
Age: Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37271 Elevation 1745 m at top of ridge, same locality as GSC loc. 37267. McDame Formation, Lower Member.
Favosites sp.
Thamnopora sp.
Stringocephalus sp.
Age: Givetian, late Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37274 Elevation 1762 m on top of ridge. Same locality as GSC loc. 37267. McDame Formation, Lower Member.
Undet. corals
Age: Probably Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37276 Northeast face, SE end of ridge, same locality as GSC loc. 37267. McDame Formation Lower Member.
Cup coral undet.
Age: Probably Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37277 Major Hart River, above north bank; 1.6 km southwest of mouth of Blue Sheep Creek at 58°56′00"N, 128°10′00"W. McDame Formation.
cf. *Ambocoelia* sp.
Age: Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37268 Same locality as GSC loc. 37277.
stromatoporoid
Favosites sp. C.
undet. brachiopod fragment
undet. ? pelecypod or ? *Stringocephalus* sp.
undet. gastropod fragment
crinoid ossicles
Age: Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37272 Elevation 1411 m on west side of 1950 m mountain near head of Ramhorn Creek at 58°50′15"N, 128°21′20"W; 0.8 km due north of cairn. McDame Formation, Lower Member.

Favosites sp.
Thamnopera ? sp.
ptenophyllid coral indet.
?*productellid*
Atrypa sp.
Stringocephalus sp.
Undet. gastropod
Crinoid ossicles
Age: Givetian, late Middle Devonian.
Identification by A.W. Norris.

GSC loc. 37269 On ridge west of headwaters of Ramhorn Creek at 58°49′08"N, 128°20′25"W. Platy limestone, McDame Formation, Upper Member.

rugose coral indet.
?*Schizophoria* sp.
?*stropheodontid*
?*Hypothyridina* sp.
Leiorhynchus sp.
Atrypa 2 spp.
Iowatrypa sp.
?*Spinatrypa* sp.
Cranaene sp.
Indet. brachiopod
Crinoid ossicles
Age: Frasnian, early Late Devonian.
This collection contains a fairly large but poorly preserved brachiopod fauna. *Iowatrypa* is the most diagnostic element of this assemblage. The form occurs more or less throughout the Upper Devonian Mount Hawk Formation in the Canadian Rocky Mountains and is known also from the Upper Mackenzie region, Northwest Territories.
Identification and comments by D.J. McLaren and A.W. Norris.

GSC loc. 37266 On west side of ridge west of headwaters of Ramhorn Creek at 58°48′40"N, 128°19′24"W. Platy limestone, McDame Formation, Upper Member.

?*productellid*
Leiorhynchus sp.
Radiatrypa sp. cf. *R. clarkei* (Warren)
Undet. coarsely costate brachiopod - poorly preserved crinoid ossicles.
This collection is doubtfully assigned a Late Devonian age on the basis of *Leierhynchus* sp. and *Radiatrypa* sp. cf. *R. clarkei* (Warren). The latter form occurs more or less throughout the lower Upper Devonian Waterways Formation in northeastern Alberta.
Age: Frasnian, early Late Devonian.
Identification and comments by D.J. McLaren and A.W. Norris.

GSC loc. 28842 On southwest side of NW trending ridge about 45 m above dry creek bed, 50 m downslope to west from GSC loc. 37269. Platy limestone, McDame Formation, Upper Member.

Atrypa spp.
The collection contains small and large specimens which resemble most closely forms that occur in the Upper Devonian Mount Hawk Formation in the Front Ranges near Athabasca River valley. It is probable that they are of early Late Devonian age.
Age: Frasnian, early Late Devonian.
Identification and comments by D.J. McLaren.

GSC loc. C-088239 West of headwaters of Ramhorn Creek, 6.1 km at 335° from north end of Blue Sheep Lake at 58°49′28"N, 128°21′33"W. Platy limestone member (upper member) of McDame Formation.

Conodont taxa: CAI 5+
ramiform elements
Ancyrodella sp. indet.
Icriodus sp.
Polygnathus sp. indet.
Ancyrodella sp. cf. *A. rotundiloba* (Bryant 1921)
Polygnathus sp. cf. *P. dengleri* Bischoff & Ziegler 1957
Age: Late Devonian, early Frasnian.
Identification by M.J. Orchard.

GSC loc. C-088248 About 4.8 km at 274° from the SW end of Blue Sheep Lake at 58°55′45"N, 128°25′50"W. McDame Formation.

Conodont taxa: CAI 5
Polygnathus? sp.
ramiform elements
Age: Middle Devonian-Early Carboniferous, Eifelian-Tournaisian.
Identification by M.J. Orchard

GSC loc. C-088250 About 4.8 km at 274° from SW end of Blue Sheep Lake at 58°46′10"N, 128°24′40"W. McDame Formation.

Conodont taxa: CAI 5
ramiform elements
Ancyrodella ex gr. *binodosa* Uyeno 1967
Icriodus sp.
Polygnathus sp (p.)
Polygnathus webbi Stauffer 1940
Age: Middle-Late Devonian Givetian-Frasnian boundary interval.
Identification by M.J. Orchard.

GSC loc. C-103230 About 4.8 km at 274° from the SW end of Blue Sheep Lake at 58°46′10"N, 128°24′40"W. McDame Formation.

Conodont taxa: CAI 5+
Icriodus sp. indet.
Age: Devonian.
Identification by M.J. Orchard.

GSC loc. C-103231 About 15 km E of Rapid River and N of Major Hart River at 58°55′45"N, 128°29′20"W. McDame Formation (?) platy grey carbonaceous argillite at top of formation or base of overlying Earn Group.

ichthyoliths
Age: Phanerozoic.
Identification by M.J. Orchard.

GSC loc. C-103232 About 13.9 km at 263° from junction of Ramhorn Creek and Major Hart River at 58°55′45"N, 128°29′20"W. Earn Group, basal part.

Conodont taxa: CAI 5

Ancyrodella sp.
Ancyrodella nodosa Ulrich and Bassler 1926
Belodella sp.
Icriodus sp.
Icriodus symmetricus Branson and Mehl 1934
Palmatolepis sp.
Palmatolepis proversa Ziegler 1958
Palmotolepis rotunda Ziegler and Sandberg 1990
Palmatolepis subrecta Miller and Youngquist 1947
Pandorinellina sp.
ramiform elements
Polygnathus sp.
Polygnathus webbi Stauffer 1940

This is a very rich conodont fauna containing several hundred elements.
Age: Late Devonian, middle Frasnian.
Identification and comments by M.J. Orchard.

Mississippian

GSC loc. C-103233 About 13.9 km at 262° from junction of Ramhorn Creek and Major Hart River at 58°55′30"N, 128°29′50"W. Carbonate in Earn Group.

Conodont taxa: CAI 5

Gnathodus semiglaber (Bischoff 1957)
Polygnathus communis Branson and Mehl 1934
Siphonodella cooperi Hass 1959
ramiform elements

Age: Early Carboniferous (Mississippian), early-middle Tournaisian, *isosticha*-Upper *crenulata* Zone.
Identification by M.J. Orchard.

GSC loc. C-112451 Kechika map area, 12.5 km NW of Turnagain-Dall River confluence, 58°52′30"N, 127°59′45"W. Earn Group.

