

GEOLOGICAL
SURVEY
OF
CANADA

DEPARTMENT OF ENERGY,
MINES AND RESOURCES

PAPER 73-41

RECONNAISSANCE GEOLOGY OF AISHIK LAKE,
SNAG AND PART OF STEWART RIVER MAP-AREAS,
WEST-CENTRAL YUKON

D. J. Tempelman-Kluit

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D. J. Tempelman-Kluit

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GSC PAPER 73-41

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115H, 115K-J and 115N-O

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Price: \$5.00

Catalogue No. M44-73-41

Price subject to change without notice

Information Canada
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1974

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ABSTRACT

Aishihik Lake, Snag and part of Stewart River map-areas cover an area of more than 13,000 square miles, almost entirely within western Yukon Plateau, in west-central Yukon Territory.

Metamorphosed pelitic and igneous rocks of Proterozoic and/or Paleozoic age, included in the Yukon Group, underlie much of the region. They are intruded by large batholiths of hornblende, granodiorite, quartz monzonite and pink quartz monzonite of various Mesozoic ages. In the east part of the region Jurassic and Lower Cretaceous coarse clastic, immature sedimentary rocks of the Laberge Group and Tantalus Formation are faulted against this crystalline terrane. A suite of acid high-level plutonic, sub-volcanic and volcanic rocks, of Eocene age, the Nisling Range Alaskite and Mount Nansen Group, discordantly intrudes and overlies the older rocks. Basalt and conglomerate of the Carmacks Group (Eocene to Miocene) overlie all older rocks with distinct unconformity and are laid down on a surface of moderate relief that closely approximates the modern topography.

Major and minor structures in the metamorphic rocks trend generally northwest and the folded layering is a coarse schistosity that mimics a crenulation foliation. Linear elements in the rocks predate the latest folding and metamorphism which probably took place during the Early Mesozoic. Rocks of the Laberge Group are thrown into large southwestward verging folds. No recrystallization accompanied this deformation which took place in mid-Cretaceous time.

Mineralization discovered to date is of two types. Copper- and tungsten-bearing magnetite skarns in marble of the Yukon Group or in probable Triassic volcanic rocks are found mainly in Aishihik Lake map-area. Molybdenite and chalcopyrite, disseminated in rocks of the Nisling Range Alaskite-Mount Nansen Group suite, occur in Snag and northern Aishihik Lake map-areas.

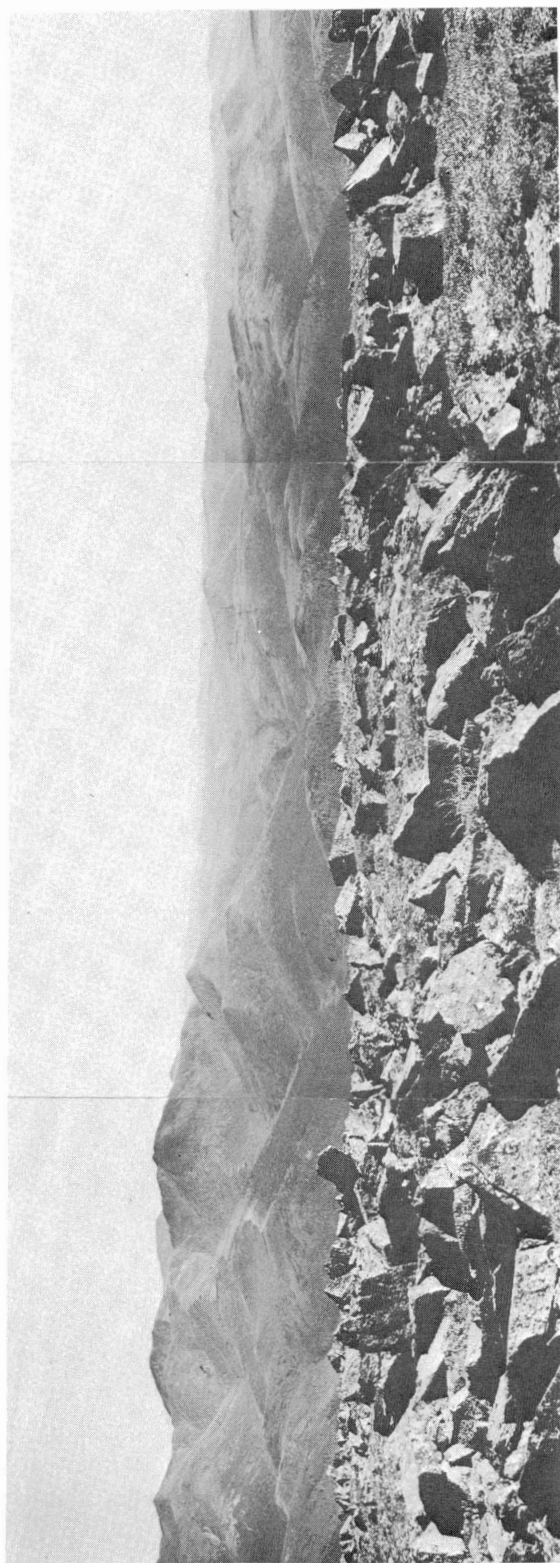
RÉSUMÉ

La section de la carte qui englobe le lac Aishihik, Snag et une partie de la rivière Stewart recouvre une superficie de plus de 13,000 milles carrés, située presque entièrement à l'intérieur du plateau occidental du Yukon, au centre-ouest du Territoire du Yukon.

La région repose en grande partie sur de la roche pélitique et ignée métamorphisée datant de l'ère protérozoïque et ou paléozoïque, qui fait partie du groupe du Yukon. Cette roche est injectée de larges batholithes de hornblende, de granodiorite, de monzonite à quartz et de monzonite à quartz rose datant de diverses âges du Mésozoïques. Dans la partie est de la région jurassique et du Crétacé inférieur, des roches sédimentaires prématurées clastiques grossières, du groupe de Laberge et de la formation de Tantalus, forment une faille dans ce terrain cristallin. Une série de roches plutoniques, sub-volcaniques, et volcaniques Très acides, de l'Éocène, appartenant au groupe d'Alaskite de la chaîne Nisling et du mont Nansen, pénètrent par injectas discordantes et recouvrent la roche ancienne. Du basalte et du conglomérat du groupe de Carmacks (de l'Éocène au Miocène) recouvrent entièrement la roche ancienne avec des discordances marquées et reposent sur une surface au relief modéré, très proche de la topographie actuelle.

Les structures importantes et minimes de la roche métamorphique affectent généralement la direction nord-ouest et les strates plissées forment une schistosité grossière imitant une foliation à plis minuscules. Les éléments linéaires de la roche sont antérieurs aux derniers plissements et au dernier métamorphisme qui s'est probablement produit au début du Mésozoïque. Les roches du groupe de Laberge sont plissées asymétriquement vers le sud-ouest. Cette déformation qui a eu lieu au milieu du Crétacé n'a été accompagnée d'aucune recristallisation.

La minéralisation découverte jusqu'ici est de deux types. On trouve surtout des skarns de magnétite contenant du cuivre et du tungstène dans le marbre du groupe du Yukon ou dans la roche volcanique datant probablement du Trias dans la partie de la carte qui décrit le lac Aishihik. La molybdénite et la chalcopryrite, disséminées dans les roches du groupe d'Alaskite de la chaîne Nisling et du mont Nancen se rencontrent dans les régions de Snag et du nord du lac Aishihik couvertes par la carte.



Frontispiece.

View looking eastward toward Apex Mountain in west-central Snag map-area showing the different outcrop characteristics of Mount Nansen Group acid explosive volcanic rocks (on the left) and basalt flows of the Carmacks Group (on the right). Individual flows of the Carmacks Group can be seen; their dip is depositional. Note the large felsenmeer blocks in the foreground which make up the "good outcrop" of this region. GSC Photo No. 202300-T

RECONNAISSANCE GEOLOGY OF AISHIHIK LAKE, SNAG AND PART OF STEWART RIVER MAP-AREAS, WEST-CENTRAL YUKON

INTRODUCTION

Aishihik Lake (lat. 61° to 62° N., long. 136° to 138° W.) Snag (lat. 62° to 63° N., long. 138° to 141° W.) and part of Stewart River (lat. 63° to 64° N., long. 140° to 141° W.) map-areas, a total of 13,365 square miles (see Fig. 1) were geologically investigated during the field seasons of 1970, 1971 and 1972. During 1970, reconnaissance studies were carried out along navigable streams with limited ground traverses by the writer and one assistant. Work in the 1971 field season consisted of helicopter-supported systematic ground traversing by the writer and eight assistants. Follow-up work in 1972 involved ground traversing in selected areas to study certain aspects of the geology and helicopter spot-checking as well as sampling for radiometric age determinations.

Able assistance in the field was provided by J. Fallon in 1970; by T. Booth, M. Delich, C. Dodds, A. Edgeworth, I. Gibson, S. Gordey, J. Nitsch, and B. Read in 1971 and by T. Booth and S. Gordey in 1972. Excellent air support was provided in 1971 by W. Johnston, pilot, and L. Vande Velde, engineer, with a Bell 47 J2A helicopter supplied by Alpine Helicopters Ltd. of Kelowna, B.C. Freighting of aircraft fuel and camp gear by boat on the Yukon River was done by R. Burian of Stewart River whose untiring efforts during camp moves greatly speeded the work.

Whitehorse and Dawson were used as bases for supplies and communication. Aishihik Lake map-area was studied from a base camp near the northern end of Aishihik Lake about Mile 60 on the branch road to the airfield. Base camps in Snag map-area were at Snag, the abandoned air field near the confluence of Beaver Creek and White River, at the mouth of Isaac Creek on the Yukon River, and near the mouth of Coffee Creek on the Yukon River. The western part of Stewart River map-area was worked from a camp on Ogilvie Island opposite the mouth of Sixty Mile River.

Travel on foot is easy in most of the region except in the swampy areas around Wellesly Lake in Snag map-area. Many of the wide, flat-floored valleys in western parts of the project area are swampy and covered by vast expanses of grass and sedge clumps which make travel on foot laborious. Aishihik Lake map-area is served by a narrow gravel road, 75 miles long, that is not maintained beyond Mile 27 and subject to washouts in spring, but which provides ready access to much of the central part of the map-area. Aishihik, Sekulmun, Long and Hutshi lakes, as well as several other lakes, are suitable for use by fixed-wing aircraft. The southwest part of Snag map-area is accessible from the Alaska Highway and northern parts are reached most readily from Yukon River, a stream navigable by the largest river craft. Fixed-wing aircraft can be easily operated off the Yukon River, but most pilots are reluctant to use the unpredictable White and Donjek rivers for that purpose. The White and Donjek rivers are navigable by shallow draft boats, but because of the muddy water, depths are difficult to judge and boats with

jet motors are well suited to travel on these streams. Some of the smaller rivers like the Nisling, Klotassin, Sixty Mile and Ladue can be travelled in powered boats only at high water and even then with considerable lining and portaging over log jams. None of the streams mentioned have difficult rapids or falls, but sweepers present a common obstacle.

Much of southern Aishihik Lake map-area is above treeline with base level about 3,000 feet. Thus there are numerous helicopter landing sites and almost any place is readily accessible by air. In marked contrast, Snag and Stewart River areas, where base level is more than 1,000 feet lower, have a much higher proportion of terrain below treeline and are much more difficult to work by helicopter, because landing sites are relatively few. In large parts of these areas access can only be gained on foot from landing sites many miles away.

Weather in Yukon Plateau is warm and dry during the summer (see Pl. IX), although rainshowers of short duration are an almost daily occurrence during a normal summer. Temperatures rarely exceed 85° F and generally do not fall below 30° F from the beginning of June until the end of August. Ice on the streams generally breaks up in May and ice on the lakes has usually melted before the middle of June. In 1971 Aishihik Lake remained covered with ice until June 25th. A strong wind blows from the south up the valleys of Aishihik and Sekulmun lakes much of the summer and this considerably affects travel time in small fixed- or rotary-wing aircraft. Weather builds up in the region over the Dawson Range and over the Ruby-Nisling Range, but southern parts of Snag map-area and northeastern parts of Aishihik Lake map-area are rarely covered by cloud to the extent that it hampers helicopter work. The easiest and lowest pass ($\pm$ 3,500 ft. elevation) across Dawson Range for light aircraft under conditions of low ceiling is that between the heads of Dip and Isaac creeks.

Vegetation is stunted and small in much of the project area, except along stream valleys. Black spruce is the commonest tree although white spruce, poplar and balsam are also widespread. Lodgepole pine is found on some of the dry slopes in eastern parts of Aishihik Lake map-area. Treeline is generally below 4,000 feet, but much of southwestern Snag map-area and northeastern Aishihik Lake map-area, being below this level, are tree-covered. Scrub willow, alder and dwarf birch grow above the treeline to elevations of 5,500 feet and above this only mosses, lichens and alpine flowers are found. Many of the south-facing slopes at lower elevations, particularly those along stream valleys are open and covered only with sparse grass and local isolated stands of poplar (see Pl. XVIII). Many of the valley floors in the western part of the region are covered by grass tussocks, with willow, alder and black spruce.

Game is not plentiful in most of the region. Small herds of caribou were seen at isolated localities in the Dawson Range and in parts of Aishihik Lake map-area. Moose were observed fairly commonly in the valleys of the entire area. Several large bands of Stone and Dall sheep were seen in parts of the Nisling Range and in the mountains between Aishihik and Sekulmun lakes, and also in parts of the Dawson Range. Black bears are fairly common along the Yukon and White rivers, but only two grizzly bears were seen (both in the Dawson Range). Wolves are fairly common along the Yukon River. Several bison, introduced in the country near Aishihik village some years ago, were reported seen along Nisling River in 1970 and again in 1972. Coyotes were seen along the valley of Nordenskiöld River in Aishihik Lake map-area.

Bald eagles and some golden eagles are commonly seen, particularly in the northeastern half of Aishihik Lake map-area and their nests are found at many places in this region on south-facing cliffs overlooking the larger streams. Although only about half the nests are occupied the region must be considered one of the prime nesting localities for these birds. Various kinds of ducks are seen on every lake and swamp during the summers and numerous varieties of small birds nest in or near the swampy areas of this region.

PREVIOUS WORK AND ACKNOWLEDGMENTS

Although no comprehensive geological maps exist for the project area, various parts have been studied by a number of geologists. In addition, geological maps, and in some instances reports, are available for all adjoining map-areas in Yukon (see Fig. 1). This wealth of data has proven invaluable to the present investigation.

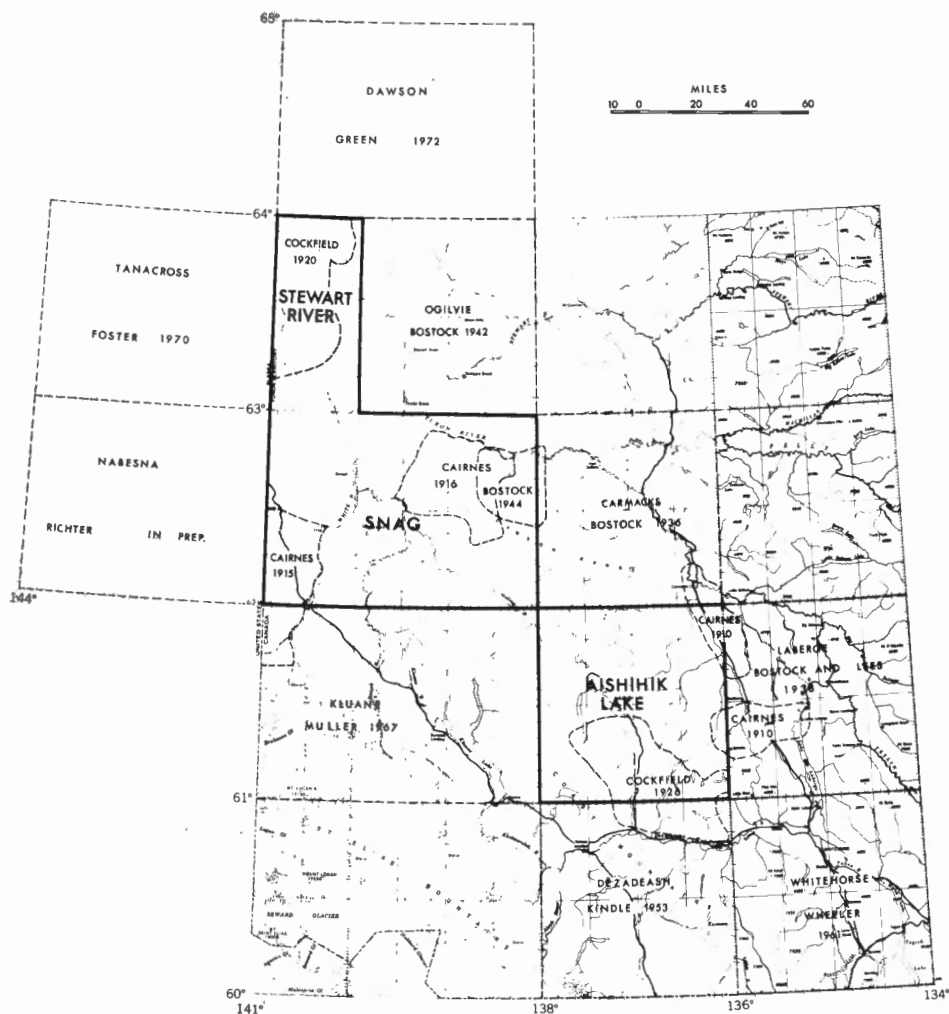


Figure 1. Index map showing location of the project area and references to previous regional geologic studies in and adjacent to it.

Much of southern Aishihik Lake map-area was mapped and briefly reported on by Cockfield (1927). Cairnes (1910) prepared a map and report on the Nordenskiöld and Lewes rivers coal fields and a small part of the area covered by his report is in Aishihik Lake map-area.

Cairnes (1917) produced a map and report concerning the geology of part of the Dawson Range near Klotassin River, a region entirely within Snag map-area. Bostock (1944) authored a map with marginal notes for part of the Dawson Range around Apex Mountain at the boundary between Snag and Carmacks map-areas. A report and map by Cairnes (1915) describes the Upper White River district in southwest Snag map-area. In addition Brooks (1900) gave much useful information describing a geological reconnaissance of the western part of Snag map-area.

The geology of much of the west part of Stewart River map-area is described in a report, with map, by Cockfield (1917) on the Sixty Mile and Ladue rivers district and Spurr (1897) included reference to geological data that pertains to northwestern Stewart River map-area.

The geology of adjoining areas in Yukon Territory is contained in maps with or without reports by Bostock and Lees (1938) on Laberge map-area (105 E), Bostock (1936) on Carmacks map-area (115 I), Bostock (1942) on Ogilvie map-area (115 O), Green (1972) on Dawson map-area (116 B and C), Muller (1967) on Kluane Lake map-area (105 F and G) and by Kindle (1953) on Dezadeash map-area (115 A). The geology of Tanacross Quadrangle, which adjoins Stewart River map-area on the west, is described by Foster (1970) and an open file report by D.H. Richter (1973) of the U.S. Geological Survey describing Nabesna Quadrangle (adjoining Snag map-area) is now available.

In addition to the published data the writer was fortunate to have at his disposal geological reconnaissance maps made by geologists working for various mining exploration companies. These include a map and brief report covering much of the northeast half of Snag map-area by geologists working for Archer Cathro and Associates Ltd., a compilation of much of Snag and part of Stewart River map-areas by Atlas Explorations Ltd., as well as various detailed maps of individual mineral properties held by a number of companies.

The writer has benefited from discussions with geologists working in the region at the time the work was being carried out. Some of these were A. Archer, R. Cathro, G. Abbott, M. Phillips of Archer Cathro and Associates, W. Karvinen of Atlas Exploration, R.E. van Tassel of Falconbridge, J.J. Brummer and C. Gleeson of Occidental Minerals Corp. and R. McMichael of Silver Standard. Many of these geologists and their organizations also kindly provided logistic support at various times during the field work. The list of mineral properties included in this report owes much to data kindly supplied by Archer Cathro and Associates Ltd.

HISTORY

Because the project area lies along some of the main routes of travel to the Klondike gold fields its history is closely tied to that of the gold rush and subsequent events. Yukon River was the main transportation route through the region during the first half of the century and during the summer

steamers plied the river at frequent and regular intervals. A telegraph line followed the river from Whitehorse to Dawson. As a result of this activity a number of small settlements sprang up along the river. In Snag map-area these settlements were at the mouth of Kirkman Creek, Coffee Creek, Ballarat Creek, Britannia Creek, Isaac Creek and Selwyn River. These settlements, generally occupied at various times by one or two families or men, served as bases for trappers, placer miners, and those who supplied wood for fuel for the steamers. They were also sites for trading posts, telegraph stations or post offices. At most of these settlements there were several log buildings and generally a vegetable garden. Steamer traffic and the telegraph line were abandoned in the 1950's with the construction of an all-weather road from Whitehorse to Dawson and at present the settlements are idle; at most only the fallen ruins of the buildings and clearings, rapidly being overgrown, remain. One family lived at Ballarat Creek during 1971. The settlement of Stewart River, once an important stopping point on the way to the Klondike and later the main transshipping point for silver ores bound from Keno Hill to Whitehorse (see Shand and Shand, 1950), is now occupied only by the Burian family who have lived there for 20 years. Stewart Island is being rapidly eroded by the river.

The Dalton Trail, which passes along the valley of Nordenskiöld River through the southeast part of Aishihik Lake map-area, was an important route by which men and pack animals reached the Yukon River from tide water in early attempts to reach the Klondike (see Kindle, 1953, Tyrrell, 1899). The village of Hutshi on Hutshi Lake, one of the prettiest places imaginable, lies on the old Dalton Trail, but has been long abandoned. The Dalton Trail, though overgrown and covered by fallen trees after much of the Nordenskiöld valley burned, is still visible and easy to follow in places, particularly where it passes through natural, open grassy meadows.

Aishihik village, at the north end of Aishihik Lake, is occupied intermittently by one or two families. The airfield and air base built near the village were abandoned in 1969 but many of the buildings and control tower are still in fair condition. The airfield at Snag is still usable by aircraft but the buildings have been levelled since the base closed about 1965. The settlement at the mouth of Beaver Creek has also been abandoned although it was occupied by a few people until the air base closed.

During the Chisana gold rush of 1915 many people made their way to these newly discovered placer fields from Dawson via White River and the Coffee Creek trail (see Cairnes, 1915). A number of road houses were built and operated along White River about this time, but of these only overgrown ruins remain; many of these places cannot even be found now. No trace remains of Lynx City a small trapping centre near the mouth of Nisling River. Trapper's cabins or their remains can be found at the mouths of nearly all streams, tributary to the White and Donjek rivers and at several places along Ladue and Sixty Mile rivers. Some of these have been occupied within the past 10 or 15 years, but most are older and completely caved in. The placer camp at the head of the Sixty Mile River has a fairly long history which is summarized elsewhere (Green, 1972).

At present most human activity takes place along the Alaska Highway and is centred at Beaver Creek, a Canadian Customs entry point and the only settlement in Snag map-area.

PHYSIOGRAPHY AND TOPOGRAPHY

The project area lies almost entirely within the western Yukon Plateau and between the Tintina and Shakwak trenches. The various physiographic subunits and their boundaries as taken from Bostock (1938) are shown in Figure 2. Bostock (1938, p. 68-73) also gives a concise description of these physiographic subdivisions part of which is quoted here as a summary description: "This plateau (Klondike Plateau) is cut into segments by the valleys of the master streams that traverse it, and its striking characteristic is the topographic similarity of all these segments, a similarity that may be largely due to the lack of glaciation of the plateau (see Plates V, VI, VII, VIII). It also shows throughout a character of dissection distinct from that of the

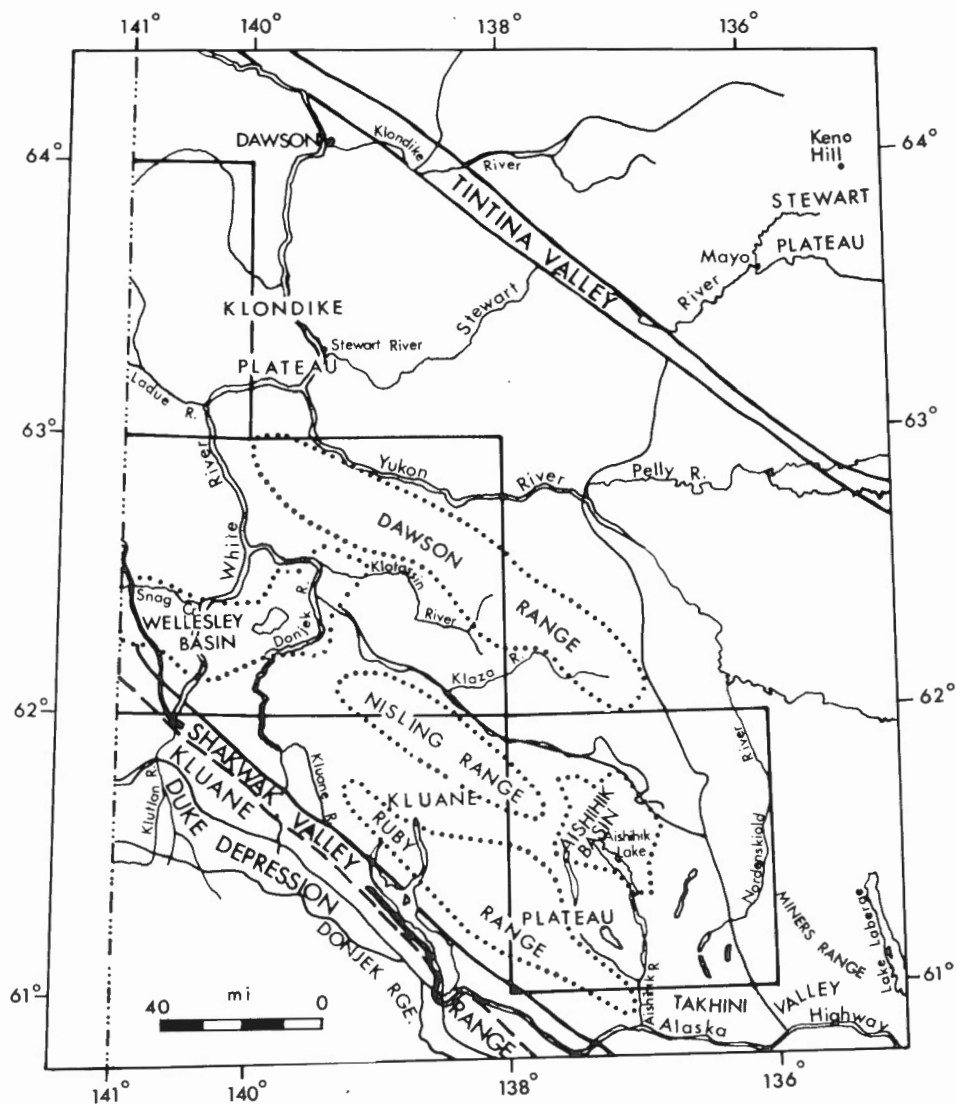


Figure 2. Physiographic subdivisions of the project area and adjacent parts of west-central Yukon.

glaciated plateaux to the east and the partly glaciated Kluane Plateau to the south. The topography is a maze of deep, narrow valleys separated by long, smooth-topped ridges whose elevations are very uniform, and which are remnants of an old uplifted erosion surface. This surface shows gentle undulations rising here and there along converging ridges to culminate in monadnocks that consist of dome-like eminences or groups of relatively smooth-sloped mountains, including Dawson Range."

Outcrop in the glaciated southern part of Aishihik Lake map-area is far better than that in the remaining unglaciated part of the project area. (see Pls. I to VIII). In Snag and Stewart River map-areas only the larger streams and rivers have important rock exposures, and elsewhere in these areas a thick residual soil covers bedrock; even the ridgetops have few exposures and are covered by vast areas of felsenmeer (see Frontispiece).

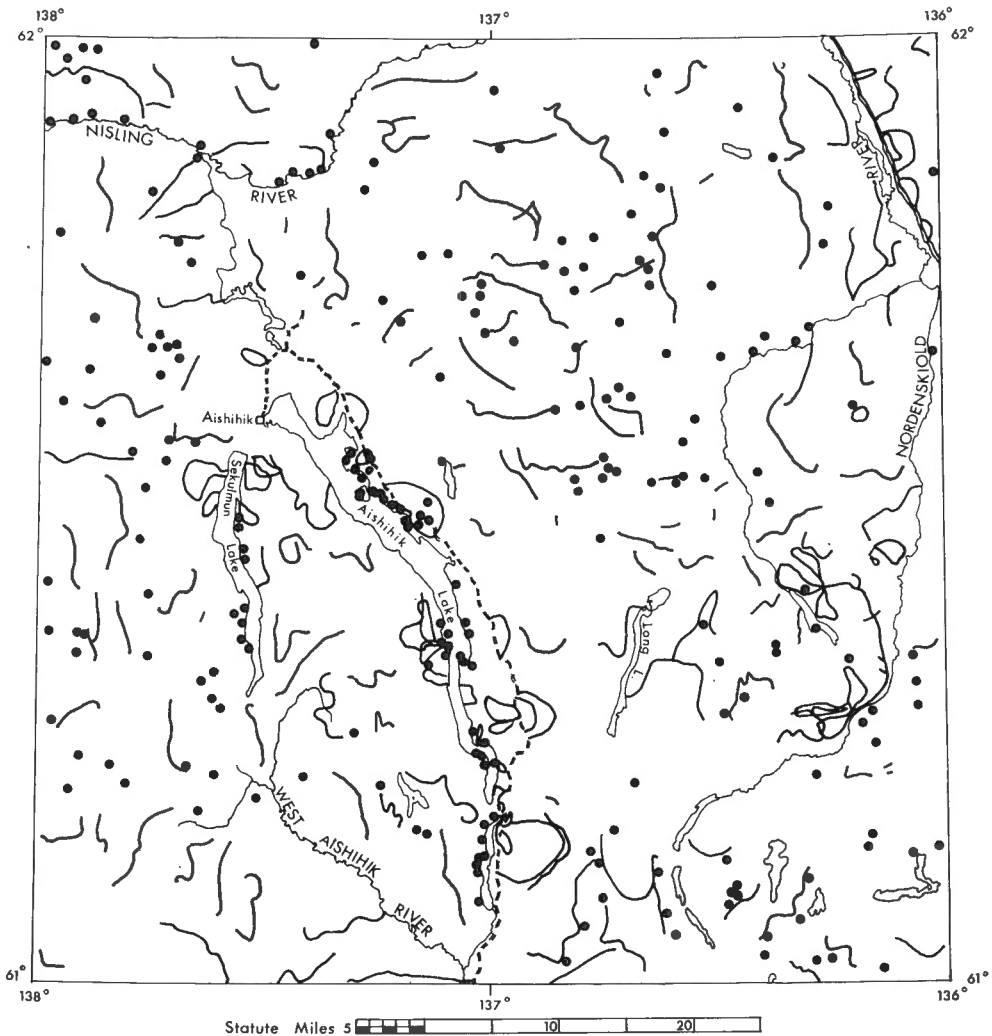


Figure 3. Index map of Aishihik Lake map-area showing traverse routes and localities visited during the present work.

