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DEPARTMENT OF ENERGY, MINES AND RESOURCES

LOWER CRETACEOUS BULLHEAD GROUP BETWEEN BULLMOOSE MOUNTAIN AND TETSA RIVER, ROCKY MOUNTAIN FOOTHILLS, NORTHEASTERN BRITISH COLUMBIA

D. F. Stott

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PLATE I

Gething strata at lower falls on Sikanni Chief River. Inclined beds at right are part of a channel structure.

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By
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PREFACE

A principal aim of the Geological Survey is the estimation of the potential abundance and probable distribution of mineral and fuel resources available to Canada. Such estimates depend on the availability of information concerning the geological framework and in this report the age, structure, sequence, relationships, thickness, and origin of Lower Cretaceous clastic rocks along the Foothills of northeastern British Columbia are described in considerable detail. The author outlines a major deltaic complex and describes the interrelationships of alluvial, deltaic, and marine facies. In addition, he establishes the relationship of the outcrop rocks with the equivalent subsurface succession in the Plains to the east. The report is a complement of Bulletin 152 which, in part, described the Bullhead Group south of Peace River.

The Bullhead Group contains extensive coal deposits and has produced petroleum and natural gas. This report outlines the limits of the coal-bearing deposits and the main occurrences of potential reservoir rock.

Y. O. FORTIER,
Director, Geological Survey of Canada

OTTAWA, May 26, 1972

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LOWER CRETACEOUS BULLHEAD GROUP BETWEEN BULLMOOSE MOUNTAIN AND TETSA RIVER, ROCKY MOUNTAIN FOOTHILLS, NORTHEASTERN BRITISH COLUMBIA

Abstract

The Cadomin and Gething Formations were studied in outcrop along the Foothills of northeastern British Columbia between latitudes 55°N and 59°N. The study was supplemented by data from boreholes in the adjoining Plains.

The Bullhead Group represents the initial deposits of the early transgressive phase (late Neocomian) of an advancing boreal sea which culminated in the widespread marine inundation of Albian time. The margins of the embayment essentially parallel the present structural trends of the Rocky Mountains but a strong northeasterly element, related to the ancient Peace River Arch, produced a major deltaic complex in the vicinity of Peace River. The group attains a maximum thickness of 2,500 feet at Peace River and thins northeastward to a depositional edge.

The Bullhead Group forms a deltaic wedge composed dominantly of detritus derived from a source area lying west of the front ranges of the Rocky Mountains and which was being elevated during the Columbian Orogeny. A basal sequence of some 500 to 700 feet of chert conglomerate and conglomeratic sandstone becomes thinner in a northeasterly direction and grades laterally into finer clastic sediments. The overlying and, in part, laterally equivalent Gething Formation contains deltaic sediments at Peace River which interfinger northward with nearshore and shallow marine sandstone and shale; those, in turn, grade into marine shale and siltstone of the offshore environment.

The base of the group is marked by an erosional unconformity and the underlying rocks, ranging in age from Valanginian (Early Cretaceous) to Triassic, are truncated northerly and northeasterly. Marine shale overlying the Bullhead Group is of Early Albian age. The group contains the "Lower Blairmore–Luscar" flora and a previously unreported marine microfauna of late Neocomian (Barremian–Aptian) to Early Albian age.

Rocks from which petroleum and natural gas already have been produced are found in the Bullhead Group. Potential reservoir rock occurs within a thick succession of Gething sandstones, which extends beneath the Plains adjacent to the Foothills of British Columbia. Deposits of sub-bituminous to bituminous coal occur within the Gething Formation between Smoky and Sikanni Chief Rivers, and a large potential reserve is indicated.

Résumé

Les formations de Cadomin et de Gething qui affleurent le long des Foothills dans le nord-est de la Colombie-Britannique, entre 55° et 59° de latitude nord font l'objet de la présente étude. L'étude a également bénéficié de données fournies par des forages dans les plaines voisines.

Le groupe de Bullhead représente les dépôts initiaux de la première phase transgressive (Néocomien supérieur) d'une mer boréale envahissante qui a atteint son point culminant lors de l'immense inondation marine de l'époque albienne. La bordure de cette baie est essentiellement parallèle à la structure actuelle des Rocheuses mais un élément fortement orienté vers le nord-est, correspondant à l'ancien arc de la rivière de la Paix, a produit un important complexe deltaïque au voisinage de la rivière de la Paix. L'épaisseur de ce groupe atteint son maximum (2,500 pieds) à la rivière de la Paix et diminue en direction du nord-est pour finir en des dépôts en forme d'arête.

Le groupe de Bullhead constitue un dépôt deltaïque composé essentiellement de détritus provenant d'une région située à l'ouest des premières chaînes des Rocheuses qui étaient en période de soulèvement durant la phase tectonique de Colombia. Une séquence basale de quelque 500 à 700 pieds composée de conglomérats de chert et de grès conglomératique va en s'amincissant en direction du nord-est et se transforme peu à peu, latéralement, en sédiments clastiques plus minces. La formation de Gething, située au-dessus et, en partie, latéralement équivalente, contient des sédiments deltaïques à l'emplacement de la rivière de la Paix, qui s'interdigitent vers le nord avec les grès et les argilites côtiers et les hauts-fonds; ceux-ci deviennent ensuite des argilites et des limons marins au large de la côte.

La base de ce groupe est marquée par une discordance due à l'érosion et les roches sous-jacentes , allant du Valanginien (Crétacé inférieur) au Trias, sont tronquées dans les directions nord et nord-est.

L'argilite marine qui recouvre le groupe de Bullhead date du début de l'époque albienne. Ce groupe contient la flore du «Blairmore-Luscar» inférieur et une microfaune marine encore jamais observée, datant de la fin du Néocomien (Barremien-Aptien) jusqu'au début de l'époque albienne.

Le groupe de Bullhead contient des roches à partir desquelles on a déjà extrait du pétrole et du gaz naturel. Des roches pouvant constituer des réservoirs apparaissent au sein d'une épaisse succession de grès de Gething qui s'étend sous les plaines adjacentes aux Foothills en Colombie-Britannique. Des dépôts de charbon bitumineux et sub-bitumineux existent au sein de la formation de Gething entre les rivières Smoky et Sikanni Chief, et pourraient comporter une importante réserve potentielle.

INTRODUCTION

Lower Cretaceous sedimentary rocks are well exposed throughout the northern Rocky Mountain Foothills and extend eastward into the Plains of British Columbia and Alberta. The coal deposits occurring within those beds along Peace River canyon have been known for more than 175 years and petroleum and natural gas have been obtained for two decades from equivalent beds in the subsurface. Despite the economic interest in the succession, no detailed investigation of its distribution and character in outcrop north of Peace River has been published.

Bullhead strata are well developed at Peace River canyon but are not present at Tetsa River, some 250 miles to the northwest (Fig. 1). One of the main purposes of this study was to investigate the reasons for the disappearance of Bullhead rocks between Peace and Tetsa Rivers. It was found that major facies changes were involved which required the study of closely spaced sections and the determination of paleoenvironments. Major facies changes from continental to marine sediments record a previously unknown transgression of latest Neocomian (Barremian–Aptian) to Early Albian age.

This report, based on stratigraphic and petrologic studies of the Cadomin and Gething Formations of the Lower Cretaceous Bullhead Group, delineates and traces the succession throughout its northern extent. Distribution, thickness variations, lithologic and facies variations are described. Age relationships, based on stratigraphic, floral and microfaunal evidence, are outlined and the relationships to regional unconformities and other rock units are discussed. The petrographic properties were investigated to provide additional data for the determination of the origin and history of the sediments. The recognition of several major environments, represented in the Gething Formation within this area, was based on comparisons with characteristic features of Recent environments, and included studies of sedimentary structures, lithology, geometry of the rock units, and organic content. Interpretation of the paleogeography, depositional environments, and tectonic influences is included.

Most of this report is based on outcrop data; thirty-six outcrop sections[1] were measured and numerous isolated outcrops were examined during the course of the investigation. A study of more than 20 sections of the underlying Minnes Group in the same region (*see* Stott, 1967a, 1969b) yielded additional data concerning the unconformity at the base of the succession. Additional information was obtained by studies of mechanical logs, samples and cores of 50 boreholes penetrating the succession.

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[1]Outcrop sections are described in Appendix.

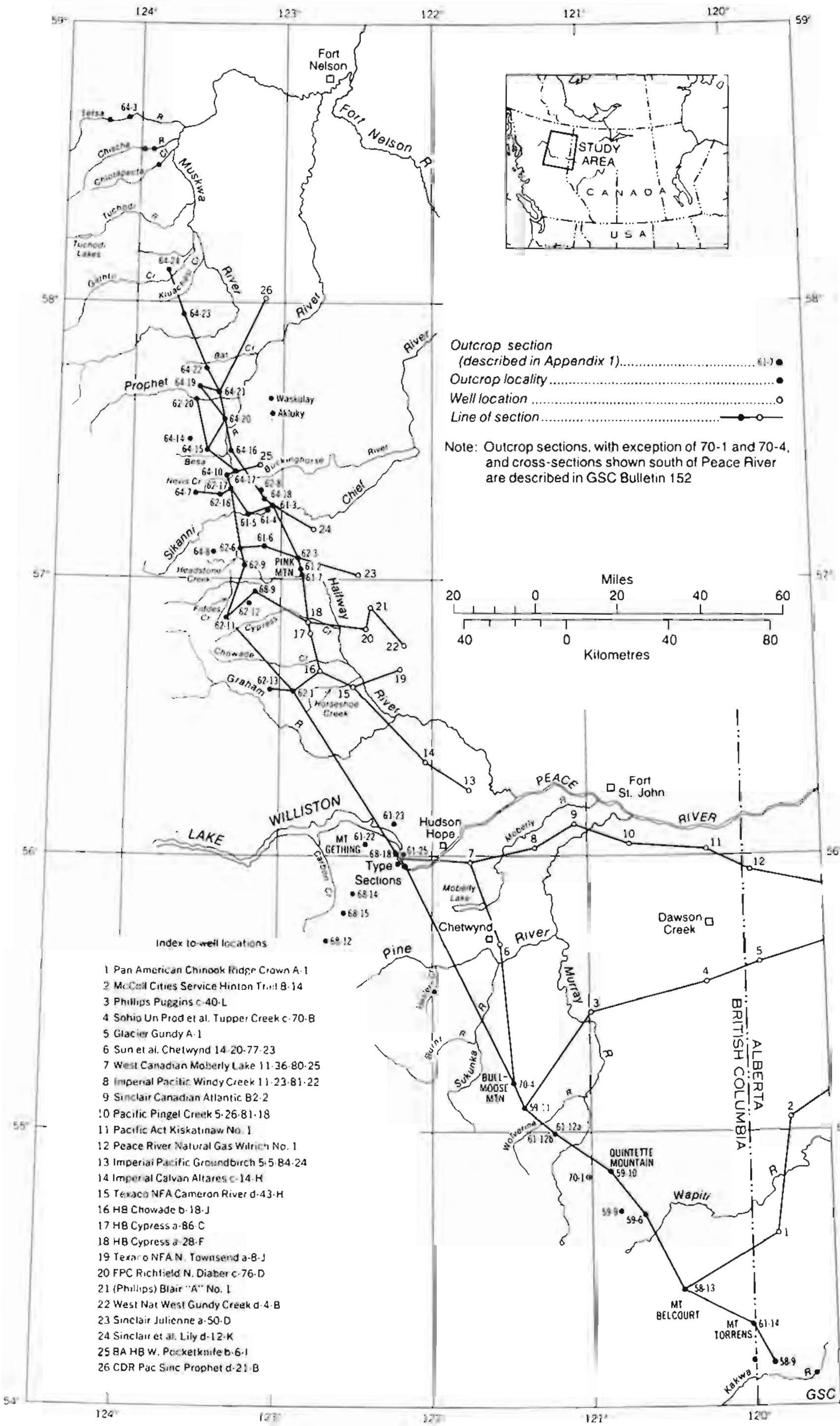

FIGURE 1. Index map showing location of sections, Lower Cretaceous Bullhead Group, Rocky Mountain Foothills, British Columbia

Regional Setting

The greatest thickness of the Bullhead Group lies within the Rocky Mountain Foothills, trending northwesterly along the front of the Rocky Mountains in northeastern British Columbia. The succession is exposed for more than 300 miles over a width of 25 miles; it can be traced eastward in the subsurface for a much greater distance. The area of study (Fig. 1) lies on the western side of the Cretaceous interior sedimentary basin, a vast region now bordered on the west by the Cordillera and on the east by the Precambrian Shield and extending from the Arctic Coastal Plain to the Gulf of Mexico. The area extends northward from Bullmoose Mountain across the type region of the Bullhead Group at Peace River (lat. 56°N) to exposures of equivalent rocks south of the Alaska Highway and Tetsa River (lat. 59°N). Studies of the formation in the subsurface were extended some 25 to 50 miles east of the Foothills, and the total area examined covers more than 7,500 square miles.

Deformation of the Cretaceous sequence during the Laramide Orogeny resulted in the formation of elongate, plunging anticlines and synclines. Within the Foothills, this series of *en echelon* folds trend northwesterly. Thrust faults, which are uncommon in the northerly part, become more numerous near Peace River. Although some of the beds are disrupted by the thrust faults, Bullhead strata commonly occur in continuous sequence without repetition. In the Foothills, most of the Cretaceous exposures occur on the flanks of major anticlines whose cores contain Triassic or older rocks. Outcrops are present on several smaller folds lying east of the main Foothills, of which the more notable are the Pink Mountain and Pocketknife Anticlines.

The Foothills in this region are mountainous, many hills attaining an elevation of more than 6,000 feet. Treeline is at an elevation of approximately 5,500 feet, so that the upper slopes support only low vegetation and exposures are common in many of the gullies and along many of the ridges.

The major river valleys have been strongly glaciated, and vegetation covers most of the valley floors. Several rivers, notably the Sikanni Chief, have been incised in the glacial valleys, producing steep canyons with well-exposed bedrock (Frontispiece). However, in general, the best outcrop sections are found on the ridges.

Field Work and Acknowledgments

The more accessible Cretaceous rocks in the vicinity of Halfway and Sikanni Chief Rivers were examined during June 1961. At the end of that season, the type Bullhead sections were studied along the north shore of Peace River, on Moosebar and Aylard Creeks, and at the head of Peace River canyon. In 1962 more remote sections between Halfway and Prophet Rivers were reached by helicopter. During the field seasons of 1964 and 1965, Cretaceous rocks were examined between Sikanni Chief and Tetsa Rivers. The Gething Formation along the western cliffs at the head of Peace River canyon, downstream from the dam site, was examined and sampled during four days in August 1968, and the section was revisited in 1969. During the field seasons of 1968 and 1969, when Pine Pass and Dawson Creek map-areas were remapped, the writer examined the Cadomin Formation at many new localities and obtained additional information on the distribution and relationships of the Bullhead Group. In 1970 the section at Bullmoose Mountain was examined, thereby establishing better control between Peace River and the sections described during the field seasons from 1958 to 1961 (Stott, 1968a).

Field studies during the first two years were carried out in conjunction with Triassic studies undertaken by B. R. Pelletier who was responsible also for logistics during 1962. Studies made during 1964 and 1965 were in conjunction with Operation Liard, a comprehensive regional structural and stratigraphic study of the foothills and mountains between latitudes 57°N and 60°N and longitudes 122°W and 124°W. Studies during 1968, 1969, and 1970 were part of Operation Smoky, a similar comprehensive project between latitudes 54°N and 57°N. The logistics of both operations were under the direction of G. C. Taylor. Numerous discussions with Taylor and Pelletier, their interest in mutual problems, and their cooperation have contributed considerably to the interpretation of Cretaceous stratigraphy.

The fossil fauna and flora of the Bullhead Group were identified by paleontologists of the Geological Survey of Canada. D. C. McGregor and W. A. Bell identified collections of flora and the former undertook a palynological study of material from the type Gething Formation. T. P. Chamney studied the microfauna from the Gething shales, gave age assignments, and discussed the regional correlations as well as general stratigraphic problems. Cretaceous invertebrate fossils were identified and dated by J. A. Jeletzky; Jurassic and Triassic fossils by Hans Frebold and E. T. Tozer respectively.

Analyses of the clay components of the Gething sediments were provided by A. E. Foscolos. Interpretations of the regional and environmental significance of those results are based on discussions with A. E. Foscolos and R. M. Procter.

Discussions with colleagues have been most helpful, particularly P. A. Ziegler, J. K. Eccles, W. B. Brady, J. Muller, E. J. W. Irish, J. E. Hughes, and J. A. Jeletzky. The writer is grateful for having had the opportunity of discussing problems of Bullhead stratigraphy and paleontology with the late Drs. F. H. McLearn and W. A. Bell, who died before this study was completed.

Helicopters were supplied in 1961 by Okanagan Helicopters Limited; in 1962 by Foothills Aviation Limited; in 1964, 1965, and 1968 by Bullock Wings and Rotors Limited; and in 1969 by Alpine Helicopters Limited. Pilots R. Burton, F. Nobels, J. Davies, H. Tetz, G. Causs, and D. Roadhouse, contributed greatly to making localities accessible for study; and engineers E. Haylock, K. Harding, J. Ward, M. Brown, P. Ettinger, and S. Chivers, serviced the machines. Also Texaco Exploration Company, Hudson's Bay Oil and Gas Company, Capilano Helicopters Limited, and Associated Helicopters Limited extended many courtesies.

British Columbia Hydro and Power Authority and its sub-contractor, Kiewit, Dawson, and Johnson permitted work within the construction area at the Peace River dam site; Mr. P. Huong and Mr. J. Reilly, safety engineers, made the necessary arrangements.

Competent assistance in the field was given in 1961 by M. L. Larson; in 1962 by A. R. Clark, and M. J. Osatenko; in 1964 by R. Armstrong, M. Wooding, D. Hetherington, and D. McDougall; in 1965 by D. Herron; and in 1968 by J. Irish. The writer is indebted also to the cooks, I. Severson, D. McDougall, A. Lamont, S. McWhinnie, and M. Lawrence. R. Cameron, O. Gauthier, W. Boring, R. L. Ross, and G. P. J. Turner assisted in camp operations.

Access

Most of the sections on which this report is based were reached on foot or by helicopter. During the season of 1961 pack horses were used in the vicinity of Halfway and Sikanni Chief Rivers. However, pack trails do not exist in many parts of the Foothills and travel by horse is not satisfactory.

The Alaska Highway provides reasonable access along the eastern border of the region between Dawson Creek and Fort Nelson and along the northern border between Fort Nelson and Summit Lake. The type sections of the Bullhead Group occur at and downstream from the new hydro-electric dam on Peace River and are reached easily by way of a paved highway which connects the dam site and the nearby town of Hudson Hope with Chetwynd on the John Hart Highway. The road between Hudson Hope and Fort St. John on the Alaska Highway has been rebuilt and paved.

Exposures in the lower part of Peace River canyon have not been affected by recent work at the dam site. The north shore may be reached by way of a trail that once served the King Gething mine. The south shore was accessible only by boat or helicopter prior to construction of the dam but Moosebar Creek can be reached now by way of an access road along the power line extending northward from Moberly River valley. The section along the west bank was examined easily along a road built from the material excavated from the diversion tunnels. Before the power generators were started in late September 1968 most of the south shore between Gething and Aylard Creeks could be readily traversed. The increased flow of water has since covered many exposures at river level, and the canyon below Gething Creek is no longer completely accessible. Consultation with the British Columbia Hydro and Power Authority at the dam site is recommended before any work is attempted along the river because the water levels are subject to rapid fluctuations.

Base camps used during the early years of this study were located at Gold Bar (now submerged) on Peace River, Pink Mountain at Halfway River, Redfern and Tuchodi Lakes, and at Trutch on the Alaska Highway. In 1968 and 1969 localities were reached from Hudson Hope and from Silver Sands Creek on the John Hart Highway.

Historical Review

Sir Alexander Mackenzie, the first white man to traverse the Peace River canyon, spent the winter of 1792–93 at the junction of Peace and Smoky Rivers, and continued his epic journey to the Pacific Coast in May 1793. After attempting to line canoes through the canyon, he finally had to have them hauled up the cliffs and across the wooded hills to the head of the canyon. Mackenzie (1801, p. 175) noted:

> Along the face of some of those precipices, there appears a stratum of a bituminous substance which resembles coal; though while some pieces of it appeared to be excellent fuel, others resisted for a considerable time, the action of fire and did not emit the least flame.

Early exploration was marked by the establishment of trading posts along Peace River. The first post, Rocky Mountain House, was established near the present site of Fort St. John, but was replaced in 1806 by the original Fort St. John, built some miles downstream near Beatton River. Another post, Rocky Mountain Portage House, was built opposite the present town of Hudson Hope and was used at various times as a base by Simon Fraser (1808). In 1828 Sir George Simpson, governor of the Hudson Bay Company, accompanied by Chief Factor Archibald McDonald (1872), ascended the river; four of his canoe men managed to navigate the canyon for probably the first and only time. Later trappers and fur traders continued to traverse the portage.

In September 1872 Charles Horetzky and John Macoun undertook a survey of the Peace River country as part of the search for the best route for a transcontinental railway; Horetzky reported (*in* Fleming, 1874) that "immense treasures of fuel lie but a little way beneath the surface."

In 1875, Alfred R. C. Selwyn (1877) of the Geological Survey of Canada, accompanied by John Macoun and Arthur Webster, explored a part of northeastern British Columbia in the vicinity of Peace and Pine Passes of the Rocky Mountains. During the summer, Selwyn traversed between Quesnel in the interior of British Columbia and Smoky River in Alberta, descending Peace River from Finlay Forks. On arriving at Fort St. John, the party separated; Selwyn and Webster ascended Pine River while Macoun continued eastward. Selwyn went beyond the junction of the Pine and Murray (East Branch) Rivers before returning to Fort St. John and continuing his descent of Peace River to its junction with Smoky River. On his return journey up the Peace, he examined the rocks in the "Cañon of the Mountain of Rocks."