Conodont taxa: CAI 5

Gnathodus cf. *pseudosemiglaber* 3 mature Pa elements
?*Idioprioniodus* sp.
Abundant ramiform fragments

G. pseudosemiglaber ranges from the *anchoralis-latus* through *texanus* zones. Three small specimens are similar to *G. typicus* but may represent juvenile specimens of *G. pseudosemiglaber*. The sample is clearly post-Devonian.
Age: Upper Tournaisian (TN3) to Lower Visean (VI) age (Lane et al., 1980).
Identification and comments by Charles Henderson.

GSC loc. C-103238 About 15 km E of the north-trending stretch of Rapid River at 58°56′30"N, 128°30′50"W. Earn Group.

spumellerian radiolarians?

Age: Phanerozoic.
Identification by M.J. Orchard

GSC loc. C-103241 About 2 km S of Major Hart River and 11.95 km at 330° from N end of Blue Sheep Lake at 58°51′48"N, 128°25′07"W. Earn Group.

Conodont taxa: CAI 5

ramiform elements
Polygnathus sp. indet.

Age: Middle Devonian-Early Carboniferous (Mississippian), Eifelian-Tournaisian.
Identification by M.J. Orchard.

GSC loc. C-103242 About 2 km S of Major Hart River, 11.95 km at 330° from N end of Blue Sheep Lake at 58°51′48"N, 128°25′07"W. Earn Group.

Conodont taxa: CAI 5

ramiform elements
Gnathodus sp.
Polygnathus communis communis Branson and Mehl 1934
Siphonodella sp.

Age: Early Carboniferous (Mississippian), early-middle Tournaisian.
Identification by M.J. Orchard.

GSC loc. C-103243 About 2 km S of Major Hart River, 11.1 km at 330° from N end of Blue Sheep Lake at 58°51′56"N, 128°24′38"W. Earn Group, directly beneath base of Sylvester Allochthon.

Conodont taxa: CAI 5

'*Hindeodella*' *segaformis* Bischoff 1957
ramiform elements
Hindeodus? sp.
Polygnathus communis communis Branson and Mehl 1934

Age: Early Carboniferous (Mississippian), late Tournaisian.
Identification by M.J. Orchard.

GSC loc. C-103235 About 13.6 km at 149° from S end of Ewe Lake in McDame map area and 15 km E of Rapid River at 58°56′06"N, 128°31′46"W. Sylvester Complex or Earn Group.

Conodont taxa: CAI 5

'*Hindeodella*' *segaformis* Bischoff 1957
ramiform elements
Geniculatus n. sp. *A*
Polygnathus communis communis Branson and Mehl 1934
Protognathodus sp.
Pseudopolygnathus sp.

Age: Early Carboniferous (Mississippian), late Tournaisian.
Identification by M.J. Orchard.

GSC loc. C-103237 About 15 km E of Rapid River and 13.6 km at 149° from the S end of Ewe Lake in the McDame map area at 58°56′03"N, 128°31′53"W. Sylvester Complex or Earn Group.

Conodont taxa: CAI 5

'*Bispathodus*' ex gr. *stabilis* (Branson and Mehl 1934)
ramiform elements
Gnathodus sp.

Hindeodus sp.
Siphonodella? sp.
Age: Early Carboniferous (Mississippian), ?Tournaisian.
Identification by M.J. Orchard.

GSC loc. C-116039 On ridge S of Rapid River, 2.5 km NNE of N arm of Cry Lake at 58°59′30″N, 128°40′W. Sylvester Complex.
Conodont taxa
ramiform elements
Gnathodus sp. cf. *G. texanus* Roundy 1926
Age: Early Carboniferous (Mississippian), Visean-Serpukovian.
Identification by M.J. Orchard.

Pennsylvanian

GSC loc. C-70298 Ridge just NW of Rapid River, approximately 19.3 km ENE of Beale Mountain at 58°58′40″N, 128°51′55″W. Unnamed Pennsylvanian limestone unit in the Sylvester Complex.
Fusulinella sp. (adv, form).
Age: Middle Carboniferous, Moscovian, middle part = Early to Middle Desmoinesian.
Identification by C.A. Ross.

GSC loc. C-116428 About 15.2 km at 262° from junction of Ramhorn Creek and Major Hart River at 58°55′45″N, 128°31′W. Sylvester Complex.
Conodont taxa: CAI 6
ramiform elements
Gondolella ex. gr. *laevis* Kosenko and Kozitskaya 1975
Idiognathoides sp.
Idiognathodus sp.
Age: Late Carboniferous (Pennsylvanian), Bashkirian-Moscovian.
Identification by M.J. Orchard.

GSC loc. C-156636 In limestone unit of Sylvester Complex about 3.1 km west of Four Mile River at 58°58′N, 129°16′W.
Conodont taxa: CAI 6-7
ramiform elements
Idiognathodus sp. indet.
Age: Pennsylvanian-Early Permian, Bashkirian-Asselian.
Identification by M.J. Orchard.

Permian

GSC loc. C-116040 On ridge on S side of Rapid River, 22.5 km NNE of N arm of Cry Lake at 58°59′22″N, 128°40′07″W. Sylvester Complex.
Conodont taxa
ramiform elements
Neogondolella sp. indet.
Age: Permian.
Identification by M.J. Orchard.

GSC loc. C-116419 On ridge E of Rapid River at 58°56′45″N, 128°35′30″W. Sylvester Complex.
Conodont taxa: CAI 5
ramiform elements
Idiognathodus? sp.
Age: Probably Late Carboniferous-Early Permian, Bashkirian-Asselian.
Identification by M.J. Orchard.

GSC loc. 28834 In French Range 0.8 km SW of Peak 1889 m, at 58°42′N, 130°29′W. Teslin Formation in Cache Creek Complex. Impure brown limestone at base of section.
Schwagerina sp. is common and a primitive
Neoschwagerina sp. is rare.
Schwagerina? and *Neoschwagerina?* occur in one of the 4 pieces sent which was more thoroughly recrystallized than the other pieces. These appear to be different species of *Schwagerina*? and *Neoschwagerina*?
Age: late Early Permian, probably late Leonardian.
Identification and comments by C.A. Ross.

GSC loc. 28858 Isolated outcrop in French Range at 58°40′N, 130°37.5′W. Teslin Formation, Cache Creek Complex.
Neoschwagerina sp. 1 (abundant small, elongate species)
Neoschwagerina? sp. (large and robust)
Yabeina sp. (large and robust)
Lepidolina? sp. in light grey calcarenitic lithology
Schwagerina sp. in dark grey calcarenite lithology
Age: Late Permian, probably late Guadalupian.
Identification and comments by C.A. Ross.

GSC loc. 28835 Creek gully in French Range 0.8 km SE of GSC loc. 28834, at probably the same horizon at 58°41′N, 130°34′W. Teslin Formation, Cache Creek Complex.
Yabeina sp.
Neoschwagerina sp.
Chusenella sp.
Age: Late Permian, probably late Guadalupian.
Identification and comments by C.A. Ross.

In addition to the localities noted above, numerous fossils, mainly fusulinids have been collected from the Teslin and Kedahda formations in the French Range by W.H. Monger (1968). They are all of Permian (Leonardian and Guadalupian) age with the exception of a collection from a clast in calcareous tuff near the base of the formation 1.69 km west of Little Dease Lake. Its fauna was reported by C.A. Ross to be of probable Pennsylvanian (Morrowan) age.