Southern Aishihik Lake map-area, on the other hand, has good exposures obscured only locally by a thin cover of glacial debris (see for example Pl. II).

GLACIATION

The project area straddles the northern limit of the main Cordilleran and St. Elias ice sheets, and contains superb examples of most glacial features including eskers, kame-and-kettle topography, morainal deposits, glacial lake shorelines, terraces, and major rock-carved outwash channels. For these reasons much of the region is of particular interest to geologists studying glacial features and the history of deglaciation. Detailed studies have been made of these features in the project area by Hughes (1967, 1968) and Rampton (1967, 1968). Bostock (1966) and Hughes *et al.* (1969) have mapped and generally described the glacial limits and flow patterns for southern Yukon. Their glacial map covers a region that includes the project area.

Figure 6 is a generalized sketch map showing the glacial limits and the flow patterns for the project area and its vicinity. The central unglaciated part of the map-area was bounded on the south by the St. Elias ice sheet, which advanced northward, and on the east by the Cordilleran ice sheet, which moved northwestward. Important lobes extended northward along the valley now occupied by Aishihik and Sekulmun lakes and down the broad open valley of Wellesley Lake and the White River. Valleys tributary to the Aishihik lobe were occupied by ice-dammed lakes. These lakes filled their valleys to different levels; the more northerly ones nearer the glacial terminus being at distinctly lower levels than more southerly ones.

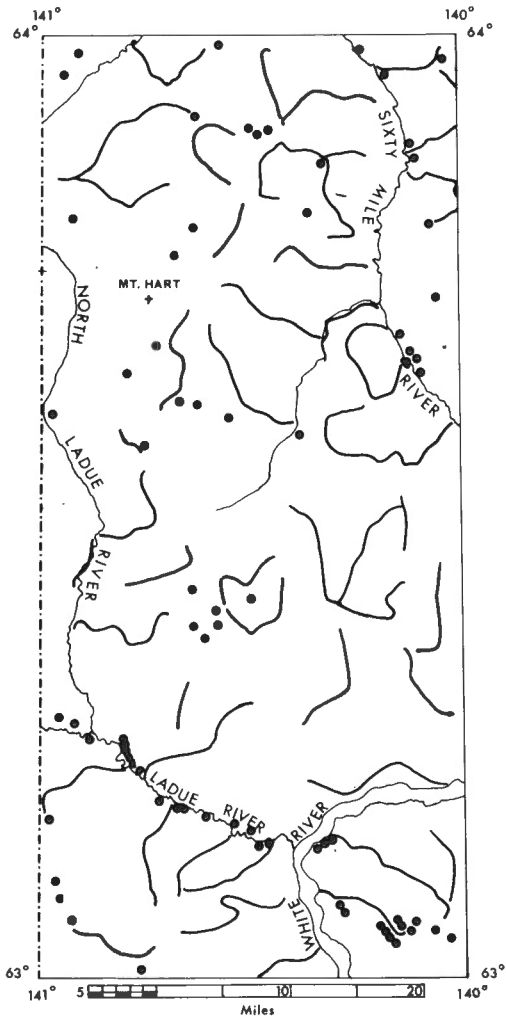


Figure 5.
Index map of Stewart River map-area showing traverse routes and localities visited during the present work.

GENERAL GEOLOGY

Much of the project area is underlain by metamorphic rocks to which the term Yukon Group has been applied by previous workers. These metamorphic rocks have been divided into a number of lithologic units some of which may be metamorphic equivalents. Lithologic subdivisions of the Yukon Group recognized and named by earlier geologists (e.g. Pelly Gneiss, Nasina Series, Klondike Schist) are practical and have been carried through the project area. The stratigraphic relations and age of the various lithologic units, however, remain a problem. Regional metamorphism of rocks in the Yukon Group is generally of upper greenschist to middle amphibolite facies. Judging from the limited radiometric data now available, the latest regional metamorphism took place in most of western Yukon during Late Triassic - Early Jurassic time.

Volcanic and related igneous and sedimentary rocks that are less metamorphosed than the rocks of the Yukon Group and which resemble those of the late Paleozoic Cache Creek Group, seen elsewhere in the Cordillera, are found in western Snag map-area. Nothing is known concerning the stratigraphic relations and age of these rocks.

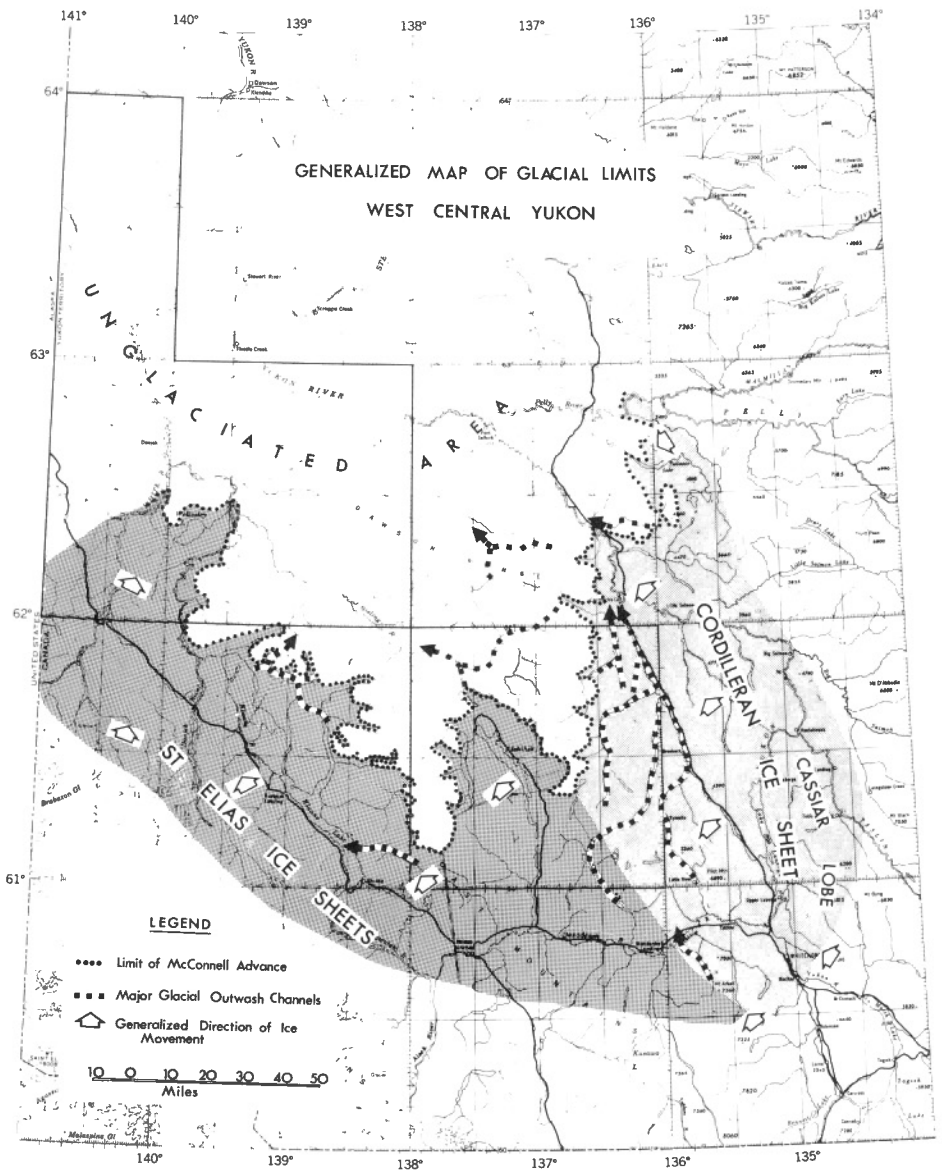


Figure 6. Generalized sketch map of glacial limits and flow patterns in west-central Yukon.

TABLE OF FORMATIONS

ERA	PERIOD OR EPOCH	UNIT NAME	MAP SYMBOL	LITHOLOGY	THICKNESS IN FEET
CENOZOIC	QUATERNARY	Columnar basalt	Tvbo	Columnar olivine basalt	50
	Eocene AND OR YOUNGER	Little Ridge volcanics	Tlr	Brown, purple and green basalt and tuff-breccia	500- 1000
		Donjek volcanics	ITvd	Purple and green tuff-breccia	-2000
		Carmacks Group	eTcv	Brown basalt and tuff-breccia	-2500
		Undifferentiated volcanics	Tv	Brown and green feldspar porphyry	
		Varicoloured acid tuff	Tvr	Acid vitric crystal tuff, lapilli tuff and welded tuff	-2000
		Quartz feldspar porphyry	Tvrp	Quartz feldspar porphyry and acid tuffs	-3000
		Felsic volcanics	ITvr	Rhyolite and acid tuffs	-1200
		Conglomerate on Sixty Mile River	eTccg	Poorly sorted, coarse-grained sandstone, con- glomerate and shale	+ 200
		Sandstone on Grayling Creek	ITsp	Poorly sorted, coarse-grained sandstone, shale and conglomerate	+ 200
		Quartzite Pebble Conglomerate	Tcgg	Quartzite pebble conglomerate; minor sandstone and shale	600
		Granite boulder Conglomerate	Tcgg	Granite boulder conglomerate; minor sandstone and shale	400
	Eocene?	Casino volcanics	Tva	Acid tuff ignimbrite and tuff breccia	-1000
		Mount Nansen Group	TMN	Aphanitic inter- mediate to acid tuff and tuff breccia	-3000

TABLE OF FORMATIONS (cont'd)

ERA	PERIOD OR EPOCH	UNIT NAME	MAP SYMBOL	LITHOLOGY	THICKNESS IN FEET
CENOZOIC	EOCENE?	Feldspar porphyry	Tfp	Feldspar porphyry dyke and flow rocks of intermediate to acid composition	
		Nisling Range Alaskite	Tgal	Fine-grained miarolitic leucogranite	
		Coffee Creek Granite	Tg	Coarse-grained equigranular biotite granite and quartz-monzonite	
MESOZOIC	CRETACEOUS?	Hornblende biotite granodiorite	Kgd	Equigranular unfoliated granodiorite	
		Hornblende diorite	LMdim	Melanocratic fine-grained hornblende diorite	
		Quartz monzonite	LMqm	Biotite quartz monzonite	
		Porphyritic monzonite	LMmzp	Porphyritic hornblende monzonite	
		Nisling Range granodiorite	Mgdb	Coarse-grained, equigranular hornblende biotite granodiorite	
	LOWER CRETACEOUS	Tantalus Formation	LKT	Chert pebble conglomerate; minor sandstone and shale	+2000 +
	LOWER AND MIDDLE JURASSIC	Laberge Group-	JL	Poorly sorted sandstone and shale with minor conglomerate	+6000
	TRIASSIC (?)	Porphyritic quartz monzonite	Mqmp	Porphyritic (pink K-feldspar) hornblende-biotite quartz monzonite	

TABLE OF FORMATIONS (cont'd)

ERA	PERIOD OR EPOCH	UNIT NAME	MAP SYMBOL	LITHOLOGY	THICKNESS IN FEET
MESOZOIC	TRIASSIC (?)	Ruby Range grano- diorite	Tgd	Medium-grained, equigranular horn- blende and biotite granodiorite	
		Massive green volcanics	Ivb	Massive green epidotized basalt	
PROTEROZOIC - PALEOZOIC	UPPER PALEOZOIC (?)	Ultramafic Rocks	PRub	Serpentinite	
		Basalt, Kluane Ranges	PMv	Aphanitic basalt, tuff, tuff-breccia	
		Greywacke, Kluane Ranges	PMs	Greywacke, argillite; slate, sandstone, lime- stone	
		Hornfels	Ppt ₁	Hornfels	
		Argillaceous rocks	Ppt	Slate	
		Ultramafic rocks	PMub	Serpentinized dunite and harzburgite	
		Gabbro	PMb	Hornblende gabbro	
		Limestone	Pc	Light grey crystalline marble	
		Massive Greenstone	PMv	Massive epidotized basalt	
		Peridotite	PMpr	Partly serpentized harzburgite	
		Sheared greenstone	Pv	Sheared to foliated greenstone	
		"Chert" and "Metachert"	Pt	Cherty low-grade meta- morphic rocks with minor greenstone and marble	
		Hornfelsed schist	EPsq	Staurolite cordierite biotite hornfels and schist	
		Marble	EPc	Light grey and white crystalline marble	

TABLE OF FORMATIONS (cont'd)

ERA	PERIOD OR EPOCH	UNIT NAME	MAP SYMBOL	LITHOLOGY	THICKNESS IN FEET
P R O T E R O Z O I C - P A L E O Z O I C	P R O T E R O Z O I C AND/OR P A L E O Z O I C	Biotite schist	PPsbq	Garnet muscovite biotite quartz schist	
		Nasina Quartzite	PPqc	Dark grey graphitic muscovite quartzite	
		Amphibolite	PPm	Amphibolite	
		Foliated biotite granodiorite	PPgd	Foliated biotite granodiorite	
		Schist	PPsb	Biotite schist and gneiss	
		Phyllite	PPps	Light grey muscovite chlorite phyllite	
		Klondike Schist	PPsqm	Chlorite muscovite quartz schist	
		Schist-Gneiss	PPsn	Mica feldspar quartz schist and gneiss	
		Foliated muscovite quartz monzonite	PPqmm	Foliated muscovite quartz monzonite	
		Pelly Gneiss	PPgdn	Gneissic grano- diorite, augen gneiss amphibolite	