The more southerly part of the region was investigated further in 1879 by G. M. Dawson (1881) and R. G. McConnell (1893), who travelled from Port Simpson on the Pacific Coast to Edmonton. They crossed the Rocky Mountains through Pine Pass, followed Pine River as far as Murray River, and then continued eastward to Dunvegan on Peace River. Dawson provided some information on Cretaceous rocks in the region of upper Pine River but most of his report concerns strata younger than the Bullhead Group. McConnell (1896) revisited the upper Peace River for a brief period in 1893 but devoted most of his time to exploration in the vicinity of Finlay and Omineca Rivers.

The reported occurrences of coal, gold, and petroleum in the Peace River region resulted in geological investigations being initiated by the Government of British Columbia. In 1906, the Provincial Mineralogist, W. F. Robertson (1907, p. H101–H131) descended Peace River, examining the coal deposits in the canyon. Those coal beds were described in more detail by C. F. J. Galloway (1913, 1915) who provided sketch maps of the distribution of the seams, sections outlining the thickness of seams in the tributaries flowing into the canyon, and analyses of the coals.

Dr. F. H. McLearn of the Geological Survey of Canada began investigations of Mesozoic rocks in the vicinity of Peace River in 1917 and his studies eventually spread over almost 50 years. In 1917 McLearn studied exposures along Peace River for a distance of some 650 miles, but owing to lack of time, he was able to make only a brief study of the Lower Cretaceous sandstones in the canyon (1918). In 1920 McLearn (1921) studied sections on the north side of Peace River from the head of the canyon to Schooler Creek. He returned to Peace River in 1922 and spent two months examining the main canyon and many of its tributaries. His report (1923) described the stratigraphy in considerable detail, outlining the presence of 50 coal seams. Although most of McLearn's later field studies dealt with rocks older than Cretaceous, he retained an active interest in Cretaceous investigations. In 1943 he returned once more to evaluate the coal prospects of the canyon region (McLearn and Irish, 1944). Subsequently, most of his earlier data and reports were incorporated in a comprehensive account of the geology of northeastern British Columbia (McLearn and Kindle, 1950), establishing a firm base for future geological investigations in that region.

The possibilities of obtaining oil and gas in northeastern British Columbia were investigated by J. C. Gwillim (1920) of the British Columbia Department of Lands and J. S. Stewart of the Geological Survey of Canada. They studied the geology in the vicinity of Hudson Hope during the summer of 1919. In 1920, J. A. Dresser (1921, 1922) and E. Spieker (1921), working for the British Columbia Department of Lands, continued those investigations north and south of Peace River. As a result of their work, five holes were drilled by the Department during 1921 and 1922 in the Farrel Creek area some 18 miles northwest of Hudson Hope. The possibilities for coal development continued to be explored and John D. Galloway (1924) of the British Columbia Department of Mines examined coal occurrences on Carbon Creek and also in the Peace River canyon. Later, in 1929 and 1930, the geology of a large part of northeastern British Columbia was investigated by M. Y. Williams and J. B. Bocock (1932) as part of a study underlain by the Pacific Great Eastern Survey of Resources.

The demands for new supplies of fuel, in particular petroleum, during the Second World War, accompanied by better accessibility provided by construction of the Alaska Highway, resulted in an expansion of geological activities within the region. The Dunlevy–Portage Mountain map-area was surveyed by H. H. Beach and J. Spivak (1944). A large part of the Mount Hulcross–Commotion Creek map-area in Pine Valley was mapped by R. T. D. Wickenden and G. Shaw (1943). This latter study was undertaken to determine the geological complexities encountered in the Commotion Creek well which had been drilled in 1940 and 1941 by the British Columbia Government. In 1943 C. O. Hage (1944) made a reconnaissance study along the newly built road between Fort St. John and Fort Nelson and extended his investigations westward to the Foothills in the vicinity of Pink Mountain and Sikanni Chief River. During the same year, J. Spivak (1944) examined the coal deposits in the vicinity of Hasler Creek.

During 1944 and 1945 W. H. Mathews (1947) investigated the coal deposits of the Carbon Creek basin west of Peace River canyon for the British Columbia Department of Mines. An appraisal of the coal reserves of the Hasler Creek–Pine River area was undertaken for the Coal Division of the British Columbia Department of Lands and Forests between 1946 and 1951 by N. D. McKechnie (1955). Additional studies of areas in the vicinity of Pine, Moberly, and Peace Rivers were made for the British Columbia Department of Mines and Petroleum Resources by J. E. Hughes (1964, 1967) who also examined drill cores from potential dam sites along Peace River canyon.

More recently, Halfway River (94B) map-area was mapped by E. J. W. Irish (1961, 1963, 1970) and Pine Pass (93O) map-area was mapped by J. E. Muller (1961) for the Geological Survey of Canada.

In 1958 the writer initiated a long-term study of Cretaceous rocks in the Foothills between Smoky River and latitude 60°N. From 1958 to 1961 the Bullhead Group was studied in its type region around Peace River and southward and the resultant stratigraphic reports (Stott, 1960a, 1961a, b, 1963b, 1968a) included reconnaissance maps of the Foothills in that region.

The Lower Cretaceous stratigraphy in the subsurface of northeastern British Columbia was first described by the Alberta Study Group (1954). The Gething and Bluesky Formations were described later in a preliminary account by D. C. Pugh (1960). Rudkin (1964) summarized the available information concerning Lower Cretaceous rocks in western Canada. Hughes (1967, Fig. 4) illustrated the relationship of Cretaceous formations outcropping in Pine Valley with beds drilled in the Sun *et al.* Chetwynd 14–20–N–23 well (14–20–77–23W6). A contemporary report by Stott (1968a) showed by means of a series of cross-sections that the Bullhead and Fort St. John Groups of the Foothills between Peace and Smoky Rivers could be traced into the subsurface of the Plains.

The earliest paleontological reports on Lower Cretaceous fossils were by Whiteaves (1885, 1893) who identified the collections made by Selwyn, Dawson, and McConnell. The distribution, composition, and zonation of the Lower Cretaceous fauna were described in numerous reports by McLearn (1929, 1931a, 1932, 1933, 1944a, c). Dinosaur tracks in the canyon of Peace River, first reported by McLearn, were studied and interpreted by C. M. Sternberg (1932, 1933). The flora of the Gething Formation was studied by W. A. Bell (1956).

Some of the earliest suggestions concerning paleogeography were made by Dawson (1881). McLearn (1931b, 1932) discussed environments of deposition and paleogeography, later updating his reports by a revision (1944b) and then by a complete summary (McLearn and Kindle, 1950). Paleogeographic reconstructions of Cretaceous units were presented by Rudkin (1964) and more recently by P. A. Ziegler (1969). The writer (Stott, 1968a, Fig. 18) showed the distribution of Cretaceous paleoenvironments in northeastern British Columbia in the region south of Peace River. Jeletzky (1971b, c) recently presented an interpretation of the paleogeography of western and Arctic Canada at various stages of Cretaceous time, showing the inferred maximum extent of marine invasions.

The present study of the Bullhead succession north of Peace River began in 1961 when the writer spent part of the field season at Gold Bar on Peace River. In the following year, studies were extended northward, being concentrated mainly in the region between Halfway and Prophet Rivers. During those two years, camp and helicopter facilities were shared with B. R. Pelletier who was studying the Triassic succession. As a result of that association and of the close areal relationship of the Triassic and Cretaceous rocks, a preliminary map and report of Trutch (94G) map-area was published (Pelletier and Stott, 1963).

In 1963 a major geological program, Operation Liard, headed by G. C. Taylor, was initiated by the Geological Survey in northeastern British Columbia. The writer's Cretaceous studies were integrated with that program in 1964 and 1965, during which time studies of Cretaceous rocks were completed in the region between Peace River and the region of Liard and Mackenzie Rivers previously investigated in 1957 (Stott, 1960b). Two preliminary reports concerning the Cretaceous stratigraphy between Peace and La Biche Rivers, including brief discussions of the Gething Formation and equivalents, were published (Stott, 1967b, 1968b). The distribution of Cretaceous rocks in the region is shown on maps for Fort Nelson (94J), Maxhamish Lake (94O), Tuchodi Lakes (94K), (Taylor and Stott, 1968a, 1968b, 1973) and a revision of Trutch (94G) is being prepared.

Another major geological program, Operation Smoky, was initiated by the Geological Survey of Canada in 1968 to investigate in detail the region south of Peace River. During the field seasons of 1968 and 1969 in conjunction with that program, the writer was able to obtain considerable supplementary information on the Bullhead Group in the vicinity of Peace River; one of the more significant results being the description of the Gething Formation in the west bank section at Peace River (Stott, 1969a).

During the course of this study, Peace River has been dammed at the head of the canyon as a result of the hydro-electric power project of the British Columbia Hydro and Power Authority. The valley upstream from the dam is now submerged. The dam itself covers the massive cliffs of conglomeratic sandstone, which once contributed valuable geological data concerning the Bullhead Group. On the other hand, the west bank of the upper canyon became accessible for the first time and, during construction of the dam, long stretches of the middle canyon were at least temporarily dry and accessible.

STRATIGRAPHY

Discussion of Terminology

Lower Cretaceous coal-bearing sediments and massive conglomerates occurring in the Peace River canyon were first described by Selwyn (1877) who placed them in his Division III (*see* Table I), and tentatively dated them as lower Mesozoic or Paleozoic. On his return journey up the Peace River, Selwyn (op. cit., p. 64) climbed Portage Mountain, noting that "The whole mass of the mountain consists of coarse gritty sandstones and conglomerate grits, similar to those exposed in the Cañon at its base." He stated also (op. cit., p. 74) that "The best exposures of this group are seen in the Portage and Horse-head (Bullhead) Mountains, and they likewise form both sides of the Cañon of the Mountain of Rocks."

Subsequently, Dawson (1881, p. 117B) equated the canyon succession, which he had not seen, with the much younger Dunvegan Formation occurring farther east on Peace River. That miscorrelation, accepted by such later workers as McConnell (1893, p. 540), Galloway (1913, p. K125; 1915) and Dowling (1915a, p. 5), was rectified by McLearn (1918) who assigned the strata to the "Bull Head Mountain formation."

Those beds were described originally by Selwyn (1877, p. 63) as consisting:

> . . . mostly of massive brown-grey and whitish gritty sandstone, which is brecciated or conglomeratic in patches and bands; there are also some thin interstratified beds of dark shale and . . . there was one seam of coal which I judge to be about six inches thick. Plant remains—mostly large and small stems and branches—were the only fossils found.

He described them (op. cit., p. 74) also as:

> . . . hard, occasionally slightly calcareous sandstones, brown reddish and whitish, with thick beds of rough, brecciated conglomerate or pudding stone, thin bands of dark slaty shale and true bituminous coal.

McLearn (1918, p. 16C) stated that the:

> Bull Head Mountain formation consists of a thick series of strata of freshwater origin lying between the Triassic shale below and the St. John shale above. It first appears in the canyon midway between Deep (Starfish) and Johnson Creeks and continues to the west as far as Twenty-mile Creek.

When McLearn realized that Jurassic shale occurred within the succession, the definition was modified (McLearn and Kindle, 1950, p. 63) to include only the overlying sandy strata.

The Bull Head Mountain Formation was divided originally into two members, described by McLearn (1918, p. 74):

> The upper member consists of sandstones, shales, and coal beds and is well exposed in the canyon and on Gethring (sic) and Johnson Creeks. The lower part is made of massive, coarse, crossbedded sandstones and is exposed at the head of the canyon, on Portage and Bull Head mountains, and the high hills to the west. . . . No fossils have been found in the lower part, but a few plants were collected in the upper coal-bearing shales and sandstones. These include

SELWYN 1877			Division III
DAWSON 1881			DUNVEGAN FORMATION
McLEARN 1918	BULL HEAD MOUNTAIN FORMATION		Upper Member
			Lower Member
McLEARN 1923	BULL HEAD MOUNTAIN FORMATION		Gething Member
			Lower Member
WICKENDEN AND SHAW 1943	BULLHEAD GROUP		Gething Member
			Lower Conglomeratic Member
BEACH AND SPIVAK 1944	BULLHEAD GROUP		GETHING FM
			DUNLEVY FM
MATHEWS 1947	BULLHEAD GROUP	NON-MARINE BULLHEAD	
		MARINE BULLHEAD	MONACH FM
			BEATTIE PEAKS FM
			MONTEITH FORMATION
ALBERTA STUDY GROUP 1954	BULLHEAD GROUP		GETHING FM
			CADOMIN FM
	unconformity		
	NIKANASSIN FORMATION		
WARREN AND STELCK 1958	BULLHEAD GROUP		GETHING FM
		LOWER BULLHEAD	DUNLEVY FM
			unconformity
			MONACH FM
			BEATTIE PEAKS, FM
			MONTEITH FORMATION
			Shaly beds
			NIKANASSIN FM
MULLER 1961	BULLHEAD GROUP		GETHING FM
			MONACH FM
			BEATTIE PEAKS FM
			MONTEITH FM
			NIKANASSIN FORMATION
STOTT 1962	BULLHEAD GROUP		GETHING FM
			CADOMIN FM
			unconformity
			Unnamed
			MONACH FM
			BEATTIE PEAKS FM
			MONTEITH FM
HUGHES 1964	CRASSIER GROUP		GETHING FM
			DRESSER FM
			BRENOT* FM
	disconformity		
	BEAUDETTE GROUP		MONACH FM
			BEATTIE PEAKS FM
			MONTIETH FM
STOTT 1967a 1968b	BULLHEAD GROUP		GETHING FM
			CADOMIN FM
	unconformity		
	MINNES GROUP		Unnamed
			MONACH FM
			BEATTIE PEAKS FM
			MONTEITH FM

GSC

* Note: The name "Brenot" is considered invalid for the outcrop succession (Stott, 1967a)

TABLE I. *History of nomenclature of Bullhead rocks*

> a few cycads, conifers, etc., and a single specimen of a dicotyledon.... The plant association of this flora suggests that of the lower part of the Blairmore Formation of the Crowsnest district.

A few years later, the upper member was named Gething by McLearn (1923, p. 4B). In 1940, McLearn (p. 72) with considerable insight, suggested that the Bull Head Mountain Formation could be divided into three members:

> A lower sandstone, a middle conglomerate-bearing and an upper coal-bearing member, the Gething—comparable respectively to the Nikanassin, Cadomin conglomerate, and Luscar formations of the Mountain Park area and the Kootenay, basal Blairmore conglomerate and lower part of the Blairmore of the Blairmore area.

The formation was raised to group status and the name shortened to Bullhead by Wickenden and Shaw (1943, p. 2). Beach and Spivak (1944, p. 4), apparently acting on a later recommendation by McLearn, applied the name Dunlevy to McLearn's original lower subdivision. The Dunlevy was defined as having its upper boundary at the top of the massive conglomerates and below the coal-bearing beds of the Gething Formation. Later, however, according to the Alberta Study Group (1954, p. 277), Beach and Spivak changed their opinion, believing that the lower Dunlevy was the Nikanassin Formation as recognized in the Foothills to the south of Peace River area. By so doing, they reverted to the suggestion made by McLearn in 1940.

In the meantime, Mathews (1947, p. 9), working farther west in Carbon Creek basin, recognized three formations in beds which he considered equivalent to the lower Dunlevy which were, in ascending order, Monteith, Beattie Peaks, and Monach. Mathews referred to these formations as the "marine Bullhead" and the continental coal-bearing upper part, as the "non-marine Bullhead."

The Alberta Study Group (1954, p. 277) assigned strata in the subsurface of the Peace River region to the Bullhead Group, stating:

> A succession of strata consisting of conglomerates, sandstones, siltstones, shales, and coals underlying the Bluesky formation is shown unconformably overlying fine brown sandstones and dark carbonaceous shales. These latter are considered to be the Nikanassin sandstone and Fernie shale.... Because the unconformity appears to be a significant break with the underlying recognized Fernie shale, the base of the Bullhead group is here placed at the top of the Nikanassin formation, though it is the opinion of some of the study group that the Nikanassin itself should be considered part of the Cretaceous Bullhead group.

The Bullhead Group, as used in that report, therefore comprised the Cadomin and Gething Formations.

The writer (Stott, 1962) indicated that unnamed strata in Carbon Creek basin separated the Monach sandstone from massive conglomeratic sandstones which he assigned to the Cadomin Formation. Investigations by the writer (1962, 1967a) and those of Hughes (1964) confirmed that Mathews' three formations, Monteith, Beattie Peaks, and Monach, were useful and also readily recognized throughout much of the region. The term Dunlevy was therefore abandoned, as had been suggested earlier by the Alberta Study Group (1954) and also by Gussow (1960, p. 61).

Hughes (1964) proposed two new groups: the Beaudette Group which included the Monteith, Beattie Peaks, and Monach Formations; and the Crassier Group which included two newly named formations, Brenot and Dresser, and the Gething Formation. Hughes suggested that the name Bullhead be retained as a "super group" to include the two new groups.

Problems of nomenclature and modifications of the definitions of existing groups and formations were discussed in two recent reports by the writer (1967a, 1968a; *see also* Table I).

Table of Formations

		Formation or Group	Thickness	Lithology
Lower Cretaceous	Fort St. John Group		3,000–5,000 feet (900–1,500 m)	Dark grey, marine shale with fine-grained sandstone
Lower Cretaceous	Bullhead Group 0–2,500 feet (0–750 m)	Gething Formation	0–1,800 feet (0–540 m)	Fine-grained, cherty to quartzose sandstone; rusty weathering shale; carbonaceous mudstone and coal seams; minor conglomerate
Lower Cretaceous	Bullhead Group 0–2,500 feet (0–750 m)	Cadomin Formation	0–770 feet (0–230 m)	Massive chert conglomerate and coarse-grained sandstone; carbonaceous shale; minor coal
	Regional erosional unconformity; bevels rocks of succeedingly older age northward and eastward			
Lower Cretaceous / Jurassic	Minnes Group		0–6,000 feet (0–1,800 m)	Massive, quartzose sandstone; alternating units of fine-grained sandstone and mudstone; minor carbonaceous sediments
Jurassic	Fernie Formation		0–1,800 feet (0–540 m)	Calcareous and phosphatic shales; rusty weathering shale; glauconitic siltstone; sideritic shale; thinly interbedded sandstone, shale, and siltstone

As indicated there, geological studies during the last 25 years or more have shown that the Bullhead Group, as originally defined, consists essentially of two major divisions differing in age, lithology, and sedimentary history. Although recognition of two groups as proposed informally by Mathews (1947) and formally by Hughes (1964) is desirable, the actual division proposed by them is not the most practical one throughout much of the region.

Hughes (1964, p. 3, 17) believed that a disconformity was present at the top of the Monach Formation and drew the boundary between his Beaudette and Crassier Groups there, a position which coincided with the boundary between Mathews' "marine Bullhead" and "non-marine Bullhead." Hughes also considered that the strata overlying the Monach were closely related to the overlying conglomerates and coal-bearing beds of the Gething

Formation. The presence of a disconformity at the top the Monach Formation has not been clearly demonstrated. Although a hiatus may be represented locally, recent collections obtained by the writer and identified and dated by J. A. Jeletzky show that a marine Valanginian fauna extends above the Monach Formation in parts of Carbon Creek basin and that no major faunal or sedimentary break occurs in the sandy strata lying between the Cadomin conglomeratic sandstone and the Jurassic Fernie Formation. Furthermore, as indicated previously (Stott, 1967a, 1968a, 1969a) and as shown in more detail herein, a major erosional unconformity underlies the conglomerates in most if not all of the region. The underlying succession is extensively bevelled and the unconformity marks a significant event in the history of the basin. If two groups are to be established, the most logical place to make the division is at the unconformity, that is, at the base of the Cadomin conglomerate which lies some 800 to 1,000 feet above the Monach Formation in Carbon Creek basin. Furthermore, the alluvial conglomeratic succession of the Cadomin Formation and overlying coal-bearing beds of the Gething Formation are facies of one major depositional sequence (Stott, 1968a; this report) related to the initial transgressive phase of a marine incursion from boreal regions. The strata between the Monach and conglomeratic beds are much more closely related to the underlying marine succession that represents the major regression after the flooding of the mid-continent by Jurassic seas.

Some interval of non-deposition is indicated by the ages assigned to the two successions. The post-Monach beds contain a marine fauna that is dated by J. A. Jeletzky as middle to late Valanginian. The succession, which lies within an unbroken sequence of faunal zones, represents continuous or almost continuous sedimentation within the basin. On the other hand, the Gething Formation contains a marine microfauna that T. P. Chamney dates as late Neocomian (Barremian–Aptian)–Early Albian. As the Cadomin conglomerates are a lateral facies equivalent of the basal Gething, they can be assigned also a late Neocomian age. Thus, based on current knowledge, a time gap representing the Hauterivian stage and possibly part of the Barremian stage exists between the succession of conglomerates and coal-bearing Gething beds and the underlying strata. If the original Bullhead Group were to be subdivided as proposed by Hughes, the major hiatus would not be at the base of his Crassier Group but well within it. Furthermore, the base of the Cadomin Formation is the only definable horizon south of Pine River as the Monach Formation is not easily recognized or is not present.

A distinct lithologic change occurs between the post-Monach beds and the Cadomin conglomerates. The post-Monach beds consist mainly of moderately recessive, fine-grained sandstone with interbedded mudstone and shale. Locally, they include a few thin seams of coal and, in the vicinity of Mount Bickford, some beds of medium-grained sandstone towards the top of the unit. In contrast, the Cadomin succession consists of massive, coarse-grained to conglomeratic sandstone with lenses and beds of pebble-conglomerate. The contrast is readily apparent and the contact between the post-Monach succession and the Cadomin is well defined. However, the post-Monach succession is similar to the underlying Monach sandstones and, in many localities, no sharp or distinct boundary exists. For mapping purposes, the boundary at the base of the conglomeratic succession is much more satisfactory.