An interesting fauna was collected in the French Range by F.A. Kerr (1925). It contained the brachiopod identified by E.M. Kindle as *Leptodus* cf. *tenuis* which had long been known in China and India under the generic name *Lyttonia*. Kindle noted that this fauna was unknown in North America except for a locality in Texas and the unusual sponge *Amblysiphonella*, also collected in the French Range, was unknown in the interior faunas of the continent. Kindle's observations gave the first hint of the exotic nature of the Cache

Creek faunas in British Columbia, later confirmed by the identification of the fusulinid Verbeekina by C.A. Ross (Monger and Ross, 1971).

GSC loc. C-176495 Headwaters of Canyon Creek, 3 km east of Tuya River at 58°53′N at 130°39′W. Limestone unit structurally below chert and greywacke sequence of Cache Creek Complex.
Conodont taxa: CAI 4.5-5
Neogondolella sp. indet.
Pb elements
S elements
Age: Permian?
Identification by M.J. Orchard.

GSC loc. C-87100 At 1196 m on main branch of Itsillitu Creek at 58°14′40"N, 130°21′24"W. Limestone unit, unnamed Permian unit.
ichthyoliths
Conodont taxa: CAI: 5
Sweetognathus? sp. indet
Age: Probably Early Permian.
Identification by M.J. Orchard.

GSC loc. C-87097 At 1187 m, S of the Stikine River on Klastline Plateau at 58°05′35"N, 130°36′14"W. Limestone unit.
Conodont taxa: CAI: 5-6
Neogondolella sp. indet.
Age: Permian.
Identification by M.J. Orchard.

GSC loc. C-87099 At 1471 m north of Stikine River in Hotailuh Range at 58°14′38"N, 130°25′06"W. Limestone unit.
ichthyoliths
Conodont taxa: CAI: 5.5-6.5
ramiform elements
Neogondolella sp. indet.
Neostreptognathodus sp. cf. *N. sulcoplicatus* (Youngquist, Hawley and Miller 1951)
Neostreptognathodus pequopensis Behnken 1975 s.l.
Age: Early Permian, Artinskian.
Age: Upper Lower Permian (Leonardian).
Identification by M.J. Orchard.

GSC loc. C-87098 At 930 m north of Stikine River on Tanzilla Plateau at 58°10′45"N, 130°34′24"W. Limestone unit.
Conodont taxa: CAI: 5.5-6
ramiform elements
Neostreptognathodus sp. indet.
Age: Early Permian, Artinskian.
Identification by M.J. Orchard.

GSC loc. C-87096 At 430 m on the south wall of the Grand Canyon of the Stikine at 58°05′50"N, 130°42′24"W. Limestone unit.
Conodont taxa: CAI: 5
Neostreptognathodus cf. *pequopensis* Behnken, 1975
Age: Early Permian, Artinskian.
Identification by M.J. Orchard.

GSC loc. C-87095 At 265 m on south bank of the Grand Canyon of the Stikine at 58°06′33"N, 130°42′22"W. Limestone unit.
ichthyoliths
Conodont taxa: CAI: 5.5
ramiform fragments
Neostreptognathodus? sp. indet.
Age: Early Permian, ?Artinskian.
Identification by M.J. Orchard.

GSC loc. C-86297 On the east bank of the Stikine River at 1025 m, 1.45 km above the junction with Tanzilla River at 58°07′50"N, 130°39′00"W. Unnamed limestone unit.
Conodont taxa: CAI: 4.5-5.5
ramiform fragments
Neostreptognathodus sp. aff. *N. pequopensis* Behnken, 1975
Age: Early Permian, Artinskian.
Identification by M.J. Orchard.

GSC loc. C-86299 On the south canyon wall of the Grand Canyon of the Stikine at 2375 m, 4.3 km at 116° from the confluence of the Tanzilla River at 58°06′40"N, 130°37′00"W.
Conodont taxa: CAI: 5-5.5
ramiform elements
Neostreptognathodus cf. *N. pequopensis* Behnken, 1975
Age: Early Permian, Artinskian.
Identification by M.J. Orchard.

GSC loc. 87658 About 2.1 km at 200° from peak, elev. 1570 m+ at 58°00′00"N, 130°38′48"W. Phyllitic carbonate unit.
ichthyoliths
Conodont taxa: CAI: 5-5.5
Adetognathus? sp. indet.
Sweetognathus? sp. indet.
Age: Carboniferous-Early Permian. Named genera are Permian but elements could be *Cavusgnathus* and *Rhachistognathus* of mid-Carboniferous age.
Identification and comments by M.J. Orchard.

Triassic

GSC loc. C-28828 In stream valley 5.1 km SW of Mount Shea at 58°17′00"N, 129°01′00"W. Sinwa Formation.
Poorly preserved pelecypods.
Lima? sp. and some shells that probably represent *Palaeocardita*
Age: Mesozoic, probably Triassic.
Identification and comments by E.T. Tozer.

GSC loc. 95246 About 32.2 km SE of Turnagain Lake, just east of Kehlechoa River at 58°08′25"N, 128°40′40"W. Sinwa Formation.

Crinoid columnals

Age: Probably Triassic.

Identification and comments by E.T. Tozer.

GSC loc. 95238 About 8 km SE of the mouth of Goldpan Creek at 58°24′N, 129°39′W. Sinwa Formation.

Minetrigonia sp. indet.

Age: Probably Late Triassic.

Identification and comments by E.T. Tozer.

GSC loc. 95249 About 32.2 km SE of Turnagain Lake, just east of Kehlechoa River at 58°07′45"N, 128°41′00"W. Sinwa Formation.

Crinoid columnals

Age: Probably Late Triassic.

Identification and comments by E.T. Tozer.

GSC loc. C-088212 About 3 km SW of Snow Peak at 58°33′N, 130°28′60"W. Limestone clast (Sinwa Formation) in Takwahoni Formation.

Conodont taxa: CAI: 5

Epigondolella sp. cf. *E. englandi* Orchard 1991

Age: Late Triassic, late Middle-Late Norian.

Identification by M.J. Orchard.

GSC loc. C-086313 About 5 km S of Snow Peak at 58°25′N, 130°26′45"W. Limestone clast in Takwahoni Formation.

ichthyoliths

Conodont taxa: CAI: 5

Epigondolella sp. cf. *E. postera* (Kozur and Mostler 1971)

Age: Late Triassic, Norian.

Identification by M.J. Orchard.

GSC loc. C-086314 About 5.1 km S of Snow Peak at 58°25′N, 130°26′30"W. Limestone clast in Takwahoni Formation.

Conodont taxa: CAI: 5

ramiform elements

Epigondolella sp. cf. *E. postera* (Kozur and Mostler 1972)

Age: Late Triassic, Norian.

Identification by M.J. Orchard.

GSC loc. C-102252 On crest of Mount Defot at 58°54′N, 130°24′W. Limestone clast in Nazcha Formation.

Conodont taxa: CAI: 3

Metapolygnathus primitius (Mosher 1970)

Age: Late Triassic, Late Carnian-Early Norian, *primitius* Zone.

Identification by M.J. Orchard.

GSC loc. C-087030 On crest of Mount Defot at 58°53′10"N, 130°24′02"W. Limestone clast in Nazcha Formation.

ichthyoliths

Monotis sp.

Conodont taxa: CAI: 3-3.5

ramiform elements

Epigondolella sp. indet.

Neogondolella sp. cf. *N. steinbergensis* (Mosher 1968)

Age: Late Triassic, probably Middle-Late Norian.

Identification by M.J. Orchard.