LEGEND

- Major division; Relations unknown or unclear
- Relations unknown or unclear
- ~~~~~ Probable unconformity or disconformity-
- Probable sedimentary facies equivalent
- Volcanic units probably equivalent or broadly correlative
- Probable extrusive-intrusive equivalents

Massive dense greenstone and altered volcanic rocks, possibly of Triassic age, are found in a faulted block in northeastern Aishihik Lake map-area. Thick-bedded sandstone and conglomerate of the Laberge Group, from which middle Jurassic fossils were collected, are found in west-central Aishihik Lake map-area, and are exposed in a series of asymmetrical westward-verging folds.

A variety of plutonic rocks ranging from quartz diorite to granite and ranging through the Mesozoic and Tertiary in age intrude the metamorphic complex. The oldest of these, a hornblende granodiorite, that occurs extensively in Snag and Aishihik Lake map-areas, along with a younger distinctive pink quartz monzonite, apparently predate Lower Jurassic conglomerate of the Laberge Group and are probably Triassic or older.

Miarolitic alaskite that grades into biotite granite or quartz monzonite and which is associated with northward-trending feldspar porphyry dyke swarms of regional extent, is found in much of western Aishihik Lake and eastern Snag map-areas. This assemblage of plutonic and subvolcanic rocks, which has given early Tertiary radiometric ages, is spatially associated with explosive, acid to intermediate volcanic rocks, that are similar to the Mount Nansen Group as mapped in adjacent regions. These volcanic rocks are now thought to be broadly equivalent to the Sloko and Skukum groups as defined in areas to the south.

Flow rocks and tuff-breccias of basaltic composition (Carmacks Group), locally associated with conglomerate, and probably of Eocene age, overlie the older strata unconformably and cover a large part of eastern and central Snag map-area. These rocks are equivalents of the Little Ridge Volcanics and the Hutshi Group of other areas. Immature terrestrial conglomerate and sandstone are found at widely scattered localities at the base of the Carmacks Group. In places acid tuff is found between the basaltic flow rocks and the immature sedimentary rocks.

YUKON GROUP OR YUKON METAMORPHIC COMPLEX

Following Cairnes (1914) who first used the term Yukon Group for those "older metamorphic, probably Pre-Cambrian schistose or gneissoid rocks" of the Yukon Plateau and adjacent areas, most metamorphic rocks in central Yukon have been collectively referred to as the Yukon Group by geologists working in this large region. The usage has become so loose that any metamorphic rock anywhere in southern Yukon is a candidate for inclusion in this group. It has long been suspected and has become clear through the work of many geologists that not all metamorphic rocks of Yukon Plateau are part of one time-stratigraphic sequence of Precambrian age. Instead, the metamorphic complex of central Yukon includes, aside from such older rocks, at least a small proportion that are probably Paleozoic, but which have been so intimately involved in the deformation and metamorphism as to be indistinguishable from the older strata. Furthermore the metamorphic rocks include a variety of lithologic units whose relations to one another are unknown. For these reasons the metamorphic rocks do not satisfy the requirements of a group. The metamorphic rocks of central Yukon are more accurately referred to as the Yukon Metamorphic Complex. When this complex is better understood it may be possible to establish an assemblage within it to which the old name Yukon Group may come to be correctly applied.

The metamorphic complex of central Yukon, between the Shakwak and Tintina trenches includes two distinctly different assemblages of rocks that occur separately in irregular northwest-trending belts (see Fig. 7). The northeasternmost of these includes rocks of the Pelly Gneiss, Klondike Schist and Schist-Gneiss unit. Near the Alaska border rocks of the Pelly Gneiss and Klondike Schist are common in the belt, but in its southeastern part these rocks gradually disappear and are replaced by the Schist-Gneiss unit. This belt of rocks includes a prominent zone of marble lenses that are the structurally disconnected remnants of one or more originally more continuous limestone units. At various places along the length of this belt from localities in Alaska to central Yukon the marble contains nondiagnostic fossils which indicate that some are Paleozoic. The northern belt of meta-

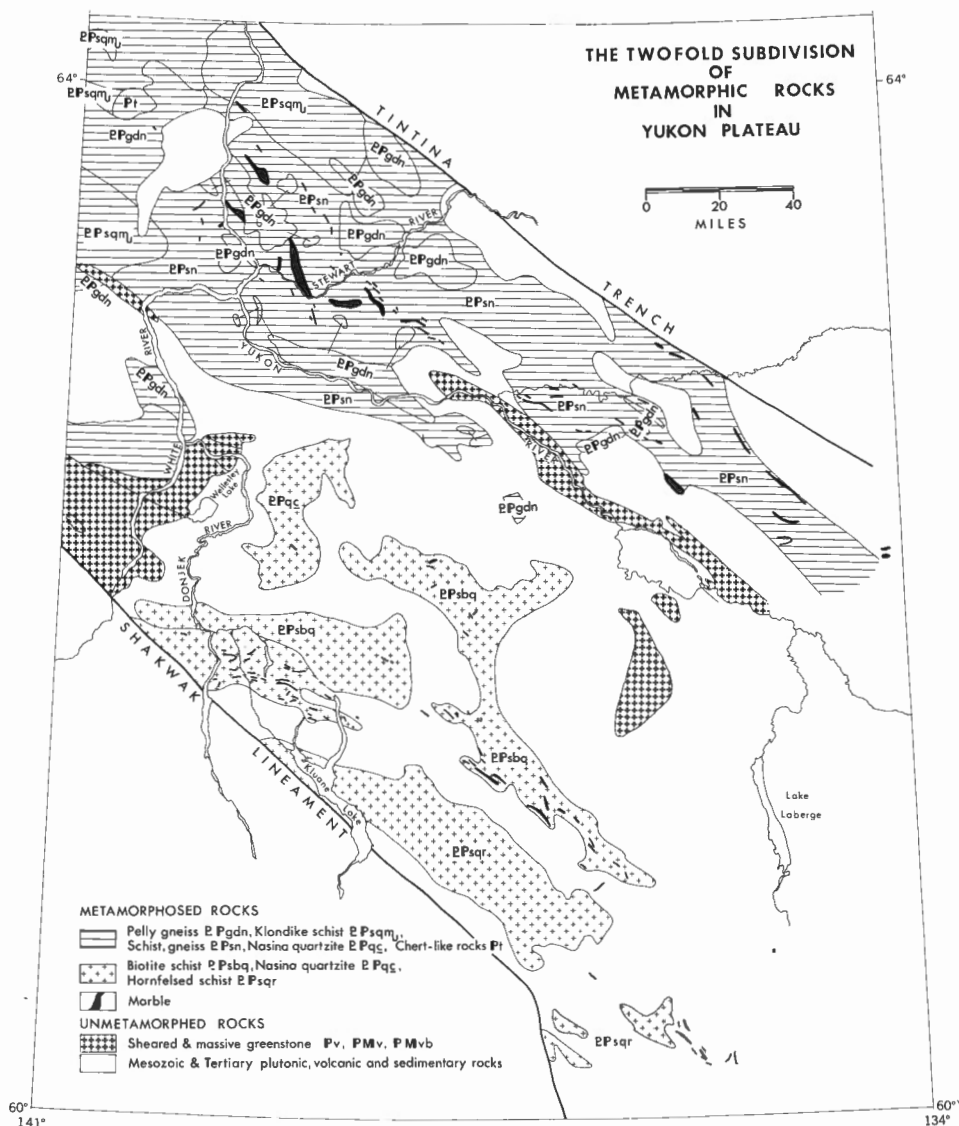


Figure 7. Lithologic subdivisions of a part of the Yukon Metamorphic Complex.

morphic rocks also includes an area of weakly metamorphosed chert-like sedimentary rocks that may overlie the more highly metamorphosed rocks unconformably. In Alaska also these cherty looking rocks are found.

The southern belt of metamorphic rocks is more irregular than the northern and is in fact a series of disconnected outcrop areas. Not only does this belt lack the units found in the northern one, but it contains unique rock units. These are biotite schist, the Nasina Quartzite, the hornfelsed schist and an unnamed assemblage in Kluane Lake map-area. The main difference between rocks of the two belts is that whereas the northern one contains abundant and widespread orthogneiss, the southern belt lacks such rocks altogether. The southern belt includes, like the northern, a zone in which marble lenses figure prominently, but unlike the northern marbles none of those in the south have yielded fossils.

The degree of metamorphism in rocks of both belts is roughly similar, though it varies from place to place. Biotite is present nearly everywhere and garnet is common. Kyanite is rare. Metamorphic isograd surfaces dip gently and no distinct zoning has been outlined.

The weakly metamorphosed greenstone and other rocks found in irregular patches through the centre of the Yukon Plateau between the northern and southern metamorphic belts are so distinctive and so much less metamorphosed than other rocks that they have never been considered a part of the Yukon Group. They are also not properly a part of the Yukon Metamorphic Complex because they postdate the main metamorphic event and were involved only in a later weak metamorphic stage. These volcanic rocks floor the Whitehorse Trough and their presence northwest of this sedimentary basin indicates that the ancestral Whitehorse Trough was more extensive in late Paleozoic and early Mesozoic time than it was during the Jurassic and early Cretaceous when sedimentation occurred.

The differences between the northern and southern metamorphic belts are perhaps the expression of differences in the level of exposure so that the northern belt, which contains rocks that may be interpreted as remobilized crystalline basement rocks, now exposes rocks from a deeper level than does the southern belt. Such a fundamental and regional difference in the level of exposure implies uplift of the northern crystalline block relative to the southern, probably after deformation and metamorphism. This differential vertical movement may have occurred at the time of emplacement of the late Paleozoic and early Mesozoic greenstones.

The regionally metamorphosed rocks of Yukon Plateau have yielded radiometric ages of 180 to 200 m.y. at several localities. This and the fact that Laberge Group rocks postdate metamorphism gives a reliable minimum age and indicates the rocks are Triassic or older. It is uncertain whether the radiometric ages reflect the latest regional metamorphism or whether they are an indication of important plutonism at that time. The presence of unmetamorphosed and slightly metamorphosed greenstone and related rocks presumed of late Paleozoic or early Mesozoic age suggests a minimum late Paleozoic (?) age of the regional metamorphism.

Pelly Gneiss

The name Pelly Gneiss (Pp_{gdn}), first used by McConnell (1905a), is used as originally intended, to designate specifically a group of granodiorite gneisses, of which the age and stratigraphic relations are unknown.

Rocks lithologically similar to McConnell's Pelly Gneiss (1905a) are found extensively in the northern part of Stewart River map-area where they occupy an irregular area and in northeastern Snag map-area where they lie in a northwest-trending belt 5 to 10 miles wide. They also occur locally intimately mixed with and included in the Klondike Schist and the Schist-Gneiss unit. The best exposures within the project area are along the north side of the Yukon River (see Pl. XX) particularly near the mouth of Selwyn River (Snag map-area) and along Sixty Mile River in Stewart River map-area.

The Pelly Gneiss is described in detail by Cockfield (1912, p. 22-23) and by Green (1972, p. 118) and only a summary is given here. The rocks are grey to brown, fine- to medium-grained, muscovite-biotite-quartz-feldspar schists or gneisses with a strong, pervasive foliation, but with poor development of compositional layering. In places much quartzofeldspathic material in the form of sills and boudins has been introduced and makes up perhaps 15 per cent of the volume of the rocks. The rocks are remarkably homogeneous, but grade locally into garnetiferous amphibolite. In Stewart River map-area particularly they include much augen gneiss. The gneisses have been strongly sheared to produce the flaser texture seen in some specimens, but metamorphic recrystallization continued later than the shearing and obscures much of this texture. Most of the unit has the mineralogical composition of a granodiorite to quartz diorite.

Foliation has a remarkably uniform orientation over large areas and folds are not seen thereby suggesting that much of the shearing that formed the foliation predated their heating and recrystallization. The rocks are uniformly metamorphosed to biotite grade (lower amphibolite facies).

The Pelly Gneiss as used in the map-area is lithologically the same as and continuous with rocks mapped as unit D by Green (1972) in Dawson map-area. They are also similar to, and probably correlative with, map-unit A of Bostock (1942). Foster (1970) has mapped equivalents of the Pelly Gneiss in Tanacross map-area, where they are included in the Birch Creek Schist (Mertie, 1937).

Cockfield (1921) and other authors have suggested that the Pelly Gneiss is a metamorphosed granitic rock, but Green (1972) considered these gneisses to be metasedimentary in origin.

The age of the Pelly Gneiss is unknown because no stratigraphic limits are available, but one potassium argon age determination (see Fig. 8) of 202 m.y. on these rocks outside the map-area and several others about 180 m.y. near Dawson, commented on by Green (1972, p. 118), suggests they were metamorphosed in Late Triassic time. A Proterozoic and/or Paleozoic age for these rocks is likely.

The stratigraphic relations between the Pelly Gneiss and other units are unclear, but the gneisses are spatially closely associated with those of the Klondike Schist and Schist-Gneiss unit. Along the north side of the Yukon River, Pelly Gneiss overlies the Schist-Gneiss unit structurally, but whether the relationship there is faulted, overturned, or normal is unknown.

Foliated Muscovite Quartz Monzonite

Extensive felsenmeer of a distinctive foliated muscovite quartz monzonite (EPqmm_0) is found on and near Crag Mountain in northwest Stewart River map-area. The rock is separated on the map, but its boundaries are only located approximately.

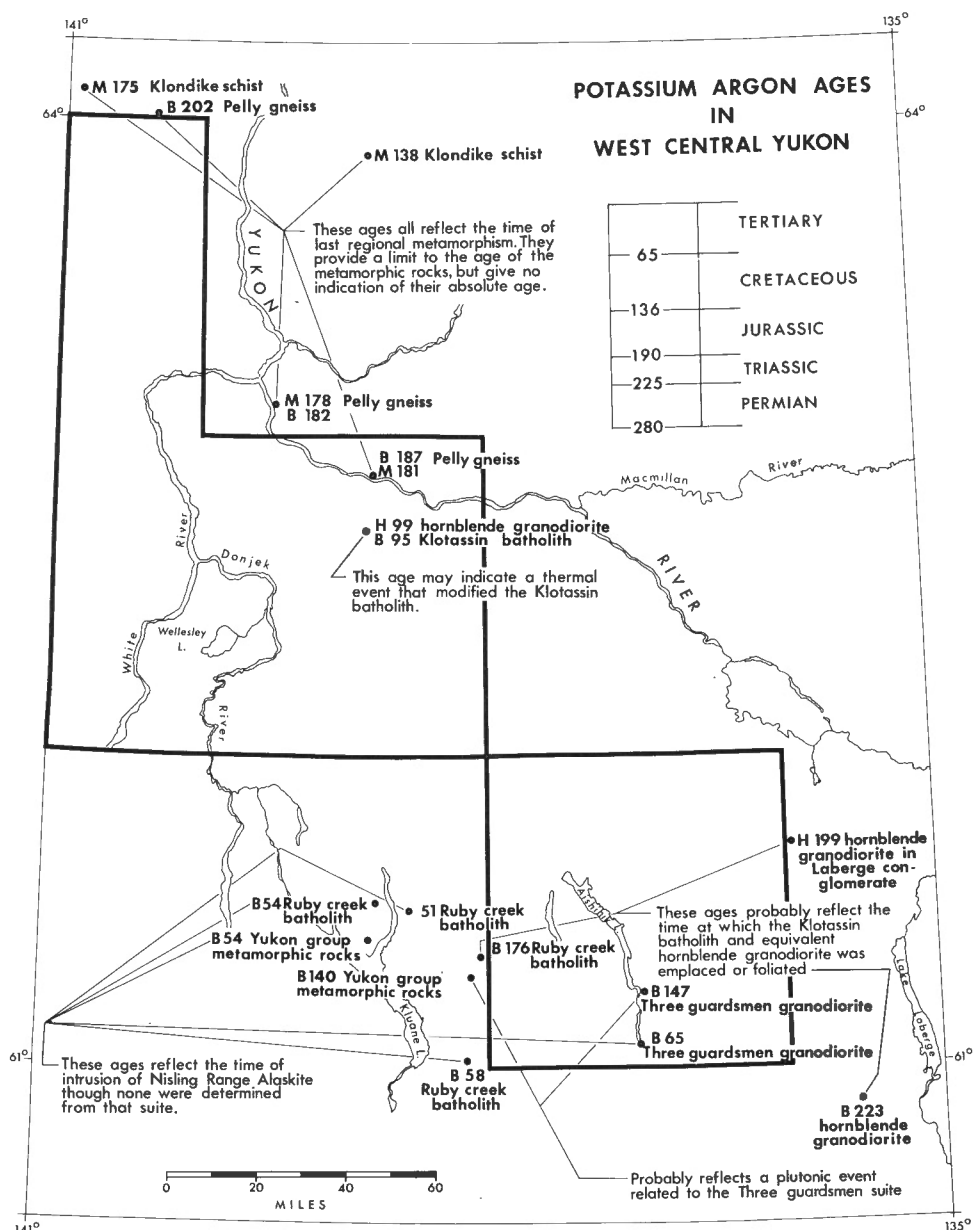


Figure 8. Available potassium-argon age determinations in west-central Yukon. The number represents the age in millions of years. The letters preceding the number indicate the mineral dated (M - muscovite, B - biotite, K - hornblende).

The quartz monzonite weathers a rusty orange colour, but is white on fresh surfaces and is a medium-grained equigranular rock made up of roughly equal proportions of quartz, plagioclase and potash feldspar. It contains

5 per cent muscovite and lacks mafic minerals. The rock has a well-developed foliation resulting from preferred orientation of elongated, anhedral quartz and feldspar grains which lends it a distinctly metamorphic aspect. No compositional layering is developed. The foliation is enhanced by preferred orientation, parallel with it, of muscovite, but the mica postdates the development of foliation in the quartzofeldspathic constituents and locally truncates and grows across these minerals. The muscovite is euhedral and is not bent or fractured as are many of the quartz and feldspar grains.

Muscovite quartz monzonite is mixed with float of Pelly Gneiss at a number of places near the Crag Mountain pluton. Relations seen in blocks of float indicate that the quartz monzonite forms sills within, and parallel with, the foliation of the Pelly Gneiss. These sills were evidently emplaced in Pelly Gneiss after it was already foliated and were subsequently themselves metamorphosed with their enclosing rocks. The quartz monzonite is therefore considered to be a synmetamorphic intrusion into the Pelly Gneiss.

The age of the quartz monzonite is unknown as no radiometric or stratigraphic data are available. The relations outlined above suggest a Paleozoic age. Rocks like the muscovite quartz monzonite are uncommon in the Pelly Gneiss and have not been described from elsewhere in Yukon Plateau. However they may be present at some localities and included with the Pelly Gneiss.

Schist and Gneiss

An unnamed assemblage of schist and gneiss (P P sn) is found in northeastern Snag map-area south of Yukon River and in eastern parts of Stewart River map-area. These rocks are recessive weathering and generally poorly exposed except along the Yukon River and some of its tributaries. Some good exposures are seen on the ridge between the Yukon and White rivers.

The unit is made up largely of nondistinctive and monotonous muscovite-biotite quartzite and quartz mica schist, but it locally includes granodiorite gneiss and augen gneiss like the Pelly Gneiss. Minor amounts of amphibolite and coarsely crystalline marble are interfoliated with the schists. The rocks are metamorphosed to biotite grade (upper greenschist facies) and have a well-developed schistosity.

The rocks probably represent or include somewhat higher grade metamorphic equivalents of the Klondike Schist and Pelly Gneiss, but on the ridge between the White and Yukon rivers Klondike Schist apparently overlies (structurally) the Schist-Gneiss unit. Mertie's (1937) Birch Creek Schist (also see Foster, 1970) which is probably equivalent to the Schist Gneiss unit is also thought to include metamorphic equivalents of Foster. The schist and gneiss is equivalent to, and continuous with, map-unit E of Bostock (1942). The age of the rocks is unknown, but the unit was metamorphosed with the other rocks and it is therefore probably Paleozoic and/or older.

Klondike Schist

The name Klondike Schist (P P sqm) is an informal one first applied by McConnell (1905a) to certain rocks in the Klondike district. The name as

used here refers only to the characteristic lithologies and implies nothing regarding the age, thickness or stratigraphic relations of the rocks.

Rocks lithologically like McConnell's Klondike Schist (1905a) occur extensively in west-central Stewart River map-area and two small areas of these rocks are differentiated in northern Snag map-area. The rocks are recessive and weather a rather distinctive orange colour; they are generally poorly exposed even on ridge tops. The best area in which to see these rocks is on the hill at the head of Rice Creek. Similar lithologies are included locally in the Schist-Gneiss unit.

Cockfield (1921, p. 14-18), and Green (1972, p. 109-110) give detailed lithologic descriptions of the Klondike Schist. Rocks of the unit include pale green, fine-grained, chlorite-muscovite-quartz schist with minor augen gneiss and amphibolite. All rocks have a well-developed, rather irregular foliation. Compositional layering, where seen, is a flaser structure that results from strong shearing and granulation. The latest recrystallization of the rocks postdates strong shearing. Metamorphism was of moderate to upper greenschist facies. Lenses and boudins of white quartz are common in the Klondike Schist and may total 5 per cent of its volume. Amphibolite, an important constituent of this unit, is interfoliated with the micaceous schists and is itself an actinolite quartz schist.

The unit resembles map-unit B of Dawson map-area (Green, 1972) and map-unit B of Ogilvie map-area (Bostock, 1942). In Alaska similar rocks have been mapped by Foster (1970) as Klondike Schist.

Little is known of the stratigraphic relations of the Klondike Schist, but its spatial association with rocks of the Pelly Gneiss suggests that the two units are broadly contemporaneous. Their metamorphism is probably of the same age.

Cockfield (1921) and others give evidence suggesting that the Klondike Schist is metagneous, but Green (1972) considers the unit metasedimentary.

Potassium argon age determinations of micas in the Klondike Schist (see Fig. 8) in adjacent areas (Green, 1972, p. 116) suggest that this rock was last metamorphosed about early Mesozoic time and considering similar evidence for the Pelly Gneiss both units are probably pre-Mesozoic.

Phyllite

Exposures west of White River in Snag map-area are fewer than in most other parts of the project area and the geology of the region is consequently poorly known. There, light grey weathering phyllites (P Pps) occupy a large and ill-defined area whose map-boundaries are approximate.

The phyllite is a fine-grained, silvery grey and pale greenish rock made up of quartz, muscovite, and chlorite, with minor biotite. It has a well-developed crenulation foliation that transposes an earlier foliation. The phyllite unit includes a considerable proportion of grey, slightly micaceous quartzite similar to that of the Nasina Quartzite. The phyllite is less metamorphosed than, but otherwise similar to the Klondike Schist.

Nothing is known of the relations of the phyllite and its assigned age is questionable. Because the rocks are metamorphosed they are presumed to be Paleozoic or older.

Foliated Biotite Granodiorite

An assemblage of light weathering, recessive, sheared, foliated and gneissic plutonic rocks (PPgd) occurs near Kennebec Creek west of White River in Snag map-area. A body of similar rocks that extends into Stewart River map-area is found north of Katrina Creek. Float is sparsely distributed and outcrop is rare. The best, and most easily observed exposures are along White River. Because of poor outcrop map-boundaries must be considered approximate.

The foliated granodiorite weathers to shades of white and is therefore prominent. It ranges from weakly foliated, fine-grained equigranular, leucocratic biotite-quartz monzonite or granodiorite to a fine-grained gneissic or strongly foliated biotite granodiorite or biotite-plagioclase gneiss. The rock everywhere has a distinct foliated texture defined mainly by the preferred orientation of its micas, but also by preferred form orientation of its quartzofeldspathic constituents. Biotite is everywhere fresh and occurs as tiny anhedral flakes. Quartz and feldspar are also anhedral and are unaltered.

Nothing is known of the field relations of the foliated granodiorite to other rock-units except that it appears from the mixed float seen locally that they are interfoliated with, or perhaps a part of, the biotite gneiss seen nearby. Relationships between the various different types that make up the unit are also unclear. Because the rocks are metamorphosed they are thought to be Paleozoic or older. They are somewhat like the Pelly Gneiss, but are generally more acid in composition and are therefore not considered equivalent. The rocks are altogether more strongly sheared and metamorphosed than are those of the Klotassin Batholith.

Amphibolite

Amphibolite (PPm) is found throughout the Yukon Metamorphic Complex and, although it has not been generally possible to differentiate this rock, known occurrences have been indicated on the map by symbol. An area where these rocks make up the bulk of the float is mapped west of White River south of Katrina Creek. There is little outcrop in the area. The amphibolite here is a black-green rock composed almost solely of actinolite that generally lends the rock a strong lineation by virtue of its preferred form orientation. Garnet is seen locally.

No evidence is available to suggest that these rocks are not an intimate part of the Yukon Metamorphic Complex. Their age and relationship to other rocks is unknown.

Nasina Quartzite

The name Nasina Quartzite (PPqc), first used by McConnell (1905a) refers to a group of rocks of distinctive lithology. The name is not intended to imply anything regarding age or stratigraphic relations. Nasina-type quartzite is found in small areas in northernmost Stewart River map-area, but in the project area its main exposures are in central Snag map-area. The unit is recessive weathering and good exposures are rare. The best area for study is on Stevenson Ridge where small exposures and plentiful float give

a good impression of the unit. Some good exposures of these rocks are also found on Nisling River.

As detailed descriptions of the lithology of the Nasina Quartzite by Cockfield (1921, p. 14-15) and Green (1972, p. 108) are readily available only a summary is given here. Rocks of the Nasina Quartzite are dark grey to black, graphitic and micaceous quartzite with interfoliated graphitic biotite-muscovite schist. Thin colour lamination, the result of alternating layers of light and dark grey quartzite, is common and characteristic. The unit includes local thick lenses of grey laminated marble. The Nasina rocks are metamorphosed to greenschist facies and are of metasedimentary origin. They have a fairly well-developed schistosity and their recrystallization continued after minor structures were formed.

The Nasina Quartzite, like most other rocks of the Yukon Group, is probably pre-Mesozoic. Its metamorphism, inferred from age determinations of other Yukon Group strata, is probably Triassic. The stratigraphic relations of the Nasina Quartzite are unknown and give no clue about the age of the rocks. Cockfield (1921, p. 16) contended that rocks of the Nasina "series" "are the oldest in the Sixty Mile district, for they are cut or overlain by all the other rocks." The writer saw no evidence to support this contention. Green (1972, p. 109) implies that the Nasina Quartzite is Paleozoic on the basis of fossils collected by him and by Mertie (1937). No fossils were found in the present investigation. The area of Nasina Quartzite in central Snag map-area is new and has not previously been studied, unlike the area in northern Stewart River map-area. These rocks have unfortunately yielded no new information on their age. Rocks like those of the Nasina Quartzite are included by Muller (1967, p. 22) in his map-unit 1 which includes equivalents of several map-units described herein. Some quartzite like that of the Nasina is found in northwestern Aishihik Lake map-area where it is included in the Biotite Schist unit.

Biotite Schist

Biotite schists (EPsbq) and related rocks that occur in southeastern Snag and northwestern Aishihik Lake map-areas are recessive weathering and best exposed on ridgetops. Fair outcrop is seen in Snag map-area, on the ridge leading south to Klaza River from the peak elevation 4,131, and in Aishihik Lake map-area, on the ridge between the headwaters of Schist and Lonely creeks.

The rocks are coarsely crystalline muscovite-biotite schists and micaceous quartzites that commonly contain garnets. They are metamorphosed to amphibolite facies rank and have a well-developed schistosity generally with a strong coarse crinkle lineation that is parallel with quartz rodding and streaking in the more quartzitic members. The unit contains lenses of garnetiferous amphibolite and local small bodies of marble and related skarn.

Some of the quartzite in the biotite schist unit is identical to that of the Nasina Quartzite and the two units are probably equivalent in part. Rocks of the biotite schist unit resemble those of the Schist-Gneiss unit, but lack its gneisses and are generally garnetiferous.

The biotite schist is continuous with rocks referred to simply as Yukon Group by Bostock (1936) in Carmacks area and is thought equivalent to unit 1 of Muller's (1967) Yukon Group.

Like other metamorphic rocks in central Yukon, the age of the biotite schist can only be inferred from the meagre isotopic age data presently available, which suggests broadly that this unit, if metamorphosed at the same time as metamorphic rocks elsewhere, is probably Paleozoic or Precambrian. Muller (1967, p. 24-25) lists the isotopic data presently available that bear on this problem.

Marble

Figure 7 is a compilation showing that marble (PPc) occurs as small lenses within the regional metamorphic rocks of Yukon Plateau in two separate belts and that the intervening area contains few such bodies. The southern marble band has so far yielded no fossils but several of the northern marbles contain crinoid columnals and corals at widely separated localities, (Cairnes, 1914, p. 39-40) (Bostock, 1936, p. 18) (Campbell, 1967, p. 45), (Green, 1972, p. 107). The southern marble band is so uniform in lithology and association that it is thought to represent one stratigraphic unit if not a single bed, but the northern marbles differ markedly and probably include units of more than one age.

Marble in biotite schist in Aishihik Lake map-area. Lenses of marble, interfoliated with biotite schist, are common near the southern end of Aishihik Lake and lie in a remarkably continuous, irregular zone that extends northwest diagonally across Aishihik Lake map-area from south of Hutshi Lake to the southern end of Sekulmun Lake. A second series of marble lenses extends northwest from the northern end of Sekulmun Lake.

Most marble lenses in Aishihik Lake map-area are conspicuous because they weather a bright white. The rock is a white, coarse-grained marble which locally has fine grey colour lamination, probably bedding, emphasized by graphitic partings. At some localities, notably three miles east of Giltana Lake, much pale grey tremolite is developed. It forms rosettes of acicular crystals along the layering. Elsewhere near granitic contacts, the marble contains coarsely crystalline grossularite, idocrase, epidote, and diopside with only minor amounts of calcite. The freshly broken rock is generally fetid. These marble lenses are generally about 100 feet thick, parallel with the schistosity of the enclosing schists, and only a few hundred feet, but locally nearly a mile long. Because of their small size, many have been generalized or exaggerated on the map.

Because they are interfoliated with the schists the marbles are thought an integral part of the sequence of regionally metamorphosed rocks and they probably represent one or two structurally disrupted and repeated, thin, but continuous, beds within that sequence. Unfortunately no fossils were discovered and nothing is known of their age except that they are Paleozoic or older.

Marble in rocks of the Nasina Quartzite (Snag map-area). Several lenses of grey, well-layered crystalline marble occur within grey graphitic quartzite of the Nasina Quartzite. Good exposures are seen along Nisling River. This marble does not differ from some seen in the biotite schist unit. Its age is unknown, but must be Paleozoic or older.

Marble in Stewart River map-area. A large body of coarsely crystalline white marble lies within rocks of the Pelly Gneiss along the north side of Fifty Mile Creek in Stewart River map-area. The rock is resistant weathering and forms good cliff exposures. It is massive and made up of white calcite flecked with subhedral crystals of graphite. The relations and age of this marble lens are unknown, but judging from the degree of metamorphism the rock is probably not one of the younger marbles that occur in this region.

Several other marble lenses in Stewart River area lie within the "chert" and "metachert" unit. These marbles are less metamorphosed than those enclosed by other metamorphic rocks and are thought to be Paleozoic.

Hornfelsed Schist

The regionally metamorphosed rocks exposed in southwest Aishihik Lake map-area have been thermally overprinted on a regional scale so that the rocks are hornfelsed schists (PPsqr). The sequence is remarkably homogeneous unlike the other metamorphic units and dips gently and uniformly to the northeast. Good exposures are seen on all the ridges.