On the basis of the factors outlined, a proposal was made by the writer (1967a, 1968a) to restrict the Bullhead Group to include only the Gething and Cadomin Formations. The retention of the name Bullhead for this upper succession was favoured from an historical standpoint, being in common use for the coal-bearing strata of the Peace River canyon for more than 50 years. Secondly, those beds and their type locality were clearly included by the original definition of McLearn and actually were the only well-known part of the succession for many years. The underlying marine succession, comprising the Monteith, Beattie Peaks, Monach, and the unnamed post-Monach beds were assigned to the Minnes Group (Stott, 1967a)[1].

Bullhead Group

The Bullhead Group comprises a thick succession of piedmont fan, alluvial plain, and transitional sediments. The main alluvial facies of the group was described by the writer (1968a) in a report dealing with the development of Bullhead sediments southeasterly from Peace River. The group forms a wedge that decreases from about 2,500 feet in the western Foothills of northeastern British Columbia to only a few hundred feet in Peace River Plains and to a zero edge northeast of Fort St. John (Fig. 2).

The Bullhead Group in the region of Peace River canyon was described in considerable detail by McLearn (1918, 1923; *see also* McLearn and Kindle, 1950); to the north, in the region around Sikanni Chief River, it was outlined briefly by Hage (1944; *see also* McLearn and Kindle, 1950, p. 70). Irish (1961, 1963, 1970), in mapping Halfway River map-area, did not subdivide the Lower Cretaceous sandy strata, including all the beds between the Jurassic Fernie shales and Lower Cretaceous Buckinghorse shales in one map-unit, although, in his text (1970), he discussed both the Minnes and Bullhead Groups. As shown by Stott (1967a, 1969b, Fig. 2), formations of the Minnes and Bullhead Groups are characterized by distinct lithology and are readily recognizable and mappable in Trutch and Halfway map-areas.

[1]The development of terminology of the Minnes Group was discussed in that report and will be reviewed in a later publication.

PLATE II

Gething Formation in canyon of Sikanni Chief River. Section 61–5.

129296

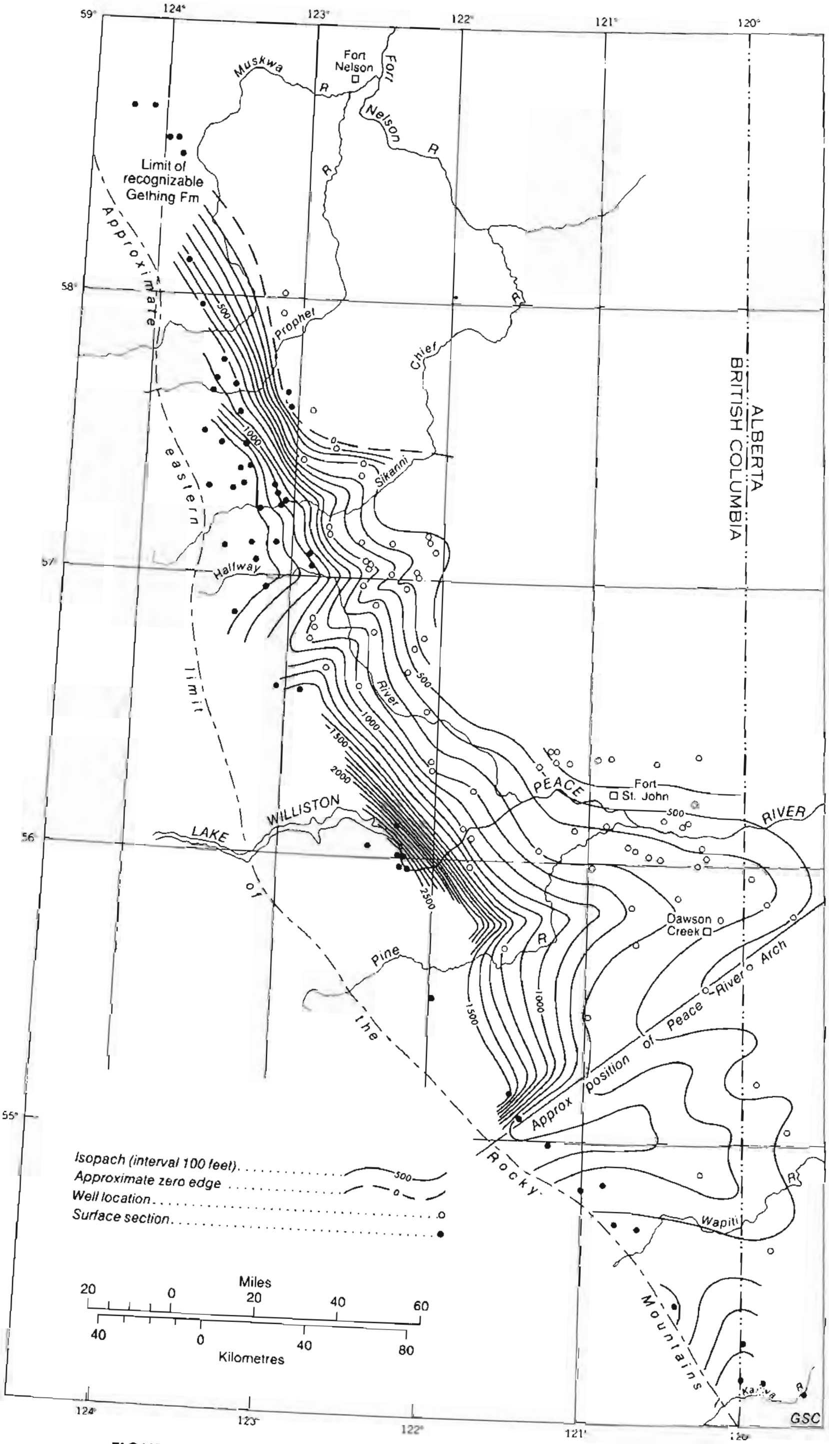

FIGURE 2. Isopach map of Cadomin, Gething, and Bluesky Formations

The Bullhead Group near Peace River canyon comprises the Cadomin and Gething Formations, which are contrasting and mappable units. Northward beyond Graham River, the massive conglomeratic Cadomin sandstone grades laterally into predominantly fine-grained sandstone, essentially indistinguishable from the overlying Gething Formation. Thus, it becomes impracticable to attempt to map more than one unit and the term Gething is used from Graham River northward.

The distribution of the Bullhead Group is shown on several recent maps. Of those, one by Stott (1969b; Fig. 2) covers most of the region of this report, extending from Pine River to Prophet River. That map is a compilation of published 4-mile maps, including Trutch (94G) (Pelletier and Stott, 1963), Halfway River (94B) (Irish, 1961, 1963, 1970), and Pine Pass (93O) (Muller, 1961), all of which have been modified by additional data obtained during this study. In addition, the northern limits of the Gething Formation are shown in the Fort Nelson (94J) map-area (Taylor and Stott, 1968b) and the distribution of the group south of Peace River is shown by Stott (1968a, Fig. 2).

Pre-Bullhead Unconformity

An unconformity below the Cadomin Formation, as well as its equivalents in the Foothills of western Canada, has been recognized for many years; it has been the subject of several published discussions, most of which dealt with its presence in the southern and central Foothills. In the upper Peace River region, the unconformity lies at the base of the Cadomin conglomerates or equivalent Gething sandstones and above successively older beds, ranging in age from earliest Cretaceous to Triassic, northward from Peace River and eastward from the Foothills to the Plains.

McLearn (1944a) was one of the first to recognize that this major break occurred within, rather than below, Cretaceous sediments. He placed the base of the Cadomin well above the Jurassic–Cretaceous boundary and accepted the Cretaceous dating of beds lying beneath the Cadomin and Gething in the central and northern Foothills (*see also* McLearn and Kindle, 1950, Fig. 12).

Warren and Stelck (1958b) indicated that in the Jasper region the hiatus below the Cadomin conglomerate represents "most of the Portlandian, Tithonian, and Neocomian stages of the Jurassic and Cretaceous periods." They also stated that:

> The hiatus indicated by this unconformity is represented in the Peace River basin by a continuous sequence of *Aucella*-bearing beds of the Nikanassin (Upper Jurassic) and lower Bullhead (Lower Cretaceous) group of formations.

As used by Warren and Stelck "lower Bullhead" refers to the beds below the conglomeratic sandstones that are part of the succession assigned previously to the Dunlevy Formation of the unrestricted Bullhead Group.

Loranger (1958, p. 35) stated that the Cadomin marked "a time of great erosion which cut across pre-existing formations of both Cretaceous and Jurassic age." Ziegler and Pocock (1960) believed that the Cadomin conglomerates rested unconformably to disconformably on Lower Cretaceous Minnes beds north of Kakwa River. Mellon (1967, p. 80) suggested that "a large part of Early Cretaceous time, equivalent to the Neocomian and Aptian Stages of Europe, is represented by the unconformity at the base of the Blairmore–Mannville succession in Alberta." Jeletzky, in unpublished reports dealing with fossils from the region and in a recent paleogeographic discussion (1971b, c), has commented on the apparent lack of Hauterivian and Barremian (mid-Early Cretaceous) beds in northeastern British Columbia.

Gussow (1960) stressed the importance of recognizing the unconformity at the base of the Cadomin Formation, stating emphatically that "[The Dunlevy Formation] is now obsolete and must be broken down into the Cadomin Formation and the Nikanassin." He believed, however, in contrast to the previous writers, that the unconformity below the Cadomin conglomerate marked the Jurassic–Cretaceous boundary. Although Rudkin (1964, Fig. 11–1) showed in his Correlation Chart that the unconformity was of Neocomian age, he referred to it as the "sub-Cretaceous unconformity" and stated (p. 158) that the Cadomin Formation "forms the basal deposit of Cretaceous sedimentation in the Foothills following a period of uplift and erosion." Hughes (1964, p. 20) considered that a disconformity occurred well below the conglomeratic sandstones in Pine River region. He believed that the overlying succession, including the Cadomin and Gething Formations as used here, contained no major break or discontinuity although he did state (p. 20) that sedimentation was interrupted "by local breaks which were followed by the spread of coarse sands and gravels."

The pre-Bullhead unconformity, which was described previously by the writer (1967a, p. 41; 1968a, p. 11), lies at the base of the Cadomin conglomerates and conglomeratic sandstones or equivalent Gething sandstones. It truncates successively older beds eastward from the Foothills into the Plains and northward to northwestward from Peace River.

South of Peace River, studies by the writer of the pre-Bullhead succession are incomplete but the information that is available supports the concept of the easterly truncation of pre-Bullhead beds. More than 6,300 feet of sediment, mainly of Early Cretaceous age, occurs between the Fernie and Cadomin Formations in the upper Kakwa River region (Ziegler and Pocock, 1960). To the east near Torrens River, Warren and Stelck (1958, p. 59) reported about 2,700 feet in that interval. In the subsurface beyond the Foothills, all strata between the Fernie and Cadomin disappear (Stott, 1968a, Figs. 3, 4), and the Cadomin lies directly on Jurassic Fernie shale.

Along the western Foothills (Fig. 3a), Cadomin conglomerate or basal Gething sandstone lies on successively older beds from southeast to northwest. In the Carbon Creek basin (sec. 68–12), the underlying beds are those of the uppermost unit of the Minnes Group of middle to late Valanginian age. At Fiddes Creek (sec. 62–11), the Gething sediments still lie on upper Minnes beds (Pl. III) and the boundary in the intervening region may be only disconformable, representing little or possibly no hiatus. Farther north at Trimble Lake (sec. 64–7), however, the conglomerate lies on the Monteith Formation, dated elsewhere as Berriasian to earliest Valanginian; and north of Besa River (sec. 64–15), the basal sandstone lies on shale of the Jurassic Fernie Formation (Pl. IV). Beyond Prophet River (secs. 64–10, 64–17), the underlying sediments are those of the Triassic Pardonet Formation and at Gathto Creek (sec. 64–24), the Gething lies on the older Triassic Liard Formation (Pl. V). At Tetsa River (sec. 64–3) on the Alaska Highway, the Triassic beds are truncated even further, and basal Cretaceous sediments rest on the Toad Formation.

The eastward truncation of beds below the Bullhead sediments is shown in a series of cross-sections between Peace and Prophet Rivers (Fig. 3). The truncation is more pronounced in the northern part of the region (Fig. 3a). In the vicinity of Peace River near latitude 56°N (Fig. 3b), the succession is traced eastward from the headwaters of Carbon Creek (sec. 68–12) through a series of wells to Imperial Spirit River No. 1 well (lsd. 12, sec. 20, tp. 78, rge. 6, W6) which serves as a standard for much of the Lower Cretaceous succession (Badgley, 1952; Alberta Study Group, 1954; *see also* Stott, 1968a). In the west, the Cadomin lies on middle to late Valanginian Minnes beds some 6,000 feet above the top of the Jurassic Fernie Formation. In West Canadian Moberly Lake 11–36–80–25 well (11–36–80–25W6) the underlying beds are those of the Beattie Peaks Formation, a few hundred feet above the Monteith sandstone and 1,060 feet above the Fernie Formation. To the east, the Monteith is gradually bevelled until, at the Imperial Spirit River well, the Cadomin lies directly on the Fernie. To the north (Figs. 3c–d), in the middle and along the northern boundary of Halfway River map-area (lat. 57°N), the underlying beds are intensely bevelled within a short distance. Near Christina Falls (sec. 62–13; Fig. 3c), the Gething Formation lies on upper Minnes beds, 2,265 feet above the Fernie. In the easternmost well, Texaco NFA Townsend a–8–J (a–8–J/94–B–9), the Gething sediments lie on the Monteith Formation, only 300 feet above the Fernie. Similarly near Halfway River (Fig. 3d), the Gething lies on upper Minnes beds at Fiddes Creek (sec. 62–11; Pl. III), just above the Monteith Formation in HB Cypress a–28–F well (a–28–F/94–B–15) and on beds well within the Monteith Formation at Gulf States Gundy Creek No. 4 well (d–4–B/94–B–16).

Between Halfway River and Nevis Creek at latitude 57°30′N (Figs. 3e, f, g) the Gething lies on the Monteith Formation or on slightly higher beds in the western Foothills and on the Jurassic Fernie Formation in the eastern Foothills and in the subsurface of the adjacent Plains. Northwest of Mount Stearns (sec. 64–8, 64–9; Fig. 3e), the Gething lies on beds only slightly above the top of the Monteith Formation. All the Monteith disappears eastward and much of the Fernie Formation is bevelled between Mount Wooliever (sec. 62–6) and Sinclair Canadian Julienne Creek a–50–D well (a–50–D/94–G–1). At Trimble Lake (sec. 64–7; Fig. 3f), the Monteith is still represented but in more easterly sections (62–17, 61–5, 61–3, 61–4), successively older parts of the Fernie Formation are in contact with the Gething. Farther northwest at Nevis Creek (sec. 64–10; Fig. 3g; Pl. IV), only a small thickness of Fernie shale remains and to the east at Waskulay Creek, the Gething lies directly on Triassic sediments.

PLATE III

Contact of Minnes Group and Gething Formation near Fiddes Creek, looking north. Sandstone to right of peak is within the Gething; the beds to the left of peak lie within the Minnes Group. Section 62–11 was measured immediately to the south of this peak.

130584

130594

PLATE IV

Looking south near Nevis Creek to lower beds of Gething Formation. On ridge in background, Gething beds on the right lie unconformably on Fernie shale which forms small notch at centre. Triassic beds, forming light coloured peak to left, lie unconformably beneath Fernie beds. Section 62–17.

128437

PLATE V

Contact of Gething Formation and Triassic beds north of Prophet River. Fragments of Triassic limestone occur in basal Gething sandstone at this locality. Section 64–19.

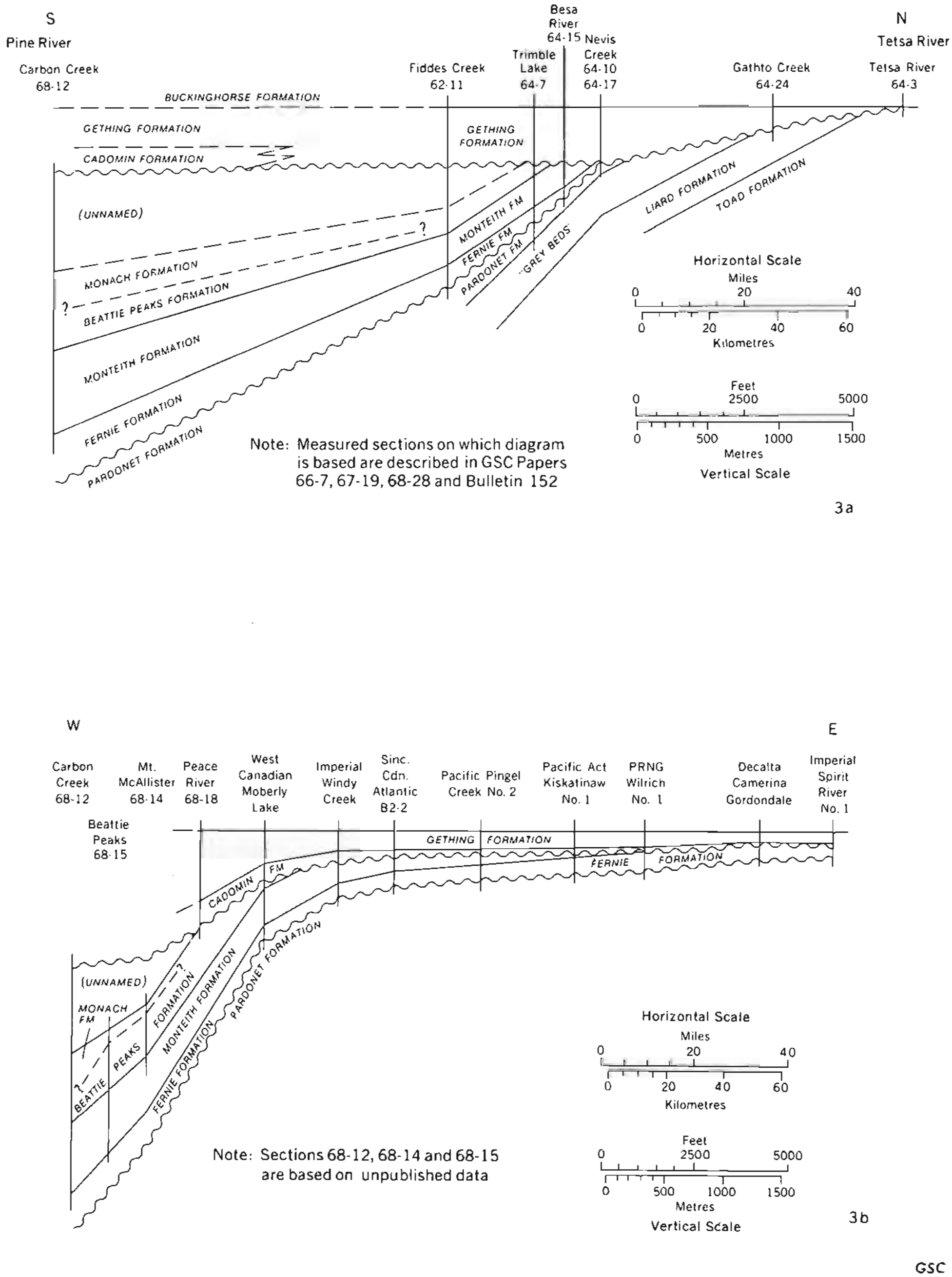

FIGURE 3. Schematic diagrams illustrating relationships of the unconformity below Cadomin and Gething Formations in region between Pine and Tetsa Rivers, northeastern British Columbia

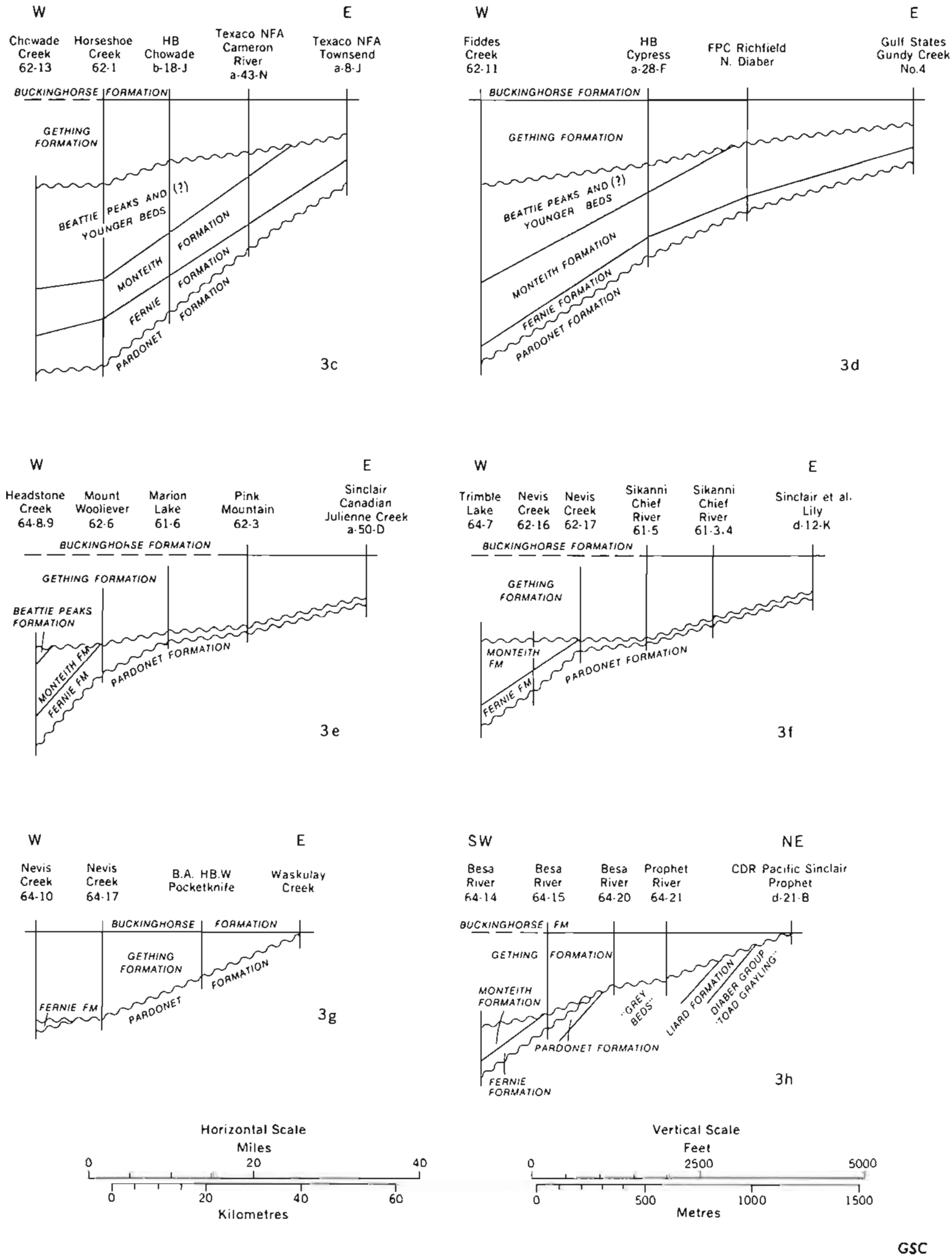

FIGURE 3.—*Continued*

Between Besa and Prophet Rivers (Fig. 3h), Monteith and Fernie beds are well represented in a western section (64–14) but the Monteith disappears a few miles to the east (sec. 64–15) and the Fernie disappears between there and Klingzut Mountain (sec. 64–20). At the latter section, the Gething lies on the Triassic Liard Formation, and farther east at CDR Pac. Sinc. Prophet d–21–B well (d–21–B/94–J–3), basal Cretaceous sediments lie on the older Triassic Diaber Group.