GSC loc. C-086315 About 4 km SW of Coulahan Mountain at 58°56′30"N, 130°32′30"W. Limestone unit below limestone conglomerate; uppermost part of Shonektaw Formation.

ichthyoliths, microgastropods, tubes, shell fragments

Conodont taxa: CAI: 4.5-5

ramiform elements

Epigondolella quadrata Orchard 1991

Age: Late Triassic, Early Norian, *quadrata* zone.

Identification by M.J. Orchard.

Fossils collected from limestone about 4 km southwest of the crest of Mount Coulahan (Watson and Mathews, 1944) include caudal vertebrae of an ichthyosaur suggesting *Delphinosaurus perrini* Merriam. C.M. Sternberg noted that this genus occurs in the lower or shaly horizon of the Upper Triassic (Carnian) Hosselkus Limestone in California (eastern Klamath Mountains).

GSC loc. C-177542 Headwaters of Canyon Creek at 58°52′53"N, 130°39′20"W. Grey ribbon chert interbedded with greywacke in Cache Creek Complex.

Pseudostylosphaera sp.

Triassocampe sp.

Radiolarian preservation moderate

Age: Middle or Late Triassic (Upper Ladinian to Upper Carnian).

Identification and comments by F. Cordey.

GSC loc. C-177541 58°52′51"N, 130°39′21"W. Grey ribbon chert interbedded with greywacke in Cache Creek Complex.

Pseudostylosphaera sp.

Radiolarian preservation moderate

Age: Middle or Late Triassic (Upper Ladinian to Upper Carnian).

Identification and comments by F. Cordey.

GSC loc. C-177543 Headwaters of Canyon Creek at 58°53′53"N, 130°39′18"W. Grey ribbon chert interbedded with greywacke of Cache Creek Complex.

Canesium lentum Blome

Capnodoce sp.

Triassocampe sp.

Radiolarian preservation good

Age: Late Triassic (Upper Carnian to Middle Norian).

Identification by F. Cordey.

The following collections were made by P.B. Read and J.F. Psutka in the area near the Grand Canyon of the Stikine River.

GSC loc. C-87501 At 900 m on the north bank of the Grand Canyon of the Stikine at 58°09′18"N, 130°23′01"W. Limestone unit.

Conodont taxa: CAI: 4.5-5
ramiform elements
Neospathodus? sp.
Neogondolella sp. indet.
Age: Early-Middle Triassic.
Identification by M.J. Orchard.

GSC loc. C-87509 Elevation about 502 m on the north bank of the Grand Canyon of the Stikine, 2.1 km above the junction with Pallen Creek at 58°07′41"N, 130°19′06"W. Medium grey micritic limestone in a dark grey argillite to phyllite sequence.

Sponge spicules and radiolarians
Small fauna, good preservation
Conodont taxa: CAI: 3.5-4.5
ramiform elements
Neogondolella ex gr. constricta (Mosher and Clark 1965)
Nicoraella? sp.
Radiolarian taxa:
?*Archeothamnulus verticillatus* Dumitrica
Enactinosphaera? *romuli* Lahm
Tandarnia? sp.
Xiphosphaera spp.
Xiphostylus spp.
Age: (Conodont) Middle Triassic.
Identification by M.J. Orchard.
(Radiolarians) Middle Triassic, probably Late Anisian-Ladinian
Identification by E.S. Carter.

E.S. Carter comments as follows: " This sample contains excellent, well preserved, but poorly known radiolarians. There are numerous species of *Xiphosphaera* and *Xiphostylus*. Of the former, some are similar to *Xiphosphaera* ? sp. *B* (Yao, Matsuda and Isozaki, 1980) from the lower part of the *Dictyomitrella* sp. *A* Assemblage dated by conodonts, as Middle Triassic (Ladinian)-early Carnian. *Entactinosphaera* ? *romuli* Lahm is described from the Middle Triassic (Ladinian) Buchenstein Limestone (Vicentinian Alps) Recoaro, northern Italy. The most interesting aspect of this fauna is the number of spicular radiolarians present. These forms appear throughout the fossil record but are most always very rare. Several forms in this sample are similar to Middle Triassic spicular radiolarians described by Dumitrica (1980) also from the Buchenstein Limestone at Recoaro and Rarau Mountain (Eastern Carpathians, Romania). *Archeothamnulus verticillatus* is known from the Lower Ladinian and Tandarnia from the Pelsonian and Lower Fassan (Upper Anisian-Lower Ladinian). This sample is very likely older than Late Triassic and probably Middle Triassic."

GSC loc. C-87656 On left bank of Stikine River 0.7 km at 023° from junction with Klastline River at 58°02′50", 130°46′44". Stuhini Group.

Conodont taxa: CAI: 5-5.5
Metapolygnathus sp.
Metapolygnathus sp. cf. *M. primitius* (Mosher 1970)
Age: Late Triassic, Late Carnian-Early Norian.
Identification by M.J. Orchard.

GSC loc. C-87659 At 4740′ (1445 m), 4.4 km at 346.5° from the mouth of Tsenaglode Creek at S end of Tsenaglode Lake, at 58°13′07"N, 130°02′21"W. Stuhini Group, grey limestone unit in augite porphyry breccia.

ichthyoliths
Conodont taxa: CAI: 2.5-3.5
Neogondolella sp. aff. *N. tadpole* (Hayashi 1968)
Neogondolella inclinata (Kovacs 1983)
Age: Middle-Late Triassic, late Ladinian-early Carnian.
Identification by M.J. Orchard.

GSC loc. C-87706 About 0.5 km at 232° from Thenatlodi Mountain, elevation 5225′ (1593 m) at 58°10′53"N, 129°59′50"W. Lower sedimentary unit (sample from light grey chert) of Stuhini Group.

Conodont taxa CAI: 5-7
ramiform elements
Neogondolella sp. cf. *N. constricta* (Mosher and Clark 1965)
Neogondolella sp. indet.
Age: Middle Triassic.
Identification by M.J. Orchard.

GSC loc. C-102761 On right bank of Stikine River, 5.85 km at 117° from mouth of Pallen Creek, elev. 1553′ (473 m) at 58°06′54"N, 130°15′45"W. Stuhini Group. Dark grey limestone layer in well bedded argillite.

Conodont taxa: CAI: 4.5-5
ramiform elements
Cornudina? sp.
Age: Early-Middle Triassic.
Identification by M.J. Orchard.

GSC loc. C-102762 On right bank of Stikine River, 5.85 km at 117° from the mouth of Pallen Creek at 58°06′54"N, 130°15′45"W. Stuhini Group. Dark grey limestone 25 cm thick in well bedded dark grey to white siliceous argillite and siltstone.

Conodont taxa: CAI: 5
"*Oncodella*" n.sp. *A*
ramiform elements
Neospathodus ex gr. *homeri* Bender 1970
Neospathodus triangularis Bender 1970
Age: Early Triassic, Spathian.
Identification by M.J. Orchard.

GSC loc. C-102763 At elevation 1415′ (431.3 m), 6.10 km at 117° from the mouth of Pallen Creek at 58°06′59"N, 130°15′31"W. Stuhini Group. Dark grey limestone layer 40 cm thick in massive to poorly bedded black siliceous argillite.

Conodont taxa: CAI: 5

ramiform elements
Neogondolella ex gr. *carinata* (Clark 1959)
Age: Early Triassic.
Identification by M.J. Orchard.