The schist weathers brown and brownish grey with a purplish cast on fresh surfaces. At most places it contains cordierite and staurolite in addition to quartz, biotite, muscovite, plagioclase, chlorite, graphite and tourmaline. Andalusite is fairly common but garnet is rare. Pink andalusite is found as vein fillings. The rocks have a well-developed schistosity, defined by the micaceous minerals, which is parallel to weak compositional segregation of micas and quartz. New micas and cordierite have grown later to produce a coarse hornfelsic texture. Staurolite has been retrograded and is evidently a product of the regional metamorphism.

On the hills northeast of the head of McKinley Creek at least 10,000 feet of this unit, measured relative to the schistosity, are found. There is no evidence of repetition by faulting or folding. The metamorphic rocks may be a part of the biotite schist sequence found in central Aishihik Lake map-area. However, the absence of marble in the rocks of the southwest corner of Aishihik Lake map-area suggests that they are not exact equivalents. The hornfelsed schist unit is unique in Yukon Plateau and is unlike other rocks in the Yukon Metamorphic Complex. There is no information on the age of these metamorphic rocks, but they are thought Proterozoic and/or Paleozoic. No evidence was seen to indicate whether the thermal metamorphic effects are a late phase of the regional metamorphism or whether they result from thermal metamorphism later than, and unrelated to, regional metamorphism. Young granitic rocks, to which such late thermal metamorphism may be related, are seen at several places in the metamorphic terrain.

The hornfelsed rocks extend into the northwest part of Dezadeash map-area (Kindle, 1952), and are also found in the southeast part of the Kluane map-area (Muller, 1967). However, in these areas such hornfelsed rocks have not been separated from the regional metamorphic rocks.

"CHERT" AND "METACHERT"

A relatively small area of fine-grained, cherty, low grade metamorphic rocks found in northern Stewart River map-area is here referred to

informally as the "chert" and "metachert" unit (Pt). Unfortunately, exposure of these rocks is particularly poor and neither the lithology of the rocks nor their relations are adequately understood.

The rocks are pale weathering, pale green and purplish brown hornfelsed argillaceous chert, with lenses of chloritic phyllite and marble. For the most part, the rocks are massive and structureless, and lack layering of any kind. Some of the greenstone and marble show a good foliation. The rocks are weakly recrystallized and metamorphosed to chlorite grade, but biotite and muscovite are seen in places.

No fossils were discovered in the hornfelsed rocks. The age assigned to the rocks is therefore speculative. The cherty rocks are distinctly less metamorphosed than the surrounding strata and they are therefore inferred to overlie those more highly metamorphosed rocks unconformably. They somewhat resemble the Devonian and Mississippian cherty and argillaceous clastic rocks seen farther to the southeast in the Pelly Mountains. They are also similar to Ordovician and Silurian chert and slate of the Pelly Mountains. The rocks are tentatively considered to be Paleozoic.

The unit is most probably equivalent to Foster's (1970) Schist and quartzite unit of Tanacross Quadrangle, which includes lithologies like those described above and which has relations that are similar. In Tanacross map-area, as in the region under consideration, no conclusive age can be determined.

SHEARED GREENSTONE

Sheared or foliated greenstone (Pv) is found along the valley of the lower Ladue River in Stewart River map-area and in the general area west and north of Wellesley Lake in Snag map-area. The rocks are generally poorly exposed and only scattered outcrops are seen. For this reason, the relations of the various types to each other and to other units are obscure.

Most of the rocks are medium green fine-grained chloritic greenstone with abundant epidote. Foliation is developed at most places, but to varying degrees, and the shearing that led to its formation was by no means pervasive. In places there are lithic tuffs in which volcanic fragments are still recognizable. Elsewhere fine tuffaceous banding or layering is seen. The rocks include, in exposures along Donjek River, tuffaceous chert, impure greenish argillaceous chert, black chert and ribbon chert and these lithologies appear an intimate part of the greenstone unit.

The greenstone is inferred to be late Paleozoic on the basis of its lithologic similarity to rocks of the Cache Creek Group. Because the rocks are only weakly metamorphosed they are presumed to be younger than the regionally metamorphosed strata. The sheared greenstone and the massive greenstone, which occur in the same general area and have similar relations may be correlative and differ mainly in the degree to which they are sheared. The two greenstone units of western Snag map-area, therefore, may be related to the massive green volcanics of northeastern Aishihik Lake map-area and central Carmacks map-area, which are tentatively correlated with rocks of the Triassic Lewes River Group.

PERIDOTITE

A large body of ultramafic rocks lies astride Donjek River from about 4 to 10 miles above its confluence with White River in central Snag map-area (PMpr). Two smaller masses of these rocks are found a few miles east. A fourth large body is on the western side of Eikland Mountain in southwest Snag map-area. Good exposures are seen at all occurrences because the rocks are resistant and because vegetative cover is thin or absent.

The rocks are dark green on fresh surfaces, but have the thick, dun brown weathering rind so characteristic of ultramafic rocks everywhere. Most are harzburgites, made up of magnesian olivine (FO_{90}) and enstatite with subordinate serpentine, brucite, picotite, magnetite and magnesite (Delich, 1972). The olivine is partly serpentinized, and the enstatite, which contains inclusions of diallage, is partly altered to bastite. The rocks are medium grained, but the enstatite commonly occurs as phenocrysts. On Eikland Mountain dunite, made up essentially of olivine and serpentine, is an important phase.

Field relations are obscure, but the peridotite on Donjek River is probably fault-bounded to the north where it abuts the massive green volcanic rocks that separate it from the Klotassin Batholith. Faulted relations may also obtain where this mass is in contact with the sheared greenstone, but no outcrop was seen. Although exposure is poor the outcrop patterns on the south side of the Donjek River body suggest that the ultramafites are overlain by the Donjek volcanics. The harzburgite in all the occurrences is relatively fresh, has been only weakly metamorphosed, shows no evidence of having been sheared and lacks detected primary layering or compositional zoning.

The age of the ultramafites is unknown. Because the rocks are not strongly deformed, they presumably postdate the strong metamorphism that affected the surrounding rocks. Their association with rocks lithologically like those of the Cache Creek Group or Taku Group, and the fact that ultramafic rocks in much of the Canadian Cordillera are Permian and/or Triassic, suggest that these peridotites are of like age. Richter (1973) has mapped peridotites in adjacent Nabesna Quadrangle that are equivalent to those of Snag map-area, but unfortunately his data on the age of these rocks are as limited as those presented here.

The peridotites have most characteristics of alpine ultramafic bodies, but show no spatial relationship to any known zones of major faulting. Aeromagnetic patterns (see Fig. 16) suggest that the rocks lie in an arcuate belt that swings away from, and bears no relationship to, the Shakwak lineament.

MASSIVE GREENSTONE

Massive greenstone (PMv) outcrops on Koidern Mountain, Sanpete Hill, Siwash Ridge, Eikland Mountain, Macauley Ridge and at a number of other places in southwest Snag map-area. Good exposures are seen at all these localities because the rocks are resistant and form prominent cliffs.

The greenstone is monotonously uniform. It is a massive, structureless and textureless, aphanitic rock that weathers dark brown and which

is dark green on fresh surfaces. Epidote veining is common and is the sole feature noted in most exposures. The rocks grade into gabbro in places and it is unknown whether this rock is intrusive into the greenstone.

The greenstones are spatially closely allied with gabbro and ultramafic rocks and apparently are also associated with impure argillic and cherty rocks. Although the relationships between the various rocks are unknown the entire assemblage so much resembles the Cache Creek Group of more southern areas that the rocks are considered late Paleozoic and tentatively assigned to the Pennsylvanian and/or Permian.

Cairnes (1915) included the massive greenstone in his "Older Volcanics" and assigned these rocks a Pennsylvanian to Cretaceous age, but his unit includes rocks of two different ages and different stratigraphic affiliation that are lithologically indistinguishable.

The greenstone has no equivalent in adjacent Nabesna Quadrangle (Richter, 1973).

LIMESTONE

A large lens of coarsely crystalline massive white marble (Pc) is exposed about midway between the White and Donjek rivers five miles north of the southern boundary of Snag map-area. This rock is unfossiliferous and its relations to the massive greenstone nearby are unknown. It is thought to be late Paleozoic because of its association with the massive greenstone. Richter (1973) has mapped limestone lenses in adjacent Nabesna map-area which contain corals and stromatoporoids of Devonian age.

GABBRO

Gabbro (Pmb) which is found in southwest Snag map-area, is invariably closely associated with the massive greenstone and ultramafic rocks and has gradational boundaries with them. Map-boundaries are therefore approximate and in many instances the gabbro is not differentiated from massive greenstone.

The gabbro is a medium- to coarse-grained, equigranular, dark green rock that is generally resistant and well exposed. It is made up of euhedral crystals of dark green hornblende intergrown with subhedral plagioclase that appears mauve on fresh surfaces. The hornblende, pleochroic in green, is primary and only locally epidotized, whereas plagioclase is so badly saussuritized that its composition is difficult to determine. Apatite and magnetite are abundant and both these minerals are interstitial. Some hornblende is replaced by actinolite. The rocks are hornblende gabbros that are altered, but unmetamorphosed; they are not sheared and lack layering.

The assemblage with which the gabbro is found is so like rocks of the late Paleozoic Cache Creek Group that the gabbro is tentatively presumed of Pennsylvanian or Permian age.

ULTRAMAFIC ROCKS

Ultramafic rocks (PMub) outcrop at two localities at the headwaters of Borden Creek in Stewart River map-area, and at two places near the heads

of Coffee and Independence creeks along the northern contact of the Klotassin Batholith in Snag map-area. The rocks are resistant and well exposed and weather the characteristic brown colour of many ultramafic rocks. For the most part, they are dark green serpentinite. Thin sections show that the weakly serpentinized rocks are peridotite or dunite made up largely of olivine with subordinate serpentine, talc, tremolite and magnetite. The rocks differ from other ultramafites of the project area in having a pronounced foliation, parallel with that in the surrounding gneiss and schist, which is revealed by preferred orientation of minerals.

The ultramafic rocks form lenses as much as several hundred feet thick and as long as a mile; they are thought to be alpine bodies that lie along important fault zones. Although they are not associated with massive green volcanic rocks, as are the other ultramafic rocks of the project area, they are tentatively thought to be of the same age as the ultramafites of Donjek River and Eikland Mountain.

ARGILLACEOUS CHERT AND HORNFELS

At several widely scattered localities in western Snag map-area, notably on Gates Ridge and in borrow pits at milepost 1194 and 1215 on the Alaska Highway, there are exposures of recessive weathering thinly bedded, dark brownish and greyish cherty slate and argillite (Ppt and Ppt₁) inter-bedded with dark grey fine-grained quartzite.

Nothing is known of the relations of these rocks, because they are so poorly exposed. They are unmetamorphosed and are apparently closely related to the green massive volcanic rocks and because of this they are presumed to be late Paleozoic. Brooks (1900) reports finding late Paleozoic fossils in the Wellesley Formation which is the presumed Alaskan equivalent of these rocks.

The hornfels mapped on Horsecamp Hill and Koidern Mountain is a purplish brown fine-grained dense massive rock that is tentatively considered a thermally metamorphosed equivalent of the argillaceous rocks.

MASSIVE GREEN VOLCANICS

A suite of massive, dense, green volcanic rocks (Tv_b) is present southwest of the Nordenskiöld River in northeast Aishihik Lake map-area, where they are generally well exposed. The rocks outcrop particularly well in the area around the mouth of Kirkland Creek.

The volcanics generally weather a rusty colour, but are dark green on fresh surfaces. Most specimens are aphanitic, massive and structureless flow rocks, but a fair proportion are tuffs in which lapilli and groundmass are nearly identical. Some pale green cherty tuff was noted. In places augite porphyry, with subhedral, equant augite crystals to 2 mm across, in an aphanitic matrix is present. The rocks have been strongly epidotized and their aphanitic groundmass is a mixture of fine-grained alteration minerals. The green volcanics have a remarkably high specific gravity and are basaltic in composition. For the most part they are massive, but near their contact with other rocks they are commonly sheared.

The stratigraphic relations of this unit are uncertain. Contacts with the hornblende granodiorite are sheared and may be faulted. At their

southern margin the rocks may be faulted against the Laberge Group. Their eastern margin, along the valley of Nordenskiöld River is also assumed to be faulted. Flow outlines were not distinguished and it is unknown if the massive green volcanics are folded or essentially flat lying. In any case their thickness was not determined.

Conglomerate in the Laberge Group at Conglomerate Mountain (Laberge map-area) contains a high proportion of boulders of massive green volcanic rocks like those under consideration. The unit is therefore probably pre-Jurassic and a Triassic age is tentatively assigned to it. The massive green volcanics are lithologically like, and thought equivalent to, rocks at the mouths of McGregor Creek and Williams Creek in Carmacks map-area. These rocks were included by Bostock (1936) in his Mount Nansens Group. Campbell (1967) mapped similar lithologies on Frenchman Ridge and Tatchun Mountain (Glenlyon map-area) and tentatively correlated the rocks with those of the Lewes River Group. This correlation is supported by the limited data from the project area. Cairnes (1910) who studied the northeast quadrant of Aishihik Lake map-area included the massive green volcanics in his Hutshi Group. The massive green volcanics may be equivalent to the greenstones found in western Snag map-area to which a late Paleozoic age is tentatively assigned.

RUBY RANGE GRANODIORITE

The area around the Three Guardsmen in southern Aishihik Lake map-area has excellent exposures of grey granodiorite and quartz monzonite (Tgd). These rocks are continuous with, and almost certainly equivalents of, the Ruby Range granodiorite (Muller, 1967). The Ruby Range granodiorite mapped in Aishihik Lake map-area includes areas of undifferentiated diorite like that described elsewhere.

The granodiorite is a heterogeneous medium grey rock made up of 25 per cent quartz, 15 per cent potash feldspar and 50 per cent plagioclase. In addition, the rock contains approximately equal amounts of hornblende and biotite. Locally the texture is porphyritic with large euhedral plagioclase phenocrysts, but generally it is hypidiomorphic and equigranular. Sphene is a common and prominent accessory mineral that is easily seen with the naked eye. The mafic minerals are fresh and occur as small intergrown anhedral grains giving a clotted appearance. At most places the rock has a faint, and in places distinct, layering defined by alignment of mafic minerals. The granodiorite differs from the other granitic rocks because of its grey colour, the clotted mafics, faint layering, and plentiful sphene. Muller (1967, p. 61-64) gave a complete petrographic description of the unit.

Ruby Range granodiorite is lithologically similar to the hornblende granodiorite, but distinctly unlike other plutonic suites. The rock is cut by the Nisling Range Alaskite and is therefore considered older than Eocene, even though a number of potassium-argon age determinations on Ruby Range rocks have yielded Eocene ages (see Fig. 8). The radiometric age of 176 m. y. determined from Ruby Range rocks in Kluane map-area is probably closer to the true age of these rocks (see Fig. 8) and the rocks are considered Triassic. Ruby Range granodiorite is tentatively thought equivalent to the hornblende granodiorite, but the two rocks have had different post-crystallization histories.

HORNBLENDE GRANODIORITE

Large parts of central Snag and central Aishihik Lake map-area are underlain by hornblende granodiorite (Tgdm). The part of Snag map-area underlain by these rocks is referred to as the Klotassin Batholith, and forms the core of the Dawson Range on the divide between the White and Yukon rivers drainage. Good exposures are found at numerous localities along this divide where the rocks weather into large isolated "castles" (see Pls. X, XV). These rocks are also well exposed along some stretches of Aishihik Lake. Boundaries of the granodiorite with other granitic map-units are gradational in many places and the extent of these rocks as shown on the maps is in part arbitrary.

The hornblende granodiorite ranges in composition from quartz monzonite to quartz diorite with a distinct predominance of the more mafic types. The rock is equigranular and generally coarse-grained with granitic texture. Andesine is the main constituent making up 40 per cent of the rock; quartz makes up about 25 per cent and potash feldspar about 15 per cent. The potash feldspar, commonly perthite, occurs interstitially to quartz and plagioclase. Hornblende, pleochroic in green, and characteristically present as euhedral, short prismatic crystals, is everywhere the main mafic mineral, constituting 12 per cent on average. Biotite is a minor component generally present in anhedral bent flakes. Sphene is an important accessory mineral seen nearly everywhere in the rocks; apatite is also common. The granodiorite though usually fresh, is altered in places so that the feldspars have a greenish tint. The hornblende in these altered rocks is partly chloritized.

The rock commonly has a planar fabric brought out by alignment and streaking of mafics. This fabric has involved recrystallization of biotite only locally (e. g. along the shore of Aishihik Lake and west of White River near Katrina Creek and north), but for the most part only physical reorientation without wholesale movement of the constituents is seen. The planar fabric is seen not only near the contacts of the granodiorite with metamorphic rocks, but also in central parts of the batholiths. The granodiorite is a homogeneous rock, but locally where shearing has been strong it contains large "schlieren" of dark minerals parallel with the rock fabric. Inclusions, generally much resorbed and rich in biotite are common, but not volumetrically important.

In much of Aishihik Lake map-area and locally in Snag map-area the granodiorite is invaded by pink quartz monzonite. Generally where this has happened the granodiorite host retains its character, but is cut by veins, dykes, plugs and large masses of the quartz monzonite resulting in an agmatitic relationship. Boundaries between the granodiorite and quartz monzonite, though locally sharp are commonly indistinct and gradational.

The hornblende granodiorite intrudes the metamorphic rocks surrounding it, but this relationship is modified in places by shearing and differential movement. The contact between the granodiorite and metamorphic rocks seen on the large island in Aishihik Lake dips steeply, and is parallel with the foliation of the intrusive and metamorphic rocks. Locally much mixing occurs near the contact of the granodiorite and metamorphic rocks, with the development of lenses, dykes, and local lit-par-lit gneisses. The northern contact of the Klotassin Batholith near Canadian and Britannia creeks, though poorly exposed, shows a particularly wide zone of such migmatites. The northern contact of the Klotassin Batholith near the heads

of Independence and Coffee creeks is sharp and the rocks on either side of the contact are much sheared. This boundary is also marked by small bodies of strongly foliated and metamorphosed ultramafic rocks and may represent a zone of faulting.

Two lines of evidence for the age of the granodiorite suggest these rocks are early Mesozoic or older. The rock postdates deposition, but not the last regional shearing and recrystallization, of the enclosing metamorphic rocks. From the evidence of the limited radiometric data presently available this shearing and metamorphism is probably Late Triassic. Therefore, the granodiorite is Triassic or older. The second line of reasoning is based on stratigraphic evidence; a large proportion of the boulders in the Laberge conglomerate within and very close to Aishihik Lake map-area are of hornblende granodiorite and foliated granodiorite (and granodiorite invaded by pink quartz monzonite) that is lithologically like the hornblende granodiorite. As the Laberge is Early Jurassic and younger the granodiorite must be Triassic and/or older. Two potassium argon ages outside the project area (see Fig. 8), one on granodiorite boulders from the Laberge conglomerate and one on hornblende granodiorite like that of the Klotassin Batholith, also support a Triassic or older age.

The hornblende granodiorite may be equivalent to lithologically similar rocks in Whitehorse and Dezadeash map-areas south of the project area. Equivalents of the hornblende granodiorite are included with other plutonic rocks in map-unit 10 of Carmacks map-area (Bostock, 1936). Glenlyon map-area (Campbell, 1967) also has rocks that are equivalent. Souther (1971) described rocks whose lithology, field relations and age limits are identical to those of the hornblende granodiorite (i.e. his map-unit 6).

PINK QUARTZ MONZONITE

Pink to orange-red quartz monzonite (Tqm) occurs extensively in Aishihik Lake map-area on the mountains east of Long Lake and north of Mount Cooper, where it forms a large batholith with gradational borders that intrudes hornblende granodiorite. A similar rock forms a small plug a few miles south of Casino in Snag map-area. The rocks are resistant and well exposed and form prominent cliffs which from a distance have a diagnostic and distinctive pink hue.

The pink quartz monzonite ranges from a leucocratic, coarse-grained, equigranular rock with allotriomorphic texture to a coarse-grained porphyritic mesocratic rock with hypidiomorphic texture. The equigranular types contain roughly equal proportions of quartz, microperthitic potash feldspar, and albite-oligoclase, all intricately intergrown. Biotite makes up one or two per cent and is interstitial to the quartz and feldspar. It forms ragged, anhedral, fresh, small grains. In the porphyritic varieties hornblende constitutes about 10 per cent of the rock, but the proportion of the quartzofeldspathic constituents is the same. These rocks have conspicuous, euhedral orange-pink phenocrysts of simply twinned potash feldspar to 7 cm long. Both types locally display a foliation and have cataclastic structures. Pyrite, pyrrhotite and hematite are sparingly distributed through most of the rocks and their oxidation product, limonite, is common as a partial cavity filling. Finely divided hematite probably accounts for the salmon-pink colour. Contacts between the porphyritic and equigranular types are gradational and the

change from one rock type to the other takes place over a wide zone. The potash feldspar is sericitized in places but plagioclase is relatively fresh.

In the project area the pink quartz monzonite only invades the hornblende granodiorite and is not found in any other setting. Relations between the two rock types are varied. Aside from the large batholith, the pink quartz monzonite forms plugs and dykes of varied shape and size and generally with indistinct gradational boundaries. The boundaries are such that the rocks range generally over distances of many feet from mesocratic coarse-grained equigranular hornblende granodiorite through porphyritic (pink K-feldspar) coarse-grained hornblende granodiorite or quartz monzonite to leucocratic coarse-grained pink quartz monzonite. The granodiorite and the quartz monzonite are foliated in places, but the foliation of the quartz monzonite is less prominent than that of the granodiorite. The relations suggest that the quartz monzonite may be a late magmatic, wholesale hydrothermal alteration of the granodiorite rather than a younger plutonic rock unrelated to it. The quartz monzonite may also have formed by partial melting and mobilization of the granodiorite.

The age of the quartz monzonite is not closely limited by stratigraphic data and no radiometric ages are available. Because the quartz monzonite invades hornblende granodiorite, but is foliated with it, it is tentatively considered Triassic. Some boulders in conglomerate of the Laberge Group (at Conglomerate Mountain in Laberge map-area) look distinctly like the pink quartz monzonite. If these boulders are derived from the pink quartz monzonite a Triassic age is reasonable. The pink quartz monzonite is directly overlain by Upper Jurassic and/or Lower Cretaceous rocks of the Tantalus Formation (on the mountain north of Mount Cooper; see Pl. XVI). This indicates that the quartz monzonite is Early Cretaceous or older. The pink quartz monzonite is lithologically like Wheeler's (1961, p. 99) pink quartz monzonite judging from his description, but the stratigraphic relations of the rocks here under study and those in Whitehorse map-area differ considerably.

PORPHYRITIC BIOTITE QUARTZ MONZONITE

Much of northern Aishihik Lake map-area is underlain by a batholith of porphyritic hornblende-biotite quartz monzonite (Mqmp). The boundaries of the porphyritic quartz monzonite are gradational over wide zones and the contacts as mapped are therefore rather arbitrary. The quartz monzonite weathers to large tors and castles (see Pl. XIII) which have rounded corners and edges. Because its grains are rather loosely held the rock disintegrates physically so that large areas underlain by them are covered with an orange-yellow weathering coarse sand.

The rock contains about 40 per cent plagioclase, 30 per cent quartz and 25 per cent potash feldspar and grades from quartz monzonite to granodiorite. Most of the potash feldspar is present as euhedral, thick tabular phenocrysts of bright to pale pink microperthitic potash feldspar to two inches across. The quartz and oligoclase, grey and white respectively, make up the coarse-grained groundmass and are present as anhedral to subhedral grains with minor interstitial potash feldspar. The rock is leucocratic and generally contains less than 5 per cent mafic minerals. In some places biotite predominates over hornblende, although elsewhere the reverse is seen. The mafic minerals are found as subhedral grains smaller than, and

interstitial to, the quartz and feldspar. The rocks are homogeneous and vary only slightly in the proportion of their contained minerals and texture. Locally the phenocrysts are absent and in some places a faint layering, brought out by alignment of mafic minerals, is present. Xenoliths and inclusions are uncommon.

The porphyritic quartz monzonite is closely associated with the hornblende granodiorite and the pink quartz monzonite and is not found where these rocks do not occur. The three rocks have broadly gradational contacts with each other although the relations of the quartz monzonite to the other rocks is not clear. The porphyritic quartz monzonite is thought to be the product of wholesale alteration of the hornblende granodiorite by invasion of the pink quartz monzonite.