The total thickness of sediments removed along the eastern Foothills and Plains by the pre-Bullhead erosion is unknown, but an estimated order of magnitude can be suggested. It would be incorrect to assume that a uniform thickness of Jurassic and earliest Cretaceous rocks once extended across the Foothills and Plains. Rather, eastward convergence of those beds is to be expected and can be demonstrated to some extent. Nevertheless, several hundreds to thousands of feet of sediment must have been removed. More than 6,000 feet of Minnes sediments occur between the Fernie shales and Bullhead conglomeratic sediments in the Carbon Creek basin but no representative of that interval is preserved near the Alberta–British Columbia boundary. Over 2,800 feet of beds were measured between Triassic and Bullhead strata at Fiddes Creek but the sequence disappears completely northeastward between there and Pocketknife Anticline on Waskulay Creek (Fig. 3g) and northward between Halfway River and Richards Creek (Fig. 3a). In addition to the Minnes and Fernie strata that have been removed, a large part of the Triassic succession was eroded.

The precise time interval represented by the pre-Bullhead unconformity is a matter of some conjecture but can be placed within fairly narrow limits. In the Pine Pass–Carbon Creek region, beds underlying the Cadomin Formation have yielded *Buchia* cf. *B. bulloides* (Lahusen) and *Buchia* n. sp. aff. *B. inflata* dated by Jeletzky as middle to late Valanginian. The precise age of the Cadomin is not known but microfauna from upper Cadomin at Peace River and from the Gething Formation, which is in part laterally equivalent, are dated by Chamney as late Neocomian (Barremian–Aptian)[1]. In the Pine River and Peace River region, no record of the Hauterivian stage has been recognized. Because considerable time would be required for the erosion, it seems likely that the pre-Bullhead unconformity represents much of Hauterivian and possibly part of Barremian time. However, Loranger (1958, 1960), on the basis of ostracods, and Ziegler and Pocock (1960), on the basis of spores, maintained that Barremian beds were present below the unconformity in some parts of the Foothills, although they did not record any representatives of Hauterivian time. Despite these somewhat conflicting conclusions, it is clear that the pre-Bullhead unconformity in the Foothills represents some time between Hauterivian and Aptian and that it developed well within Early Cretaceous time.

It is possible that erosion was active for a longer time eastward on the cratonic margin where the limits of the Minnes embayment are largely unknown. Parts of the cratonic margin subsequently covered by Bullhead sediments or their equivalents may have been undergoing active erosion during deposition of Minnes sediments in more westerly regions.

The truncation of Triassic beds cannot be attributed entirely to erosion within Early Cretaceous time. An unconformity between the Jurassic Fernie Formation and underlying Triassic Pardonet Formation in the Foothills (*see* Stott, 1967a, p. 4) indicates that the Pardonet Formation, at least, was bevelled prior to Jurassic deposition. Other studies by Armitage (1962), Barss *et al.* (1964) in the Fort St. John region to the east show that erosion of Triassic sediments occurred prior to deposition of Jurassic sediments. Nevertheless, erosion

[1]The Neocomian Stage includes several substages. For the purposes of this report, both Chamney and Stott follow the usage of Jeletzky (1968) who includes the Berriasian, Valanginian, Hauterivian, Barremian, and Aptian substages.

during post-Jurassic time in the Fort St. John region is well documented and large erosional channels were cut into Jurassic and Triassic sediments prior to the deposition of Bullhead sediments (*see* Armitage, 1962, Fig. 17; Barss *et al.*, 1964, p. 129).

Cadomin Formation

Nomenclature and Definition

Conglomeratic sandstone lying below the coal-bearing Gething strata in Peace River canyon was originally included in the lower Bull Head (McLearn, 1918, 1923) and later formed the upper part of the Dunlevy Formation (Beach and Spivak, 1944, p. 4; *see* Table I). The writer (1962, 1963, 1968a) applied the name Cadomin to those beds, stating that they were stratigraphically equivalent to the Cadomin Formation of the Athabasca region and were lithologically similar to the formation as mapped between Smoky and Peace Rivers. The Alberta Study Group (1954) applied the name Cadomin to the conglomerate in the subsurface and Rudkin (1964, p. 160) referred to the conglomerate in northeastern British Columbia as the Cadomin Formation although he noted that it was much thicker than the Cadomin of the central Alberta Foothills.

Subsequently, Hughes (1964, p. 23) assigned the conglomerate and coarse-grained sandstone to a new formation which he called Dresser. Although he described several sections, particularly those drilled during the preliminary investigations of the Peace River dam site, Hughes did not map that unit during his investigations in the valleys of Pine and Peace Rivers (Hughes, 1964, 1967). During recent mapping in the Pine Pass and Dawson Creek map-area, the writer recognized conglomeratic beds along the axes of many large synclines and traced those beds southward across Pine, Burnt, and Sukunka Rivers into beds previously mapped as Cadomin (*see* Stott, 1963, 1968a). The succession of coarse-grained conglomeratic sandstone in Peace River canyon closely resembles, in composition and texture, beds assigned to the Cadomin Formation south of Wolverine River (Stott, 1968a, sec. 61–12A). Furthermore, the term Cadomin is used extensively in the Peace River Plains and the conglomerate there can be traced into the Foothills (*see* Rudkin, 1964; Stott, 1968a). It appears that the Dresser Formation, as proposed by Hughes, is stratigraphically equivalent to the Cadomin, has many lithological features in common, and can be traced in the surface and subsurface into beds assigned to the Cadomin Formation. As the name Dresser would have, at most, only limited local application, the name Cadomin is retained.

Type Section

The Cadomin Formation was defined at Cadomin south of Athabasca River by MacKay (1929, p. 9B; *see also* 1930, p. 477). He described it as a massive conglomerate, averaging about 35 feet thick and "composed of flattened and well-rounded pebbles of black, white, and green chert, white and grey quartzite, and quartz, which range in diameter from $\frac{1}{4}$ to over 3 inches." MacKay considered that the conglomeratic beds disconformably overlay the Nikanassin Formation. The Cadomin Formation has been traced northward from its type locality to Smoky River (Lang, 1947a, c; Irish, 1951, 1965; Eccles, 1957; Thorsteinsson, 1952) and beyond there to Peace River by the writer (Stott, 1960a, 1961a, 1968a). The conglomerate and its equivalents have a remarkable distribution, forming a distinctive marker in the Foothills from Peace River southward into the Blairmore region of southern Alberta (Norris, 1964; Mellon, 1967).

The Cadomin Formation in its type region is characteristically a massive, resistant unit of conglomerate. However, in the Foothills north of Smoky River, it has proven desirable for mapping purposes to include also massive units of conglomeratic sandstone and thin units of intervening carbonaceous mudstone with some thin coal seams. In the Carbon Creek basin and eastward to Peace River canyon, the Cadomin consists dominantly of thick units of coarse-grained sandstone, in part conglomeratic, and in many places containing disseminated pebbles and lenses of conglomerate.

Contact Relationships

Basal Contact

The contact of the Cadomin with the underlying Minnes Group is distinct and abrupt. Channels in the underlying beds and local angular relationships provide some evidence of the unconformable relationships. At some locations, such as Fisher Creek and along the west flank of Mount Bickford, units of medium-grained sandstone occur near the top of the Minnes succession, resulting in a more transitional appearance. Despite the regional truncation of underlying beds, the rocks on either side of the contact appear to be structurally concordant.

The contact at Peace River canyon was below river level even before the construction of the dam. Farther west at Rainbow Rocks, on the north side of Peace River and west of Dunlevy Creek, 34 feet of massive, coarse-grained conglomeratic sandstone lies on fine- to very fine grained, platy to thin-bedded sandstone. The lower beds have been channelled and the base of the conglomeratic sandstone is uneven. The contact there is drawn stratigraphically higher than that determined by Hughes (1964), who reported an interval of approximately 400 feet between massive quartzose sandstone and the base of his "Dresser Formation." Apparently Hughes drew the boundary at the base of the first appearance of thick-bedded, fine- to medium-grained sandstone. Although there is considerable similarity between that sandstones and the conglomeratic sandstone marking the base of the Cadomin, the boundary as drawn by the writer at the base of the distinctive conglomerate is more consistent and more readily defined in the field.

Upper Contact

The upper contact of the Cadomin Formation is drawn at the top of the conglomeratic sandstones. This boundary lies at no persistent stratigraphic horizon but occurs at the top of different sandstones from one locality to another.

Distribution and Thickness

The Cadomin Formation extends northward from Smoky River through the central and western parts of the Foothills. It forms a prominent and easily recognizable resistant marker along the flanks of several broad anticlines, outlining the major structures. It is especially well developed on the eastern flank of a large syncline lying in front of the main ranges of Paleozoic rock between Narraway River and Kinuseo Creek. Between there and Bullmoose Mountain the formation is exposed on the flanks of several smaller anticlines and synclines, and is easily recognized at Quintette Mountain, on ridges in the vicinity of Wolverine River, on Bullmoose Creek and west of Bullmoose Mountain[1].

A large area between Sukunka and Burnt Rivers is underlain by Lower Cretaceous strata including the Cadomin Formation but, because the area is heavily forested, the succession

[1]For additional details of the Cadomin Formation in the region between Smoky River and Bullmoose Mountain, *see* Stott, 1968a.

is not easily studied. The Cadomin is well exposed on two prominent summits south of Burnt River lying along a major anticlinal axis and resistant beds can be traced eastward around two saucer-like structures. Cadomin beds are exposed also in the footwall of the thrust which extends northwesterly from the "big bend" of the Sukunka River and which places Paleozoic rocks on Cretaceous sediments. North of Burnt River, conglomerate of the Cadomin Formation is exposed on forested hills lying east of Goodrich Peak, and it extends across the headwaters of Falling Creek to Beaudette Creek.

Between Pine and Moberly Rivers, Cadomin strata are present in a syncline along the western flank of Mount Bickford. Cadomin beds are well exposed also along Fisher Creek northeast of Mount Bickford and are readily recognized on the flanks of the major anticline between Crassier and Fisher Creeks.

Although no large areas are covered by Cadomin strata between Moberly River and Carbon Creek, basal beds are present along the axes of two small folds at the headwaters of Carbon Creek, on the east flank of Mount Monteith, and on the northeast flank of Beattie Peaks. The main area of outcrop lies within the Carbon Creek basin, a large syncline whose axis trends northerly along Carbon Creek. Although no sections were measured there, traverses were made across those beds on the northeast flank of the Monach, off the west side of Mount McAllister, and off the west side of Battleship Mountain. Farther east, coarse-grained sandstones of the Cadomin Formation are well exposed on the east flank of Mount Gething and also on the west flank of the same structure on the mountain immediately to the south.

Cadomin beds were well exposed at the west end of Peace River canyon before the power dam was constructed and were described previously by Stott (1968a, sec. 61–25). Some of the upper beds are still visible at the toe of the dam (Pl. VI) but most of the Cadomin is now covered. The formation is exposed at Grant Knob and Mount Johnson at the east end of the canyon and extends northward in the several folds forming Portage Mountain and Butler Ridge. It occurs around the periphery of the Dunlevy Syncline, forming a prominent ledge at Rainbow Rocks below Dunlevy Lake. In sections north of Graham River, conglomeratic sandstone is not abundant although disseminated pebbles and a few lenses and beds of conglomerate do occur within medium- to coarse-grained sandstone. However, as those sediments differ only slightly from overlying beds, they are mapped as part of the Gething Formation.

The Cadomin Formation in northeastern British Columbia was shown (Stott, 1968a, Fig. 10) to comprise two major depositional lobes; the southerly one centred between Mount Belcourt and Onion Creek and the northern one at Peace River. The southern lobe decreases from a maximum of 530 feet at Mount Belcourt (Stott, 1968a, sec. 58–13) and 472 feet at Onion Creek (Stott, 1968a, sec. 59–9) to 169 feet at Quintette Mountain (Stott, 1968a, sec. 59–10) and only 45 feet north of Wolverine River (Stott, 1968a, sec. 59–11). From the last locality, the development of the northern lobe can be traced toward Peace River where a maximum of more than 700 feet is attained (Stott, 1968a, secs. 61–22, 61–23). The conglomerate and conglomeratic sandstone sequence thins rapidly eastward, decreasing to less than 50 feet in the subsurface near Fort St. John and Dawson Creek.

The coarse sediments grade laterally into fine-grained sandstones southward beyond Pine River and northward beyond Graham River. The geometry of the northern lobe is difficult to determine in the Foothills because exposures are poor and closely spaced control sections are unobtainable. However, the lobe extends along the Foothills for about 75 miles

PLATE VI

Uppermost Cadomin coarse-grained and conglomeratic sandstone exposed at toe of W. A. C. Bennett dam, Peace River. Lower beds of Gething Formation appear in cliff at extreme left and top of photo. West Bank section of Gething Formation. Section 68–18.

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and has a wedge-like form, decreasing rapidly eastward. The rapid change in thickness and its tongue-like extension across the regional structure suggest that it may have developed as a major alluvial fan complex.

At Bullmoose Mountain, 276 feet of conglomeratic sediments is included in the Cadomin and that thickness is maintained along the eastern flank of a major anticline between Sukunka and Burnt Rivers. South of Beaudette Creek, 96 feet of conglomeratic beds is assigned to the Cadomin. Numerous exposures of the Cadomin Formation occur between Pine and Peace Rivers but measurable sections are not common. One of the better exposures (sec. 69–26) occurs west of Cleveland Creek in a power line cut near the John Hart Highway (Pl. VII) and reveals 188 feet of beds but the basal contact is covered there and the total thickness is unknown. To the north on the west flank of Mount Bickford (sec. 69–8) at least 90 feet of strata can be assigned to the formation and a few miles farther north along the same structure (sec. 69–17) more than 400 feet is exposed. On the east flank of that anticline, about 600 feet outcrops along Fisher Creek (sec. 69–9). At that locality, Hughes (1964, p. 62) assigned 1,200 feet to his Dresser Formation, presumably including some underlying medium-grained sandstone beds, which the writer assigns to the upper Minnes. Hughes may have included also some overlying beds which the writer places in the Gething Formation.

The Cadomin is 203 feet thick on the east flank of Mount Monteith, and westward at the headwaters of Carbon Creek, about 100 feet of conglomerate at the base of the formation is exposed. To the northeast on the east flank of Mount Gething, more than 500 feet of coarse-grained conglomeratic sandstones is present (Stott, 1968a, sec. 61–22). At the head of Peace River canyon (Stott, 1968a, sec. 61–25), more than 340 feet of similar sandstones was exposed before the construction of the dam. At present, only 186 feet is exposed at the toe of the dam

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PLATE VII

Conglomeratic sandstone of Cadomin Formation exposed on north side of John Hart Highway, west of Cleveland Creek.

(sec. 68–18, Pl. VI). The massive coarse-grained conglomeratic succession at the west end of Peace River canyon was drilled prior to the construction of the power dam and, according to Hughes (1964, p. 46), the total computed thickness there is 770 feet. More than 660 feet of those beds is exposed on Butler Ridge (Stott, 1968a, sec. 61–23).

Lithology and Facies Variations

The Cadomin Formation in its type region is characteristically a single massive, resistant unit of conglomerate. In many sections, the Cadomin is formed by a continuous succession of conglomerate, but in the Foothills north of Smoky River, a succession of thick conglomeratic units separated at most by a few tens of feet of recessive sediments has been included in the formation. The recessive beds include carbonaceous mudstone, fine-grained sandstone, siltstone, and a few thin coal seams. The conglomerate consists predominantly of well-rounded pebbles, cobbles, and boulders of chert, quartz, and quartzite.

The thick succession of Cadomin conglomerate in the vicinity of Mount Belcourt and Onion Lake was shown (Stott, 1968a, Figs. 6, 7) to grade laterally eastward into coarse-grained sandstone and coal-bearing beds which are included in the Gething Formation. It was suggested that similar facies changes probably occurred throughout the Foothills. Before the construction of the dam at Peace River canyon, one could readily observe that some of the higher and coarser Cadomin sandstones graded laterally into interbedded coal, sandstone, and shale, and similar changes may still be seen at the toe of the dam.

The lateral change in the vicinity of Pine and Peace Rivers is somewhat obscured by the lack of continuous exposures. However, the general trend is clear. South of Beaudette Creek, the formation comprises three massive conglomeratic, coarse-grained sandstone units separated by recessive beds. West of Cleveland Creek, four massive conglomeratic sandstone units occur. In the vicinity of Mount Bickford (secs. 69–8, 69–9, 69–17), conglomeratic sandstones occur through 500 to 600 feet. The recessive units separating the more massive units of the Cadomin comprise dark grey to olive-brown mudstones which are in part carbonaceous, siltstone, fine-grained sandstone, and thin seams of coal. Similar pelitic sediments within the conglomeratic succession were described by Hughes (1964, sec. 7) from cores taken at the dam site. On the east flank of Carbon Creek basin, on slopes of Mount McAllister and Battleship Mountain, the succession consists dominantly of thick, massive units of coarse-grained sandstone, in many places containing disseminated pebbles and lenses and thin beds of conglomerate. At Mount Gething, a similar succession consists almost entirely of sandstone without any shaly intervals (Stott, 1968a, sec. 61–22). Farther west at the headwaters of Carbon Creek, the basal 100 feet, at least, consists of conglomerate with cobbles as much as 3 inches in diameter. On Butler Ridge (Stott, 1968a, sec. 61–23), conglomeratic sediments occur through more than 660 feet but there are many covered, recessive intervals, presumably containing shale and coal. From these observations, it appears that conglomerate occurring in the western Foothills grades laterally eastward into conglomeratic sandstone which is concentrated in the vicinity of Carbon Creek basin and Peace River canyon. The conglomeratic sediments grade laterally into fine-grained sandstone and shale to the north and northeast beyond Butler Ridge, and into a coal-bearing succession included in the Gething Formation to the south in the vicinity of Mount Bickford and beyond.

The clasts are generally of pebble size with most being about $\frac{1}{2}$ to 1 inch but ranging from very coarse sand to boulders as much as 15 inches in diameter. In most units, the clasts are in a matrix of fine- to coarse-grained sand but, in a few units, pebbles are tightly packed without much matrix. A general increase in average and maximum size of pebbles westward indicates a source region in that direction. Between Sukunka and Burnt Rivers, the Cadomin contains pebbles, most of which are 2 to 3 inches in diameter though some have a maximum of 6 inches. At Bullmoose Mountain to the east, pebbles are between 1 and $1\frac{1}{2}$ inches in diameter. As previously described (Stott, 1968a), the largest clasts are found between Mount Belcourt and Onion Creek, where boulders from 10 to 15 inches are common. To the northwest at the headwaters of Carbon Creek, pebbles have a maximum diameter of 3 inches and average between $\frac{1}{2}$ and 1 inch. To the east in the vicinity of Mount Bickford, the average diameter is about $\frac{1}{4}$ to $\frac{1}{2}$ inch with the maximum size being about 2 inches in a dominantly coarse-grained sandstone facies. Similar lithology and pebble sizes were noted around the Carbon Creek basin and also in the vicinity of Mount Gething. Farther east at Peace River canyon, only a few thin beds of conglomerate occur and the pebbles, where present, are commonly about $\frac{1}{2}$ inch in diameter with a maximum size of about 1 inch.

The clasts are composed mainly of chert, quartzose sandstone, and quartzite although some are composed of quartz. Limestone pebbles and cobbles are relatively abundant between Kakwa and Wapiti Rivers, but become less numerous northward. Most of the chert is white, grey, or black but some is bluish grey and other pebbles are pale green. Light pink quartz pebbles occur near Mount Belcourt. The clasts are subangular to well rounded with most being rounded. The conglomerate beds are generally grey although the sand matrix is commonly brownish grey.