GSC loc. C-102764 On right bank of Stikine River 5.25 km at 115° from mouth of Pallen Creek at 58°07′10"N, 130°16′14"W. Stuhini Group. Grey massive chert in dark grey siliceous argillite.
ichthyoliths
Conodont taxa: CAI: 4.5-5.5
ramiform elements
Neogondolella ex gr. *excelsa* (Mosher 1968)
Age: Middle Triassic, late Anisian-Ladinian.
Identification by M.J. Orchard.

GSC loc. C-102765 On right bank of Stikine River, 5.25 km at 115° from the mouth of Pallen Creek. Elevation 1838′ (560 m) at 58°07′10"N, 130°16′14"W. Stuhini Group. Grey massive to bedded chert in argillite.
Conodont taxa: CAI: 5
ramiform elements
Neogondolella ex. gr. *excelsa* (Mosher 1968)
Age: Middle Triassic, late Anisian-Ladinian.
Identification by M.J. Orchard.

GSC loc. C-102766 At 1705′ (520 m) on right bank of Stikine River, 6.45 km at 120° from the mouth of Pallen Creek at 58°06′32"N, 130°15′33"W. Stuhini Group. Black, pyritic limestone lens in black siliceous argillite.
Conodont taxa: CAI: 5
ramiform elements
Ellisonia sp.
Neogondolella sp.
Age: Early-Middle Triassic.
Identification by M.J. Orchard.

GSC loc. C-102767 Right bank of Stikine River at elev. 660 m, 4.98 km at 117° from mouth of Pallen Creek at 58°07′08"N; 130°16′32"W. Stuhini Group. Grey chert in black, siliceous argillite.
Conodont taxa: CAI: 5
ramiform elements
Neogondolella sp.
Age: Probably Middle Triassic.
Identification by M.J. Orchard.

GSC loc. C-102768 At elev. 684 m (2247′) on right bank of Stikine River, 4.75 km at 117° from mouth of Pallen Creek at 58°07′09"N, 130°16′48"W. Stuhini Group. Grey massive chert in green tuffaceous wacke with angular cherty fragments.
radiolarians
Conodont taxa: CAI: 5
Neogondolella sp. indet.
ramiform elements
Cratognathus sp.
Neogondolella ex gr. *constricta* (Mosher and Clark 1965)
Neogondolella ex gr. *excelsa* (Mosher 1968)
Age: Middle Triassic, probably late Anisian-early Ladinian.
Identification by M.J. Orchard.

GSC loc. C-102769 On N bank of Stikine River, 4.6 km upstream from mouth of Pallen Creek, elev. 1071′ at 58°07′06"N, 130°16′06"W. Stuhini Group. Chert interbedded with grey limestone layers 10 to 15 cm thick in well bedded siliceous argillite and chert.
Conodont taxa: CAI: 5-5.5
ramiform elements
Neogondolella sp. indet.
Age: Middle? Triassic.
Identification by M.J. Orchard.

GSC loc. C-102770 On N bank of Stikine River, 4.3 km upstream from mouth of Pallen Creek, elev. 1673′ at 58°07′09"N, 13°16′24"W. Stuhini Group. Medium grey limestone lenses in dark grey argillite.
Conodont taxa: CAI: 4.5-5.5
?*Ozxarkodina* kochi Huckriede 1958
ramiform elements
Neogondolella ex gr. *regale* Mosher 1970
Neospathodus ex gr. *homeri* (Bender 1970)
Neospathodus gondolelloides (Bender 1970)
Age: Early Triassic, late Spathian.
Identification by M.J. Orchard.

GSC loc. C-102771 On right bank of Stikine River, 6.25 km at 122° from mouth of Pallen Creek, elev. 1629′ (497 m) at 58°06′33"N, 130°15′37"W. Stuhini Group. Chert in sequence of medium to dark grey, graphitic siltstone.
Conodont taxa: CAI: 4
Neogondolella? sp indet.
Age: Triassic.
Identification by M.J. Orchard.

GSC loc. C-102772 On right bank of Stikine River, 6.0 km at 114° from mouth of Pallen Creek, elev. 1871′ at 58°07′02"N, 130°15′27"W. Stuhini Group. Dark grey, crystalline limestone in sequence of dark grey, graphitic siltstone.
Sponge spicules
Conodont taxa: CAI: 5
ramiform elements
Age: Triassic?.
Identification by M.J. Orchard.

GSC loc. C-102901 Stikine River, elev. 4500′ (1372 m), 11.7 km at 267° from N end of Tsenaglode Lake. Stuhini Group. Light to dark grey ribbon chert.

sphaeromorphs
Conodont taxa: CAI: 6
Neogondolella sp. indet.
Age: Middle? Triassic.
Identification by M.J. Orchard.

GSC loc. C-102918 In unnamed creek on N bank of Stikine River, 3.0 km downstream from mouth of Pallen Creek at 58°09′21"N, 130°23′22"W. Stuhini Group. Grey limestone layer 25 to 30 cm thick in grey chert and siliceous argillite.
sphaeromorphs
Conodont taxa: CAI: 3.5-4.5
ramiform elements
Neogondolella ex. gr. *constricta* (Mosher and Clark 1965)
Age: Middle Triassic, late Anisian-early Ladinian.
Identification by M.J. Orchard.

GSC loc. C-102920 North bank of Stikine River, 2.5 km downstream from mouth of Pallen Creek at 58°08′36"N, 130°23′12"W. Stuhini Group. Black chert in grey and green tuffaceous argillite.
radiolarians
Conodont taxa: CAI: 4-4.5
Neogondolella sp.
Metapolygnathus sp. cf. *M. nodosus* (Hayashi 1968)
Age: Middle-Late Triassic, Ladinian-Carnian.
Identification by M.J. Orchard.

GSC loc. C-102924 Elev. 3490′ (1064 m) on E bank of Pallen Creek at 58°10′59"N, 130°18′10"W. Stuhini Group. Ribbon chert in black argillite.
Conodont taxa: CAI: 5-6
ramiform elements
Neogondolella sp.
Age: Middle Triassic.
Identification by M.J. Orchard.

GSC loc. C-103668 On south bank of Stikine River at water level, 0.85 km downstream from mouth of Klastline River at 52°02′08"N, 130°48′17"W. Stuhini Group.
Conodont taxa: CAI: 5
Metapolygnathus sp.
Age: Late Triassic, Carnian.
Identification by M.J. Orchard.

GSC loc. C-103689 On southeast bank of Stikine River 2.67 km upstream from mouth of Klastline River at 58°03′31"N, 130°45′10"W. Stuhini Group.
ichthyoliths
Conodont taxa: CAI: 4.5
Neogondolella sp.
Age: Triassic.
Identification by M.J. Orchard.

Limestone represented by the following collection occurs at the top of the Stuhini Group in Stikinia.

GSC loc. C-117416 In dry creek bed 10 km east of McBride River at 58°07′30"N, 129°00′00"W. Limestone unit.
Hexacorals, indet.
fragmentary pelecypods indet.
ichthyoliths
Conodont taxa:
Epigondolella ex gr. *bidentata* Mosher 1968
Age: Late Triassic, Late Norian, Lower bidentata Zone.
Identification by M.J. Orchard.
Clasts from several localities underlain by conglomerate of the Bowser Lake Group in southeastern Cry Lake map area yielded radiolaria identified by F. Cordey. Their ages range from Middle or Late Triassic to Early or Middle Jurassic.

GSC loc. 95247 About 3.2 km NNE of north end of Turnagain Lake at 59°19′00"N, 129°07′45"W. Sinwa Formation.
Bivalve fragments, indet.
Age: undetermined.
Identification by E.T. Tozer.