No data are available to closely date the porphyritic quartz monzonite. The rocks are overlain by basalt of the Carmacks Group outside the map-area and on the basis of this evidence are probably early Tertiary or older. If the theory that this rock is a product of the alteration of the hornblende granodiorite by the pink quartz monzonite is correct and if the dating of the pink quartz monzonite as Triassic is correct the porphyritic quartz monzonite must also be Triassic. Careful isotopic dating is required to resolve this problem.

PORPHYRITIC QUARTZ MONZONITE

A small body of quartz monzonite (Mqmp) at the head of Carlisle Creek in Snag map-area intrudes the Schist Gneiss unit. The rock is poorly exposed and its limits are not well defined.

The rock is a rusty weathering, medium-grained, fresh, porphyritic biotite quartz monzonite, with phenocrysts of potash feldspar. The rock somewhat resembles the porphyritic monzonite. The quartz monzonite is unfoliated and probably postdates the Klotassin Batholith - it is thought older than the Coffee Creek granite. On this data the rocks are most likely Jurassic or Cretaceous.

LABERGE GROUP

The name Laberge Group (Jl) (Cairnes, 1910) applies to a folded succession of Jurassic immature sandstone and conglomerate that underlies the Tantalus Formation. Rocks assigned to the Laberge Group are found in east-central and northeastern Aishihik Lake map-area. They are generally recessive weathering and poorly exposed, but exceptionally good outcrop is seen in the canyon cut by a small stream tributary to Nordenskiöld River just north of Mount Vowles. Good outcrop readily accessible from the Carmacks road is seen on the small stream immediately north of Montague Mountain.

In east-central Aishihik Lake map-area the Laberge Group includes rusty yellow weathering, yellow or pale yellowish, coarse gritty sandstone with minor interbedded brown shale and local thin pebble-conglomerate beds. The sandstones are made up of rock fragments, feldspar, and quartz in order of importance. The rocks are so poorly indurated locally that they are sands rather than sandstones, but in general they are fairly well cemented (carbonate cement). Flat tabular limy concretions many metres long, but half a metre or less thick are common in the more indurated beds (Pl. XIX). Thin coaly

seams with abundant plant leaf impressions are locally interbedded with the sandstones (Pl. XI). In places anhydrite crystals in their characteristic "swallow tail" twin form weather out of the sandstones. Bedding thickness in the sandstones ranges from 2 to 5 metres and most beds are massive. Locally, faint colour layering, perhaps the result of variation in limonite content, is seen parallel to bedding. Sole markings in shaly beds and occasional trough crossbeds indicate that the succession is right way up. Laberge Group rocks in the northeast part of the map-area include sandstones like those described, but also contain substantial amounts of conglomerate. The conglomerates have rounded boulders and pebbles of low sphericity about 10 cm in diameter in a matrix of coarse-grained sand. The matrix to clast ratio is highly variable from bed to bed and ranges from 95 to 15 per cent matrix. Most clasts are of hornblende granodiorite and massive green volcanic rock, but some of a medium grey fetid limestone and others of strongly schistose and gneissic rocks were also noted. One pebble of massive green volcanic rock contained evenly disseminated fine-grained chalcopyrite.

The Laberge Group is known to be younger than some hornblende granodiorite and some massive green volcanic rocks, and in Whitehorse map-area the rocks overlie those of the Lewes River Group (Wheeler, 1961). In Aishihik Lake map-area the relations of the Laberge Group to underlying units are unknown. The Tantalus Formation is deformed with rocks of the Laberge Group which suggests the two units may be conformable. The Tantalus lies directly on the pink quartz monzonite north of Mount Cooper, however, and thus the possibility of an unconformable or disconformable relationship between Tantalus and Laberge rocks cannot be ruled out. Similar relations obtain in Whitehorse map-area (Wheeler, 1961, p. 62). No major plutonic rocks intrude the Laberge Group in the project area, but the sandstone and conglomerate are overlain unconformably by rocks of the Little Ridge volcanics, the Carmacks Group and the Hutshi Group. As the base of the Laberge Group was not seen the thickness of these rocks is unknown, but the geometry of the structures indicates that at least 7,000 feet of strata are present in east-central Aishihik Lake map-area and a thickness of 10,000 feet is not inconsistent with the data.

Many rock-units and tectonic events in west-central Yukon are dated indirectly by reference to their relationship with the Laberge Group. It is therefore doubly fortunate that the Laberge Group is fossiliferous and reasonably well dated. In Whitehorse map-area many fossils of Early Jurassic age and some of Early Middle Jurassic age have been collected and identified from these rocks (Wheeler, 1961, p. 51-54). Only two fossil collections were made from the Laberge Group during the present study, but these are instructive for two reasons. Firstly, the fossils are nearly all pelecypods, whereas in Whitehorse map-area mainly ammonite species were discovered. Secondly, the fossils are Middle Jurassic and are tentatively thought to be slightly younger than any yet found in the Laberge Group (Appendix II). The collections were made from beds possibly as much as 2,000 feet below the top of the Laberge Group. The age of the Laberge Group is Early and Middle Jurassic.

TANTALUS FORMATION

In the project area the Tantalus Formation (T_{KT}), named and first described by Cairnes (1910) from localities in Carmacks map-area, is found

only in the eastern part of Aishihik Lake map-area. Good exposures are seen wherever the rock is found, for example on Mount Vowles (formerly Vowel Mountain) on Division Mountain and on Cub Mountain. Lone Pine Mountain in northeast Aishihik Lake map-area also has fair exposures of these rocks.

Descriptions of the lithologic character of the Tantalus Formation by Wheeler (1961, p. 71-72) and Cairnes (1910, p. 36) are readily available and because these hold for the area of study only a summary description is given herein. Conglomerates, made up of pebbles of black, greenish grey, pale green and white chert, argillaceous chert and quartzite in a matrix of sand-sized materials, makes up the bulk of the Tantalus Formation. Pebbles are well rounded, of moderate sphericity and generally about 2 cm across. The cement is siliceous or calcareous. Pebbles break out of the rock readily and the rocks are generally porous. There is little gradation in fragment size between pebble-sized clasts and the coarse sand-sized matrix so that the grain size distribution is distinctly bimodal. Locally the Tantalus Formation contains sandstone and shale, the latter with abundant detrital muscovite, but because these rocks weather recessively and are poorly exposed among the more resistant conglomerate, such rocks are rarely observed. Bedding is poorly defined in outcrops and the rocks appear massive except from the distance or on air photographs. Beds are commonly 3 to 5 metres thick.

The thickness of the Tantalus Formation varies from place to place. On Mount Vowles and Division Mountain at least 2,500 feet are present and the sequence may be as much as 4,000 feet thick. On Lone Pine Mountain about 2,000 feet of strata occur and on the peak north of Mount Cooper 4,000 feet could be present. Cub Mountain has a section of about 2,000 feet of these beds.

On Mount Vowles and at other localities the Tantalus Formation overlies Laberge Group rocks and although the contact was not seen the relations appear conformable or disconformable. However, on the peak north of Mount Cooper the Tantalus Formation lies directly on the eroded surface of the pink quartz monzonite (see Pl. XVI). It is puzzling in view of this relationship that there are no clasts of the pink quartz monzonite, or any other granitic rock, in the conglomerate. The contact is sharp and planar and dips eastward at about 30 degrees. There are no dykes or other apophyses of the granite in the Tantalus and the contact is not faulted. The Little Ridge volcanics lie unconformably on rocks of the Tantalus Formation on the flank of Mount Cooper.

The Tantalus Formation is Lower Cretaceous and may range down into the Upper Jurassic (Wheeler, 1961, p. 74). A collection of plant fossils by the writer from shaly beds of the Tantalus on the Carmacks road in north-eastern Aishihik Lake map-area was examined by Rouse (see Appendix I) who reported: "Of the 10 Species, 5 have been recorded from the early Cretaceous, one from the Jurassic and three from the late Jurassic and early Cretaceous. The remaining one (*Coniopteris* sp., cf. *Yukonensis*) has been recorded previously only from the Tantalus Formation of uncertain age. Hence the age of this collection is Neocomian; a more precise dating is impossible because of the small number of species and the fragmental condition of the leaves. The closest correlative assemblages are those of the lower Blairmore, Luscar, and Gething reported by Bell."

Wheeler (1961, p. 73) has suggested that the distinct difference between Tantalus and Laberge rocks may have resulted from a marked change in climatic conditions, subdued relief, and the exposure of siliceous source rocks during the time the Tantalus Formation was laid down.

NISLING RANGE GRANODIORITE

Two distinct batholiths of biotite granodiorite (Mgdb) along the southern boundary of Snag map-area are continuous with Muller's (1967) Nisling Range granodiorite. The rocks are poorly exposed in the eastern batholith, but good exposures of the western one are seen in castellated weathering forms on ridge tops between the Donjek and White rivers.

The Nisling Range granodiorite is a homogeneous, coarse-grained, equigranular rock with a distinctly purplish or mauvish cast. The dull green colour of amphiboles give it a diagnostic mottled green and mauve appearance. The rock is a hornblende-biotite granodiorite to quartz diorite, with granitic texture, made up of about 50 per cent andesine and 25 per cent quartz. Mafic minerals occur in clots of anhedral grains and constitute 15 per cent by volume. In addition to its distinctive colour the rock everywhere contains large, euhedral, fresh biotite crystals that partially replace the mafic clots. The Nisling Range granodiorite is compositionally similar to the hornblende granodiorite, but generally lacks the euhedral hornblende crystals and has the distinctive colour and fresh biotite not found in the hornblende granodiorite. The Nisling Range granodiorite also lacks foliation or layering and appears to have been emplaced to a higher level than the hornblende granodiorite.

Nisling Range granodiorite intrudes metamorphic rocks of the Yukon Metamorphic Complex, whose metamorphism is Triassic or older, and is invaded by swarms of dykes and other bodies of Nisling Range Alaskite dated by K-Ar at about 55 m.y. It is therefore broadly Mesozoic in age. The Nisling Range granodiorite and the hornblende granodiorite may be broadly correlative. The biotite in the Nisling Range granodiorite is probably the result of late hydrothermal deuteric alteration.

PORPHYRITIC MONZONITE

A small body of porphyritic, biotite monzonite (Mmzp) straddles the border between Snag and Stewart River map-areas and is found on the mountain west of White River. Exposures are few, but extensive felsenmeer with black lichen covers the hill on which the rock is found. The monzonite contains euhedral equant phenocrysts of white potash feldspar about one inch across, set in a medium-grained groundmass of plagioclase, biotite, hornblende and minor quartz. Mafic minerals comprise about a quarter of the volume of the rock. The monzonite grades locally into syenite in which K-feldspar generally occurs as phenocrysts and constitutes a small proportion of the groundmass. The monzonite is a fresh homogeneous rock clearly intrusive into the hornblende granodiorite although the contact is nowhere exposed.

No data on the age of the rock are available; it is probably Cretaceous or Tertiary. The Mount Fairplay syenite in adjacent Tanacross Quadrangle (Foster, 1970), though lithologically unlike the monzonite, may be related. This syenite has yielded ages of 103 m.y. (lead - alpha age on zircon) and 69 m.y. (rubidium - strontium method).

HORNBLENDE DIORITE

Several small plugs of biotite hornblende diorite (M₁dm) occur in south-central Aishihik Lake map-area and a small mass of similar rocks, possibly equivalent to them, occurs in Snag map-area near the heads of Big Creek and Moose Creek. The largest mass is on the prominent hill immediately east of the mouth of west Aishihik River. The rocks are resistant and well exposed and weather a dark grey. Boundaries are gradational and the contacts shown on the map are arbitrary.

The diorite is a fine-grained, equigranular, homogeneous, melanocratic rock made up of plagioclase, hornblende and biotite. The constituent minerals are fresh and contain 50 per cent subhedral Carlsbad-Albite twinned andesine intergrown with subhedral, short prismatic hornblende, pleochroic in khaki brown, and brown subhedral biotite. Minor primary epidote (?) is present. A few flakes of chlorite were noted. Apatite and magnetite are plentiful accessory minerals. The latter accounts for the prominent anomalies coincident with these rocks on aeromagnetic maps.

Because its relations to other rocks are obscure the age of the diorite is in doubt. The rock is presumably Mesozoic and because it is unfoliated and fresh it is most likely younger than Triassic.

HORNBLENDE BIOTITE GRANODIORITE

Medium-grained equigranular hornblende-biotite granodiorite (K₁gd) in the southwest corner of Snag map-area is part of a large body that occupies parts of adjacent Nabesna and Kluane map-areas. The rock is veined by epidote and its plagioclase is greenish. In thin sections, however, the constituent minerals are fairly fresh. The granodiorite contains minor amounts of disseminated pyrite and pyrrhotite. The rocks are not distinctly like any found northeast of the Shakwak lineament and because they are fresh and unfoliated they are considered Cretaceous or Tertiary.

COFFEE CREEK GRANITE

Coarse-grained equigranular biotite granite to quartz monzonite (T₁g) forms a batholith on Coffee Creek in north-central Snag map-area and occurs also north of the Yukon River opposite the mouth of Isaac Creek. Similar rocks are found in western Aishihik Lake map-area between Albert and Isaac creeks (note that two different streams, one in northeast Snag map-area, the other in west-central Aishihik Lake map-area, have the name Isaac Creek). Another pluton is known southeast of Canyon Lake in south-central Aishihik Lake map-area. Figure 9 illustrates their distribution relative to associated rocks. The rocks generally weather recessively and hillsides underlain by them are covered with a yellowish sand. Occasional "castles", remnants of more resistant parts of these rocks, stand on the hills (see Pls. XII, XIV).

The rocks are homogeneous, massive, coarse-grained and equigranular and range from quartz monzonite to granite; the majority contain roughly equal amounts of smoky grey quartz, perthitic potash feldspar and albite. Their texture is decidedly granitic in that most grains are subhedral and equant. Biotite, the only mafic mineral, makes up about 3 per cent by

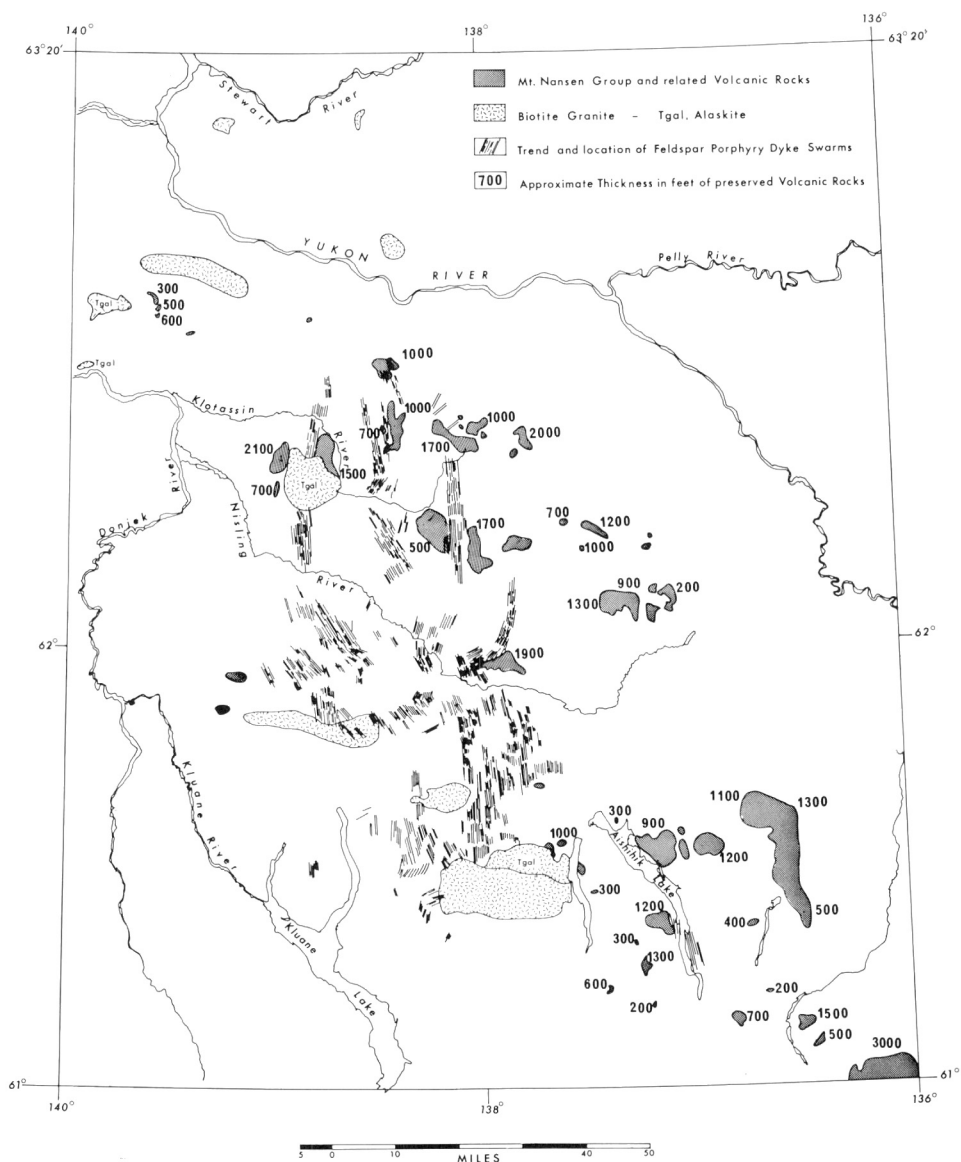


Figure 9. Sketch map to show the distribution of the genetically related volcanic (Mount Nansen Group), subvolcanic (feldspar porphyry) and plutonic (Nisling Range Alaskite and Coffee Creek Granite) rocks of west-central Yukon. The diagram also shows the approximate thickness of preserved Mount Nansen Group volcanic rocks at various places. Note the dominant northward trend of the dyke swarms and the apparent restriction of the plutonic rocks to the western part of this region and volcanic rocks to the eastern part.

volume and occurs as small euhedral fresh flakes interstitial to the quartz-feldspathic constituents. The rock has much intergranular space and because of this, its grains are loosely held together making it particularly susceptible to physical disintegration.

Plutons of Coffee Creek Granite are discordant and transgressive and intrude metamorphic rocks of the Yukon Group as well as other plutonic rocks. They postdate the hornblende granodiorite and are younger than the Three Guardsmen suite. The Coffee Creek Granite is gradational into Nisling Range alaskite along the west edge of Aishihik Lake map-area and the contact between the two rocks is rather arbitrarily placed. Because of its close spatial relationship with the Nisling Range alaskite at several places, the Coffee Creek Granite is thought to be genetically related, and roughly equivalent, to these rocks. As such it is probably early Tertiary. No radiometric dating has yet been done to test this possibility. Coffee Creek Granite is probably equivalent to Wheeler's (1961, p. 99) biotite granite and Souther's (1971) younger quartz monzonite. Kindle (1953, p. 40) described similar rocks from near Kusawa Lake in Dezadeash map-area. Muller's (1967) Nisling Range alaskite includes undifferentiated equivalents of the Coffee Creek Granite.

NISLING RANGE ALASKITE

Three distinct bodies of miarolitic leucocratic granite referred to as the Nisling Range Alaskite (Tgal)(Muller, 1967), are found in Snag map-area on Home Creek, near the mouth of the Donjek River and between the Nisling and Klotassin rivers. The same rocks are also found near the north end of Sekulmun Lake and at several other localities in Aishihik Lake map-area. The distribution of the alaskite is roughly shown on Figure 9.

The term Nisling Range Alaskite is restricted in this report to those medium-grained miarolitic granites found in the Yukon Plateau, it does not include, as does Muller's (1967) original description, the coarse-grained equigranular biotite granite and quartz monzonite herein referred to as the Coffee Creek Granite.

Because the grains are loosely held the rocks weather to a yellowish sand at many places, but castellated weathering forms are also common. The rocks weather a diagnostic yellow or orange to buff colour.

The alaskite is a distinctive rock with miarolitic cavities and 'smoky' grey euhedral-terminated quartz crystals. The rock is medium grained and equigranular. About half its volume is made up of perthitic potash feldspar that occurs as subhedral, porphyritic crystals slightly larger than the ground-mass or more commonly as anhedral grains intergrown with other minerals. Quartz, which makes up about a third of the rock, forms individual equant, euhedral grains and also occurs interstitially in cuneiform, myrmekitic or graphic intergrowths with potash feldspar. Plagioclase (albite) constitutes less than a quarter of the rock's volume and forms subhedral to euhedral crystals. The rocks contain about one per cent biotite as anhedral fresh flakes. Hornblende was noted locally. Fluorite is a common minor constituent which occurs interstitially. Miarolitic cavities make up as much as 5 per cent of the volume at many places and the rock is consequently of low density. These cavities are lined by clear, well-terminated quartz crystals commonly coated thinly with black manganese oxides. The alaskite is only

weakly altered. Chlorite locally replaces biotite and fine-grained sericite has replaced some plagioclase.

A complete range exists between the alaskite and the feldspar porphyry and between the alaskite and the Coffee Creek Granite. Boundaries between these gradational types are therefore arbitrary. The alaskite invades metamorphic rocks and granitic rocks alike and is grossly discordant. The youngest rocks cut by it in the project area are those of the Klotassin Batholith. The rocks are correlated with lithologically identical types recorded widely in the northern Cordillera. Such probable equivalents include Wheeler's (1961) leucocratic granite (unit 8b), Aitken's (1959) alaskite and quartz monzonite (unit 13), Souther's (1971) felsite and younger quartz monzonite (units 15 and 16). Although the rocks have not been isotopically dated in the project area potassium-argon ages on the Ruby Range Batholith in adjacent Kluane map-area have yielded dates of about 55-60 m. y. (see Fig. 8). These dates, though determined on the older Ruby Range rocks, are thought in fact to reflect the age of the Nisling Range Alaskite. Available ages for the correlatives listed above correspond with this early Tertiary age.

FELDSPAR PORPHYRY

Eastern Snag map-area and western Aishihik Lake map-area are intruded by wide and extensive dyke swarms of feldspar porphyry (Tfp) (see Fig. 9). Extrusive equivalents are also present. Good exposures are rare and in most instances only extensive felsenmeer occurs. Where found the feldspar porphyry generally dominates the float and commonly only few pieces of the country rock are seen in the jumble of boulders to indicate that the porphyry occurs as dykes. In most places where differentiated on the map, dyke rocks make up more than three quarters of the float. In such places it is generally difficult to determine which rock makes up the host or to carry through boundaries between the intruded rock-units. Some outcrops are seen in westernmost Aishihik Lake map-area and on the high hills 15 miles south of Apex Mountain.

Rocks included in the map-unit vary considerably and the single feature they hold in common is that they nearly all have feldspar phenocrysts. In most specimens, the feldspar (andesine) occurs as white, yellowish or faintly pink, euhedral, equant, thick-tabular crystals several millimetres across and makes up between 10 and 20 per cent of the rock. Hornblende phenocrysts (short prismatic, fresh, black 2 or 3 millimetres long) are less plentiful and not as common. Biotite is uncommon. The groundmass ranges from aphanitic to very fine grained and varies in colour from a greenish grey to brownish or mauve. The groundmass is a crystalline mixture of quartzofeldspathic constituents. The feldspar porphyries are gradational between the "frothy" alaskite and the extrusive flow rocks of the Mount Nansen Group and textures range between these two end members. Some of the porphyries that have a fine-grained groundmass have many miarolitic cavities and closely resemble the alaskite. On the other hand, the extrusive extremes of the suite have an aphanitic dark, or medium-green, textureless groundmass.

That the bulk of the feldspar porphyry occurs as dykes is not readily apparent on the ground because of generally poor outcrop. Air photographs, however, show a pronounced stripping or linear pattern in areas underlain by the feldspar porphyry and even though most areas are merely extensive

felsenmeer without outcrop, the pattern is still readily seen. Stripping is shown subjectively on the maps and is compiled for the project area and for adjacent Kluane and Carmacks map-areas on Figure 9. The stripping is difficult to explain as any feature other than dyking direction and the relatively small number of observations on outcrop supports this conclusion. The general width of dykes is unknown although the few seen are 50 to 100 feet thick and vertical. Dykes invade most of the older rocks. The youngest intruded rocks are those of the Klotassin Batholith or the Nisling Range granodiorite. The dykes are truncated and overlain by the Carmacks Group south of Apex Mountain. The two swarms that run into alaskite between Klotassin and Nisling rivers evidently grade into the plutonic rocks and the boundary between them is drawn arbitrarily. A similar gradation of the feldspar porphyry into Mount Nansen Group volcanic rocks is seen on the hills 15 miles south of Apex Mountain.

The dominant, regionally discordant, northward trend of the dyke swarms is marked (see Fig. 9) and invites speculation about its cause. It may result from a period of major east-west crustal extension in a large, but localized part of the Yukon Plateau during early Tertiary time. As such it may well be related to transcurrent or vertical (?) movement along the Shikwak and possibly also the Tintina fault zones.

Figure 9 which shows the distribution of the dyke swarms and related plutonic and volcanic rocks shows that the plutonic rocks generally occur west of the dyke swarms and that these subvolcanic rocks are found west of the bulk of the related extrusive rocks. The cause of this apparent zoning is not clear.

Because of their association with the Nisling Range Alaskite, which is tentatively thought to be 55-60 m.y. old, the feldspar porphyry is regarded as early Tertiary. The meagre stratigraphic data do not conflict with this assignment.

Feldspar porphyry dykes mapped and described by Bostock (1936) in Carmacks map-area are probably equivalents of those mapped in the project area. Because no airphotos of Carmacks map-area were readily available during the compilation of Figure 9, the dykes in that area are not shown. It is also not known if feldspar porphyry dykes in central Carmacks map-area show the stripping pattern on air photographs. The feldspar porphyry dykes have counterparts in Tulsequah map-area, where they are associated with volcanic rocks of the Sloko Group. There also the dykes show strong discordance and display general northward trend. Wheeler's (1961, p. 101) granite porphyry is lithologically similar, and stratigraphically equivalent to, the feldspar porphyry.

MOUNT NANSEN GROUP

The name Mount Nansen Group was first used by Bostock (1936) for volcanic rocks in south-central Carmacks map-area. Unfortunately, Bostock applied the name to two groups of rocks now considered of different age. The name is retained in this report, but refers only to that group of fresh, dark weathering acid volcanic rocks (TMN) found as cappings, on some of the higher parts of the Dawson Range similar to those at Mount Nansen. The name should not be used to refer to the northwest-trending belt of dense, green, altered volcanic rocks found in the valley of Yukon River (Carmacks map-area). These rocks are most likely equivalents of the Lewes River Group and Triassic in age.

In the project area the Mount Nansen Group outcrops in parts of the Dawson Range (Apex Mountain and the peak 14 miles south of it, and south of the mouth of Colorado Creek in western Snag map-area), and in a belt of disconnected centres trending across Aishihik Lake map-area from the Sifton Mountains to peak 5,850 in the northwest corner. The rocks are generally well exposed, but for the most part only float is found and outcrops are relatively rare.

The rocks characteristically weather a dark grey or black and from a distance give a distinct black mantle to the hilltops. They have a remarkably uniform appearance and are medium to dark greenish grey and aphanitic and show no texture or structure on the fresh surface. Some weathered surfaces reveal the presence of tuffs and tuff-breccias in which the fragments range up to several inches across. Locally the rocks grade into and include porphyries that are lithologically indistinguishable from the feldspar porphyry unit. The tuff fragments are identical to their matrix. These rocks characteristically break into thick slabby fragments a foot or two across, that give a distinctive clear ringing sound when struck. No chemical analyses are available, but they are probably of intermediate to acid composition. The tuffs and tuff-breccias of the Mount Nansen Group are thought to be the products of explosive volcanism.

Within the project area rocks of Mount Nansen Group overlie the Nasina Quartzite and the hornblende granodiorite. They are overlain by basaltic flow rocks of the Carmacks Group. Mount Nansen Group rocks are flat lying and their base is essentially level through much of the project area. Local relief beneath the Mount Nansen Group in the Sifton Range appears to be nearly 2,000 feet. It is unclear whether this relief predates deposition of the rocks or whether it is caused by post-depositional faulting. Figure 9 gives the variation in thickness of preserved Mount Nansen Group rocks. The elevation of the base of each of the disconnected remnants of Mount Nansen volcanic rocks in west-central Yukon is remarkably uniform and lies at about 4,000 feet over much of this area (see Fig. 10). Only in the south is the level of the base of these rocks significantly higher. This suggests that the surface on which Mount Nansen Group rocks were laid down was one of extremely low relief over a large area and implies that the Mount Nansen Group was extruded prior to the development of the present drainage.