The conglomerates generally exhibit some cross-stratification although bedding of any type is fairly obscure. Prominent, high-angle crossbedding is typical in the region between Kakwa and Wapiti Rivers. Stratification is revealed by variation in pebble size, lenticles and stringers of sandstone and by variation in the amount and the grain size of matrix material.

The lower boundaries of the conglomerates are sharp and erosional and commonly the beds fill channels cut in underlying sediments.

Carbonaceous material occurs as coalified drifted logs or stumps with some small lenses of finely macerated plant fragments and coal.

Gething Formation

Nomenclature and Definition

Coal-bearing strata of the upper Bull Head Mountain Formation were assigned to the Gething Member by McLearn (1923, p. 4B). He measured and described the beds along the lower canyon of Peace River, the exposures of the upper canyon being partly inaccessible at that time. Although the Bullhead succession was raised to group rank by Wickenden and Shaw (1943, p. 2), the Gething remained as a member until Beach and Spivak (1944) named the lower member and gave formational status to both the Dunlevy and Gething beds.

As defined by McLearn, the Gething comprised predominantly fine-grained sediments and coal, the lower boundary being placed at the top of the coarse-grained conglomeratic sandstone of the lower Bullhead. In the region south of Peace River, conglomeratic beds occur sporadically throughout the coal-bearing succession and grade laterally into fine-grained sandstone. The writer (1968a) found it convenient to include in the Gething Formation those conglomerate units above the main, more continuous basal succession. The Gething Formation north of Peace River, in contrast to the coal-bearing succession of the type section, is dominantly fine-grained sandstone of deltaic to marine origin. Conglomerate, a minor constituent, is most abundant and coarsest in the westernmost sections. The formation grades laterally northward into thinly interbedded sandstone and shale, and presumably into shale of the Buckinghorse Formation.

Type Section

The well-exposed sections along the lower part of the canyon were measured and described as type by McLearn (1923, secs. C1–C2, E1–E3, and Fig. 2). He spent two months in the area, undertaking a detailed study of the coal seams and describing the rocks between Grant Flat and Milligan Point on the north shore; exposures on Moosebar and Aylard Creeks; the east side of the river at the head of the canyon; and isolated occurrences of coal seams on Johnson, Mogul, and Gething Creeks. McLearn illustrated his correlation of coal seams by means of columnar sections and showed his interpretation of relationships of the successions occurring on the north and south sides of the canyon. Additional studies of coal seams in the area were made by McLearn and Irish (1944). Those reports were incorporated later in a more complete summary on the geology of northeastern British Columbia (McLearn and Kindle, 1950). The type exposures on the north shore and on Aylard Creek were redescribed by the writer (1968a, p. 23–30, and Fig. 9) in 1961 while Peace River was discharging its normal flow of water, thus limiting access to parts of the river banks. The section is a composite one, as the river prevents the beds being traced directly across from the north shore into Aylard Creek.

McLearn, when he measured the canyon sections, determined from his columnar sections that the thickness from the top of the formation to the Riverside seam was 1,250 feet. He anticipated some errors in measurement, however, and suggested that 1,125 feet would be reasonable. McLearn considered that about 300 feet of unexposed basal strata occurred

PLATE VIII

Transition beds of basal Gething sandstone in overturned section south of Bat Creek. Section 64-22.

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between the Riverside seam and the underlying conglomerate and, therefore, estimated that the total thickness of the Gething in the vicinity of Peace River was somewhat more than 1,400 feet. The writer (1963, 1968a), in the course of his initial studies in the canyon, suggested an alternative interpretation, thereby reducing the thickness of exposed Gething strata to 1,000 feet which gave, using McLearn's estimate of the covered interval at the base, a total thickness of about 1,300 feet. Hughes (1964) stated that the Gething Formation in the Peace River canyon is approximately 1,050 to 1,300 feet thick.

During the construction of the W. A. C. Bennett dam, the flow of water through the canyon was temporarily reduced and the excellent Gething section on the west side of the river at the head of the canyon (Pl. IX) became accessible. During the field season of 1968 the writer measured and described the section, and found that the total thickness of the Gething Formation in that area is considerably greater than previously believed. Columnar sections were published (Stott, 1969a) illustrating the relationship of that section to earlier descriptions of the Gething Formation from Moosebar and Aylard Creeks, and along the north shore of the lower reaches of the canyon. The writer experienced considerable difficulty in correlating coal seams in the lower part of the section and provisionally concluded that the section on the west bank was disrupted by a fault. Based on that assumption, the thickness of the Gething Formation was determined to be approximately 1,600 feet. A re-examination of the section in 1969 convinced the writer that no fault occurs within the succession on the west bank and therefore the total thickness of the Gething in the canyon region approaches 1,800 feet. A corrected version of the description appears in the Appendix (sec. 68-18; *see also* Fig. 4). The canyon exposures constitute the type section of the Gething Formation and the section along the western cliff is the most reliable and continuous. The relationship of the

PLATE IX

Type locality (West Bank section) of Gething Formation, canyon of Peace River: below W. A. C. Bennett dam.

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West Bank section to sections on Moosebar and Aylard Creeks and North Shore and a comparison of their descriptions with those of McLearn were discussed by the writer (1969a). Although the sections on Moosebar and Aylard Creeks can be related and placed, with some confidence, in proper relationship with the West Bank section, there is not much similarity between the lower parts of the North Shore and West Bank sections (Fig. 4, *in pocket*). This lack of continuity suggests that the coal seams vary rapidly both in thickness and in lateral extent or, alternatively, that the suggested relationship is incorrect.

Contact Relationships

Basal Contact

The contact between the Gething Formation and underlying beds north of Graham River was shown previously to represent a major unconformity, and the regional relationships were discussed in detail. The contact of the Gething and Cadomin Formations lies at no persistent stratigraphic horizon but is drawn at the top of different conglomeratic sandstones from one locality to another, as outlined previously (Stott, 1968a). The following discussion provides a more specific description concerning the contact where the Cadomin is absent by facies change and where the Gething lies unconformably on older Mesozoic rocks.

Where the Gething lies on the upper Minnes beds, the contact is readily determined. Between Graham and Halfway River the lower contact is marked by a distinct change from the argillaceous, recessive sediments of the upper Minnes Group to thick-bedded, conglomeratic sediments of the Gething Formation (Pl. III). The beds on either side of the contact appear parallel although some evidence of channelling can be found at the base of the coarser sediments. At Horseshoe Creek (sec. 62–1), near Christina Falls (sec. 62–13), at Fiddes Creek (sec. 62–11), and north of Mount Stearns (sec. 64–8), thick units of fine- to coarse-grained sandstone with disseminated pebbles and some conglomerate overlie recessive shales and argillaceous siltstones. The average size of the pebble is from $\frac{1}{4}$ to $\frac{1}{2}$ inch and the largest are about 1 inch in diameter.

Where the Gething lies directly on the massive quartzose sandstone of the Monteith Formation, the contact may be more difficult to define because of a similarity of lithology. Nevertheless, the two sandstones can generally be differentiated because of the coarse-grained, quartzose sandstone in the Monteith Formation and the conglomerates and the abundance of chert in the Gething. In the eastern section near Halfway River (62–5), the contact can be readily discerned. Near Nevis Creek (secs. 62–17, 64–10), fine- to very fine grained quartzose sandstone resembling some of the Monteith sandstone lies on eroded beds of the Fernie Formation. That sandstone is overlain with no apparent break by cherty sediments typical of the Gething Formation. It appears that part of the Monteith sandstone was eroded and redeposited at the beginning of Gething deposition. Since only quartz-rich detritus could be derived from the Monteith, the basal Gething sandstone would be quartzose also but reduced in grain size. At Besa River (sec. 64–14), definite angularity was observed at the contact between the Gething and Monteith Formations. There, over 200 feet of thick-bedded, fine-grained sandstone overlies flaggy to thin-bedded sandstone that was assigned to the Monteith Formation. The succession on either side of the contact is similar to that found near Trimble Lake (sec. 64–7).

The basal contact of the Gething is abrupt and distinct where it lies on part of the Fernie Formation. In the vicinity of Sikanni Chief River (secs. 61–5, 61–3, 64–18) and at Pink Mountain (secs. 62–3, 61–2), medium- to coarse-grained sandstone, in part quartzose and conglomeratic, lies on the lower part of the Fernie Formation. Pebbles averaging about $\frac{1}{2}$ inch and cobbles as much as 3 inches in diameter are present. To the north near Nevis Creek (secs. 62–17, 64–10), 100 feet of very fine grained, quartzose, thick-bedded sandstone overlies earlier lower Fernie sediments (Pl. IV).

The Gething lies on Triassic rocks at Waskulay Creek on the west flank of the Pocketknife Anticline. Eighteen feet of black, fine- to coarse-grained sandstone is underlain by 3 feet of black shale that weathers rusty orange. Well-rounded quartz pebbles from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter occur in the sandstone. The shaly beds were mapped previously by Hage (1944) as Jurassic but they are not typical of basal Fernie (Nordegg) beds anywhere in the region. Although they do bear some resemblance to the Jurassic shale, they are not calcareous and appear to be carbonaceous. Detritus from eroded Fernie shales was probably incorporated in the basal part of the Gething Formation. A similar type of sandy mudstone occurring at the base of the Gething in the Plains is easily confused with Fernie shale.

The relationships between Triassic sediments and the Gething are varied. At Besa River (sec. 64–16) fine-grained, thick-bedded sandstone with fine conglomerate lies without discordance on Triassic limestone. At Nevis Creek (sec. 64–17) and north of Prophet River (sec. 64–1) fine-grained, thin- to thick-bedded quartzose sandstone lies on Triassic limestone and shale. In a nearby section (64–21) the upper beds of the Triassic are truncated by the Gething Formation and show a relief greater than 6 feet. Platy to argillaceous siltstone and minor fine- to coarse-grained sandstone overlie dense Triassic limestone with interbedded black shale. At Gathto Creek (sec. 64–24) fine-grained, thick-bedded grey Gething sandstone lies on calcareous orange weathering sandstone of the Triassic Liard Formation and the boundary between sandstones is difficult to recognize.

Basal sandstone occurring on Chlotapecta Creek and Chischa River may represent some part of the Gething Formation but for mapping purposes has been included in the Buckinghorse Formation. On Chlotapecta Creek, 48 feet of sandstone lies on the Triassic Liard Formation. The sandstones are fine grained, grey, thick bedded with some intercalated silty shale. Some conglomerate occurs near the top. At the westernmost exposure of Cretaceous beds along Chischa River, black shale appears to lie directly on Triassic rocks although 2 to 3 feet of fine-grained sandstone occurs about 10 feet above the base. On the western flank of the next anticline downstream, the basal Cretaceous beds comprise 9 to 10 feet of fine-grained, siliceous, massive sandstone with some pebbles embedded in the upper surface.

The basal contact of the Buckinghorse Formation with the Triassic Toad strata is present on Tetsa River (*see* Stott, 1967b, sec. 64–3) and the lower 200 feet of the Buckinghorse is well exposed at Mile 375 on the Alaska Highway. At the latter locality, the basal 9 feet comprises conglomerate, argillaceous sandstone with disseminated pebbles, and interbedded silty mudstone. A block of calcareous sandstone, occurring at the base, is similar to the underlying Liard sandstone.

Upper Contact

The Gething Formation is overlain by dark grey to black mudstone and shale of the Fort St. John Group which is assigned to the Moosebar Formation at Peace River and to the Buckinghorse Formation in the Foothills between Peace and Tetsa Rivers. To the east in the subsurface of the Plains, equivalent shale is assigned to the Wilrich Member of the Spirit River Formation. Despite the multiplicity of names, the basal shale of all those units is approximately of the same age, containing a microfauna commonly known as the "Clearwater microfauna" (*see* Stelck *et al.*, 1956; Mellon *et al.*, 1963; Chamney *in* Stott, 1968a, p. 55), and considered by Chamney (1969a, p. 39, Table 2) to be of Early Albian age. It appears that the basal Fort St. John shale represents a transgression which rapidly overlapped the Gething sediments throughout the region.

In the northern part of the region where a restricted marine basin already existed, only a slight break in sedimentation occurred, and the contact lies within a succession that is almost gradational. To the south, the marine invasion covered the deltaic to littoral sediments and the change in lithology is more apparent; again, the Gething–Buckinghorse contact appears conformable and there may be little or no break in sedimentation. Farther south beyond Peace River, the marine muds were deposited over Gething sediments of the alluvial environment. It is possible that Gething strata were being eroded there or that some areas were temporarily the site of non-deposition immediately prior to the advance of the Fort St. John sea. In that region the Gething–Moosebar contact is probably disconformable, representing a hiatus of short duration.

The upper contact of the Gething with the overlying Moosebar Formation is exposed at Moosebar, Aylard, and Gething Creeks. At Gething Creek, gritty sandstone with disseminated pebbles is overlain by 6 inches of argillaceous sandstone with pebbles which is in turn overlain by dark grey to black mudstone of the Moosebar Formation. At Aylard Creek, chert pebbles $\frac{1}{8}$ to $\frac{1}{2}$ inch in diameter are scattered over the surface of the upper Gething sandstone. At Contact Point at the lower end of the canyon, thick-bedded argillaceous sandstone of the Gething Formation is overlain by 1 foot of dark, fine- to medium-grained sandstone with disseminated small chert pebbles. That bed is in turn overlain by silty, dark grey Moosebar mudstone with reddish brown weathering concretions. The boundary is distinct at each locality and is probably slightly disconformable throughout that region.

The uppermost beds of the Gething at Fiddes Creek near Halfway River comprise 10 feet of massive conglomerate with well-rounded pebbles, $\frac{1}{2}$ to 1 inch in diameter, composed of chert, quartz, and quartzite. That conglomerate closely resembles the uppermost beds in core from Imp. Pac. Altares c–42–A well (c–42–A/94–B–8), just east of the Foothills, and some 60 miles to the southeast. Glauconite occurs in the cored section. However, a few miles directly east of Fiddes Creek (sec. 68–9), the highest Gething beds appear to be fine-grained, thin- to thick-bedded sandstone. The contact with the overlying Fort St. John shale is not exposed at those localities near Halfway River but an abrupt change from sandstone to shale seems likely.

On Sikanni Chief River at Chicken Creek, the contact between the Buckinghorse and Gething Formations (sec. 61–3) is covered. However, upstream on the west side of a small anticline, two beds of extremely glauconitic concretionary siltstone overlie Gething sandstone, and are in turn succeeded by 7 feet of shale topped by a concretionary layer and glauconitic shale. The contact is well exposed at the headwaters of Chicken Creek (sec. 62–8) where fine-grained sandstone is abruptly overlain by flaky to rubbly shale. A bed of siltstone, 6 inches thick, with lenses of coarse-grained sandstone marks the contact.

At Nevis Creek (sec. 64–17), dark grey to black, concretionary mudstone with thin seams of bentonite overlies interbedded silty mudstone and platy siltstone and sandstone. Platy siltstone and sandstone are not present in the overlying Buckinghorse Formation, and the contact is drawn at the change in lithology from interbedded shale and sandstone to shale only.

In the vicinity of Besa and Prophet Rivers, the upper contact is indistinct also. In a western section (sec. 64–15), the upper beds of the Gething are dominantly mudstone but the top of the formation is marked by a unit of interbedded siltstone, sandstone, and mudstone. On Prophet River (sec. 62–20), 31 feet of fine-grained sandstone is overlain by 19 feet of siltstone, sandstone, and mudstone containing abundant glauconite. The uppermost beds of the formation comprise 3 feet of very silty, glauconitic mudstone to argillaceous siltstone, capped by a reddish brown weathering concretionary layer. The beds immediately overlying the concretionary mudstone are covered, but about 60 feet of silty, black mudstone with thin seams of bentonite are exposed a few feet higher. North of Prophet River (sec. 64–21), a 6-foot-thick unit of fine-grained glauconitic sandstone at the top of the Gething Formation is overlain by concretionary black mudstone. A similar sandstone occurs at Bat Creek (sec. 62–22) and at Gathto Creek (sec. 64–24). At Kluachesi River (sec. 64–23), the uppermost Gething sandstone is 22 feet thick and is overlain by rusty weathering mudstone of the Buckinghorse Formation.

Distribution and Thickness

The Gething Formation is widely distributed in the Foothills, extending northward from Peace River almost to Tuchodi River. Its westernmost exposures lie along a line joining Gold Bar and Trimble Lake. The easternmost outcrops occur along the outer Foothills, capping such anticlinal structures as Butler Ridge, Pink Mountain, and Klingzut Mountain. The formation is poorly exposed between Peace and Graham Rivers but numerous sections occur between Graham and Prophet Rivers. Northward beyond Prophet River, the Gething forms a thin prominent band marking the eastern limit of the Foothills and extending as far north as Tuchodi River. A thin sandstone occurring at the base of the Buckinghorse shale between Tuchodi and Tetsa Rivers may represent some part of the Gething, but for mapping purposes it is included with the overlying Buckinghorse shale. The Gething strata extend beneath the surface of the Plains but have limited distribution east of the region between Sikanni Chief and Prophet Rivers.

The thickness of the Gething Formation increases markedly in the Foothills region (Fig· 2). A lobe of maximum thickness, with depocentre in the vicinity of Peace River canyon and axis of greatest sedimentation paralleling the Peace River Arch, trends northeastward between the canyon and Fort St. John. To the north, the isopachs are deflected to the north and northwest, becoming subparallel to the structural trend of the present Rocky Mountains.

The thickness of 1,800 feet assigned to the Gething Formation in Peace River canyon is considerably greater than elsewhere. Only 843 feet of sediments was assigned to the Gething in the West Canadian Moberly Lake 11–36–80–25 well (11–36–80–25W5) which is only 15 miles east of the canyon (Stott, 1968a, p. 22). Farther south, the Gething is 1,264 feet thick at Bullmoose Mountain (sec. 70–4), 677 feet at Wolverine River, and only 260 feet at Mount Torrens (Stott, 1968a, secs. 59–11, 61–14).

Muller (1961), in mapping the Pine Pass (93O) map-area which includes the Carbon Creek basin and lies south of Peace River, indicated that the Gething was "probably more than 4,000 feet thick." His application of the name "Gething" to strata equivalent in large part to the "non-marine Bullhead" of Mathews (1947) was a misnomer. His map-unit includes a much greater succession than the type Gething and in many places contains no beds equivalent to that formation. That failure to differentiate continental sediments overlying Monach Formation beds in northeastern British Columbia is reflected also by Jeletzky and Tipper (1968, p. 84) who indicate that post-Monach non-marine sediments are "lumped together with Gething Formation."

Between Peace and Halfway Rivers, the formation averages about 1,100 feet and attains a maximum of 1,300 feet at Fiddes Creek (sec. 62–11). It maintains that thickness along the western Foothills almost to Prophet River but thins eastward in the Foothills to about 900 feet. A strong deflection in isopach trends toward the northeast in the vicinity of Halfway River may represent in-filling of a major channel cut in underlying beds by the pre-Bullhead erosion. Such features are known to exist in the Plains east of the Alaska Highway where a well-developed drainage system was superimposed on Jurassic and Triassic rocks.

The pattern of isopachs (Fig. 2) between Prophet and Tetsa Rivers indicates a northwesterly trending embayment bordered on the northeast by land. The formation thins rapidly to about 500 feet at Gathto Creek (sec. 64–24) and to only about 50 feet of sandstone at Chlotapecta Creek. Much of the decrease is related to depositional convergence, but in the northeast some may be due to non-deposition of beds equivalent to the basal Gething of more southerly regions.

The zero edge of the Gething Formation is fairly well defined (Fig. 2) by the subsurface control that is available from wells drilled in the region. The edge has a southeasterly trend between Tuchodi and Buckinghorse Rivers but assumes a more easterly trend south of Sikanni Chief River. North of Buckinghorse River the Gething sediments are therefore rather narrowly limited to the region west of the Alaska Highway. To the southeast, however, the zero isopach is subparallel to the main axis of the major lobe extending from the upper reaches of the Pine and Peace Rivers and represents the northern limits of that major delta. The zero edge in this region is a depositional edge marking the maximum transgression of coarse clastics before the major advance of the boreal incursion represented by the younger overlying Fort St. John shale.

A series of islands extending from southern Manitoba northwesterly across the Plains into northeastern British Columbia was outlined by Rudkin (1964, p. 161) in his discussion of the regional geology of the Lower Cretaceous unit that included the Cadomin and Gething Formations. He indicated that those islands paralleled the sub-Cretaceous subcrop pattern and are formed by ridges of relatively resistant Devonian and Mississippian beds. It is clear from Rudkin's isopach and lithofacies map (op. cit., Fig. 11–2) that a large island separated the region of Gething deposition from that of McMurray deposition along the west edge of the craton. The zero isopach of the Gething marks the western edge of that island.

Lithology and Facies Variations

The Gething Formation is a heterogeneous stratigraphic unit containing several distinct but genetically related lithofacies. These include: (1) chert pebble conglomerate and conglomeratic to coarse-grained sandstone; (2) fine-grained sandstone; (3) a cyclical coal-bearing succession; (4) dark grey marine siltstone and mudstone; and (5) glauconitic argillaceous sandstone, siltstone, and mudstone.

Chert pebble conglomerate facies: Chert pebble conglomerate and conglomeratic coarse-grained sandstone, similar to those of the Cadomin Formation, occur sporadically throughout the formation but are most common in the lower beds. Clasts, almost entirely of pebble size, are similar in composition to those of the Cadomin conglomerate. The pebbles, commonly rounded to well rounded, are embedded in a matrix of coarse- to fine-grained sandstone, similar to other sandstone within the formation. The conglomeratic sandstone occurs in 5-foot to 40-foot units that weather grey. Bedding is not always apparent but both planar and crossbedded units are present.