GSC loc. 95248 About 3.2 km NNE of north end of Turnagain Lake at 58°19′00"N, 129°08′05"W. Sinwa Formation? (boulder in creek).
Mollusk fragments, indet.
Age: undetermined.
Identification by E.T. Tozer.

GSC loc. 95106 About 3.2 km SW of Glacial Lake at 58°13′N, 129°31′W. Stuhini Group.
Crushed impressions of ammonoids, indet.
Age: undetermined.
Identification by E.T. Tozer.

GSC loc. 95239 About 22.5 km SE of peak of King Mountain, 58°11′15"N, 128°32′55"W. Sinwa Formation.
Mollusc fragments, indet.
Age: undetermined.
Identification by E.T. Tozer.

GSC loc. 95017 On ridge east of McBride River at 58°10.5′N, 129°07′W. Pelecypods in a limestone cobble in Sinemurian conglomerate, Takwahoni Formation.
Bivalves indet.
Age: undetermined.
Identification by E.T. Tozer.

GSC loc. 95255 About 15 km north of 58°N on 129°W. Boulders of Sinwa Formation in creek.
Fragmentary bivalves and brachiopods indet.
Age: undetermined.
Identification by E.T. Tozer.

F.A. Kerr (1925) made a collection of fossils from the Sinwa Formation 1.6 km south and 1.21 km west of the south end of Dease Lake. These were examined by H.W. Shimer who commented as follows: "The few fossils were very poorly preserved. But one specimen showing transverse sections of six corallites is without very much doubt *Isastrea vancouverensis* characteristic of the Upper Triassic Coral Reef Fauna of western North America. Another compound coral has thick walls characteristic of *Isastrea cowichanensis*, but with a diameter of only a millimetre instead of a normal 3 millimetres. It is hence not this species. A third coral may be a *Calamophyllia*." On the basis of these determinations, Shimer concluded that the limestone of the Sinwa Formation was of Late Triassic age.

Jurassic

Sinemurian

GSC loc. C-90952 Nazcha Formation, 2.4 km west of Mount Coulahan at 58°57′42"N, 130°30′40"W.

Bivalves:
Frenguelliella sp.
Rhychonellid brachiopod (?)
Coral (?)

Age: Probably pre-Middle Jurassic, and very likely Sinemurian.
Identification and comments by T.P. Poulton.

GSC loc. 95256 South end of ridge, SW of Wade Lake, at 58°08.5′N, 129°00′W. Fragments of a small specimen, probably *Arnioceras*.

Age: Early to Late Sinemurian.
Identification and comments by Hans Frebold.

GSC loc. 95092 On bearing 200°, 20.0 km from Mount Shea, Cry Lake, B.C., 58°08′N, 129°00′W.

Ammonites:
Inner whorls of ammonites:
Arnioceras sp. indet.

According to Dean et al. (1961), *Arnioceras* is one of little stratigraphic use. It ranges from the *Bucklandi* Zone in the Early Sinemurian up to a horizon high in the *Obtusum* Zone in the Late Sinemurian. The age of the *Arnioceras* specimens in the Cry Lake area is not accurately determinable, but they are definitely older than *Paltechioceras* found in the same area.

Age: Early to Late Sinemurian.
Identification and comments by Hans Frebold.

GSC loc. 95095 About 20 km on bearing 200° from Mount Shea at 58°08′N, 129°00′W.

Epophioceras aff. *E. carinatum* Spath
Gleviceras sp.
Arnioceras sp.
Asteroceras cf. *A. varians* Fucini

Age: Late Sinemurian.
Identifications by H. Frebold and H.W. Tipper.

GSC loc. 94993 About 19.3 km southeast of Turnagain Lake at 58°09′N, 128°58.5′W.

Paltechioceras cf. *P. harbledownensis* (Crickmay)
Crucilobiceras sp. indet. Faint impression showing two rows of spines.
bivalves, a wide variety (particularly species of trigonids) and gastropods

Age: Late Sinemurian.
Identifications by H. Frebold and H.W. Tipper.

GSC loc. 94990 About 14.5 km S of Turnagain Lake at 58°09′N, 129°07′W.

Poorly preserved ammonite fragments, resembles *Asteroceras*

Age: Possibly Late Sinemurian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95094 About 17.7 km SE of Turnagain Lake at 58°10′00"N, 128°58′00"W. Just below and north of volcanic unit.

Paltechioceras sp.
Phylloceras sp.
numerous and varied bivalves

Age: Late Sinemurian.
Identification by H.W. Tipper.

GSC loc. 95099 About 20 km on bearing 210° from Mount Shea, at 58°09′N, 129°05′W.

Gleviceras sp.
aptychi

Age: Late Sinemurian.
Identification by H.W. Tipper.

GSC loc. 90996 Same locality as GSC loc. 94993.

Juraphyllities n. sp.?

Age: Late Sinemurian because of association with GSC loc. 94993.
Identification by H.W. Tipper.

GSC loc. 95015 About 10.5 km W of McBride River and 18.5 miles N of 58° at 58°10′N, 129°00′W.

Paltechioceras cf. *rothpletzi* (Bose)
Paltechioceras sp., coarsely ribbed
Plesechioceras? sp.
Phylloceras sp.
multitude of bivalves, many genera and species

Age: Late Sinemurian, almost the latest.
Identification by H.W. Tipper.

Pliensbachian

GSC loc. 94991 About 12.9 km S of Turnagain Lake at 58°11′N, 129°07′W.

Dubariceras sp. indet. (poorly preserved fragments)

Age: Early Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94992 About 6.4 km at 110° from Tanzilla Butte in creek at 58°22′N, 129°40′W.

Dubariceras sp. indet. (small fragments) impressions of small ammonites

Age: Early Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94988 About 27.4 km WNW of Turnagain Lake at 58°22′N, 129°36′W.
Dubariceras spp. indet. (poorly preserved)
Age: Early Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94987 About 8.9 km W of Turnagain Lake at 58°18′N, 129°18′W.
Impression of small ammonite, indet.
Age: Probably Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94989 About 9.7 km W of Turnagain Lake at 58°18′N, 129°19′W.
Poorly preserved whorl fragment of ammonite, indet.
Age: Probably Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95022 Same locality as GSC loc. 94992.
Dubariceras sp. (fragments and impressions)
Acanthopleuroceras?
Protogrammoceras? sp. indet. (impressions of inner whorls)
Age: Early Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 90992 About 9.7 km SW of Wade Lake at 58°11′N, 129°01′15″W.
Coeloceras? sp.
Phylloceras spp.
derolytoceratid?
Gemmellaroceras sp.
polymorphitid spp.
inner whorls of *Tropidoceras* cf. *erythraeum*?
Miltoceras? sp.
other indeterminate forms
Age: Early Pliensbachian, Imlayi zone. This is possibly the earliest known Pliensbachian fauna in Canada.
Identification and comments by H. Frebold and H.W. Tipper.

GSC loc. 95258 About 17 km bearing 198° from Mount Shea, at 58°10.5′N, 129°05′W.
Protogrammoceras? or *Fuciniceras?* sp. indet.
Poor impressions of whorl fragments
Prodactylioceras aff. *P. italicum* (Meneghini)
Prodactylioceras aff. *P. meneghinii* (Fucini)
Prodactylioceras spp. indet.
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95269 About 17.5 km on bearing 200° from Mount Shea, Cry Lake, B.C. at 58°11′N, 129°02′W.
Ammonites:
Very poorly preserved small specimens:
Protogrammoceras sp. indet.
Arieticeras? sp. indet. Impression of a distorted fragment, showing keel with shallow sulci.