Rocks of the Mount Nansen Group locally overlie and elsewhere are cut by the feldspar porphyry dykes and this relationship, seen at several places, suggests contemporaneity. Mount Nansen Group rocks similarly overlie Nisling Range Alaskite at several places, but elsewhere, apophyses of these granitic rocks invade the volcanics. Furthermore, the volcanic rocks of the Mount Nansen Group are spatially related to the Nisling Range Alaskite and the feldspar porphyry dyke swarms over much of west-central Yukon and there can be little doubt of a genetic connection between them. Consequently the age determined for the Nisling Range Alaskite gives an idea of the approximate age of Mount Nansen volcanic rocks. No stratigraphic or isotopic data are available to limit the age of Nisling Range Alaskite in the project area, but the rocks are thought to be 55 or 60 m.y. old on the basis of isotopic age determinations on similar rocks to the south (Souther, 1971, p. 37) and on the basis of isotopic ages in adjacent Kluane map-area (see Fig. 8). No dates are yet available for Mount Nansen Group rocks.

Rocks of the Mount Nansen Group are tentatively correlated with those of the Skukum Group (Wheeler, 1961) in Whitehorse map-area and the

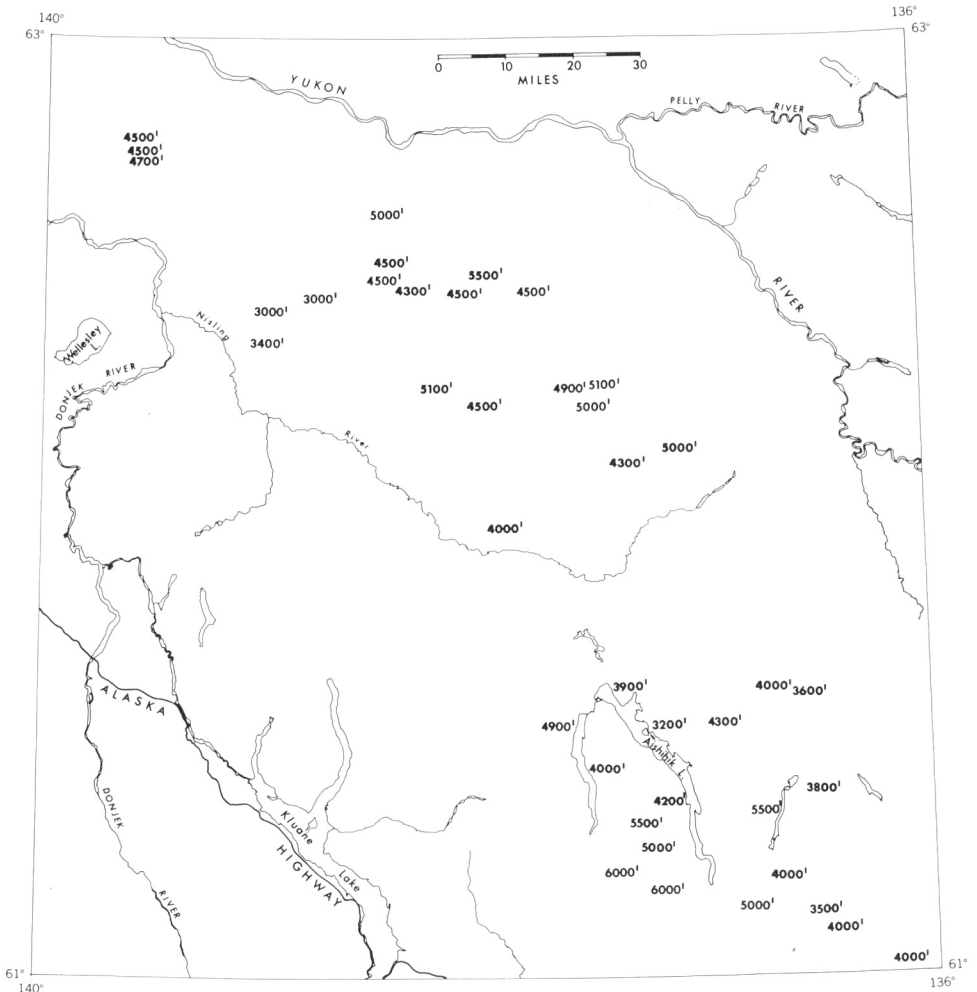


Figure 10. Sketch map to show the elevation of the base of the Mount Nansen Group volcanic rocks (and related types) at various places in west-central Yukon. Note that the majority of these fall between 4,000 and 5,000 feet and that the overall relief is small. This suggests that the surface upon which this suite of rocks was laid down was essentially a plateau and indicates that the drainage and topography seen in this region today was developed subsequent to the deposition of the Mount Nansen Group.

Sloko Group (Souther, 1971) in Tulsequah map-area. All three groups have similar lithology, stratigraphy and structural relations. Volcanic rocks in the Sifton Range tentatively thought equivalent to the Mush Lake Group by Kindle (1952) are now included with the Mount Nansen Group. The Casino volcanics of Snag map-area are probably equivalents of the Mount Nansen

Group. The volcanic rocks in the Miners Range (Laberge map-area), included by Bostock and Lees (1938) in the Hutshi Group, are largely equivalent to the Mount Nansen Group as used in this report.

CASINO VOLCANICS

Volcanic and related subvolcanic rocks, probably equivalent to the Mount Nansen Group, but different from them in some respects, that are here referred to informally as the Casino volcanics (Iva), are found in Snag map-area on some of the higher peaks of the Dawson Range. The rocks occur as isolated small masses the largest of which is on Mount Cockfield. Others are found at the head of Casino Creek and on the divide between Home Creek and Coffee Creek (see Pl. X). The rocks are recessive-weathering and the slopes they underlie are covered by small talus fragments that are coated with black lichen. Where the stable, lichen-covered, talus is disturbed, ochre and orange colours are common.

The Casino volcanics include a wide variety of pale coloured, grey to buff, acid to intermediate tuffs, ignimbrites, breccias and flow rocks. Although the rocks are generally aphanitic they locally include feldspar porphyries. The rocks commonly contain disseminated pyrite and locally chalcopyrite is seen. At Mount Cockfield the rocks range from explosive breccias and eruptive flow rocks to subvolcanic dykes and breccia pipes. At Casino only the breccia pipe is present and the explosive volcanics that may have been associated with them have been eroded. At the head of Home Creek the rocks are mainly extrusive and include hornblende porphyry and welded tuff with relatively few subvolcanic varieties.

The maximum thickness of the Casino volcanics seen on Mount Cockfield is about 1,000 feet, elsewhere the preserved thickness of these rocks is less (see Fig. 9). The base of the unit is essentially level with minor relief at individual occurrences. The elevation of the base of the Casino volcanics is between 4,500 and 5,000 feet (see Fig. 10). The Casino volcanics cut and overlie rocks of the Klotassin Batholith.

No isotopic age determinations have been made of the Casino volcanics, but on the basis of the relations and lithology of Casino and Mount Nansen rocks these two are tentatively correlated. Mount Nansen Group rocks are probably Lower Tertiary.

GRANITE BOULDER CONGLOMERATE

Poorly indurated, unsorted, compositionally immature boulder conglomerate (Tgg) is found on the hill three miles north of Mount Pattison (Snag map-area). Exposures are poor, but the rock is made up of boulders, cobbles and pebbles of locally derived, weathered granitic rocks and Nasina Quartzite in a matrix of coarse-grained sand. Plant impressions are found in some of the thin shaly interbeds. The conglomerate overlies hornblende granodiorite and is directly overlain by flat-lying hornblende andesite thought to be equivalent to the Carmacks Group. About 400 feet of beds are present. The age of the granitic-pebble conglomerate is unknown but is probably correlative to the Grayling Creek sandstone and the quartzite-pebble conglomerate found at the end of Stevenson Ridge. They are most likely also

correlative to the conglomerate and sandstone at the base of Carmacks Group and are considered younger than Eocene.

QUARTZITE-PEBBLE CONGLOMERATE

Large exposures of quartzite pebble-conglomerate (Tcgq) occur at the southwest end of Stevenson Ridge south of Mount Werry in Snag map-area. A small area of similar rocks is found on a ridge near the head of Colorado Creek five miles south of Mount Cockfield.

The rocks are resistant and brownish weathering and form prominent bluffs in which bedding is readily seen from a distance. Most are poorly sorted conglomerate, but coarse gritty sandstone and shale form thin beds locally. The conglomerate contains clasts up to two metres across although most fragments are measured in centimetres. Most clasts are of grey graphitic quartzite like that of the Nasina Quartzite seen nearby. Minor volcanic and granitic pebbles were noted. The fragments are fairly well rounded, but of low sphericity. Many are decidedly slabby in shape. The matrix of predominantly sand size is made up of smaller fragments of the same lithologies as the clasts. The rocks are thick bedded and the conglomerate appears massive with only local fine-grained interbeds to define bedding. It is fairly well indurated, but breaks as readily around the clasts as it does across them.

No section was measured but it is estimated that about 600 feet of these rocks are preserved at the locality south of Mount Werry. The unit is evidently of very local derivation and overlies the Nasina Quartzite, its main source, unconformably. Thin flows of the Donjek volcanics are intercalated with and overlie the conglomerate. The rocks are evidently equivalent to the Grayling Creek sandstone and probably a correlative of the conglomerates found at the base of the Carmacks Group at many places.

The occurrence of widespread conglomerate (Fig. 11) and other associated texturally and compositionally highly immature terrestrial sedimentary rocks at many isolated localities over a large part of the Yukon Plateau, is supporting evidence for uplift and rejuvenation of much of the Yukon Plateau immediately prior to deposition of the Carmacks Group. The remnants of these sediments are the fragmentary record of what appears to have been a more widespread, intermittent blanket or series of channel deposits laid down essentially instantly as a result of sudden and rapid uplift and development of relief by downcutting streams. Some local relief may have been fault generated at this time, but there is scant evidence of this.

SANDSTONE ON GRAYLING CREEK

Grayling Creek, a tributary of the Donjek River in south-central Snag map-area has fair exposures of sandstone, shale and conglomerate (ITsp) that underlie the Donjek River volcanic sequence. Poorly sorted, immature, medium-bedded sandstone makes up much of the section. The rocks are resistant and weather brown although they are grey on fresh surfaces. Sandstone beds are about two feet thick and are separated by shale partings generally less than one inch thick. Five-foot beds of pebble-conglomerate are common in the basal part of the sequence. The beds are distinctly lensy

and show marked lateral variation in thickness. Sole markings and load casts are common but crossbedding is rare. Grain size ranges from boulders up to two feet across to pebbles of about an inch in the conglomerate, to sand and silt in the sandstone, but coarse sand sizes predominate. Grains are poorly rounded, but of fair sphericity.

Black chert and dark grey micaceous quartzite, like that of the Nasina Quartzite, make up most of the clasts and grains but cobbles of green volcanic rocks and one boulder of granodiorite were also seen. Muscovite, most prominent in the shales, is an important constituent. The rocks are well indurated and grains are strongly cemented, for the most part breaking around clasts. Some of the shaly beds contain abundant plant leaf impressions and thin coaly partings and the sequence looks distinctly terrestrial.

The beds are essentially flat lying, but dips up to 20 degrees were noted. At least 200 feet of strata must be present on Grayling Creek, but a thickness of 500 feet is not inconceivable. The sandstones overlie black quartzite of the Nasina Quartzite with distinct unconformity (see Fig. 11) and are intercalated with, overlain by and cut by the felsic volcanic rocks with which they are thought to be contemporaneous. No age has yet been determined for the collections of plant macrofossils made, but the rocks are tentatively considered Lower Tertiary.

The sandstone and shale sequence of Grayling Creek may be equivalent to the conglomerate and sandstone found at or near the base of the Carmacks Volcanics at many places in west-central Yukon (map-unit 3 of Bostock, 1942 and map-unit 11 of Bostock, 1936). The rocks are lithologically alike and have similar stratigraphic relations.

CONGLOMERATE ON SIXTY MILE RIVER

On Sixty Mile River and at nearby localities in Stewart River map-area, sandstone, shale and conglomerate (eTccg) underlie and are intercalated with volcanic rocks of the Carmacks Group. These clastic rocks are continuous with similar strata in adjacent Ogilvie map-area. The rocks resemble those found on Grayling Creek in Snag map-area and include poorly sorted, moderately well indurated, white feldspathic sandstone, pebble-conglomerate and shale. Well-rounded clasts of low sphericity are as much as 15 cm across but are generally 1 or 2 cm in diameter. The volume ratio of clasts to matrix varies widely. The rocks are thick bedded and cross-stratification is rarely seen. Most clasts are of Klondike Schist, but some of Pelly Gneiss were noted. Thin shale partings and local lignite seams containing plant impressions are common. A layer of acid welded tuff about 15 cm thick is interbedded with the sedimentary rocks and narrow dykes of quartz feldspar porphyry, like that seen on Mount Tyrrell, cut the sandstone.

The conglomerates on Mount Hart are probably equivalents of those along the Sixty Mile River and are included in the same unit. The rocks on Mount Hart are better indurated than those along the Sixty Mile and include more conglomerate and less sandstone.

Bedding in the rocks dips gently; only 200 feet of these beds is present on Sixty Mile River, but 500 feet is not inconsistent with the data.

The rocks are thought to be Eocene or younger and they may be as young as Miocene. This age assignment is based on the tentative correlation with lithologically similar strata that are homotaxial equivalents (see Fig. 11). None of the plant fossils have been determined.

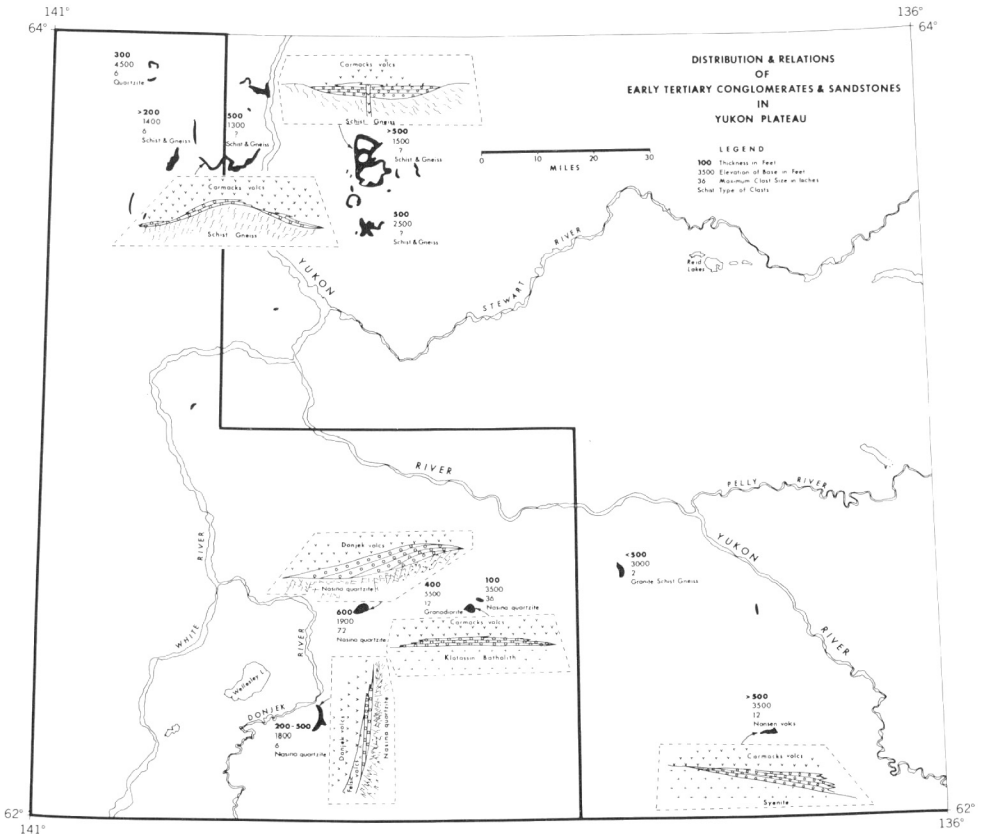


Figure 11. Sketch map to show the distribution and stratigraphic relations of Tertiary immature, coarse clastic, terrestrial sedimentary rocks in Yukon Plateau. The rocks of these widely separated localities are presumed equivalent although they show a wide variety of relationships. These coarse clastic rocks indicate that sudden rapid uplift of the Yukon Plateau took place immediately before extrusion of the Carmacks Group.

FELSIC VOLCANICS

Light coloured aphanitic volcanic rocks (HIVr), presumably of acid composition, are found in Snag map-area on and near Grayling Creek. Exposures are generally poor, but some good outcrops are seen along the stream. The rocks weather a pale buff or white colour, locally with distinct orange shades. The felsite is generally aphanitic but in places the ground-mass contains scattered anhedral phenocrysts of clear quartz up to a millimetre across and some tiny feldspar laths.

Some felsite occurs as 5-foot flows interbedded with the Grayling Creek sandstones and as dykes cutting them but the bulk overlies this sandstone conformably. The felsite is essentially flat lying, judging from the few

places where flow boundaries are seen, and is overlain by the Donjek volcanics. The rocks must vary markedly in thickness. At the locality on Grayling Creek only 50 feet of felsite separates the sandstone from the Donjek volcanics, but 5 miles south about 1,200 feet of these rocks are present beneath the Donjek volcanics. In some places, the felsite occurs within the Donjek volcanics. From these relations it is evident that the felsite, the Donjek volcanics and the Grayling Creek sandstones are roughly contemporaneous. Unfortunately no isotopic dating has yet been done on any of these rocks and fossils from the sandstones have not yet been determined. However, the rocks are tentatively assigned an Early Tertiary age.

The felsite, and the overlying Donjek volcanics, are tentatively correlated with the Carmacks Group with which they have many lithologic and stratigraphic affinities. Equivalents of the felsite are probably included in Muller's (1967) unit 4. The felsites are thought to represent flow rocks accumulated during relatively calm eruption of viscous lavas from one or more local vents. The felsic volcanics may be equivalent to the quartz feldspar porphyry of Stewart River map-area and the varicoloured acid tuffs of Aishihik Lake map-area.

QUARTZ FELDSPAR PORPHYRY

Fine scree of fresh quartz feldspar porphyry (Ivvp) covers Mount Tyrrell and occurs at the head of Dawson Creek and west of the North Ladue River in Stewart River map-area, but outcrop is scarce. The rocks weather dark grey and are pale grey, mauvish, pale yellow or buff, bottle green and brick red on fresh surfaces.

The porphyries are acid flow rocks or rhyolites which have an aphanitic quartzofeldspathic groundmass. Equant, anhedral, clear, glassy and black quartz phenocrysts about 2 mm across make up about 20 per cent of the rocks and euhedral, pale pink, thick tabular potash feldspar phenocrysts constitute a similar proportion. The porphyries also include flow rocks, tuff breccias, crystal tuffs and welded tuffs.

It is not clear from the available exposure whether the porphyries intrude and overlie the more basic rocks of the Carmacks Group, or whether they are themselves cut and overlain by these strata. The porphyries are younger, in any case, than the conglomerate and sandstone found at the base of the Carmacks Group along Sixty Mile River. Exposures generally are too poor to show layering in these rocks, but if they lie essentially flat about 3,000 feet of these rocks must occur on Mount Tyrrell. The porphyries are probably an essential, though distinctive, part of the Carmacks Group and are most likely equivalent to the felsic volcanics that lie between the Grayling Creek sandstone and the Donjek volcanics in Snag map-area. Their age is considered Tertiary and on the basis of their equivalence to the Carmacks Group is probably Eocene to Miocene.

Rocks equivalent to the quartz porphyry are mapped by Foster (1970) in the eastern part of Tanacross map-area. Bostock's unit 13 (1936) includes equivalents of the quartz feldspar porphyry, but also contains rocks that are correlatives of the feldspar porphyry and Nisling Range Alaskite.

VARICOLOURED ACID TUFF

East of Aishihik Lake a large area is underlain by an assemblage of brightly coloured acid tuff and welded tuff with minor flow rocks (Ivr). Exposures are poor, but the hillsides are covered with a fine scree so that the lithology is readily studied.

These rocks weather to a wide variety of bright, light colours, but the commonest weathering shades are purplish, red, yellow and white. The scree, where not disturbed, is covered with black lichen which tends to dull the weathering colours as seen from a distance. On fresh surfaces these rocks are even more brightly coloured and kaleidoscopic than on weathered edges. All shades of red, brown, blue to mauve, green, white and pink can be found in close proximity. Textures vary markedly. Most of the rocks seen are vitric crystal tuffs and lapilli tuffs that contain crystal fragments or glassy rock fragments in a devitrified glassy matrix. Welded tuffs are also common. The matrix of the tuffs is most commonly a glass, brownish or yellowish coloured in thin section, in which the outlines of constituent shards are well preserved. Locally the matrix is a finely crystalline mat of quartzofeldspathic constituents. The lithic crystal fragments are generally smaller than 1 mm. Lithic fragments are mostly of glass or partly devitrified glass like that which constitutes the matrix. Crystal fragments are of quartz which is clear, with euhedral outlines and only slightly resorbed, and of sodic plagioclase which is euhedral and rarely zoned, but complexly twinned. In some places the rocks contain small, fresh, euhedral crystals of biotite or hornblende. The welded tuffs are extremely finely laminated rocks made up of glassy shards through which a few quartz crystals are scattered.

No analyses are available but the vitric tuffs are probably rhyolitic in composition. Although some of the rocks may be more basic none are basalts.

The acid tuffs dip gently in the few places where this can be determined and the eroded surface on which they lie is a gently undulating plane with a relief of perhaps 1,500 feet. In places nearly 2,000 feet of the acid tuffs are preserved.

No stratigraphic or radiometric evidence is available to limit closely the age of the acid tuffs, but the surface on which these rocks lie has the characteristics of that beneath the Carmacks Group and is unlike that on which the Mount Nansen Group was deposited. However the acid tuffs are lithologically unlike both the Carmacks and the Mount Nansen groups. The rocks are presumed to be a distinctive part of the Carmacks Group and may be equivalent to the felsic volcanics immediately beneath the Donjek volcanics and the quartz feldspar porphyry found associated with the Carmacks Group in Stewart River map-area. The acid tuffs are closely associated with, and apparently overlain by, the Little Ridge volcanics. The Little Ridge volcanics are tentatively thought to be equivalents of the Carmacks Group. On the basis of these tentative correlations the acid tuffs are assigned an Eocene or younger age.

UNDIFFERENTIATED VOLCANIC ROCKS

A variety of volcanic and subvolcanic rocks in northeast Aishihik Lake map-area, included by Cairnes (1914) in his Nordenskiöld Dacite, Schwatka

Andesite and Klusha Intrusives, is herein mapped together in an undivided unit (Tv). The distribution and lithology of these rocks are described by Cairnes (1914).

The three rock-units of Cairnes (1914) are similar and are thought to be closely allied. They are tentatively considered equivalents of one another and all younger than the Tantalus Formation. Because they display relations like the Little Ridge volcanics and the Carmacks Group the undifferentiated rocks may be equivalent in part to either of these.

CARMACKS GROUP

Rocks (cTcv) correlated with the Carmacks volcanics of Bostock (1936) and Cairnes (1910) occur in various parts of the project area, but are most extensive in west-central Snag map-area and in northeastern Stewart River map-area. Good exposures are seen in all three areas (see Pl. XVIII). Bostock's Carmacks Group (1936) includes acid volcanic rocks which in this report have been separated and mapped as the felsic volcanics, the vari-coloured tuffs and the quartz feldspar porphyry.

Detailed descriptions of the Carmacks Group by Bostock (1936, p. 40-42), Cockfield (1921, p. 31-32), and Cairnes (1910, p. 44-45), are available and only a brief account of the lithology is given here. Rocks of the Carmacks Group weather a rich brown and are generally massive. Locally individual flows are marked by small benches or cliffs of good outcrop and these show up prominently in air photographs (see Frontispiece). The group includes altered andesite and basalt that varies widely in lithology on a local scale, but which presents a more homogeneous aspect regionally. The rocks are dark green to black on fresh surfaces, but maroon, green and brown varieties are common everywhere. For the most part, aphanitic textures prevail but porphyritic types are also seen. The aphanitic groundmass is strongly altered. Phenocrysts of feldspar and augite in the porphyritic varieties, are fairly fresh. The Carmacks Group includes extrusive flow rocks and tuff breccias in which the fragments are like the groundmass. Locally plugs and dykes of diabase cut the basalt. These probably represent feeders for the flow rocks.

The Carmacks Group is 2,000 or 3,000 feet thick locally, but its thickness varies from place to place and is generally only about 1,000 feet. The variation in thickness has not been studied sufficiently to construct an isopach map, but the rocks generally accumulated to greater thicknesses in the valleys than on the highlands. They are only locally warped and faulted and structure outlined by the dip of layering largely reflects depositional slopes. Where measured the volcanic rocks dip at angles less than 20 degrees. The Carmacks Group overlies older strata with distinct unconformity.

Figure 12 is a sketch of stratum contours drawn on the base of the Carmacks Group. It approximates the present topography of the unconformable surface beneath the volcanic rocks. Although there are differences between the present topography and that just prior to deposition of the Carmacks Group as shown by these stratum contours these differences are relatively minor. The valleys of the Yukon River, Big Creek and Klotassin River were present before extrusion of the volcanic rocks. Similarly the highland separating the Big Creek and Klotassin River drainages was elevated before deposition of the Carmacks Group. A notable difference is that the

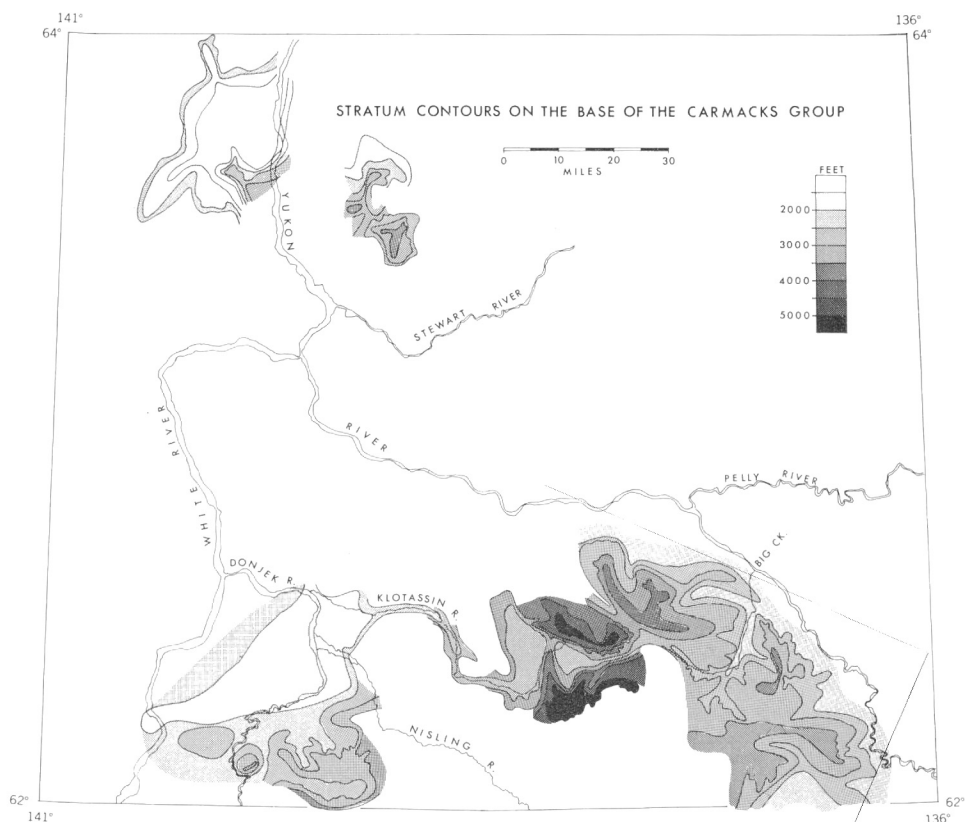


Figure 12. Sketch map of stratum contours on the base of the Carmacks Group (and probable equivalent rocks) in west-central Yukon. Note that the local relief is of the same magnitude as that seen today. Note also that where the data is available the modern topography and drainage have existed, largely unchanged, since deposition of the Carmacks Group. Contrast this diagram with Figure 9.

divide between Big Creek and Klotassin River has moved eastward since deposition of the Carmacks Group. In pre-Carmacks time this divide coincided with the prominent north-trending feldspar porphyry dyke swarm just southeast of Apex Mountain.

The Carmacks volcanics can therefore be regarded as a veneer, or sheet deposit, of relatively uniform thickness beneath the present surface extruded from relatively few centres. In contrast, the Mount Nansen Group was extruded from many isolated centres and deposited as discontinuous masses on a surface of gentle relief in which the present drainage system had little or no reflection.

Bostock (1936b, p. 42) summarized evidence to show that the Carmacks Group is Miocene or older. An upper limit on the age is now also available. The Carmacks Group overlies and truncates rocks of the Nisling

Range Alaskite and Mount Nansen suites and because these are Early Eocene (55 to 60 m.y.) the Carmacks rocks must be Eocene or younger. The best hope for narrowing these limits is to date the plant remains from the conglomerate that underlies the Carmacks volcanics conformably. No good determinations of these fossils have so far been made.

The Carmacks volcanics are tentatively considered equivalent to the Donjek volcanics found around Wellesley Lake (Snag map-area). This correlation is explored in more detail elsewhere in this report.

DONJEK VOLCANICS

The informal, Donjek volcanics, is used here for rocks of intermediate to basic composition, probably equivalents of the Carmacks Group, that are found extensively in south-central Snag map-area (IVd). The rocks are well exposed in many places particularly in cliffs along the valley of Grayling Creek and on the hills east of that stream.

The volcanics are grey weathering, lapilli tuffs and tuff-breccias, generally green and red on the fresh surface, but locally brown or grey. The rocks nearly everywhere contain euhedral white or yellowish plagioclase phenocrysts up to 3 or 4 millimetres long in an altered, aphanitic, fragmental groundmass; small altered hornblende phenocrysts are common. The rock is fragmental with clasts similar to the groundmass. They range in size to several tens of centimetres, and are generally angular. Locally, the unit includes fine-grained tuffs (see Pl. XVII).

On Grayling Creek the Donjek volcanics clearly overlie the felsic suite of rocks and the Grayling Creek sandstone. Elsewhere the Donjek volcanics directly overlie Nasina Quartzite with marked unconformity. Although none of the volcanic rocks are well dated they are tentatively thought to be Early Tertiary on the basis of poor plant fossils in the sandstone. The Donjek volcanics resemble the Carmacks Group, particularly in their stratigraphic relations and the two are provisionally considered correlative. The Donjek volcanics are continuous with part of Muller's (1967) unit 4, although this includes equivalents of the Mount Nansen Group as well as correlatives of the Donjek volcanics.

The volcanics are essentially flat lying, their maximum preserved thickness being about 2,000 feet. The surface on which the Donjek volcanics and related rocks were deposited is one of moderate relief (see Fig. 12), and the topography prior to deposition of these rocks was generally similar to that seen today. The Wellesley Basin, a small physiographic subdivision, predates deposition of the unit.

LITTLE RIDGE VOLCANICS

Chocolate brown, dun brown and reddish brown weathering volcanic rocks (IIR) are found in southeast Aishihik Lake map-area, where they overlie the Tantalus Formation unconformably. The rocks are resistant weathering and good exposures are found at several localities. In adjacent Laberge map-area they are referred to as the Little Ridge Volcanics by Bostock and Lees (1938) and the name is retained.

On the eastern flank of Mount Cooper the Little Ridge Volcanics include diagnostic dark brown basaltic flow rocks with a fresh aphanitic

groundmass and euhedral thin tabular labradorite phenocrysts to 1 cm across that generally have a parallel orientation giving the rock a prominent trachytoid texture in most outcrops. Smaller, less conspicuous subhedral equant augite phenocrysts are also present. The flow rocks are generally amygdaloidal. In places they have small ovoid vesicles filled with pale blue, delicate "robin's eggs" of thin-shelled chalcedony. Elsewhere irregular amygdules of agate occur and elsewhere again the vesicles are filled with zeolite minerals. The Little Ridge Volcanics include, in localities along upper Kirkland Creek, purplish brown weathering massive tuff breccias and flow rocks. These rocks have boulders of basalt up to a metre across in a somewhat more crumbly basalt matrix. At several localities the lowest flows include a substantial number of boulders of the underlying hornblende granodiorite and pink quartz monzonite.