The cumulative thickness of conglomerate and conglomeratic sandstone was plotted for each described section north of Peace River (Fig. 5). Four fairly well defined belts of conglomeratic deposits trend northeasterly across the basin approximately perpendicular to the regional depositional strike. They appear to represent channel deposits of major streams except for the most northerly belt which contains only a thin deposit of 10 feet or less. The next belt to the south, more than 60 feet thick at Trimble Lake and to the east near Besa River, occurs in the middle of the Gething Formation. The more southerly accumulations represent thick channel deposits formed during the early phases of Gething deposition. The major accumulation at Peace River canyon extends eastward to the Imp. Calvan Altares and Imp. Pac. Groundbirch wells and into Moberly Lake and Chetwynd areas, indicating an extremely broad deltaic plain over which the major river distributed its load. A second major lobe, probably representing another river system, is centred between Mount Belcourt and Wapiti River.

Fine-grained sandstone facies: Fine-grained sandstone dominates the Gething Formation, particularly from Sikanni Chief River northward. It is evenly bedded and commonly finely laminated. The sandstone units, ranging from a few inches to several tens of feet, commonly are separated by recessive intervals of dark grey, silty, rusty weathering mudstone. The sandstone is siliceous, platy to thick bedded, and weathers rusty brown. A few beds of medium- to coarse- grained sandstone may be associated with the finer sandstone.

The sand–shale ratio was calculated from the thicknesses of each lithologic type recorded in the described sections. Those values were plotted and contoured to determine those areas in which sandstone was most abundant (Fig. 6). Ratios were not plotted in the southern part of the region because sections are lacking between Graham and Peace Rivers. In general, the sandstone is concentrated along the western side of the trough and the shale content increases along the eastern margin. Four major lobes of sandstone occur

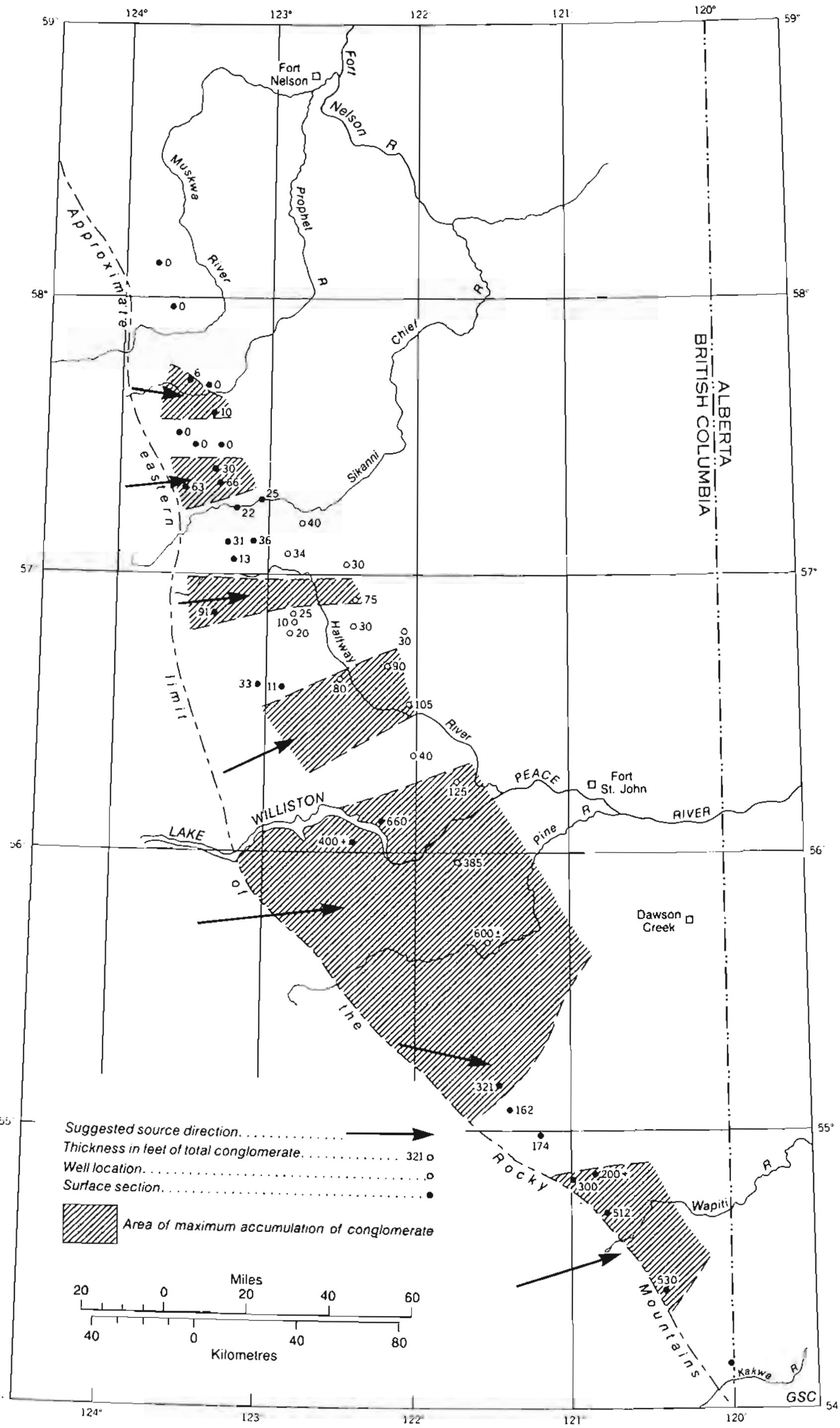

FIGURE 5. Map of concentration of conglomerate in Cadomin, Gething, and Bluesky Formations

north of Peace River, the axis of each trending approximately perpendicular to the regional depositional strike determined from the isopach map (Fig. 2). These axes correspond to a remarkable degree with the four major accumulations of conglomerate. Inasmuch as the argillaceous beds in the contoured region are predominantly marine, the area of high shale content outlines the marine embayment during Gething time.

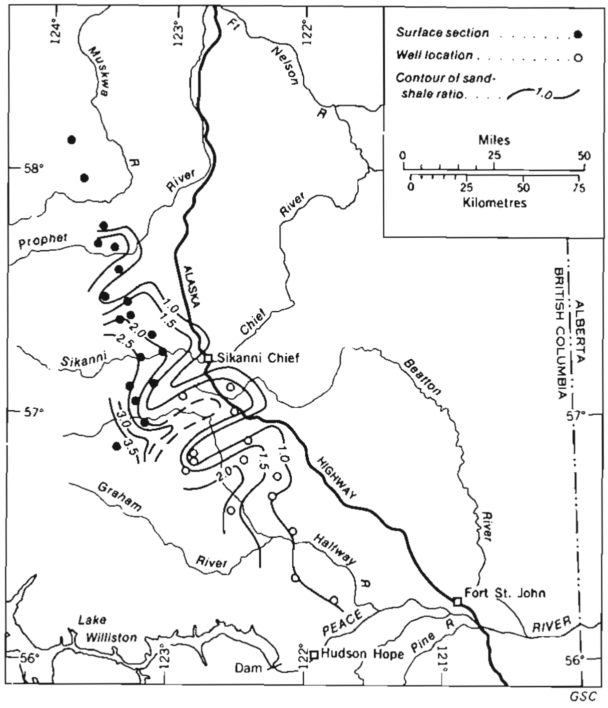

FIGURE 6

Map of sand-shale ratio of Gething Formation

Coal-bearing succession: The coal-bearing succession consists of a cyclic succession of fine- to coarse-grained sandstone, argillaceous sandstone and siltstone, silty and sandy clay, shale and mudstone, carbonaceous shale, and coal seams. A rhythmic type of sequence occurs within the Peace River canyon exposures (sec. 68–18), and consists of in ascending order: (a) fine-grained sandstone; (b) carbonaceous mudstone; (c) coal or coaly mudstone; (d) silty brown mudstone grading into dark grey to black mudstone, and (e) siltstone. The basal sandstone is commonly poorly sorted, is crossbedded in part, and fills scours in the underlying strata. The sandstone becomes siltier toward the top, is commonly finely and uniformly laminated, and is flaggy to thin bedded. The overlying mudstone is dark brown to olive-brown, is generally structureless, contains traces of rootlets and other plant fragments, and commonly contains thin concretionary layers. That sequence grades into the overlying coal or coaly mudstone. In many cycles, dark grey to black mudstone has yielded microfauna indicating that the beds are of marine origin. The upper sequence in places grades transitionally into argillaceous siltstone or silty sandstone or shows an erosional surface overlain by basal sandstone of the next cycle. This coal-bearing succession grades laterally northward into the lithofacies of fine-grained sandstone.

Dark grey siltstone and mudstone facies: Marine mudstone and siltstone, appearing near the top of the formation at Sikanni Chief River, become more prominent and abundant northward. The silty mudstone contains reddish brown weathering, sideritic (clay ironstone) concretions. The mudstones are dark grey to black, weather rubbly to blocky and commonly have a rusty, weathered surface. A rhythmic or cyclic development occurs within those beds. Rubbly to platy mudstone grades upward into silty, blocky mudstone or siltstone and, in many places, into platy, fine-grained sandstone. Those sediments resemble very closely the mudstone of the overlying Buckinghorse Formation.

Glauconitic facies: The glauconitic mudstone, siltstone, and sandstone which form a diagnostic unit at the top of the formation are part of the marine facies and grade southwesterly into glauconitic sandstone, conglomeratic sandstone, and conglomerate. This unit of glauconitic, silty sediments, marking the upper limit of sandstone development in the Prophet River region, represents some part of the Bluesky Formation, an extremely glauconitic sandstone found in the subsurface of the Peace River Plains (*see* Alberta Study Group, 1954). That unit in the Foothills ranges from 5 to 20 feet thick and weathers greenish brown. In some places, the uppermost beds are concretionary and the contact with the overlying Buckinghorse shale is abrupt. In other places, the contact has a more transitional appearance.

Regional relationships: A fairly well developed three-fold division appears possible throughout much of the southern half of the region: (1) basal conglomeratic beds with carbonaceous sediments; (2) dominantly carbonaceous and argillaceous sediments with fine-grained sandstone; and (3) a major cycle of shale and conglomeratic sandstone. Between Halfway and Sikanni Chief Rivers, this tripartite division is replaced laterally by an almost continuous succession of fine-grained sandstone which, in turn, grades laterally northward into another tripartite succession. The latter consists of two thick sequences of fine-grained sandstone separated by concretionary mudstone and siltstone (Pl. VIII).

Upper beds of the formation grade laterally northwestward from Prophet River into thinly interbedded sandstone and shale until, finally, almost all the sandstone is replaced by shale north of Chlotapecta Creek. Where the upper glauconitic unit is no longer distinct, the shale is included in the Buckinghorse or Garbutt Formation. Although a thin unit of sandstone, about 50 feet thick on Chlotapecta Creek and only a few feet thick at Mile 375 on Alaska Highway, may be equivalent to some part of the Gething, it has been mapped with the overlying Buckinghorse shales.

The regional variations within the Gething Formation are illustrated in a series of columnar sections (Figs. 7 to 14). The first two parallel approximately the present tectonic trend of the Foothills; the remaining six are transverse to that trend (Fig. 1). The pertinent details concerning each figure are outlined in the following discussion. An attempt is made in several of the sections to relate the surface sections to nearby well sections. The main datum used in these figures is the top of the Gething Formation. Where the upper beds of the Gething have been eroded or are not exposed, the base of the formation is used as a secondary but much less valid datum.

Regional Relationships

Pine River to Prophet River (Fig. 7, in pocket)

This cross-section includes the thickest and most westerly sections of the Gething Formation now preserved. It extends from Bullmoose Mountain (sec. 70–4) to Sun *et al.* Chetwynd 14–20–77–23 well (14–20–77–23W5) near Pine River, to the type section at Peace

River canyon, thence eastward into the subsurface at West Canadian Moberly Lake 11–36–80–25 well, and from there northward across Halfway River to Prophet River (Fig. 1).

Logs of both the Sun *et al.* Chetwynd 14–20–77–23 and West Canadian Moberly Lake 11–36–80–25 wells are similar to the section at Bullmoose Mountain and all correspond reasonably well to the canyon sections.

Thicknesses of the Cadomin Formation range from 276 feet at Bullmoose Mountain to 440 feet and 386 feet at Sun *et al.* Chetwynd and West Canadian Moberly Lake wells respectively; these are reduced considerably from the more than 700 feet occurring at the Peace River canyon. Overlying coal-bearing strata of the Gething Formation are 1,800 feet thick at the type locality but are 713 feet and 841 feet thick respectively in the wells. The 1,265 feet at Bullmoose Mountain lies between the maximum and the thicknesses encountered in the wells. Total thicknesses of the Bullhead Group in the wells are 1,153 feet and 1,227 feet compared with 1,541 feet at Bullmoose Mountain and more than 2,500 feet in the canyon.

Two sections north of Graham River (62–1, 62–13) contain large covered intervals but provide a measured thickness of about 1,300 feet, which compares well with that in the West Canadian Moberly Lake well and with that of the Fiddes Creek section (62–11). The latter is one of the best exposed and most complete sections in the region, providing excellent control within the central part of the region. Its thickness of 1,300 feet appears to be almost a maximum for the most westerly sections. Farther north, the upper contact with the overlying Buckinghorse shale was not found in most localities but complete sections were obtained at Nevis Creek (sec. 64–17) and Besa River (64–15) where the thicknesses are 1,331 feet and 1,330 feet respectively.

The Cadomin conglomerate is not recognized in sections north of Graham River. Some thin beds, streaks, and lenses of conglomerate do occur within the basal part of the Gething but do not form a well-defined unit. At Horseshoe Creek (sec. 62–1), the lower 34 feet includes medium- to coarse-grained, conglomeratic sandstone with pebbles as much as 2 inches in diameter. At Fiddes Creek (sec. 62–11), the basal 170 feet is formed of thick-bedded to massive sandstone with lenses and beds of coarse-grained and conglomeratic sandstone. Several beds of conglomerate occur in sections just north of Halfway River (secs. 62–9, 62–6). In other western sections not shown on the figures, massive conglomerate, 63 feet thick at Trimble Lake (sec. 64–7), occurs 400 feet above the base of the formation. Near Chowade River (sec. 62–13), the basal 46 feet contains two beds of massive conglomeratic sandstone.

Coal seams are prominent within the Gething Formation at the type locality and occur in the two wells in the southern part of the region. To the north, however, major seams do not appear to be present and even thin coal seams are rare north of Sikanni Chief River. Coal beds may be present in the recessive covered intervals at Horseshoe Creek (sec. 62–1) and Chowade River (sec. 62–13) but only traces of carbonaceous sediments occur at Fiddes Creek (sec. 62–11). The northern limit of well-developed coal seams appears to be in the vicinity of Sikanni Chief River.

The dominant type of lithology between Graham River and Besa River, particularly in the lower two-thirds of the formation, is fine-grained, medium- to thick-bedded sandstone. The sandstone units are commonly separated by as much as several tens of feet of dark grey, rusty weathering, rubbly mudstone. Only a few beds of carbonaceous shale appear north of Besa River and no coal seams were observed in that region.

North of Halfway River, much of the upper sandstone is replaced by platy siltstone and blocky, dark grey mudstone. An upper recessive unit at Fiddes Creek (sec. 62–11) south of Halfway River appears to be equivalent but also may contain carbonaceous beds. The upper shaly beds have a transitional appearance between the thick Gething sandstone and the overlying Buckinghorse shale. The unit of highly glauconitic sandstone to siltstone occurs at the top of the formation north of Sikanni Chief River and forms the datum for the cross-sections. The glauconitic beds provide a widespread and extremely useful datum for the establishment of regional relationships.

Cypress Creek to Gathto Creek (Fig. 8, in pocket)

Six wells are included to show the character of the Gething Formation in the area between Peace and Halfway Rivers and the relationships between the subsurface and the most similar outcrop sections occurring along the regional trend.

The southernmost wells, Imp. Pac. Groundbirch 5–5 (5–5–84–24W6) and Imp. Calvan Altares 83–A (83–A/94–B–8), lie farther from the Foothills than any of the others and, as shown by the isopach map (Fig. 2), lie east of the maximum accumulation of Gething sediments. The maximum thickness of this line of section is reached at Pink Mountain (sec. 62–3) and about the same thickness is maintained to the junction of Nevis Creek and Besa River (sec. 64–16). Between there and Prophet River, a reduction of 200 feet occurs as indicated by three sections (64–19, 64–20, and 64–21) which have almost identical thicknesses of about 850 feet. That thickness is maintained in the vicinity of Bat Creek (sec. 64–22) where 887 feet was measured, but another marked decrease occurs farther north at Gathto Creek (sec. 64–24) where thickness is only 517 feet.

A basal unit of conglomerate or conglomeratic sandstone occurs in all the wells. The largest accumulation of conglomerate, extending through 150 to 200 feet of beds, is present at Imp. Pac. Groundbirch 5–5 and Imp. Calvan Altares 83–A wells. Those wells lie just east of Butler Ridge in the area of greatest concentration of conglomeratic sandstone in the Foothills. Conglomerate decreases northward in the HB Chowade b-18–J well (b–18–J/94–B–10) and HB Cypress a–86–C and a–28–F wells, occurring only in the basal 30 to 40 feet. Conglomeratic sandstone, 55 feet thick, is well developed at Pink Mountain (sec. 62–3) but is present only as thin beds or lenses north of there. Pebbles and coarse-grained sandstone occur at the base of the formation at Sikanni Chief River (sec. 61–4) and Chicken Creek (sec. 64–18).

Coal seams, carbonaceous mudstone, and siltstone occur within all the wells. No coal seams were observed in the lower 500 feet of the Gething along the west flank of Pink Mountain (sec. 62–3) although a thick seam occurs at the south end of the mountain close to the base of the formation[1]. A few thin coal layers were observed on Sikanni Chief River near Chicken Creek (secs. 61–3, 61–4) but none in sections northward beyond there.

Fine-grained, thick-bedded to massive sandstone dominates the lower two-thirds of the formation from Pink Mountain north to Besa River (sec. 64–16) but shale intervals become thicker and more numerous between there and Prophet River (sec. 64–21). Dark grey to black, sideritic mudstone and shale are well developed throughout much of the formation at Bat Creek (sec. 64–22) and Kluachesi River (sec. 64–23).

The upper beds at Imp. Calvan Altares 83–A, Imp. Pac. Groundbirch 5–5, and Texaco NFA Cameron River (d–43–H) wells consist of conglomerate and conglomeratic sandstone with pebbles as much as 1 inch in diameter. Glauconite occurs abundantly within those sediments and also in the fine-grained sandstone at the top of the Gething in the HB Cypress wells. At Pink Mountain (sec. 62–3), the uppermost beds are shaly, apparently representing

[1]Thicknesses there are not readily determined because of folding. The coal overlies conglomeratic sandstone with cobbles as much as 5 inches in diameter which in turn lies on Fernie shales. Pink Mountain presumably derives its name from the pink to red coloration of rocks baked by fires within this coal seam.

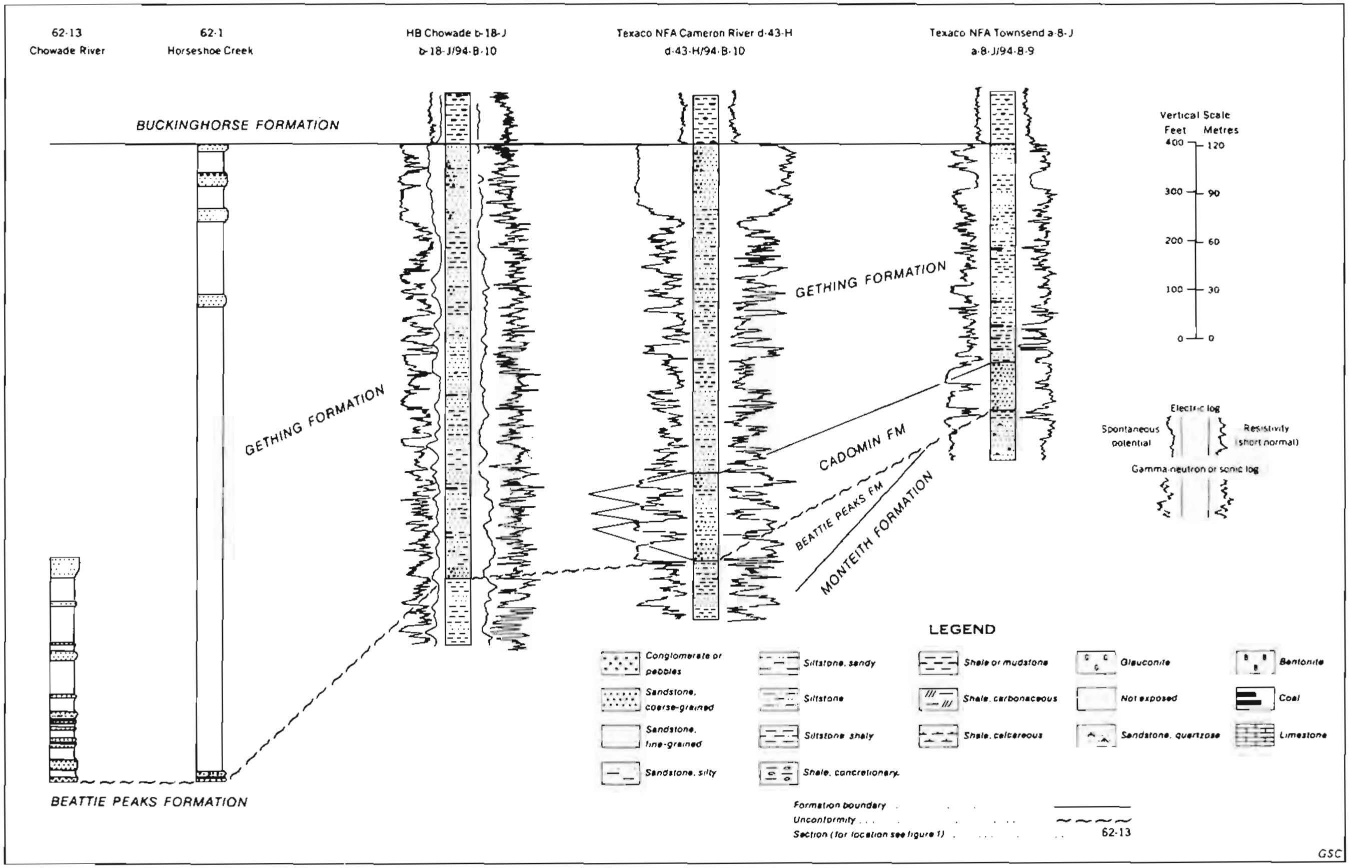

FIGURE 9. Columnar sections of Bullhead Group, illustrating variations in lithologies, facies and thicknesses between Chowade River and Texaco NFA Townsend a-8-J

northward transition from sandstone to shale. The glauconite marker is well developed at one locality along Sikanni Chief River and is prominent at Prophet River and in more northerly sections.