Age: Probably Late Pliensbachian.
Identification by Hans Frebold and H.W. Tipper.

GSC loc. 95262 Same locality as GSC loc. 95258.
Protogrammoceras? sp. indet. Impressions of small fragments.
Ammonite, gen. et sp. indet.
Faint impression of apparently narrow umbilicate specimen
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95257 Same locality as GSC loc. 95258 and 95262.
Amaltheus? sp. indet.
Prodactylioceras spp. indet. Very poor impressions of fragments
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95091 Same locality as GSC loc. 95097.
Arieticeras? sp. indet.
impressions of fragments of small ammonites
Age: probably Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95098 About 9.7 km west of McBride River and 19.3 km north of 58°N at 58°11′N, 129°00′W.
Arieticeras cf. *A. domarense* (Meneghini)
Age: Late Pliensbachian.
Identification by H. Frebold.

GSC loc. 95097 About 20 km on bearing 190° from Mount Shea at 58°09′N, 129°59.5′W.
Arieticeras aff. *A. algovianum* (Oppel)
Age: Late Pliensbachian.
Identification by H.W. Tipper.

GSC loc. 95021 About 10.5 km west of McBride River and 19.3 km N of 58° at 58°11′N. 128°59′W.
Amaltheus sp. Margaritatus Group (fragment)
Protogrammoceras spp. indet. (fragments)
Corals, *Weyla*, trigoniids, other bivalves
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94995 About 12.9 km S of Turnagain Lake at 58°11′N, 129°07′W.
Arieticeras spp. indet. Impressions of small specimens
Protogrammoceras spp.
dactylioceratid. Impression of inner whorl
Amaltheus sp.
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94986 About 16.1 km southeast of Turnagain Lake at 58°10′N, 128°59′W.
Amaltheus margaritatus de Montfort
Protogrammoceras cf. *P. normanianum* (d'Orbigny)
Protogrammoceras spp. indet. Fragments

Fuciniceras?
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 90991 Same locality as GSC loc. 94986.
Arieticeras cf. *algovianum* (Oppel)
Protogrammoceras sp.
Amaltheus stokesi (J. Sowerby)
Aveyroniceras cf. *inaequiornatum* (Bettoni)
Aveyroniceras sp.?
Leptaleoceras aff. *accuratum* (Fucini)
Small lytoceratid?
various small bivalves
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 94994 About 16.1 km SE of Turnagain Lake at 58°10′N, 128°58′W.
Protogrammoceras aff. *P. exiguum* (Monestier, non Fucini)
Protogrammoceras sp. indet.
corals, gastropods, bivalves (trigonids, *Weyla?*)
Age: Late Pliensbachian.
Identification by H. Frebold and H.W. Tipper.

Toarcian

GSC loc. C-81903 About 3.2 km SSE of Horn Mountain at 58°13′19"N, 129°31′03"W.
Hildaites levisoni
Dactylioceras sp. ind.
Pseudomercaticeras? sp. indet.
Numerous poorly preserved fragments. Some have fine, others coarser ribs; some show venter with keel and furrow. Probably several species are present
Age: Early to middle Toarcian.
Identification by H. Frebold and G. Jakobs.

GSC loc. C-95096 About 11.3 km on bearing 190° from Mount Shea at 58°09′N, 129°00′W.
harpoceratid (faint impressions)
aptychi
Age: Probably Early Toarcian.
Identification by H. Frebold and G. Jakobs.

GSC loc. 95025 West of McBride River in Three Sisters Range at 58°06′N, 129°19′W.
Ammonite gen. et sp. indet.
Age: Toarcian?
Identification by H. Frebold and G. Jakobs.

GSC loc. 95093 West of McBride River in Three Sisters Range at 58°07′N, 129°19′W.
Peronoceras verticosum ?
Zugodactylites ? sp. ind.
Harpoceras ? sp. ind.
Phymatoceras ? sp. ind.
Age: Middle Toarcian.
Identification by H. Frebold and G. Jakobs.

GSC loc. 95026 West of McBride River in Three Sisters Range at 58°06′N, 129°19′W.
probably *Hildaites* sp. ind.
Age: Early Toarcian.
Identification by H. Frebold and G. Jakobs.

GSC loc. 95263 About 17.2 km bearing 200° from Mount Shea at 58°10′N, 129°02′W.
Dactylioceras commune ?
Harpoceras sp. ind.
Hildaites sp. ind.
Harpoceras chrysanthemum ?
Age: Early to Middle Toarcian.
Identification by H. Frebold and G. Jakobs.

GSC loc. 95261 Same locality as GSC loc. 95263 but stratigraphically above.
Dactylioceratidae. gen. et sp. indet.
All specimens very poorly preserved (impressions and fragments). Ribs apparently undivided
Age: Toarcian.
Identification by H. Frebold.

GSC loc. 95264 Same locality as GSC loc. 95261 but about 40 m stratigraphically higher.
Dactylioceratidae. Very poorly preserved impressions and fragments. Ribs apparently undivided
Age: Toarcian.
Identification by H. Frebold.

GSC loc. 95265 Same locality as GSC loc. 95264 but much higher stratigraphically.
Ammonite fragment. indet.
Age: Toarcian.
Identification by H. Frebold.

GSC loc. 95266 Same locality as GSC loc. 95265 but separated from it by fault.
Small fragments of *Harpoceras* ? sp. indet.
Dactylioceratidae. Impressions and fragments. Ribs apparently undivided.
Age: Toarcian.
Identification by H. Frebold.

GSC loc. 28861 58°22′15"N, 129°45′00"W.
Imprints of small ammonites (Hildocerataceae, gen. et sp. indet.)
In well bedded slates and greywacke
Age: Early Jurassic, probably Toarcian.
Identification and comments by H. Frebold.

Early to Middle Jurassic

GSC loc. 95242 About 14 km west of Horn Mountain at 58°14′30"N, 129°46′00"W.
Weyla sp.
Ammonite fragment. indet.
Age: Early Jurassic.
Identification by H. Frebold.

GSC loc. 95091 About 20 km on bearing 190° from Mount Shea at 58°09′N, 129°00′W.

One small whorl fragment, two impressions of small whorl fragments. Straight, undivided ribs; venter with keel and sulci. The specimens are too poorly preserved for identification. They may belong to *Arnioceras*.
Age: Early Jurassic.
Identification and comments by H. Frebold.

GSC loc. 95101 Same locality as GSC loc. 95091.

Ammonites gen. et sp. indet.
Age: Early Jurassic, possibly Toarcian.
Identification by H. Frebold.

GSC loc. 95328 About 9.7 km north of Cake Hill and 3 km east of Lower Gnat Lake at 58°14′30"N, 129°46′00"W.

Coral fragments, scleractinid
Tubes
Foraminifera:
Reinholdella sp., *Ammodiscus* sp.
Polymorphinids
Fish debris
Gastropod debris
Age: Jurassic, Early or Middle.
Identification by B.E.B. Cameron.
Fossil collections from GSC loc. 95328 were studied by C.M. Henderson and D.G. Perry (1980). They reported the presence of *Heteropora tipperi* n. sp., the first reported occurrence of an Early Jurassic cyclostome bryozoa in North America. Associated with the bryozoa is the ammonite *Harpoceras* and the pelecypod *Weyla*. They suggested an Early Toarcian age for the assemblage.