The Little Ridge Volcanics overlie the Tantalus Formation unconformably and elsewhere rest on the pink quartz monzonite or the hornblende granodiorite. The rocks dip gently eastward and are not folded though they appear to be faulted. They are nowhere more than 500 to 1,000 feet thick. There is only moderate relief on the base of the Little Ridge Volcanics. About 1,500 feet maximum local relief can be demonstrated.

The strong lithologic resemblance between the Little Ridge Volcanics and the volcanics of the Hutshi and Carmacks groups and the similar stratigraphic relations of these three units suggests to the writer, as it did to Bostock and Lees (1938), that these units are broadly equivalent even though they may not be exact correlatives. Because they overlie folded rocks of the Tantalus Formation the Little Ridge Volcanics are Lower Cretaceous or younger. Rocks of the Carmacks Group are Eocene or younger.

COLUMNAR BASALT

On the mountain 8 miles southwest of Mount Tyrrell in Stewart River map-area several small exposures of orange-brown weathering, columnar-jointed olivine basalt (QTvbo) are seen. The rocks appear to be part of a single, flat-lying flow perhaps 50 feet thick. They overlie, or are the upper part of, the Carmacks Group in this area. Although the olivine basalt is compositionally similar to rocks of the Carmacks Group it is a much fresher rock. Because of this and because columnar jointing was not seen elsewhere in rocks of the Carmacks Group the olivine basalt is thought to be a younger separate unit. Columnar basalts, younger than the Carmacks Group, with which the rocks may be correlated, are found in Carmacks map-area where they are called the Selkirk Group (Bostock, 1936a). The Selkirk Group, and equivalent rocks in Whitehorse map-area, the Miles Canyon Basalt, are probably Pleistocene (Wheeler, 1961).

GEOLOGY SOUTHWEST OF SHAKWAK TRENCH

The Shakwak Trench, a major lineament, is the locus of an important fault zone that juxtaposes two entirely different terranes. The trench crosses the southwest corner of Snag map-area, and consequently the project area includes a small part of the spectacularly exposed geology seen in the Kluane Ranges. Muller (1967) and Richter (1973) have mapped and described the

geology of large parts of the mountains adjacent to Snag map-area and Cairnes (1915) and Bostock (1952) have mapped the part of the region that includes the southwest part of Snag map-area. Because the geology of these mountains is complex and because it was only briefly studied little is added here beyond what is already known. On the accompanying map the geology of this area is much generalized and the following description of the lithologic units is only an outline. Boundaries of most map-units in this area are probably faults.

Volcanics Rocks

Volcanic rocks (**PMv**) in southwest Snag map-area include aphanitic resistant, green basalt and a variety of tuffs and tuff-breccias. The rocks are pyritic and prominent bright orange gossans are common. Some of the basalt has calcite-filled vesicles and fractures. Epidote forms veins in places. The rocks are massive and lack primary layering. For the most part the volcanic rocks are equivalents of Muller's unit 10 (1967), a part of the Permian and earlier Cache Creek Group. However the volcanic rocks probably also include equivalents of Muller's unit 13 (1967) - the Nicolai Greenstone of Richter (1973).

Sedimentary Rocks

Two groups of sedimentary rocks (**PMs**), that are in some respects similar, are seen and mapped together in southwest Snag map-area. By far the commonest are those that occur on Mount Doyle. These are resistant, well-exposed, greywacke, argillite and siltstone with interbedded pebble-conglomerate and minor limestone. Graded bedding and crossbedding are prominent. Correlatives are thought to be Muller's (1967) Dezadeash Group (unit 16) and Richter's (1973) argillite and greywacke.

The other sedimentary rocks include dark grey, recessive, thin-bedded, pyritic slate with some sandstone. Lenses of light grey crystalline bioclastic limestone yielded one collection of fossils which, though poorly preserved, include some that were tentatively identified by J.B. Waterhouse of the University of Toronto as species of Cancrinella and Neospirifer. These rocks are probably equivalents of Muller's unit 11 (1967), a formation of the late Paleozoic Cache Creek Group and Richter's argillite and limestone (1973) to which he assigned a Triassic and Permian age.

Ultramafic Rocks

A lens of partly serpentinized peridotite (**PRub**) separates the volcanic and sedimentary rocks on Miles Ridge. This lens continues into Klwane map-area where Muller (1967) included it in his Permian and/or Triassic unit 12.

STRUCTURAL GEOLOGY

The main structural elements of the project area are the Yukon Plateau, Shakkwak Trench, and Whitehorse Trough fold belt. Of these, the Yukon Plateau occupies by far the largest part and only small parts of the Shakkwak Trench (southwest Snag map-area) and Whitehorse Trough fold belt

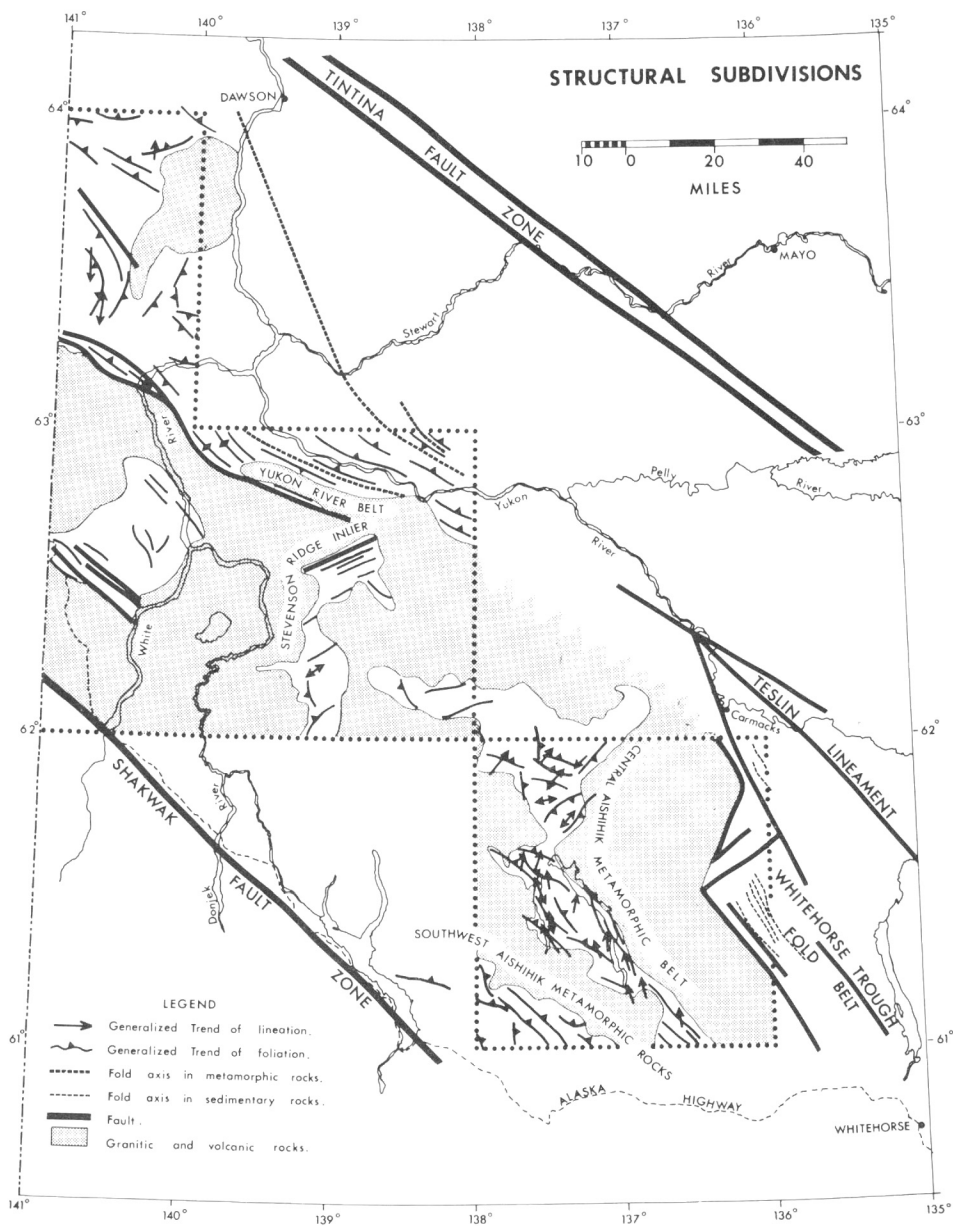


Figure 13. Structural subdivisions and main structural elements of the project area. The solid outline indicates the boundaries of the project area.

(eastern Aishihik Lake map-area) are included. The following section briefly describes the structural geology of the project area and more particularly that of the Yukon Plateau. Much has already been written about the Shakwak Trench (Muller, 1967), and structures of the Whitehorse Trough, southeast of the project area, have been described by Wheeler (1961).

YUKON PLATEAU

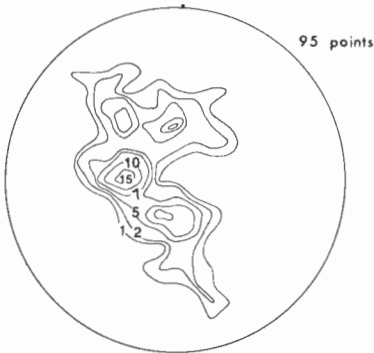
The northwest-trending structural grain of most of the older rocks in the Yukon Plateau is masked by metamorphism of the Yukon Group that took place in Triassic and earlier time and is much modified by intrusion of various concordant and discordant plutonic masses through much of Mesozoic time. Superposed on these structural elements are the early Tertiary northward trends related to intrusion of the Nisling Range granitic suite (Fig. 9). This varied history and the preponderance of structureless granitic and volcanic rocks gives much of the Yukon Plateau a homogeneous structural aspect. Figure 13 brings out this homogeneity, while emphasizing the grain imparted by the metamorphic and stratified rocks. The figure also shows that the metamorphic rocks form structural entities or belts surrounded by younger plutonic and volcanic rocks. These are the Aishihik Lake metamorphic belt, the southwest Aishihik Lake metamorphic rocks, the Yukon River belt (in northeastern Snag map-area), the Stevenson Ridge inlier and the Schist-Gneiss complex of Stewart River map-area. The major and minor structures of these divisions are briefly described below.

Aishihik Lake Metamorphic Belt

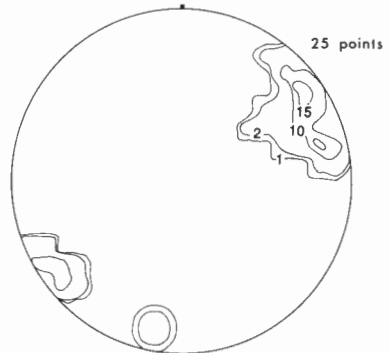
The northwest-trending belt of metamorphic rocks that crosses Aishihik Lake map-area diagonally has a uniform structural grain which varies little through its length. The boundaries of the belt are generally discordant contacts with much younger plutonic rocks of the Nisling Range and Three Guardsmen suites, but on the east the metamorphic rocks adjoin those of the hornblende granodiorite. There the contact relations are concordant on a small scale and foliation in the granodiorite dips steeply and, parallel with that in the metamorphic rocks (see cross-section). Figure 13 shows the generalized orientation of the foliation and lineation in rocks of the Aishihik Lake metamorphic belt.

The foliation is a coarse schistosity defined by preferred orientation of recrystallized micas. For the most part, the recrystallization that produced the schistosity has been so pervasive as to obliterate the crenulation foliation which it mimics. Older planar structures (such as the transposed foliation) are therefore rarely seen.

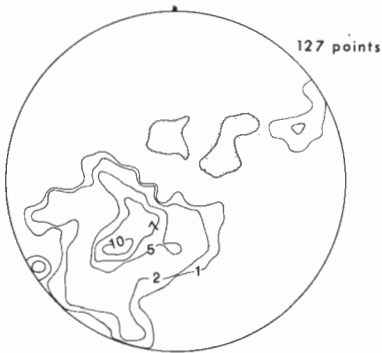
Two linear elements are seen. By far the commonest and the only one shown on Map 17-1973 and Figure 13 is a coarse crinkle lineation characteristic of the more micaceous rocks. This lineation results from open kinking of the foliation producing tiny folds with amplitudes of a millimetre and a somewhat larger wavelength. This linear element postdates deformation that produced the crenulation foliation and is most likely related to folds of this foliation. An older linear element preserved only in the more quartzose members, is a strong rodding or streaking of the quartz produced by intersection of two planar elements, presumably the crenulation foliation with the transposed planar structure.



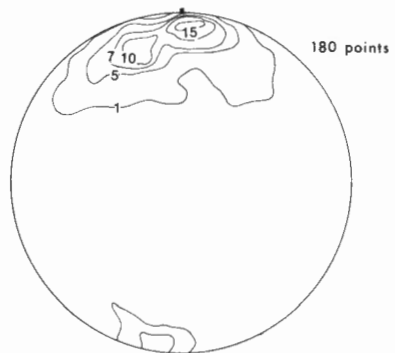
Poles to Foliation NW Aishihik Map-Area
BIOTITE SCHIST UNIT (PPsbq)



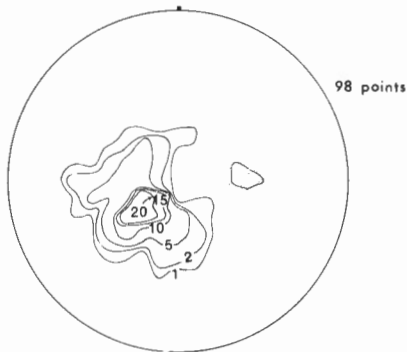
Lineations N.W. Aishihik Map-Area
BIOTITE SCHIST UNIT (PPsbq)



Poles to Foliation Central Aishihik Map-Area
BIOTITE SCHIST UNIT (PPsbc)



Lineations Central Aishihik Map-Area
BIOTITE SCHIST UNIT (PPsbc)



Poles to Foliation S.W. Aishihik Map-Area
HORNFELS UNIT (PPsqr)

Figure 14. Contoured equal area lower hemisphere stereographic plots of minor structural elements in metamorphic rocks of Aishihik Lake map-area. Contours are labelled by per cent of points per one per cent of area. See text for discussion.

In some areas deformation related to the crinkle lineation has produced a dominant joint set at right angles to the lineation.

Small scale folds are uncommon. Those formed as a result of transposition on the crenulation foliation have been obliterated by mica regrowth and the only small folds observed fold the coarse schistosity and locally the compositional layering coincident with it. These small scale folds generally plunge northward at gentle angles and are subisoclinal and asymmetrical in cross-section with a westward vergence.

Lineation and folds in the metamorphic rocks around Aishihik Lake are only the products of the very youngest phase of the youngest deformation of these rocks. Schistosity was developed earlier. Recrystallization during deformation that produced the folds and crinkle lineation was minor and did not lead to development of a new foliation. It is not known how many times the rocks were deformed prior to this youngest event, or how many earlier phases made up the latest event.

Stereograms and sketch maps (Figs. 13 and 14) show the orientation of the deformed planar element and the lineation related to the deformation. In the central part of the Aishihik Lake belt, foliation dips at moderate angles to the northeast and the crinkle lineation plunges gently northward. In the northern part of the Aishihik Lake belt, the foliation dips more to the east and southeast, and lineation trends northeastward.

The size, shape and locale of major folds in the Aishihik Lake metamorphic belt is largely unknown, but a fold that folds the schistosity and which is presumably related to the crinkle lineation, crosses the southern end of Sekulmun Lake (see map and cross-section). Although the antiform was mapped in the field, the accompanying synform shown in the cross-section, was not observed and the shape of the fold shown in the cross-section is therefore hypothetical and based only on the sense of vergence indicated by small scale folds.

It is remarkable that the isolated marble lenses within the Aishihik Lake metamorphic belt occupy a discrete, narrow zone within the schists and are essentially absent away from this zone (see Fig. 7). The individual lenses are thought to represent the disrupted remnants of a once continuous limestone. Although the individual marble lenses have fold terminations in places, they do not together outline recognizable folds, perhaps a reflection of the degree of transposition of bedding. Similarly the close parallelism between compositional layering in the marbles and schistosity in the pelitic surrounding rocks also implies that transposition of bedding has been extreme. These considerations therefore suggest that the structural history prior to the phase that produced the present schistosity may not have been important.

Several relatively small faults are inferred near the southern end of Aishihik Lake (see Map 17-1973). They are vertical or near-vertical and of small displacement. Because the faults cut young granitic rocks and feldspar porphyry dykes they are probably Tertiary in age.

Southwest Aishihik Metamorphic Rocks

Metamorphic rocks in southwest Aishihik Lake map-area dip uniformly northeast over large areas (see Figs. 13 and 14) and from a distance look like a gently dipping homoclinal sequence of bedded rocks. Their planar element is a coarse schistosity coincident with a weak, metamorphic compositional layering. The regionally metamorphosed rocks have been strongly overprinted thermally in the entire southwest part of Aishihik Lake map-area as well as part of adjoining Dezadeash and Kluane Lake map-areas. The thermal event has promoted mica, garnet, staurolite and cordierite growth across the structural layering. It masks details of the schistosity and obliterates linear elements and other small-scale structures that may have existed. The schistosity, now modified by thermal overprinting, may be the same structure as that seen in rocks of the central Aishihik Lake belt.

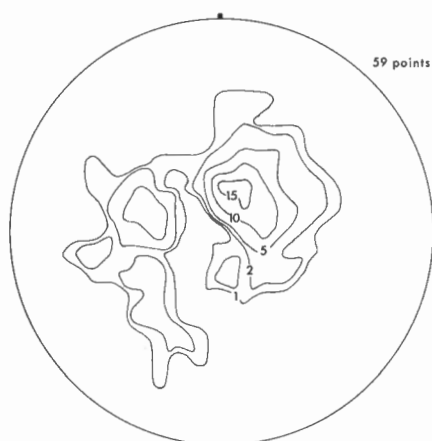
The marked difference in orientation of foliation north and south of the headwaters of McKinley Creek suggests that the valley of this stream may be faulted.

Yukon River Belt

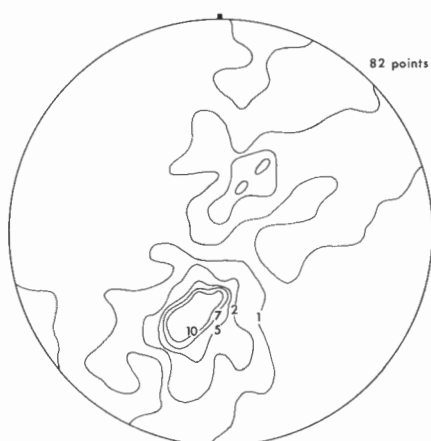
Metamorphic rocks that bound the Klotassin Batholith on the north in northeastern Snag map-area have a well-developed northwestward trend and are here referred to as the Yukon River belt (see Fig. 13). The boundaries on the northeast are indistinct. On the northwest the belt runs gradually into what appears to be a more homogeneous structural terrane. This seeming homogeneity may however be a reflection of a poorer understanding because of the lack of exposures here. On the southeast, the Yukon River belt is truncated by granitic rocks and overlain by volcanic strata.

The southern margin of the Yukon River belt is well defined and marked by the contact between granodiorite of the Klotassin Batholith and schists and gneisses. This contact is sheared in places and is thought to be faulted for part of its length. The granodiorite shows distinct signs of shearing and cataclasis near its northern contact and this shearing dips steeply, parallel with the foliation in the schists. Schists and gneisses near the contact do not differ texturally from those farther away and do not show thermal metamorphic overprinting. At two places small bodies of ultramafic rocks lie along the contact. The granodiorite is thought to have intruded the schists and gneisses about the time of their latest deformation and after development of their schistosity. The contact was initially concordant with slight local transgression. Differential movement took place along the contact during the last deformation (the folding) of the schists and gneisses because it marks a pronounced competence boundary. Movement on the contact was probably relatively small.

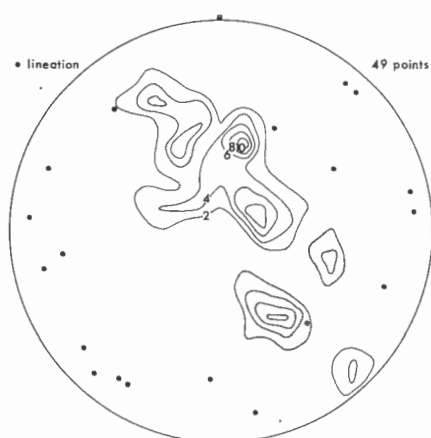
Schistosity in rocks of the Yukon River belt trends uniformly northwest but varies in dip direction because it has been folded (see Fig. 15). The folds are open structures with slight asymmetry and a southwestward sense of vergence. They have sharp hinges and in their limbs the schistosity dips uniformly. Relatively small folds, perhaps 200 feet across and smaller, of the same shape, sense and orientation as the large folds, are seen at several places and are thought parasitic to the larger structures. The folds have amplitudes of about 10,000 feet and a wavelength in the order of several miles. Their cross-sectional size indicates they are major structures that probably



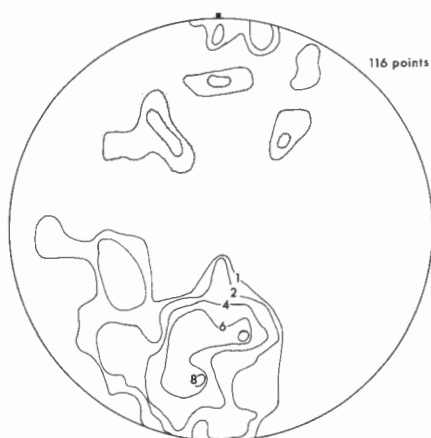
Poles to Foliation W. Stewart River Map - Area
KLONDIKE SCHIST (PPsqm)



Poles to Foliation NE. Snag Map - Area
SCHIST GNEISS UNIT (PPsn)



Poles to Foliation Central Snag Map - Area
NASINA QUARTZITE (PPqc)



Poles to Foliation NE. Snag Map - Area
PELLY GNEISS (PPgdn)

Figure 15. Contoured equal area lower hemisphere stereographic plots of minor structural elements in metamorphic rocks in Snag and Stewart River map-areas. Contours are labelled by per cent of points per one per cent of area.

affect rocks well below the surface, and their lateral extent (see Fig. 13) indicates they are regionally important structures. One of the folds is believed to be the continuation of a major structure mentioned, though not mapped, by Bostock (1942) (see Fig. 13). The axes of the major folds, though roughly parallel, diverge northwestward and the folds become correspondingly more open in this direction.

The folds postdate development of the schistosity and were not accompanied by major recrystallization or formation of a new foliation. They are brittle structures formed late in the structural and metamorphic history and may be considered a post-metamorphic kinking on a regional scale. They are therefore late in the structural history as are folds in the Aishihik Lake belt and the structures may have originated at the same time.

The folded planar element in rocks of the Yukon River belt is a coarse schistosity defined by preferred orientation of micas and by poorly developed compositional layering parallel with it. The schistosity results from pervasive late tectonic recrystallization of the rocks and is so well developed that it obliterates evidence indicating whether the schistosity is a recrystallized crenulation foliation or an axial plane foliation. The schistosity of the Yukon River belt may have developed at the same time as that seen in the Aishihik Lake metamorphic belt.

Lineation is poorly developed in most rocks of the Yukon River belt. In the more gneissic varieties, particularly some of the augen gneisses, a crude mineral streaking is all that is recognized. In more schistose members a poor crinkle lineation is developed locally. The best linear elements are quartz and quartz-feldspar boudins in the gneissic rocks. Not enough measurements of lineations were made in the Yukon River belt to generalize, but lineation and boudinage trends generally northwestward. The linear elements in the rock probably predate the open folding of the rocks as does the schistosity.

Stevenson Ridge Inlier

This structural subdivision (see Fig. 13) is referred to as an inlier only because a large part of its boundary is defined by younger volcanics that overlie the metamorphic rocks unconformably. The nature of the contact between the metamorphic rocks and those of the Klotassin Batholith is unknown.

Rocks of the Stevenson Ridge Inlier belong to the Nasina Quartzite and their minor structure differs from that of the other, more schistose, structural divisions. In general, foliation trends northeast at right angles to the grain of other structural subdivisions and lineation shows a similar preferred northeastward orientation (see Fig. 13). A stereographic plot of poles to foliation (Fig. 15) suggests that the foliation is folded about gently plunging northeast-trending axes. The foliation in rocks of the Stevenson Ridge Inlier is defined by strongly preferred orientation of micas, generally muscovite, and by segregation of the micas. Muscovite-rich layers are perhaps half a millimetre thick or less and are separated by quartz laminae more than one centimetre thick. Quartz shows strong preferred form and crystallographic orientation. The foliation is pervasive and closely parallel with compositional layering. It is probably an axial plane foliation. Lineation in the Nasina Quartzite is a pervasive and strong fold mullion structure produced by intersection of foliation and bedding, and by folding of the foliation. At some places a fine crinkle lineation, parallel with the mullions, is developed in micaceous laminae. Small scale folds are rarely seen. They fold the axial

plane foliation but were not accompanied by recrystallization that produced a new foliation. The sense of vergence of small scale folds is not known.

Large scale folds have not been recognized in the Stevenson Ridge Inlier. Judging from the lack of continuity of the few marble lenses large folds may not exist because bedding has been strongly disrupted along the axial plane foliation.

There is no evidence to show whether or not the foliation and folding of the Nasina Quartzite are contemporaneous with formation of crenulation foliation and folding in other structural subdivisions. The diversity between structural trends in the Stevenson Ridge Inlier and other structural divisions has no ready explanation, but may be the expression of a structural re-entrant.

The northeast-trending fault along the southeast side of the valley of Dip Creek, is a young structure as suggested by the fact that it has topographic expression readily apparent on air photographs. The amount of movement is unknown, but its trace indicates the fault dips steeply and suggests that the sense may be north down relative to the south side.

Schist-Gneiss Complex in Stewart River Map-Area

The metamorphic rocks of Stewart River area do not form a discrete structural entity, but are part of a large, structurally homogeneous area that occupies much of Ogilvie, Stewart River and Dawson map-areas as well as adjacent Tanacross and Eagle Quadrangles in Alaska (see Fig. 13). In this large region structural trends are not regionally continuous and large scale folds have not been recognized. The homogeneity of the pattern suggests that the deformation there has been more complex than in other parts of the project area and that it may have involved two or more folding events of relatively equal importance that produced a structural interference pattern tending to homogeneity. An understanding of the structure of this area requires more detailed study than the outcrop conditions or the reconnaissance nature of the present work have allowed.

Foliation in the Schist-Gneiss Complex is a coarse schistosity defined by preferred orientation of micas and parallel with a crude metamorphic compositional layering. The schistosity is a strongly recrystallized pervasive crenulation foliation, the same as that seen in the Yukon River belt.

A northwest-trending fault is inferred along the contact between the Pelly Gneiss and Klondike Schist in central Stewart River map-area. Not only is the contact between these rocks located approximately, but it is a gradational boundary that is by no means as steep as the indicated faulted relations may imply. This contact may instead mark a zone of movement along which two small alpine ultramafic bodies have been emplaced.

WHITEHORSE TROUGH FOLD BELT

The wedge of folded and faulted Laberge Group rocks in east-central Aishihik Lake map-area is a small part of what is herein referred to as the Whitehorse Trough Fold Belt. This structural division is unique in the project area because the rocks were involved in deformation at a much higher

level in the crust, and at a later time, than the metamorphic rocks. The deformation was not accompanied or followed by recrystallization as in other structural divisions and instead of slip folding the deformation has been entirely by flexural slip.

Folds trend north-northwest and are open and upright with somewhat sinuous axes. They are asymmetric and have a weak, but definite, westward vergence. At the surface anticlinal hinges are relatively broad with rounded hinges, whereas synclines are narrow with sharp hinge zones. Fold hinges are essentially horizontal. Some folds have wavelengths of about 10,000 feet and amplitudes of 5,000 feet. Their size and shape indicates that the depth to which strata are folded is in the order of 10,000 feet below the surface. A vertical fault zone disrupts one of the anticlines and is the locus for injection of volcanic rocks. This structure may represent the upper part of a reverse fault that dips eastward at depth.

At its northern end the belt of folded rocks disappears abruptly under cover of younger volcanic rocks and apparently abuts the massive green volcanics and granitic rocks. There is insufficient exposure to decide on the relationship between the folded rocks and the massive volcanics, but a possible interpretation of the evidence is that the two are separated by a fault. Such a fault may have existed during or prior to, deposition of the Laberge Group and may have been reactivated during folding of the rocks. A faulted relationship at the northern end of the fold belt is not incompatible with the aeromagnetic data (see Fig. 16).

On the west the folded strata are separated from older crystalline rocks by an important zone of faults that is overlain by younger volcanic rocks. The nature of the fault zone is unknown but its latest movement probably post-dates or is contemporaneous with the folding, and the effect of the faults has been to drop the block between the crystalline and folded rocks.

Rocks of the Whitehorse Trough were folded after deposition of the Tantalus Formation and before extrusion of the Hutshi Group unconformably on Tantalus strata. Although neither of the units is well dated they indicate the time of folding of the rocks to be broadly mid-Cretaceous.

AEROMAGNETIC DATA

Total intensity aeromagnetic maps are available for the project area and for adjacent parts of the Yukon. Because these data have proven useful in the mapping and interpretation they are briefly discussed in the following paragraphs.

A compilation of the total intensity data for the Yukon shows that aeromagnetic intensity increases gradually in a northeastward direction at about 3.5 gammas per mile. However, the total intensity compilation shows only vague correlation with geological features and emphasizes the regional gradient. On Figure 16 areas of high, moderate and low aeromagnetic relief are subjectively distinguished for much of west-central Yukon. Although exact boundaries are not reproducible the character and location of the highs and lows are evident. Because the treatment has not been rigorous no absolute values for the degree of aeromagnetic relief can be assigned. An aeromagnetic relief map such as this is more indicative of abrupt changes in magnetic susceptibility of rocks than is the total field map from which it is derived.

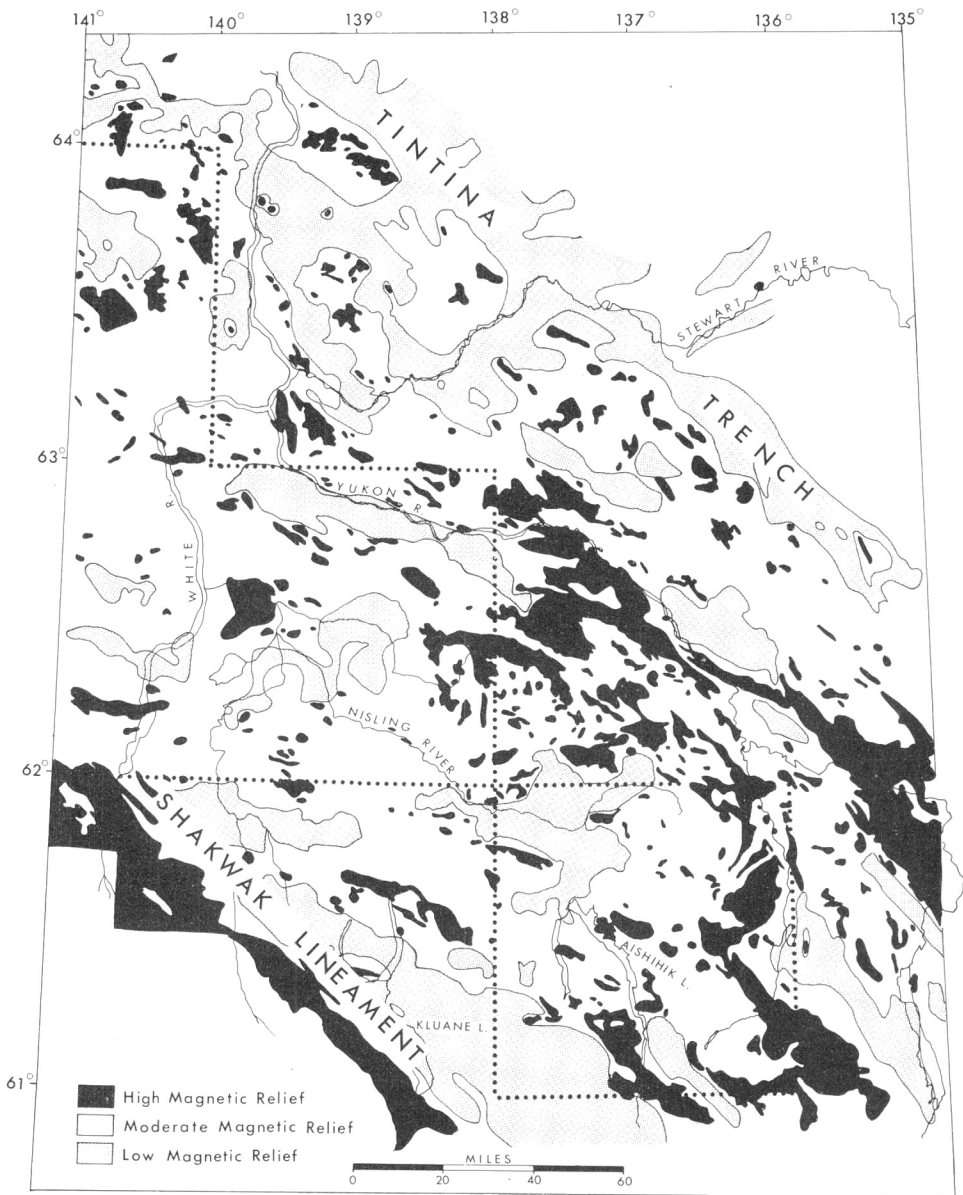


Figure 16. Subjective sketch map to distinguish areas of high, moderate and low total field aeromagnetic relief in west-central Yukon. The project area is indicated by the dotted outline.

The aeromagnetic relief sketch shows a strong northwest grain expressed by both high and low relief areas. If the effects over the Shakwak and Tintina trenches and Teslin lineament are neglected this strong northwest grain is much subdued and the intervening country takes on a much more homogeneous aspect.

This homogeneity in much of Yukon Plateau is not surprising. It is a reflection of the diversity of structural trends in the metamorphic rocks, the preponderance of undeformed granitic rocks and the widespread presence of young unfolded volcanic rocks (see Figs. 9 and 13).

In most of the Yukon individual magnetic relief features can only be related roughly to specific lithologies or structures. Nevertheless generalizations can be made. Ultramafic rocks show good correlation with zones of high magnetic relief. The metamorphic rocks are mostly represented by low relief zones, with some areas of moderate relief. The Ruby Creek Batholith and its continuation is expressed as a low relief zone whereas the Klotassin Batholith and equivalent rocks show as areas of moderate aeromagnetic relief. The green massive volcanics of northeast Aishihik Lake map-area and similar rocks in southwest Snag map-area show up well as high relief zones. Perhaps surprisingly there is no evidence of the Nisling Range Alaskite and its related volcanic and porphyry suites in the magnetic maps. Most individual small relief areas shown on the sketch can be related qualitatively to specific geological features and are therefore not true anomalies. However some zones of magnetic relief are puzzling and seem to have no explanation in the geology. One of these is the combined high and low relief zone that trends northwest across the southern boundary of Aishihik Lake map-area.