Chowade River to Texaco NFA Townsend a–8–J well (Fig. 9)

This cross-section, based on two poorly exposed surface sections and three wells, illustrates the pronounced eastward decrease in thickness of the Gething Formation. Although the Horseshoe Creek section (62–1) can be judged only as an approximation, the thickness of 1,300 feet corresponds closely to that of sections 62–11 and 68–11 farther north (*see* Fig. 7). However, in the HB Chowade b–18–J well (b–18–J/94–B–10), the formation is less than 900 feet thick; in Texaco NFA Cameron River d–43–H well (d–43–H/94–B–10), it is 850 feet and in Texaco NFA Townsend a–8–J well (a–8–J/94–B–9) is only 550 feet thick. The thickness of the formation decreases eastward at a rate of about 25 feet per mile.

A basal conglomeratic facies does not appear to be well developed in the two outcrop sections, being present only in the lower 10 to 20 feet. Admittedly, exposures are poor but if conglomeratic sandstone was present, it would likely form resistant ridges. In contrast, conglomeratic beds are well developed in the wells, where they occur in the basal 50 feet of HB Chowade b–18–J well, through 150 feet in the Cameron River well, and form the basal unit of about 100 feet in the Townsend well. Large fragments of chert, quartz, and quartzite in the samples suggest the presence of pebbles and cobbles. The conglomerate probably represents a channel deposit that was not encountered in outcrop. Alternatively, the main development of the conglomeratic facies in that region may be on the eastern side of the basin.

Carbonaceous sandstone and mudstone in the Townsend well form about 300 feet of section above the conglomeratic facies. Several coal seams and very fine grained, carbonaceous sandstone occur within the succession. This facies extends westward to the Cameron and Chowade wells but coal seams and carbonaceous sediments are much less abundant, being replaced westward by fine-grained sandstone and dark mudstone.

The upper 200 feet of the formation in the Chowade and Cameron wells consists of shale, relatively clean, fine-grained sandstone, and conglomerate. The conglomerate decreases eastward and is almost absent in the Townsend well.

Fiddes Creek to Gulf States Gundy Creek No. 4 well (Fig. 10, in pocket)

Two of the most completely exposed surface sections (62–11 and 68–9) of the Gething Formation are included in this diagram. These lie within the western Foothills and about 50 miles from the most easterly well (Fig. 1).

Pronounced eastward decrease in thickness is again evident; the formation decreases from 1,300 feet at Fiddes Creek to slightly more than 300 feet in Gulf States West Gundy Creek d–4–B well (d–4–B/94–B–16). The rate of decrease, 20 feet per mile, is not entirely uniform; the greatest change appears between the Foothills and the nearest wells in the Plains.

Conglomerate occurs at the base of the formation in all sections with the exception of the Halfway outcrop section, although some conglomerate was noted there on the ridge above the line of measured section. At Fiddes Creek, the basal 90 feet includes fine-grained, massive sandstone overlain by 80 feet of massive, fine- to coarse-grained sandstone with lenses and beds of conglomerate. Conglomeratic sandstone, represented in well cuttings by chert fragments and small pebbles in a sandy matrix, is best represented in the basal 60 feet of Phillips Blair A–1 (85–E/94–B–16) well and the basal 70 feet of Gulf States Gundy Creek (d–4–B/94–B–16) well.

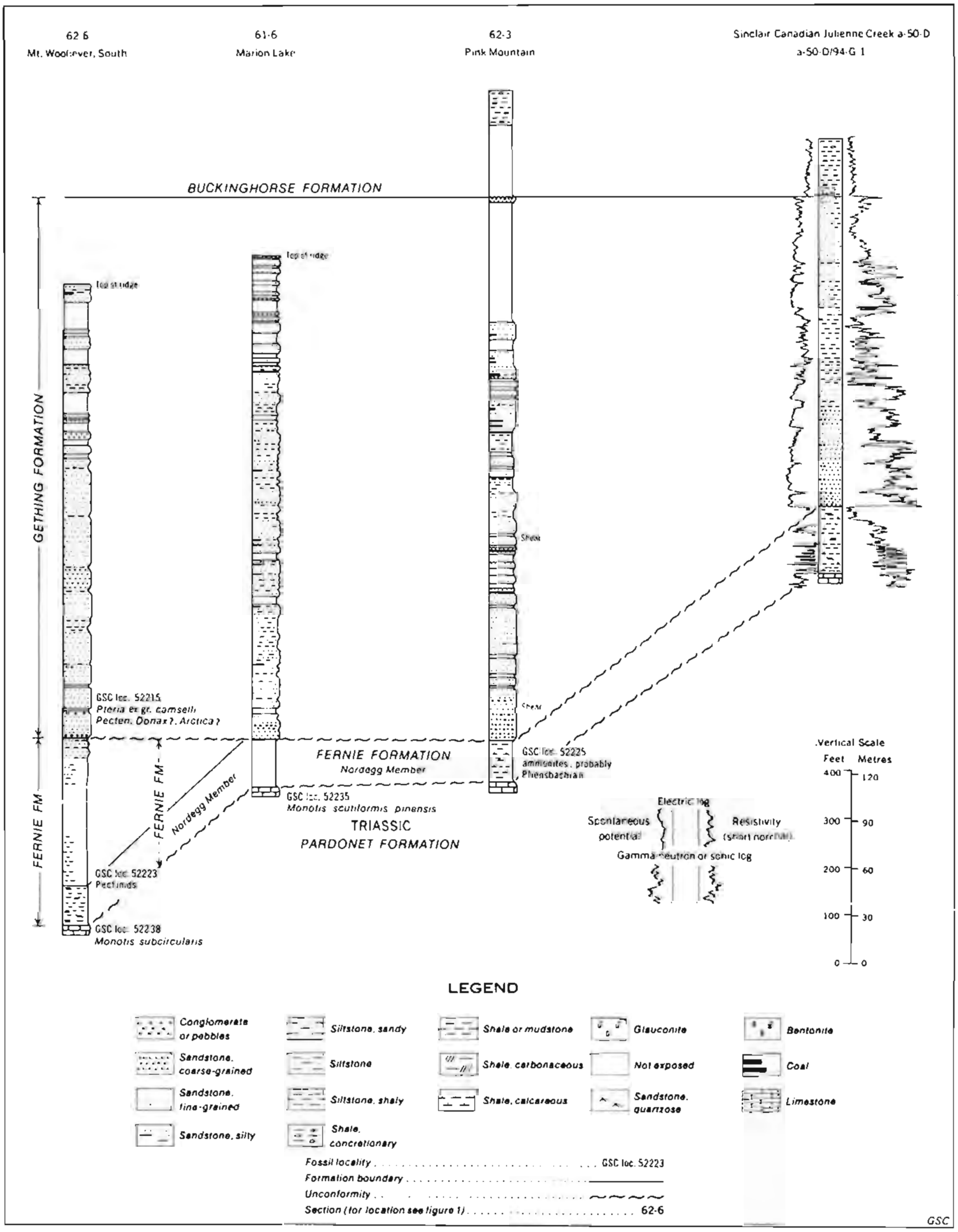

FIGURE 11. Columnar sections of Bullhead Group, illustrating variations in lithologies, facies and thicknesses between Mount Wooliever and Sinclair Canadian Julienne Creek a-50-D

The middle part of the formation in this region changes from fine-grained sandstone in the western Foothills to interbedded mudstone and sandstone farther east. Carbonaceous sediments with a few thin coal seams form a smaller proportion of the total succession than in sections farther south.

The upper part of the formation is not well exposed at Fiddes Creek, but to the east (sec. 68–9) it is dominated by silty, rubbly to blocky mudstone with units of fine-grained, flaggy to thin-bedded sandstone. Sandstone is more abundant in the easternmost wells. In the Cypress well the uppermost beds include highly glauconitic siltstone and mudstone with some glauconitic sandstone and fine conglomerate. Similar sediments occur at the top of the formation in the other wells although the abundance of pebbles appears to decrease eastward.

Mount Wooliever to Sinclair Canadian Julienne Creek a–50–D well (Fig. 11)

The base of the Gething Formation is used as the datum for the Foothills sections because the upper beds of the formation are not present in the westernmost sections. It is possible that the top of the formation is incorrectly placed at Pink Mountain (sec. 62–3) as exposures are very poor but the total thickness is about the same as that of nearby sections at Sikanni Chief River (sec. 61–3, 61–4) and Chicken Creek (62–18) (*see* Fig. 8). The variation in thickness is not readily determined because the western sections are incomplete. The formation decreases from 1,130 feet at Pink Mountain to 640 feet at Sinclair Canadian Julienne Creek a–50–D well (a–50–D /94–G–1), thinning at a rate of about 30 feet per mile.

Conglomeratic sediments occur through 200 feet of strata in the Julienne Creek well and through the basal 80 feet at Pink Mountain. Conglomerate is less abundant at Marion Lake (sec. 61–6) and Mount Wooliever (sec. 62–6).

The carbonaceous facies is developed mainly at Pink Mountain although several thin seams occur at Marion Lake. At Mount Wooliever, most of the section is fine-grained sandstone with only a few thin intervals of carbonaceous sediments. Coarse-grained sandstone also appears in the middle part of the formation which, to the east and south, contains more carbonaceous sediments.

The upper part of the formation in the outcrop sections consists of thin sandstone units with many recessive interbeds, presumably composed of shale. The uppermost 250 feet at Pink Mountain is recessive and covered. To the east at Sinclair Canadain Julienne Creek well, the upper part of the formation consists mainly of fine-grained sandstone with some traces of coarser sandstone and intervals of black mudstone and argillaceous siltstone. The uppermost 20 feet contains glauconitic, fine to very fine grained sandstone, in part argillaceous.

Trimble Lake to Sinclair et al. Lily d–12–K well (Fig. 12)

This cross-section lies some 10 to 15 miles north of that shown in Figure 11 and is similar in overall features. The western sections are incomplete, and the base of the Gething is used once more as the datum. It is possible that the uppermost exposures at Nevis Creek (sec. 62–17) and Sikanni Chief River (sec. 61–5) are the top beds of the formation but comparison with complete sections at Fiddes Creek (sec. 62–11) to the south and another section north of Nevis Creek (sec. 64–17; *see* Fig. 7) suggests that some Gething beds are not exposed.

The thickness of the Gething along this line of section decreases from about 1,300 in the western Foothills to about 1,100 feet at Chicken Creek (secs. 61–3, 61–4) and 574 feet at Sinclair *et al.* Lily d–12–K well (d–12–K /94–G–2).

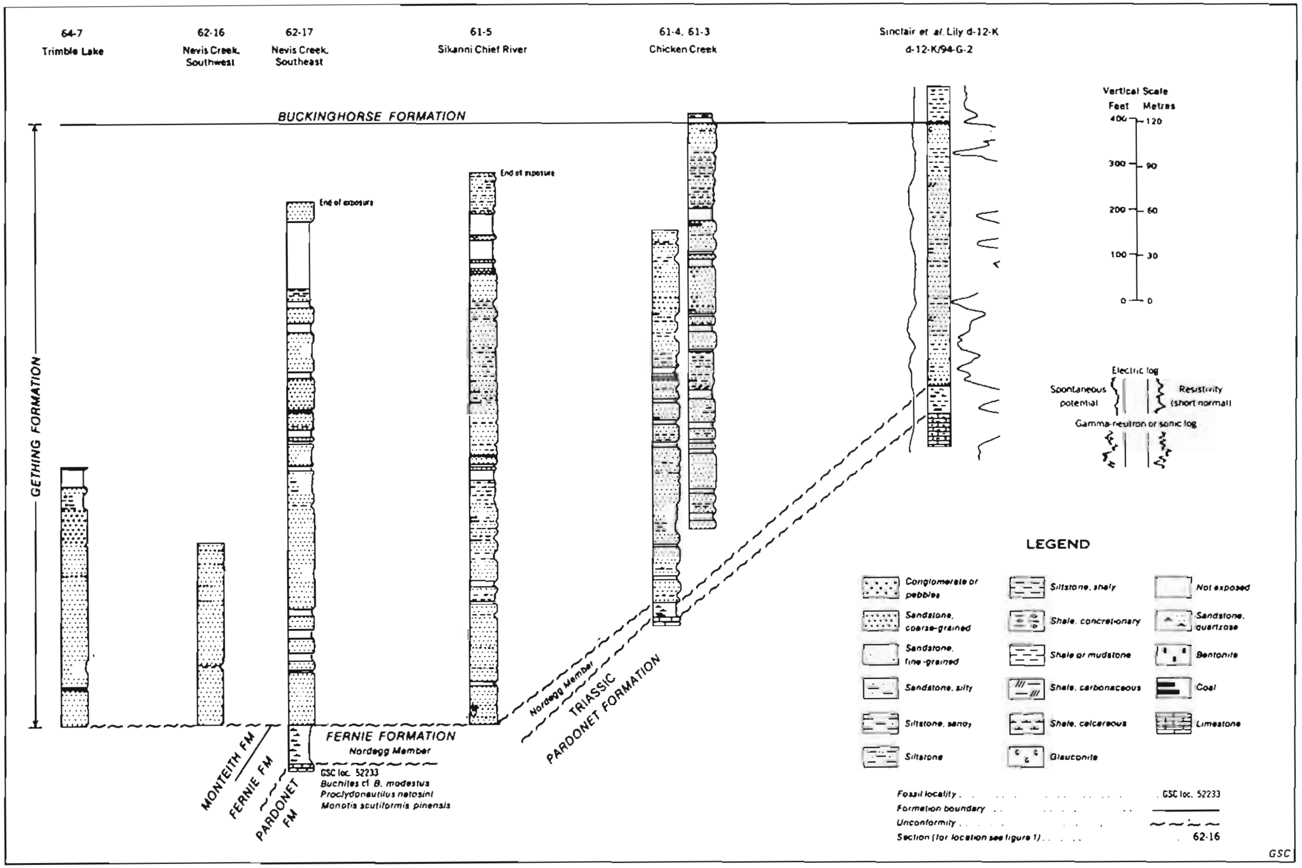

FIGURE 12. Columnar sections of Gething Formation, illustrating variations in lithologies, facies and thicknesses between Trimble Lake and Sinclair et al. Lily d-12-K

Only minor amounts of conglomerate occur within the basal beds, except on Sikanni Chief River (sec. 61–5) where the total thickness of conglomeratic sediments is about 50 feet. Farther east at Chicken Creek, only coarse-grained sandstone is present. Conglomerate is more abundant in the middle part of the formation, particularly in the vicinity of Trimble Lake and Nevis Creek.

The carbonaceous facies is developed in the eastern Foothills near Sikanni Chief River, where more sandstone is present than farther south. A few traces of coal were noted in the cuttings from the Lily well.

The uppermost beds at Chicken Creek comprise fine-grained, brownish grey sandstone with some interbedded shale and siltstone. Upstream from the measured section, two beds of extremely glauconitic concretionary siltstone overlie fine-grained Gething sandstone. At the Lily well, the uppermost beds consist of well-sorted to argillaceous sandstone. Small pebbles occur at the top of the formation in the nearby West Canadian Lily Lake c–81–F well.

Nevis Creek to BA HBW Pocketknife b–6–I well (Fig. 13)

This cross-section lies about 8 miles north of that shown in Figure 12 and reveals a marked facies change. The thickness decreases from 1,300 feet at Nevis Creek (sec. 64–17) to 634 feet at BA HBW Pocketknife b–6–I well (b–6–I/94–G–6), thinning at the rate of 60 feet per mile.

The whole formation there is composed of a single facies comprising fine-grained sandstone with some intercalated thin beds of marine shale. The basal conglomeratic facies is absent both in the surface outcrops within the Foothills and in the subsurface of the Plains. As in the two previous cross-sections, some conglomerate is present within the middle to upper part of the formation but is concentrated in the westernmost section. The carbonaceous facies is absent and is replaced totally by fine-grained sandstone and shale.

The uppermost beds at Nevis, like those in most of the other Foothills sections, contain much interbedded shale and are almost transitional between the thick-bedded Gething sandstone sequence and the rubbly mudstone of the overlying Buckinghorse Formation. A similar zone is present in the Pocketknife well where some sandstone with fine conglomerate is overlain by a few feet of argillaceous, glauconitic sandstone. Mudstone of the overlying Buckinghorse Formation contains traces of glauconite and the lowermost Buckinghorse samples are abundantly glauconitic and include small black chert pebbles.

Besa River to CDR Pac. Sinc. Prophet d–21–B well (Fig. 14)

This cross-section reveals the most marked eastward decrease in thickness found within the region. The westernmost section (64–15) is 1,320 feet thick, which is nearly the maximum found along the Foothills north of Peace River. In the eastern Foothills the thickness is approximately 850 feet (secs. 64–20, 64–21), but the entire formation is missing in the CDR Pac. Sinc. Prophet d–21–B well, some 25 miles to the northeast. It is apparent that the cross-section depicts the on-lap of Gething sediments from the centre of the trough on the west toward the positive land area on the east.

Again, the dominant facies is fine-grained sandstone and shale. A thin unit of conglomeratic sandstone and some carbonaceous sediments occur in the middle of the formation at Besa River (sec. 64–20). A thin coal seam is present near the base of the section at Prophet River.

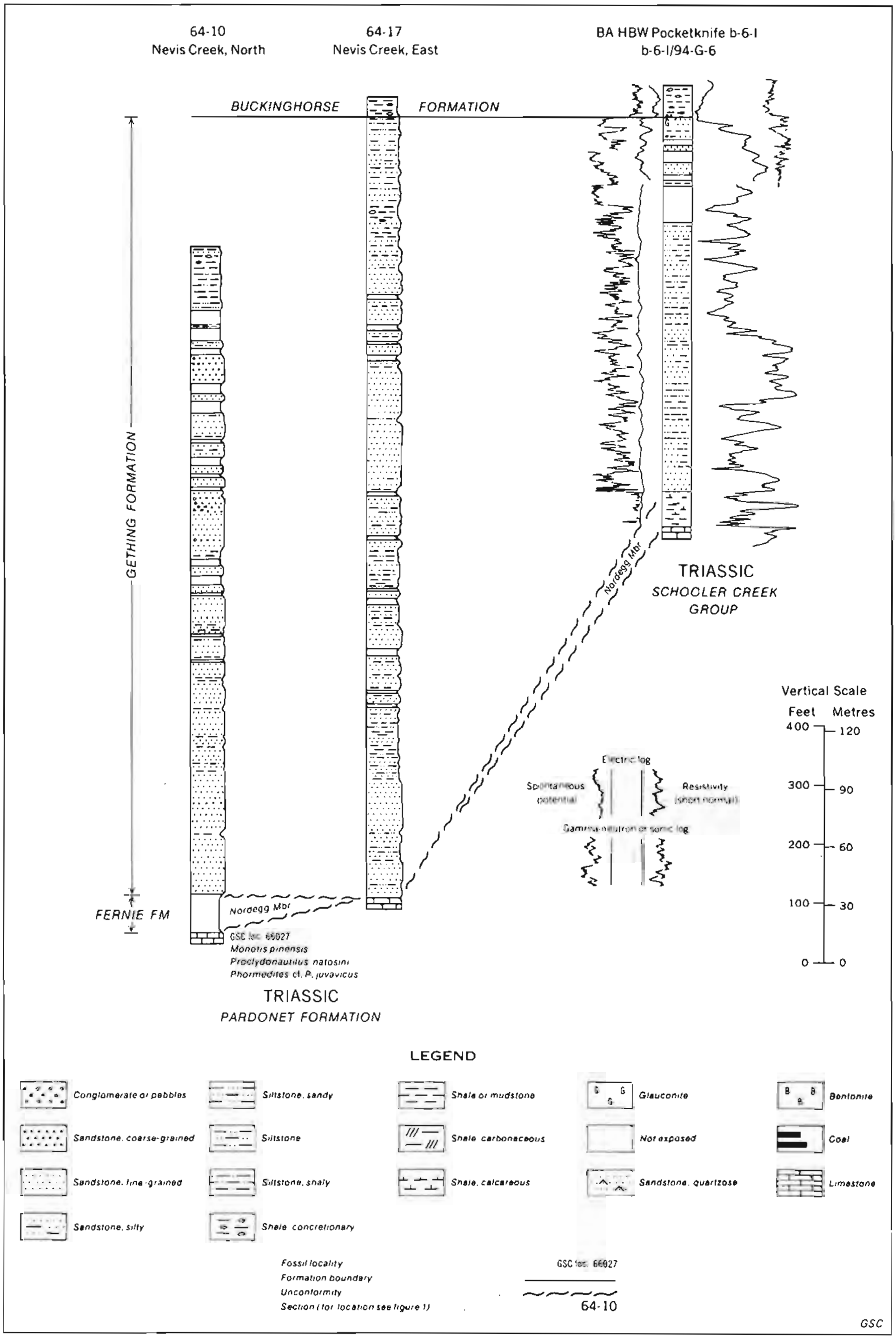

FIGURE 13. Columnar sections of Gething Formation, illustrating variations in lithologies, facies and thicknesses between Nevis Creek and BA HBW Pocketknife b-6-I