GSC loc. 95327 Same locality as GSC loc. 95328.

Foraminifera:
Linguilina sp., *Ammodiscus* sp., *Reinholdella?* sp., *Astacolus* sp.
Citharina sp.
Ostracods:
juvenile bairdiid
Radiolaria:
Sponge spicules
Holothuroid sclerite
Age: Poor state of preservation but most suggestive of Jurassic, probably Early or Middle.
Identification by B.E.B. Cameron.

GSC loc. 95240 About 19.3 km SW of King Mountain at 58°08′20"N, 129°06′45"W.

Nannobelus-like representatives of Belmnitidae d'Orbigny s. restr. (Order Belemnitida Zittel 1895 emend. Jeletzky 1966)
Indeterminate pelecypods
Indeterminate brachiopods
Age: The presence of *Nannobelus*-like belemnites combined with the apparent absence of double grooved forms (*Dicoelites s. lato*) which are usually prevalent in mid- and late ? Toarcian belemnite faunas of western British Columbia suggests a late Pliensbachian to early Toarcian age.
Identification and comments by J.A. Jeletzky.

GSC loc. 95241 About 20.9 km SW of King Mountain at 58°08′15"N, 129°07′05"W.

Indeterminate true belemnites (Order Belemnitida Zittel 1895 emend. Jeletzky 1966)
Age: Jurassic or Cretaceous. In western and Arctic Canada, however, true belemnites are almost unknown in the pre-Toarcian (rarely appear in late Pliensbachian rocks) and post-lower Aptian rocks. Therefore, a Toarcian to early Aptian age is suggested.
Identification and comments by J.A. Jeletzky.

GSC loc. 95251 In the Three Sisters Range abut 24.1 km SSW of Turnagain Lake at 58°06′45"N, 129°17′55"W.

Belemnopsis sp. indet.
Age: Bajocian or possibly Toarcian. Although present in the Toarcian (mainly upper) of western British Columbia, the representatives of genus *Belemnopsis* Bayle 1878 are much more widespread in the Bajocian rocks of this region. A general Bajocian age is therefore considered most probable.

Bajocian

GSC loc. 95016 About 25.75 km SSE of Turnagain Lake at 58°06′N, 128°57′30"W.

Chondroceras spp. indet. (fragments and distorted specimens)
Stephanoceras s.l. (fragments and poor impressions)
Brachiopods, pelecypods, gastropods
Age: Early Bajocian.
Identification by H. Frebold.

GSC loc. 95018 About 9.25 km east of McBride River and 2.4 km north of west end of two lakes at 58°07′N, 129°00′W.

Fragment of ammonite, indet. Possibly inner whorl of a sonniniid
Age: Early Bajocian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95019 About 91 m S of GSC loc. 95018.

Poorly preserved inner whorls of ammonite, indet., possibly a sonniniid
Age: Early Bajocian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95020 About 183 m SW of GSC loc. 95018.

Sonninia ? spp. indet. (very poorly preserved fragments)
Age: Early Bajocian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95023 About 137 m W of GSC loc. 95020 and stratigraphically lower.

Sonninia ? sp. indet. (impressions of inner whorls)
Age: Early Bajocian.
Identification by H. Frebold and H.W. Tipper.

GSC loc. 95024 About 91 m W of GSC loc. 95023 and down section.

Several genera of sonniniids.
Impressions of inner whorls and one poorly preserved inner whorl.
Myophorella sp.
Trigoniids, corals, other bivalves
Age: Early Bajocian.
Identification by H. Frebold and H.W. Tipper.

Cretaceous

GSC loc. C-78699 At elevation 265 m near the confluence of Stikine River and Meehaus Creek at 58°04′52"N, 130°44′01"W.
Miscellaneous fungal spores
Baculatisporites
Laevigatosporites
Bisaccate conifer pollen
Inaperturopollenites
cf. *Glyptostrobus*
Tricolpites
Tricolporopollenites
Unidentified porate pollen.
This sample contained abundant woody material, but very few palynomorphs. This small and poorly preserved assemblage is not age diagnostic. The "primitive" appearance of the angiosperms does, however, suggest an age somewhere in the lower part of the Upper Cretaceous. Further sampling of this unit may be worthwhile.
Age: Lower part of the Upper Cretaceous.
Identification and comments by W.S. Hopkins Jr.

GSC loc. 7872 SW side of Stikine River at 58°03′38"N, 130°09′00"W. Collected from basal 15.2 m of Sustut Formation.
Pseudocycas unjiga (Dawson) Bell
Araliaephyllum parvidens? Hollick
Dicotylophyllum spp.
Age: Cenomanian.
Identification and comments by W.A. Bell.

Cenozoic

Eocene to Oligocene

GSC loc. C-98054 On Tuya River at 58°14′53"N, 130°44′15"W.
Alnus verus (R. Potonie) Martin and Rouse 1966
Carya sp.
(?) *Diervilla* sp.
Engelhardia sp. in Piel 1971
Juglans sp.
Pterocarya stellatus (R. Potonie) Martin and Rouse 1966
Tilia crassipites Wodehouse, 1933 (common)
Ulmus sp.
Fungal spores (common)
Preservation and recovery good to excellent. Bisaccate pollen common, tricolpate and triporate pollen scarce. With some certainty this sample can be considered to be of Eocene or younger age based on the combined presence of the above species. The questionable presence of Diervillia raises the possibility of an Oligocene age for the sample although this is inconclusive at present.
Age: Eocene or possibly younger.
Identification and comments by A.R. Sweet.

GSC loc. C-98053 Near junction of Tuya and Little Tuya rivers on Tuya River at 58°13′36"N, 130°42′57"W.
Engelhardia sp. in Piel 1971
Potamogeton sp.
Pterocarya stellatus (R. Potonie) Martin and Rouse 1966
Tilia sp.
(?)*Ulmus* sp.
monosulcte pollen
Preservation and recovery good. Spores common (*Osmundacidites* and *Laevigatosportes*), bisaccate pollen scarce
Age: Eocene to Oligocene.
Identification and comments by A.R. Sweet.

GSC loc. C-78699 At elevation of 265 m, confluence of Stikine River and Meehaus Creek at 58°04′52"N, 130°44′01"W.
Alnus verus (R. Potonie) Martin and Rouse 1966
Myrtaceidites sp.
Potamogeton sp.
Pterocarya stellatus (R. Potonie) Martin and Rouse 1966
Tilia crassipites Wodehouse 1933
Preservation and recovery good. Bisaccate pollen common; tricolpate and triporate pollen rare. Based on the combined presence of *Tilia crassipites* and *Pterocarya* this sample is most likely no older than Eocene.
Age: Eocene.
Identification and comments by A.R. Sweet.

GSC loc. C-78699 Confluence of Stikine River and Meehaus Creek at 58°04′52"N, 130°44′01"W. About 40 m above basal unconformity.
Alnus verus (R. Potonie) Martin and Rouse 1966
Myrtaceidites sp.
Potamogeton sp.
Pterocarya stellatus (R. Potonie) Martin and Rouse 1966
Tilia crassipites Wodehouse 1933
Preservation and recovery good. Bisaccate pollen common; tricolpate and triporate pollen rare.
Based on the combined presence of *Tilia crassipites* and *Pterocarya* this sample is most likely no older than Eocene.
Age: Eocene.
Identification and comments by A.R. Sweet.