Known mineral deposits in the project area are not of sufficient size or magnetic mineral content to be expressed on the magnetic maps. In most instances the magnetic influence of geological structures or rock-units obscures or obliterates any expression such occurrences might have. The Mack's copper deposit, a fairly large occurrence of massive magnetite, is a case in point. This deposit is enclosed by the magnetically responsive green massive volcanics that totally mask the response of the magnetite. The smaller magnetite skarns in Aishihik Lake map-area, though enclosed by metamorphic rocks whose response is weak, are too small to give conclusive aeromagnetic indication of their presence without prior knowledge. The aeromagnetic maps are a poor prospecting tool by themselves. With accompanying geology, geochemical and conventional prospecting data in support, however, these maps are more useful.

MINERAL OCCURRENCES

A number of mineral occurrences are known in the project area, but none are presently economic and, aside from bulk sampling of some deposits, no mining has been carried out. Many of the mineral occurrences have characteristics in common with each other and individual showings can be classed as one of several distinct types. While summary descriptions of the properties are included a general description of these types is given here. The main classes of mineral showings are as follows:

1. Chalcopyrite, scheelite and/or molybdenite in magnetite skarns related to Mesozoic granitic rocks.
2. Chalcopyrite in magnetite skarns in volcanic rocks.
3. Disseminated chalcopyrite and/or molybdenite in and near Tertiary acid volcanic and plutonic rocks.

CHALCOPYRITE, SCHEELITE AND/OR MOLYBDENITE IN MAGNETITE SKARNS

Skarns, generally with magnetite, occur at a number of showings in central Aishihik Lake map-area close to Mesozoic or Tertiary granitic rocks. These skarns carry diopside, epidote, idocrase, garnet, and calcite. Economic minerals are chalcopyrite and scheelite, but locally they carry molybdenite or sphalerite. Pyrrhotite is found at some of the showings and malachite is a common alteration mineral. The skarns are irregular and generally lens-shaped having their greatest dimension along the layering of the marble lens they replace. The marble differs from one showing to another. At some it is a snowy white, coarsely crystalline rock, at others a laminated or banded, grey, finely crystalline marble. Generally it is fetid. Skarn minerals form massive lenses in the marble at some places, but in others occur as segregations along the layering of the rock. They are commonly coarsely crystalline, spectacular looking rocks.

At many of the showings in central Aishihik Lake area, feldspar porphyry dykes are common (Hopkins, Janisew). At others (e.g. Moraine), granitic rocks of the Three Guardsmen type are seen adjacent to the skarn. At still others (Sekulmun) Nisling Range Alaskite occurs close to the showings. It seems unlikely that all three of these plutonic rocks are mineralizing agents and because some of the dykes appear to postdate the mineralization the Three Guardsmen granitic suite probably is the important one.

CHALCOPYRITE IN MAGNETITE SKARNS IN VOLCANIC ROCKS

The Mack's copper property is the only example of a skarn developed in carbonate-rich volcanic rocks in the project area. In adjacent Whitehorse map-area similar occurrences are known. The skarn replaces a limy part of the green volcanic rocks that are thought to be Triassic, but no younger granitic rocks, to which the mineralization may be related, were seen in the vicinity. Whether the skarn in the volcanic rocks is genetically related to those found in limy lenses in the metamorphic rocks is unknown.

The green volcanic rocks are now thought to be equivalent to similar rocks mapped by Bostock (1936) in Carmacks map-area, and included by him in the Mount Nansen Group. They extend along the Teslin lineament for some distance and are favourable to exploration for similar skarn occurrences. Campbell (1967) has mapped rocks, probably equivalent to the green volcanics, in Glenlyon map-area (i.e. his map-unit 16a).

DISSEMINATED CHALCOPYRITE AND/OR MOLYBDENITE IN ACID PLUTONIC ROCKS

By far the largest number of mineral occurrences in the project area are in, or close to, rocks of the Nisling Range Alaskite suite, but although the type of mineralization is uniform its mode of occurrence is varied. The mineralization consists of disseminated very fine grained pyrite, chalcopyrite and molybdenite, commonly difficult to see. At many showings the rocks at the surface are deeply weathered and leached so that only iron oxides remain; malachite is present locally. Where mineralization occurs, rusty gossans are common, but because of the widespread presence of pyrite, ochre weathering colours are by no means unique to areas mineralized with copper.

Mineralization occurs in plutonic, subvolcanic, and volcanic rocks at various localities and the rocks are reported to have geochemically high background values in copper and molybdenum. At some showings the mineralization occurs in one or two dykes related to the alaskite suite, elsewhere it is confined to volcanic rocks or feeder pipes related to them and at other places the mineralization may be found in a part of a batholith of these rocks. In summary there seems no size of body of these rocks in which mineralization may not be found and no type of body preferred for mineralization. The mineralization at any showing is usually, but not necessarily, confined to rocks of the alaskite suite and at some localities it extends beyond them into the host rocks. There seems to be no obvious correlation between the occurrence of mineralization in the alaskite (or related rocks) and the type of rocks invaded by it.

SUGGESTIONS FOR MINERAL EXPLORATION

Future exploration in the project area, and in other parts of west-central Yukon, should consider that only one or two suites of rocks in this region have proven potential value as hosts to mineral deposits. The most important is the Nisling Range Alaskite with its related volcanic (Mount Nansen Group) and subvolcanic rocks. Molybdenite, copper and tungsten mineralization occur in rocks of this suite at many places, not only in the project area, but in adjacent regions. The Nisling Range Alaskite is equivalent to Souther's (1971) younger quartz-monzonite, Wheeler's (1961) leucocratic granites and Aitken's (1959) alaskite and quartz-monzonite. Many of these equivalent rocks have associated mineralization like that found in the project area. Rocks of this suite are worthy of careful examination, but study is required to determine which members of the suite or which environments within it are most favourable to the concentration of metals. The mineralization discovered in these rocks to date tends to be widespread, but is too low grade to be presently economical.

Carbonate rocks within the Yukon Group in central Aishihik Lake map-area have been metasomatized to copper- and tungsten-bearing magnetite skarn near Cretaceous granitic rocks. These skarns bear careful examination because of their similarity to those of the Whitehorse copper belt. Unfortunately large carbonate lenses are uncommon within the metamorphic rocks of central Aishihik Lake map-area. Some parts of the area are more likely to contain large carbonate lenses than others. Although the copper content of these rocks has been investigated in some detail their

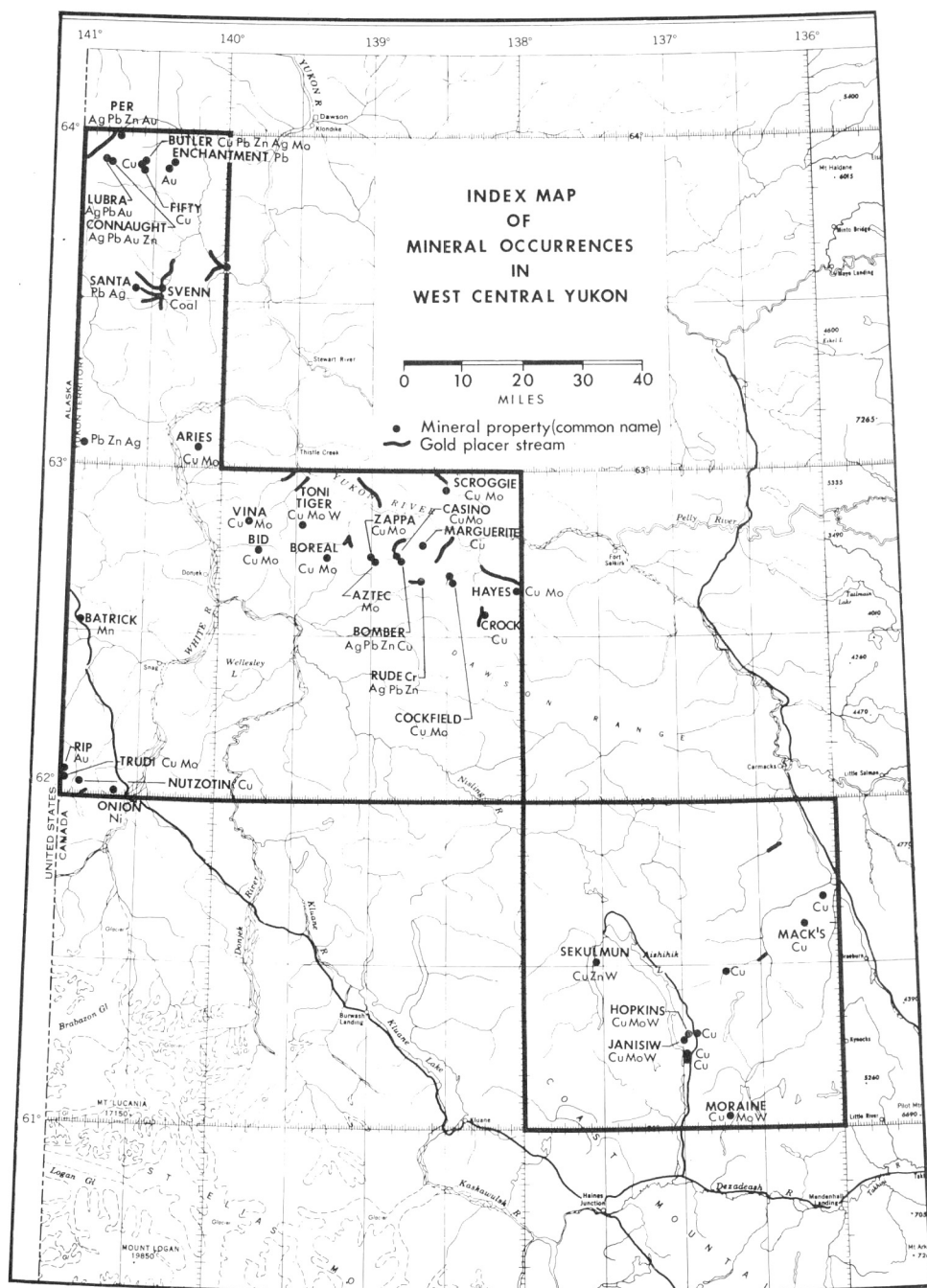


Figure 17. Index map of known mineral occurrences and mineral properties in the project area. Property names are those in most common use. A complete list of references and brief descriptions of the occurrences are given in the text.

tungsten potential has been generally neglected. They bear re-evaluation in the light of the regional geology and in view of their virtually untested tungsten potential.

The peridotites in Snag map-area are potential hosts to copper and nickel mineralization and may also contain asbestos. To the writer's knowledge these possibilities have not been investigated because the ultramafic occurrences were not known prior to the present investigation. Nickel and copper are known in some of the peridotites southwest of Shakwak Trench.

Disseminated chalcopyrite is known at two localities in Carmacks map-area in schlieren within the hornblende granodiorite (Tempelman-Kluit, 1973). It is not inconceivable that these rocks, extensive in the project-area, may carry similar mineralization there.

The conglomerate that underlies volcanic rocks of the Carmacks Group at many places in Stewart River, Ogilvie, Snag and Carmacks map-areas is a potential host to fossil placer concentrations. The conglomerate is known to contain minor amounts of gold at one or two localities.

Coal is found in rocks of the Laberge Group in eastern Aishihik Lake map-area and is also interbedded with conglomerates and sandstones beneath the Carmacks Group. The deformation of, and imperfect understanding of facies changes within, the Laberge Group makes exploration for coal in these rocks difficult. The coal in conglomerate beneath the Carmacks Group is a low quality lignite in thin seams, but that in the Laberge tends to be a more acceptable product.

The Tertiary quartz porphyry in Stewart River map-area and the felsite of Snag map-area offer some potential for gold concentrations, but are not known to have associated base metals.

Although the project area includes many varieties of, and large areas underlain by, metamorphosed Paleozoic and older rocks, few, if any, of the mineral occurrences are genetically related to these. Whether mineralization may be expected in these older rocks is unknown, but considering the dearth of related mineral occurrences in these strata in west-central Yukon and adjacent Alaska generally, it seems unlikely that they contain important unfound deposits. In view of their metamorphic and structural history it is certain that any deposits related to these rocks, if found, will be strongly recrystallized and partly remobilized.

LIST OF MINERAL OCCURRENCES

Following is list of mineral properties in the project area with brief descriptions and a list of references. Locations are shown on the geological maps by mineral or metal symbols, but for convenience the names of the showings are indexed in Figure 17. Only properties where mineralization is known are listed. The descriptions are based largely on the references as the writer has visited only a few of the properties. No descriptions are available for some of the showings. The names of the properties are those in commonest use; in various cases these are claim names, names of people, names of topographic features or names of mining companies. The index map of Figure 17 also shows those creeks in the project area where placer mining has been carried out at some time.

ARIES

N 63°03' W140°11'

Disseminated magnetite, pyrite, pyrrhotite, chalcopyrite and molybdenite occur in flat-lying intermediate volcanic rocks probably equivalent to the Mount Nansen or Carmacks groups. These volcanic rocks overlie hornblende granodiorite and metamorphic rocks of the schist gneiss unit unconformably. Bulldozer trenching was done in 1970.

AZTEC

N 62°44' W138°58'

Reference:

Craig and Laporte (1972, p. 54-55)

Minor molybdenite occurs in quartz veins cutting hornblende granodiorite of the Klotassin Batholith. The area is geochemically anomalous in molybdenum and copper.

BATRICK

N 62°32' W140°57'

Reference:

Bostock (1952, p. 44-45)

A vein of hydrous manganese oxide (psilomelane) about 20 inches wide is exposed for a length of 25 feet. The vein lies within and parallel to acid tuffs of the argillaceous chert sequence and dips 45° northwest.

A channel sample across 20 inches assayed 71.9% Mn₂O₃, 1.4% Fe₂O₃, 5.4% H₂O and 21.6% insolubles.

BID

N 62°45' W139°43'

Reference:

Craig and Laporte (1972)

Small sparsely mineralized quartz veins and veinlets with pyrite and molybdenite and with pyrite and chalcopyrite cut leucocratic granites equivalent to the Nisling Range Alaskite, which invade the Klotassin Batholith.

BOMBER

N 62°43' W138°50'

References:

Findlay (1967, p. 32-34)

Green and Godwin (1964, p. 22-24)

Green (1966, p. 39-42)

A series of northwest-trending, steep-dipping veins containing galena, sphalerite, chalcopyrite and pyrite cut rocks of the Klotassin Batholith at this showing. Much underground work and drilling has been done and a hand sorted shipment of 48 tons was shipped for testing. This shipment assayed 68% lead and 161.1 oz/ton silver. Silver-lead ratios vary from 4 to 1 to 1 to 2.

BOREAL

N 62°44'

W 139°17'

Reference:

Craig and Laporte (1972, p. 42-43)

This is a zone geochemically anomalous in copper and molybdenum. The property is underlain by rocks of the Klotassin Batholith intruded by dykes of intermediate composition. No mineralization has been found.

BUTLER

N 63°55'

W 140°35'

Reference:

Craig and Laporte (1972, p. 51-52)

A chalcopyrite-bearing epidote-magnetite-skarn 50 feet wide and 500 feet long is found at the contact of a marble lens with a Cretaceous? monzonite stock. One half mile northeast is a galena-tetrahedrite carbonate vein assaying 96.5 oz/ton silver and 36.2% lead.

CASINO

N 62°44'

W 138°50'

References:

Archer and Main (1971)
Cockfield (1928 in Bostock, 1957, p. 576-578)
Craig and Laporte (1972, p. 55-57)
Findlay (1967, p. 32-34) (1969, p. 39-40)
Green and Godwin (1954, p. 22-24)
Green (1965, p. 34-35) (1966, p. 39-42)
Phillips and Godwin (1970)

Disseminated pyrite, chalcopyrite and molybdenite are found in, and close to, a Tertiary pipe or plug of acid volcanic breccias that invades the Lower Mesozoic Klotassin Batholith. Rocks of the breccia pipe or plug are believed to be equivalent to similar acid volcanic rocks seen on Mount Cockfield and are tentatively correlated with volcanic rocks and dykes of the Mount Nansen Group. Much drilling and bulldozer stripping has been done on the property and reserves of 179 million tons grading 0.37% copper and 0.023% MoS₂ are indicated.

CO

N 62°40'

W 138°30'

Reference:

Craig and Laporte (1972, p. 64-67)

Sparse copper and molybdenum mineralization is widely disseminated in quartz monzonite that intrudes the Klotassin Batholith. The quartz monzonite may be genetically related to the nearby volcanic rocks and is thought broadly correlative with the host rocks at Casino. Considerable drilling, indicating uniform grades of about 0.03% copper and 0.01% molybdenum, has been done.

COCKFIELD N 62°39' W 138°28'

Narrow veinlets of chalcopyrite and molybdenite are found in pyritic volcanic rocks and their underlying plutonic equivalents. The volcanic rocks are probably equivalents of the Mount Nansen Group.

CONNAUGHT N 63°55' W 140°58'

References:

Craig and Laporte (1972, p. 32-34)
Findlay (1967, p. 29) (1969a, p. 32-33) (1969b, p. 20)
Green (1966, p. 28)

Five or more northeast-trending quartz veins which contain arsenopyrite, galena and some tetrahedrite and sphalerite are known in metamorphic rocks of the Pelly Gneiss and Nasina Quartzite. Much bulldozer work and considerable drilling has been done on the property and a 19.5-ton hand-culled sample was submitted for testing. This sample assayed 67% lead and 67 oz/ton silver.

CROCK N 62°34' W 138°15'

Reference:

Craig and Laporte (1972, p. 68)

Minor amounts of disseminated chalcopyrite are found in rocks of the Klotassin Batholith.

ENCHANTMENT N 63°53' W 140°24'

Float of galena has been found at the head of Enchantment Creek and stream sediment samples are anomalous in lead.

FIFTY N 63°54' W 140°38'

A high magnetite skarn with some chalcopyrite occurs in a lens of marble in metamorphic rocks of the Pelly Gneiss near its contact with a hornblende monzonite.

HAYES N 62°39' W 138°02'

Traces of chalcopyrite and molybdenite are seen in altered pyritic rocks of the schist and gneiss units.

HOPKINS N 61°17' W 156°53'

References:

Cairnes (1909, in Bostock, 1957, p. 281-282)
Findlay (1969, p. 28)

This is a well-known showing first staked in 1907. A number of small lenses of skarn are found in marble in biotite schists of the Yukon Group. These are spatially associated with green aphanitic dykes of

intermediate composition that cut the metamorphic rocks. The skarn consists of magnetite, pyrrhotite, chalcopyrite and scheelite and locally contains garnet and idocrase; molybdenite is noted in some showings. Skarn lenses are conformable with the foliation in the schists that enclose the marble host. Limited work has been done on these showings.

JANISIW

N 61°16'

W 137°00'

Reference:

Cairnes (1909, in Bostock, 1957, p. 281-282)

Magnetite and chalcopyrite occur in skarn found in the small marble lenses that are part of the biotite schist unit. Scheelite and molybdenite are reported locally. The mineralization is found near contacts of the marble with granitic rocks and dykes. Some drilling has been done.

LUBRA

N 63°56'

W 140°50'

Several quartz veins, weakly mineralized with argentiferous galena and arsenopyrite, cut metamorphic rocks. Silver to lead ratio is about 1 to 1 and gold assays up to 0.5 oz/ton can be obtained from arsenopyrite-rich portions.

MACKS

N 61°37'

W 136°11'

References:

Cairnes (1909, in Bostock, 1957, p. 280-281)

Green (1966, p. 44-46)

This showing, first staked in 1904, has been explored with considerable drilling and underground work. Mineralization occurs on two knolls about 500 feet apart and is found in a high-magnetite skarn with considerable chalcopyrite. Garnet, epidote, diopside and idocrase are the commonest silicate minerals, but constitute only a small proportion of the mineralized rocks. Some galena and considerable amounts of specular hematite were noted; azurite and malachite are widespread. The mineralization occurs as irregular replacement lenses within dense, massive, green, altered volcanic rocks of probable Triassic age. The limestone bed, mentioned as the host to ore in earlier reports, was not found.

MARGUERITE

N 62°47'

W 138°39'

Reference:

Craig and Laporte (1972, p. 51-52)

Traces of chalcopyrite were found in schist and gneiss close to the northern contact of the Klotassin Batholith over an area which is geochemically anomalous in copper.

MORAINE

N 61°02'

W 136°43'

Several irregular skarn lenses mineralized with pyrrhotite, chalcopyrite, molybdenite and scheelite are found over a large area. The skarn is

formed in marble within rocks of the biotite schist unit and is genetically related to nearby granitic rocks.

NUTZOTIN N 62°02' W 140°51'

Traces of copper oxides are found in skarn within calcareous volcanic rocks.

ONION N 61°01' W 140°38'

Reference:

Papezik, V.S. (1955)

Heazlewoodite and pentlandite occur with pyrrhotite in a narrow stringer at the contact of serpentinized peridotite with sedimentary and volcanic rocks of Early Permian to Late Triassic age.

PER N 63°59' W 140°47'

References:

Cockfield (1921, p. 52)

Green (1966, p. 26-28)

A northeast-trending vein occurs in volcanic rocks probably equivalent to the Carmacks Group which overlie metamorphic rocks. The vein is from several inches to 2 feet wide and was traced about 200 feet. The best chip assay reported returned 12.5 oz/ton silver, 26.4% lead, 4.7% zinc, and 0.04 oz/ton gold over a 2.5-foot width.

Cinnabar was found in the sluice boxes of placer miners while working this portion of the Sixty Mile River gravels but the source was never found.

RIP N 62°04' W 140°58'

Reference:

Cairnes (1915, p. 121-122)

Disseminated chalcopyrite and pyrite occur in quartz veins that cut sheared, pyritic volcanic rocks of intermediate composition. Low gold values are reported.

RUDE CREEK N 62°40' W 138°38'

Reference:

Cockfield (1927, in Bostock, 1957, p. 578-581)

A lens of massive galena and sphalerite fifteen feet long and up to three feet wide occurs in rocks of the Klotassin Batholith.

SANTA N 63°32' W 140°36'

A quartz vein several feet wide containing silver-bearing galena cuts rocks of the Klondike Schist.

SEKULMUN

N 61°30'

W 137°32'

Sphalerite and minor galena occur in garnet diopside skarn developed in well laminated fetid crystalline marble interfoliated with biotite schists. The skarn is close to outcrop of Nisling Range alaskite to which it is probably related. Considerable drilling was done in 1970 and 1971.

TONI TIGER

N 61°50'

W 139°29'

Reference:

Craig and Laporte (1972, p. 40-41)

Disseminated pyrite, arsenopyrite, chalcopyrite, molybdenite and scheelite are found in skarn developed in rocks of the Schist-Gneiss unit at their contact with biotite granite.

TRUDI

N 62°03'

W 140°59'

Some drilling was done in pyrite-bearing volcanic rocks that contain geochemically anomalous copper values. Minor values were obtained.

VINA

N 62°50'

W 139°50'

Reference:

Craig and Laporte (1972, p. 35-37)

Narrow fractures, containing minor amounts of pyrite, chalcopyrite and molybdenite are found in rocks of the Klotassin Batholith which are cut by a variety of dykes near the property.

ZAPPA

N 62°45'

W 138°59'

Reference:

Craig and Laporte (1972, p. 46-47)

Altered quartz porphyry possibly equivalent to that at Casino intrudes the Klotassin Batholith. No mineralization was seen, but the area is anomalous in copper and molybdenum.

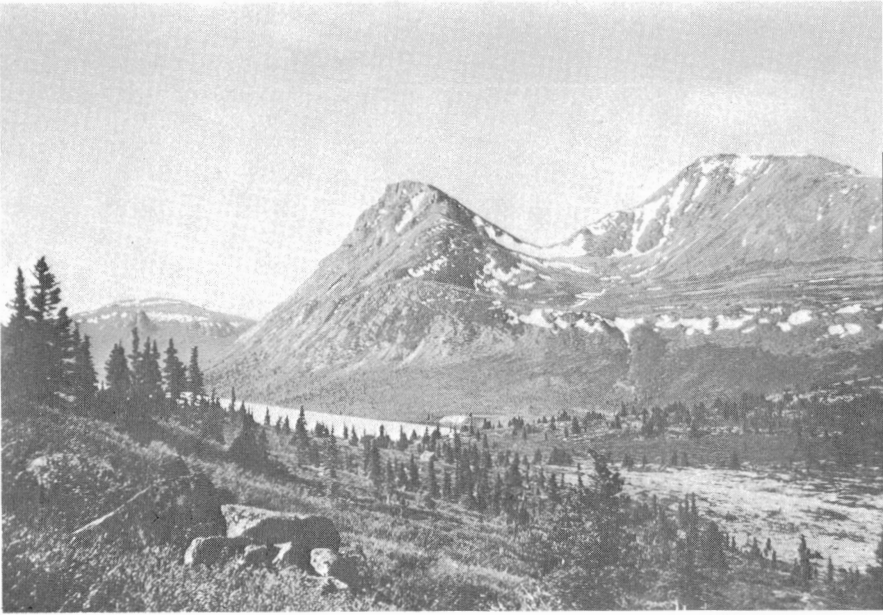


Plate I. Looking southwest across Ittlemit Lake (Aishihik Lake map-area) at exposures of the Ruby Range Granodiorite. The photo shows the glaciated character of this part of the project area. GSC Photo No. 202300



Plate II. Glacial erratics at 5,000 feet elevation. Looking southward up Sekulmun Lake (Aishihik Lake map-area). GSC Photo No. 202300-A



Plate III. The dissected surface of the Yukon Plateau in the glaciated part of Aishihik Lake map-area. Looking south across Isaac Creek at rocks of the Nisling Range Alaskite. GSC Photo No. 202300-B

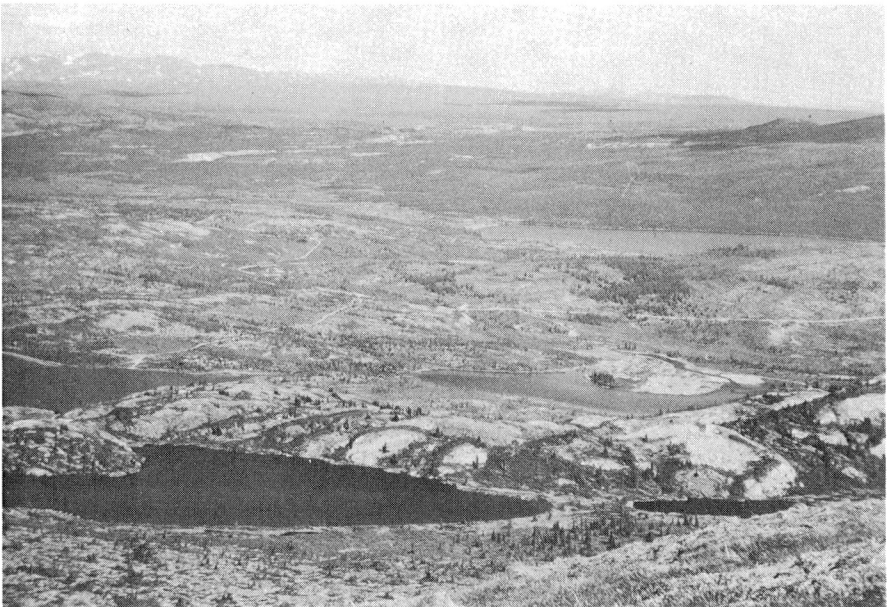


Plate IV. Looking east across the outlet of Aishihik Lake; Giltana Lake is in the right middle distance. Note the glacially scoured surface and the excellent exposures (of the biotite schist unit with carbonate lenses) even on the valley floor. GSC Photo No. 202300-C



Plate V. View of the White River looking downstream; the mouth of Ladue River is in the left foreground (Stewart River map-area). This topography is characteristic of the dissected Yukon Plateau in the unglaciated parts of the project area. GSC Photo No. 202300-D

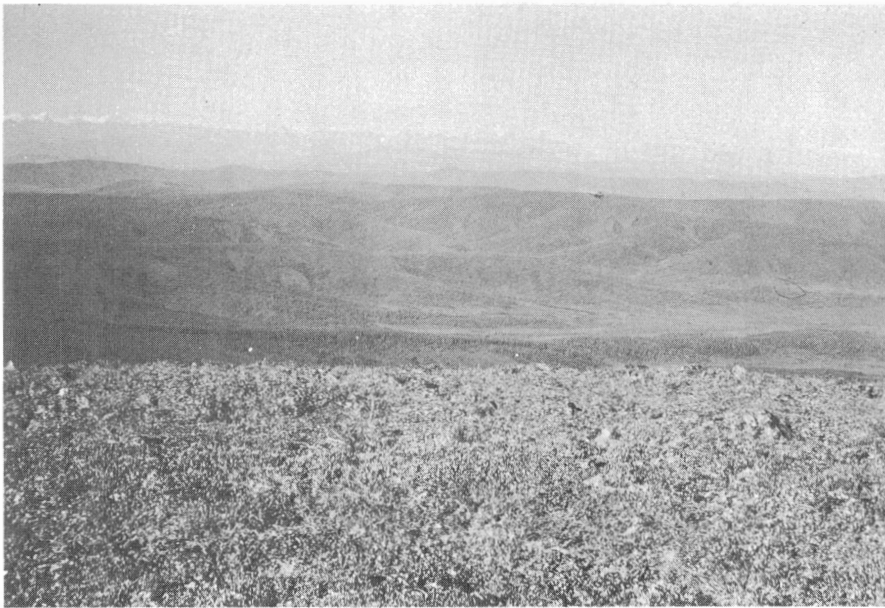


Plate VI. View to southwest from between Klotassin and Nisling rivers (Snag map-area). Note the monotonous topography, the general lack of exposures, and the frost heaved blocks in the foreground. St. Elias Mountains in the distance. GSC Photo No. 202300-E



Plate VII. View northeastward across Colorado Creek toward Mount Cockfield (Snag map-area). Note the lack of exposures and the dissected nature of the Plateau topography. GSC Photo No. 202300-F



Plate VIII. Eastward view of the mountain 10 miles south of Apex Mountain. This topography is characteristic of the unglaciated part of the project area. GSC Photo No. 202300-G



Plate IX. Wooden wheelbarrow dating to the early part of the century at the Mack's copper property in eastern Aishihik Lake map-area. In this dry country, deterioration of wood is very slow and the wheelbarrow is still functional. GSC Photo No. 202300-H

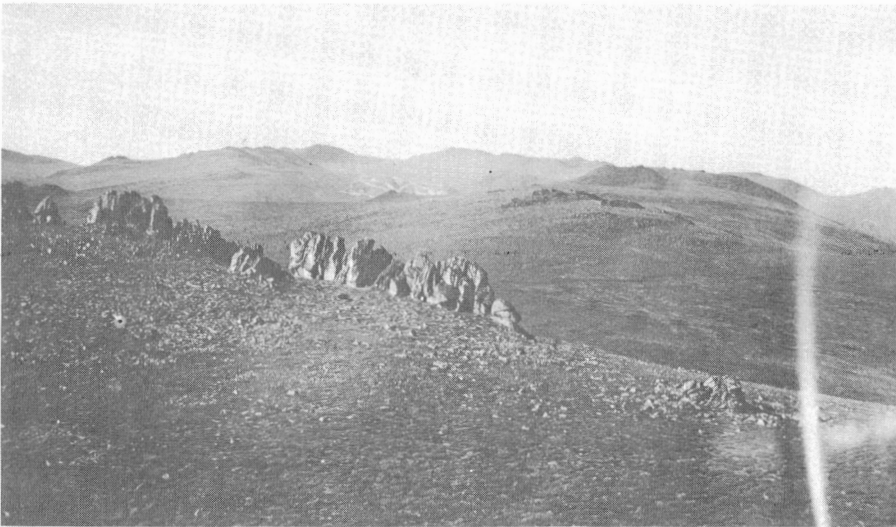


Plate X. View westward along the axis of the Dawson Range showing castellated outcrops of granodiorite of Klotassin Batholith. The Casino copper molybdenum occurrence is in the middle distance. GSC Photo No. 202300-I



Plate XI. Exposures of coal within the Laberge Group in a trench on the east side of Aishihik Lake map-area. Note the disrupted nature of the seams which makes exploration for and mining of them a problem. GSC Photo No. 202300-J

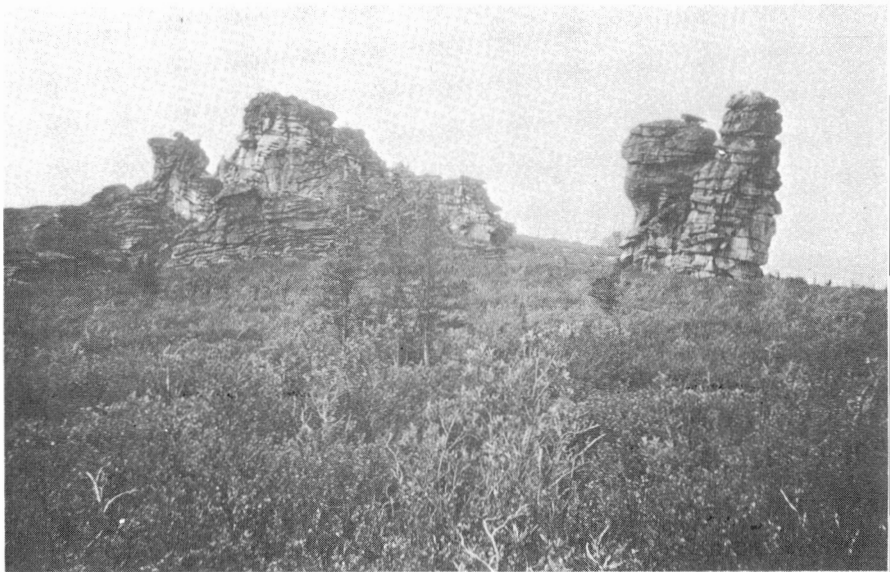


Plate XII. Castles of Coffee Creek granitic rocks in northeast Snag map-area. Such weathering forms are characteristic of the upland of the Yukon Plateau and provide the only outcrop in the unglaciated part of the country. GSC Photo No. 202300-K

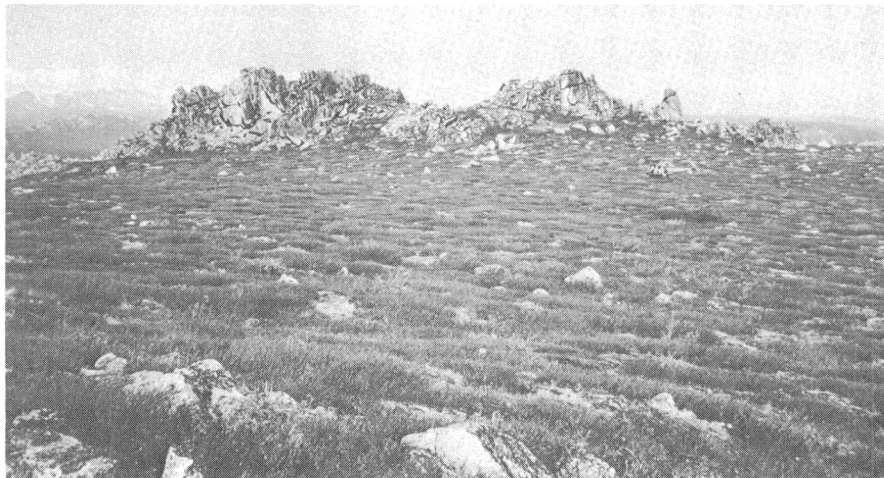


Plate XIII. Castellated weathering forms in granitic rocks in north-central Aishihik Lake map-area northwest of Buffalo Lake. The helicopter in the right middle distance gives an idea of the size of some of these features. GSC Photo No. 202300-L

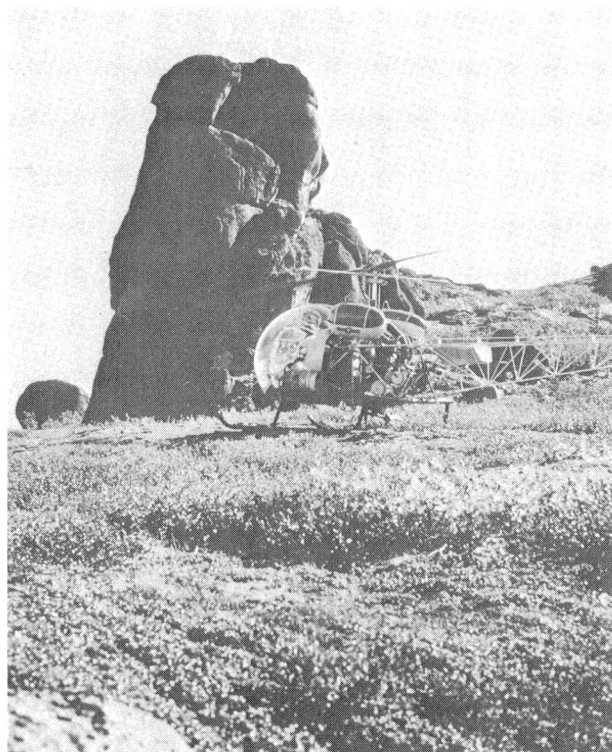


Plate XIV.
A lone "castle" of Coffee Creek Granite in the Dawson Range (Snag map-area). GSC photo 202300-M.



Plate XV. "Castles" of hornblende granodiorite of the Klotassin Batholith in Snag map-area. Note that these peculiar weathering forms are restricted to the ridges and that little outcrop is found on the slopes. GSC Photo No. 202300-N

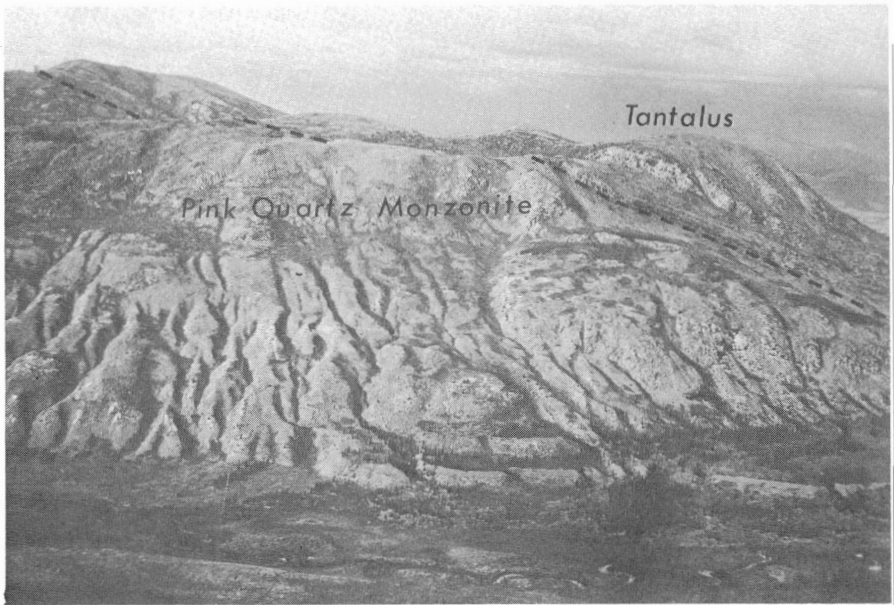


Plate XVI. View north across the valley of Nordenskiöld River from Mount Cooper (Aishihik Lake map-area). Chert-pebble conglomerate of the Tantalus Formation disconformably overlies pink quartz monzonite. GSC Photo No. 202300-O

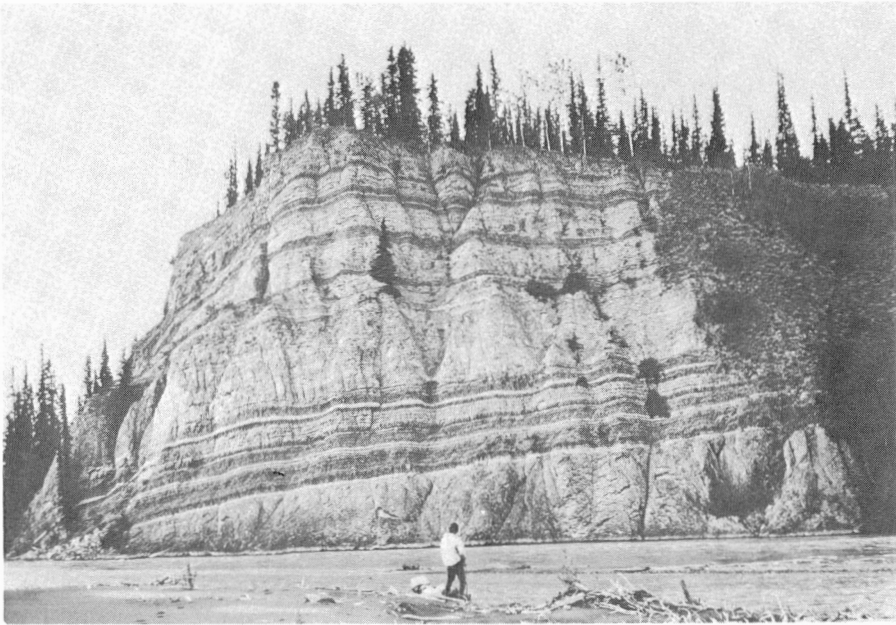


Plate XVII. Airfall tuffs of varied composition near the base of the Donjek River volcanics. Although this is the only exposure of its type this outcrop gives an idea of the variety in composition and texture of this volcanic suite. This outcrop is in the east bank of Donjek River about 10 miles upstream from the mouth of Nisling River (Snag map-area). GSC Photo No. 202300-P

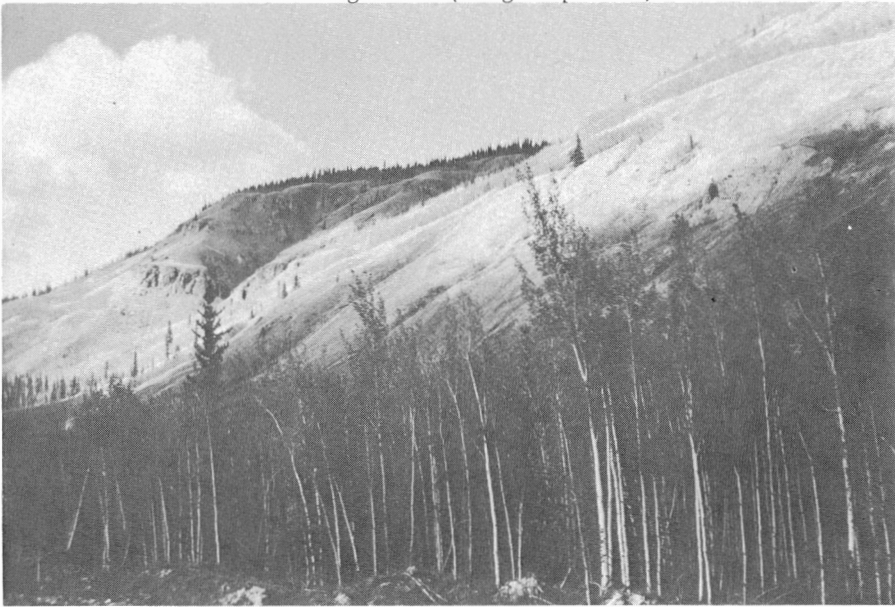


Plate XVIII. Flat-lying flows and tuff-breccias of basalt of the Carmacks Group in northeast Aishihik Lake map-area. Many of the dry south facing slopes in central Yukon are covered only with grass and small scattered stands of poplar as in the slope in this photograph. GSC Photo No. 202300-Q

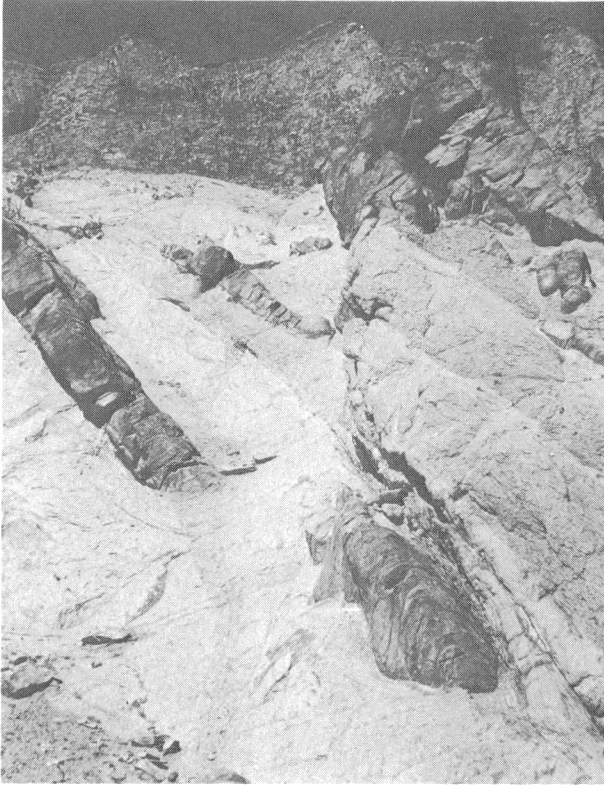


Plate XIX

Massive light weathering sandstone of the Laberge Group in northeast Aishihik Lake map-area. Note the darker tabular lime cemented concretions. GSC Photo No. 202300-R

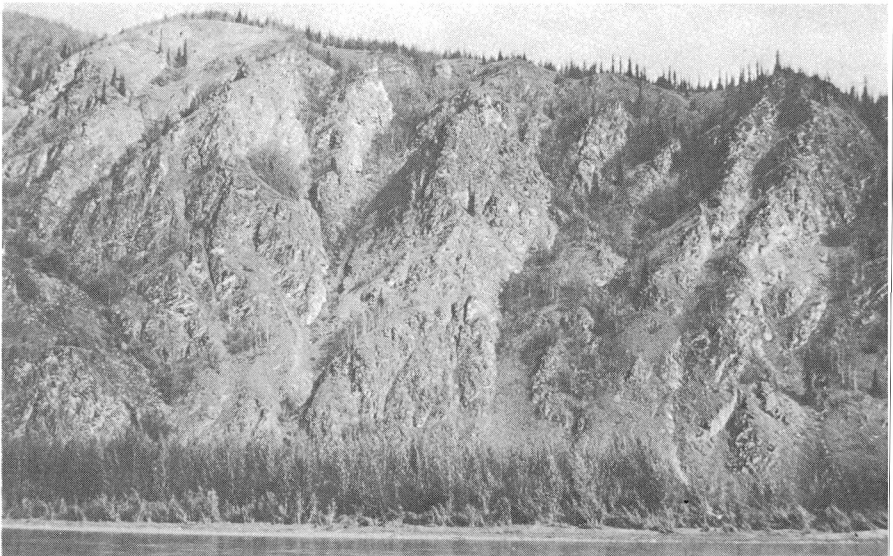


Plate XX. Good exposures like this one are common for most of the length along the northeastern side of the Yukon River. This outcrop of Pelly Gneiss is opposite the mouth of Britannia Creek. GSC Photo No. 202300-S

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APPENDIX I

Fossils collected from shaly beds low in the Tantalus Formation. Small outcrop on east side of Carmacks road at Mile 88.3 N61° 55' W136° 08.5'. Identified and reported by G. E. Rouse, Univ. Brit. Columbia. GSC Loc. No. 86352.

The following plants have been identified; the number of specimens is in brackets.

- Ferns: Coniopteris brevifolia (Fontaine) Bell (2)
Late Jurassic - Early Cretaceous
Coniopteris alata (Fontaine) n. comb. (2)
Early Cretaceous
Coniopteris rigidum (Vassilevsky) n. comb. (4)
Early Cretaceous
Coniopteris sp. cf. C. yukonensis Bell (4)
- Caytonian
- pteridosperm: Sagenopteris elliptica (Fontaine) (2)
Early Cretaceous
S. williamsii (Newberry) Bell (2)
Early Cretaceous
- Coniferales: Pityophyllum nordenskioldi (Dawson) Bell (4)
Jurassic - Early Cretaceous
- Uncertain
- Affiliation: Czekanowskia dichotoma Heer (6)
Early Cretaceous; West Greenland (Kome Series)
Podozamites lanceolatus (Lindley & Hutton)
Schimper (1)
Jurassic - Early Cretaceous
Phoenicopsis speciose Heer (3)
Jurassic

APPENDIX II

Fossils collected from sandy beds in the upper part of the Laberge Group (but possibly as much as 2,000 feet below the top) from small tributary of Nordenskiöld River about one mile north of Mount Vowles. N61° 28' W130° 09'. Identified and reported by T.P. Poulton.

GSC Loc. No. C-18178

Trigonia sp., closely similar to Middle Bajocian or latest Lower Bajocian species of Alaska, England, and central Europe.

Myophorella sp. a, similar to Bajocian species of England and Alaska.

sp. b, similar to both Bajocian and Callovian species of Alaska.

? Pleuromya sp.

Arcid pelecypod ? new genus

Pteroperna sp.

? Pholadomya sp.

Ctenostreon sp.

? Isognomon sp.

? Lima sp.

Grammatodon (? Indogrammatodon) sp.

Pteriid pelecypod ? new genus cf. Gervillia

various gastropods, not determined

corals, not determined.

Age: Middle Jurassic, possibly Middle Bajocian

GSC Loc. No. C-18179

Myophorella sp., closely similar to Callovian species of Alaska and central British Columbia, and with similarities to the Middle Bajocian argo-dawsoni species group of B. C.

Age: Middle Jurassic, ? possibly younger than C-18178?

"The trigoniids are identified in comparison with other specimens available to me, and from the literature, but species names are not applied. I don't have comparative material for the non-trigoniids, so have made only quick generic identifications; probably specific identifications would be of little use anyway due to the lack of knowledge of Jurassic North American faunas in general. The trigoniids do not appear to be identical with any others I have seen. The few other trigoniids I have seen from the Laberge Gp. are Frenguelliella (L. Jur.), not present in these collections."