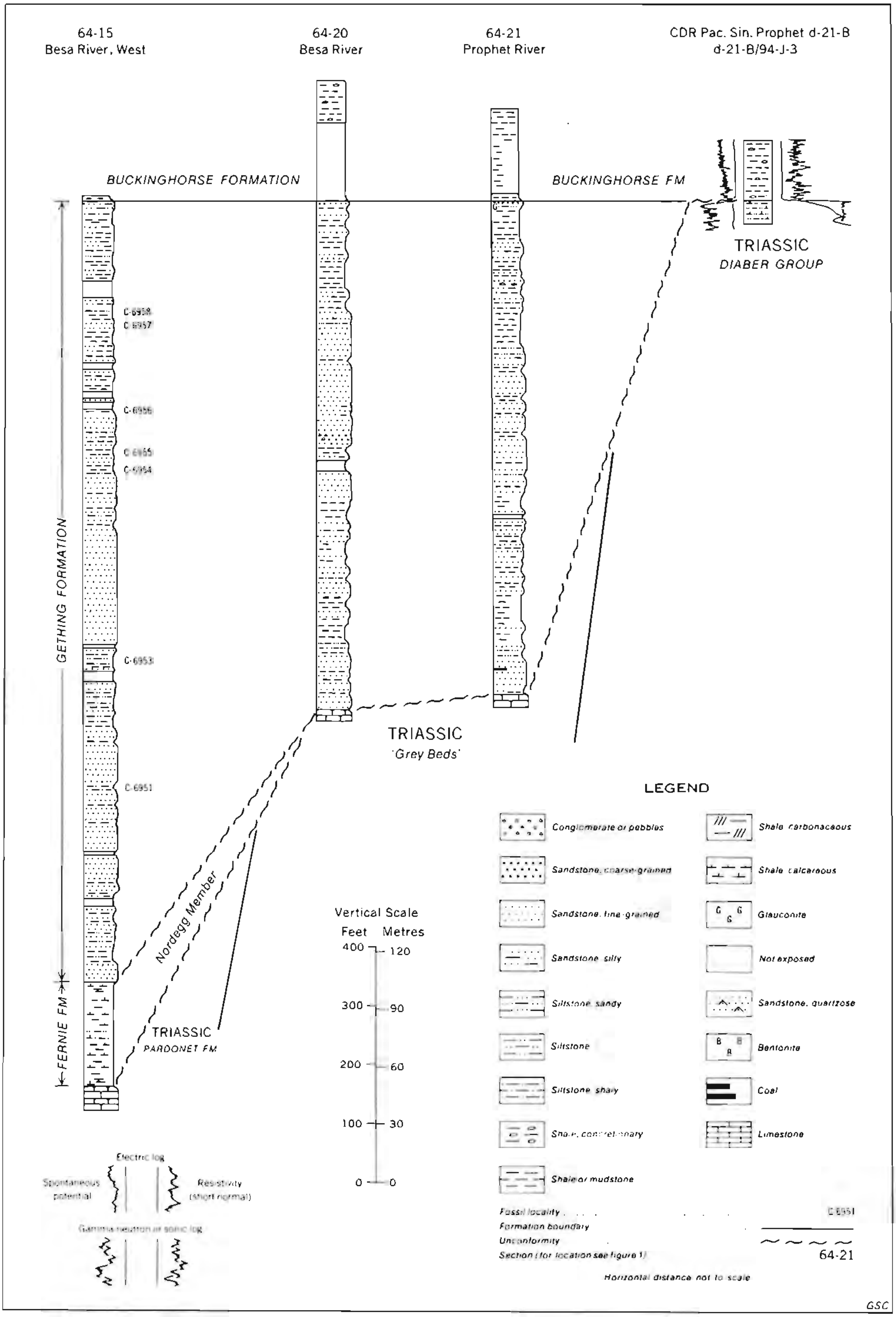

FIGURE 14. Columnar sections of Gething Formation, illustrating variations in lithologies, facies and thicknesses between Besa River and CDR Pac. Sinc. Prophet d-21-B

Shale is more abundant at this latitude than farther south. The upper third of the formation in the westernmost section contains many shaly intervals and the overall shale content increases eastward. In the Prophet River section, several thick units of marine shale occur in the upper half of the formation and shale is common throughout the lower part. Glauconitic beds at the top of the formation are best developed in the eastern section on Prophet River.

Summary of Lithology and Facies

The two major facies comprising the conglomeratic sandstone and the coal-bearing succession found at Peace River grade laterally northward into fine-grained sandstone, which in turn grades into dark silty mudstone (Fig. 15, in pocket). The thick succession of conglomeratic sandstone in the vicinity of Peace River canyon thins eastward and northeastward, grading into fine sandstone and carbonaceous sediments. The conglomeratic facies is poorly developed north of Graham River and is nearly absent beyond Sikanni Chief River in the Foothills. A similar type of basal conglomerate appears in the subsurface along the eastern margin of the Gething sediments. Northward, coal-bearing beds are fewer and thickness decreases, being best represented at Peace River canyon. The northern limit of well-developed coal seams appears to lie near Sikanni Chief River. Those beds are replaced laterally by fine-grained sandstone with thin intercalated beds of mudstone. The main development of the fine-grained sandstone facies is concentrated between Sikanni Chief and Besa Rivers. Beyond there, dark grey, marine mudstone and siltstone become more abundant. Sandstone persists farther north along the eastern limits of Gething deposition. The conspicuous glauconitic unit at the top of the Gething Formation is recognized between Sikanni Chief River and Gathto Creek and can be traced into coarser sediments in the wells included in this study.

PETROLOGY

Sandstones

Textural and compositional data on Gething sandstone beds are based on the examination of 200 thin sections taken from field samples collected at most of the described sections. Mechanical analyses using standard sieving techniques were not attempted as the sandstones are extremely well indurated and crushing results in breakage of many grains. For the purposes of heavy mineral analyses, however, samples were crushed. To provide some indication of the matrix content of the sandstone, clay minerals in 26 thin sections were identified by X-ray analyses by A. E. Foscolos.

Gething sandstones are fairly well sorted, typically fine grained but range from very fine grained to conglomeratic, and can be classified as chert (lithic) and quartz arenites to wackes. They are mainly well cemented with secondary silica which results in these rocks having little porosity. The sandstones are dominantly arenites, consisting mainly of quartz and chert with some siliceous lithic fragments; they are grey to brownish grey on a fresh surface but weather pale brown to rusty brown.

Textures and Sorting

The grain sizes of the sandstone range from very fine to very coarse (Pl. XIVa, b). The basal sandstones, particularly near Peace River, are commonly coarser and somewhat more poorly sorted. Sandstones north of Sikanni Chief River are almost entirely fine grained. Considerable variation in sorting was noted although, in the northern region, most of the sandstones are relatively clean and well sorted. Pebbly sandstones and conglomerates are bimodal and examples of bimodal distribution were found in a few of the finer sandstone beds.

Although secondary overgrowths of silica give many grains an angular to subrounded appearance, the original shapes are still indicated (Pl. XIVc, d) by rims of microscopic inclusions. The original quartz grains appear to be rounded to well rounded. Chert grains are well rounded. The sphericity of chert pebbles is less than that of the sand grains. The well-rounded nature of these grains leads to the conclusion that they are products of more than one erosional cycle.

Composition

The detrital constituents of the Gething sandstones of this region are quartz, chert, lithic fragments, and carbonate grains. The matrix is composed of clay, fine silt, and clay-size detritus with some authigenic material. In addition, considerable carbonaceous material occurs in some samples.

Detrital Grains

Detrital quartz, present as very fine to medium, subangular to well-rounded grains, comprises 20 to 100 per cent of the detrital constituents (Pl. XVa). Most grains are free of intense strain features although some show slight undulose extinctions and most contain inclusions, commonly aligned. The inclusions consist of globules of gas and fine micaceous and opaque dust. Secondary quartz overgrowths in optical continuity with original grains occur in most samples (Pl. XIVc, d). Boundaries are commonly straight to concavo-convex although some sutures occur where clay minerals rim the grains. Polycrystalline quartz grains (quartzites) are not common but appear most abundant in the more northerly sections.

Subrounded to well-rounded, fine- to medium-grained chert grains comprise the second most abundant detrital constituent, ranging from 1 to 65 per cent (Pl. XVb). The dominant type of chert has an aggregate texture and is clear. Other types range through shades of grey to dark brown, containing carbonaceous inclusions and phosphatic material. Many grains show traces of fossil fragments and others reveal rounded or spherical patches presumably representing some type of organic structure. There is some evidence of redistribution or recrystallization of chert and many grains appear to have ragged edges. Unlike quartz overgrowths, such authigenic cherty material is difficult to discern.

Feldspar is rare, but occurs as fine, subrounded grains. Most grains are extensively altered and it is possible that much of the feldspathic material has been incorporated in the matrix. Of the few grains observed, all were plagioclase or orthoclase; no microcline was noted.

Rock fragments, ranging from 1 to 10 per cent, occur in most samples. Many are crushed and grade imperceptibly into the matrix. These rock fragments, having an extremely fine texture, are mainly siliceous shales and mudstones, with, rarely grains of fine quartzose sandstone and quartzite.

Carbonate fragments, mainly dolomite, are rare in the region north of Sikanni Chief River but become more abundant in the carbonaceous facies in the vicinity of Peace River (Pl. XVc). The general absence of carbonate detritus is attributed, in part, to the low resistance of carbonate rocks to transportational abrasion and chemical weathering in the source area and possibly in the marine environment. The carbonate grains are commonly about the same size or slightly smaller than the grains of quartz and chert and, because most have suffered some crushing, boundaries are indistinct. Many grains are rimmed with limonite, which penetrates into many cracks within the grains.

Glauconite, a field term used for botryoidal clusters of a green clay mineral, occurs sporadically in Gething sandstone units and is concentrated in an argillaceous unit at the top of the formation at many localities between Sikanni Chief River and Gathto Creek. The sandstone contains much silt-sized to clay-sized particles of chert, quartz, and a clay fraction of chlorite, kaolinite, and illite. Muscovite was observed as single flakes in many samples but is not abundant.

Disseminated plant material is more abundant and coarser in the southern part of the region than north of Peace River. It includes grain-like fragments in the sandstone, concentrations of debris, well-preserved leaves, and even tree trunks and logs.

Samples of sandstone analyzed for heavy minerals required crushing and grinding, resulting in much breakage. The overall results were not satisfactory as the recovery of heavy minerals was only a fraction of one per cent of the total sample. The heavy minerals represent an impoverished suite characterized by rutile, sillimanite, and tourmaline; staurolite, zircon, apatite, and garnet are present also.

Quartz-chert Ratio

The ratio of quartz to chert shows marked variation, not only on a regional scale but also locally within a vertical succession. These two main constituents are inversely proportional; quartz ranges from 20 to 100 per cent; chert ranges from 1 to 65 per cent.

In an attempt to determine if the variation in the quartz-chert ratio was related to regional control, point counts were made of three to four thin sections from each measured section. The percentages of chert and quartz were averaged and the ratios calculated, plotted, and contoured (Fig. 16). The results indicate a marked increase in quartz content northward from Halfway River, with the greatest concentration occurring along the eastern side of the basin in the vicinity of Prophet River. In general, the overall average content of quartz is significantly greater there than in the region south of Peace River.

In addition to the regional variation, the composition of the sandstone units shows some variation locally within the vertical succession. Any increase in grain size is accompanied generally by a corresponding increase in the percentage of chert. Thus, the coarser sandstone beds, commonly found near the base of the formation, contain more chert and less quartz than the finer sandstone beds of the middle and upper part of the formation. Some of the very fine grained sandstones consist almost entirely of quartz. The variation in quartz and chert content, therefore, may be attributed partly to stratigraphic position and partly to grain size which is a function of local sorting.

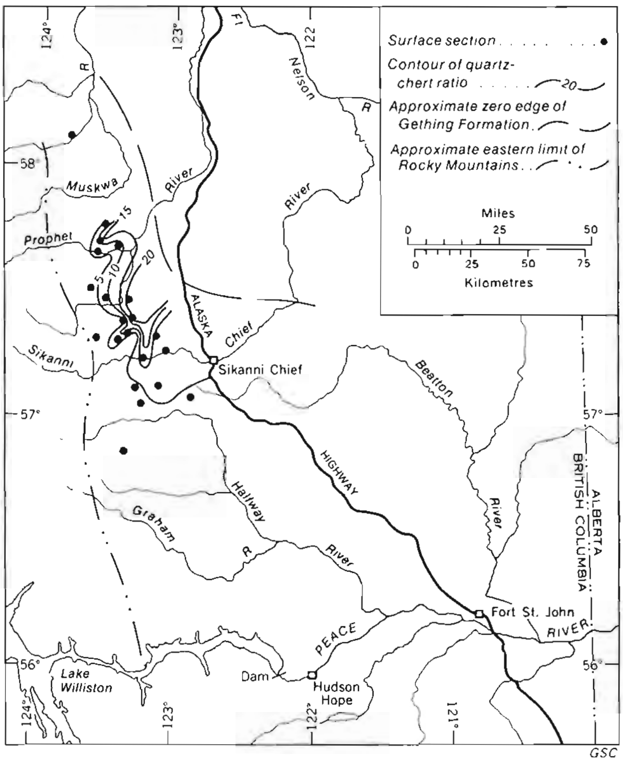

FIGURE 16

Map of quartz-chert ratio of Gething Formation

Matrix

The void-filling material consists mainly of siliceous overgrowths and clay matrix, carbonaceous material, finely divided mica and quartz and minor amounts of calcite cement (Pl. XVd). The finer sandstone beds contain the most matrix which fills or partly fills the space between adjacent grains. Therefore, the finer sandstone beds show a reduction in potential porosity and permeability.

Some of the matrix is formed by crushed detrital grains. Rock fragments and carbonate grains in particular appear to have broken up *in situ* and become inseparable from other clay-sized particles of the matrix. The welded fabric of the Gething sandstones, combined with the complex intergrowths of cementing minerals, matrix, and crushed grains precludes accurate estimates of the total matrix content.

X-ray analyses of four thin sections of samples from the glauconitic unit at the top of the formation, as reported by A. E. Foscolos, indicate an average content of 80 per cent quartz, 4 per cent chlorite, 6 per cent kaolinite, 5 per cent illite, 4 per cent feldspar, and 4 per cent carbonate. X-ray analyses of 22 thin sections of sandstone from various localities show that illite, although present in most samples, occurs only in trace amounts. Traces of feldspar also were found in three samples. Dolomite, occurring as detrital grains, ranges from 1 to 16 per cent. Calcite, ranging from trace amounts to 2 per cent, is commonly found in the form of cement.

Authigenic Minerals

Authigenic quartz occurs in almost all samples examined. It is most abundant in the better sorted sandstones but is present also in those sandstones containing some clay matrix. This secondary growth of silica produces a welded texture (Williams *et al.*, 1954, p. 264; Siever, 1959; Thomson, 1959). In the clean sandstones, quartz overgrowths fill most of the intergranular pore space. The rock then appears to be formed of angular quartz with straight, concavo-convex or sutured boundaries (Pl. XIVa, b). Sutured boundaries are more common where some clay surrounds the original quartz grains. However, in those rocks where clay appears to have filled the intergranular pore space, the development of secondary silica was inhibited and strong silicification did not develop. Many of the original grains are outlined by rims of fine inclusions but the secondary silica is in optical continuity. These rims permit the determination of the original shape of the grains.

Pyrite is found as disseminated, small, euhedral crystals and more rarely as small nodules or aggregates. Much of the limonite, which gives these sandstones a brownish colour, is probably a weathering product of the pyrite.

Porosity and Permeability

The porosity and permeability of the finer sandstones are reduced by the occurrence of clay matrix. Although the coarser sandstones were originally more porous and permeable, the large quantities of secondary silica which now fill the original pore space have reduced significantly porosity and permeability. The Gething sandstones of the Foothills, therefore, whether very fine grained or much coarser, have low porosity and permeability.

Conglomerates

Conglomerates are most abundant at the base of the succession but comprise almost the total thickness of the Bullhead Group at Mount Belcourt and occur sporadically throughout the succession elsewhere. A prominent conglomeratic unit occurs in the middle of the formation in the region of Trimble Lake and Sikanni Chief River, presumably representing some type of distributary channel deposit. Conglomerate occurs commonly at the top of the Gething Formation.

In addition to the two main lobes, centred around Mount Belcourt and Peace River, conglomerate is concentrated in four main belts between Peace and Prophet Rivers (Fig. 5). The trend of those belts is at right angles to the isopach contours, the more southerly belts having a northeasterly trend and the more northern belts an easterly trend. The general pattern suggests major distributaries flowing across an alluvial plain into the main depositional trough. It should be noted that the axes of these major concentrations closely parallel the axes of the major sand lobes indicated by the sand-shale ratio (Fig. 6).

The conglomerates show a wide range of grade sizes. To the south of Peace River, boulder and cobble conglomerates occur in the westernmost exposures, but the size decreases eastward and also northward. In the vicinity of Peace River, the largest pebbles are about 3 inches in diameter at Carbon Creek and only about 1 inch at the canyon. Farther north, the pebbles average between $\frac{1}{4}$ to $\frac{1}{2}$ inch with maximum sizes in the order of 1 to 2 inches. The decrease in maximum size and also average pebble size is accompanied by a decrease in total conglomerate as previously outlined.

The clasts are composed of several varieties of chert, quartzite, and quartzitic sandstone, with lesser amounts of dolomite, limestone, argillite, and siltstone. Carbonate clasts are rare north of Peace River. The colours of the clasts are mainly grey, bluish grey, white, and black, with pink and green being more common south of Wapiti River. The pebbles are generally rounded to well rounded. They are commonly embedded in a matrix of coarse- to fine-grained sandstone but may be tightly packed. Although the conglomerates are usually bimodal, sorting within each mode is relatively good.

Shales and Mudstones

Two main argillaceous facies are recognized; a dominantly continental succession occurring mainly to the south of Peace River and a marine succession which is best developed north of Sikanni Chief River.

Dark greenish to brownish rubbly shale or mudstone with thin beds of carbonaceous sandstone is typical of much of the succession in the vicinity of Peace River. The mudstones are blocky to rubbly, commonly structureless but may show some lamination. Only the more carbonaceous or coaly shales show much fissility. Most of these sediments are silty and true claystones are not abundant. Finely macerated plant debris is abundant and fairly well preserved twigs and plant fragments are common in some of the beds. These rocks generally are overlain by coal.

Shales and mudstones overlying the coal beds are commonly dark grey to black. Some are silty and contain thin concretionary beds or individual concretions. These beds may grade upward into dark to brownish grey and olive-brown mudstone or argillaceous siltstone.

North of Sikanni Chief River, mudstones of the Gething Formation are dark grey to black, and commonly silty, similar to those of other Lower Cretaceous marine formations. The mudstones commonly lack good bedding and weather into rubbly or blocky fragments. They contain laminae and layers of siltstone and very fine sandstone. The content of siltstone increases upward in the shaly units which grade into the overlying sandstone units. Rusty staining, caused by oxidation of iron compounds, is common. Sideritic material may be present within both the mudstones and siltstones, occurring as nodules, beds, or grains. Small-scale cross-laminations occur within the sandier beds and a few small slump structures or flow rolls as well as cut-and-fill structures are present. Bedding is commonly defined by layers of concretions or by thin beds of siltstone.

Layer-lattice Silicate Assemblages

by A. E. Foscolos

As part of a comprehensive, regional study of the clay mineralogy of Lower Cretaceous rocks in northeastern British Columbia, samples from three Gething localities were analyzed by X-ray diffraction methods, supplemented by various geochemical determinations. A detailed report (Foscolos *et al.*, in press) outlines more fully the mineralogy and geochemistry of the clays of the Gething Formation. A total of 24 samples were analyzed from Besa River (sec. 64–15), 80 samples from Prophet River (sec. 62–20), and 25 samples from Bat Creek (sec. 64–22). Those sections are located along a north-south line (Fig. 1) in the eastern Foothills, extending for 25 miles in the more northerly part of the region. Three distinct layer-lattice silicate assemblages are encountered, comprising: (1) illite only; (2) illite, chlorite, or septochlorite, with or without kaolinite; and (3) illite–chlorite. It is not known whether septochlorite and kaolinite are derived from chlorite through diagenesis or have been transported. Other minerals found in association include quartz and feldspar and various quantities of dolomite and /or calcite and pyrite.

The pH values of the water associated with the lattice of the clay minerals vary from very acidic to alkaline. There is a direct relationship of the pyrite-carbonate ratio to the pH value, probably reflecting the chemical environment at the time of deposition or early diagenesis. In general, where pH value is low pyrite is in excess of the carbonates, and where pH value is high the carbonates are in excess of pyrite.

All three assemblages of layer-lattice silicates are detected in the Besa River section (64–15). The basal part consists only of illite, a one layer silicate with a pH value of 3.3, accompanied by an abundance of pyrite. The middle part of the formation contains the illite–septochlorite–kaolinite assemblage and the upper part contains the illite–chlorite assemblage. In the middle and upper facies, the pH value of the shales ranges from 7.4 to 8.1, which is directly reflected in the excess of carbonates over pyrite.

At Prophet River (sec. 62–20), two assemblages occur in the upper part of the formation. Samples from the lower part of the formation were not available. The lower clay mineral facies consists of illite and septochlorite whereas in the upper part, an illite–chlorite–kaolinite assemblage is present. In this section, the pH value of the shales ranges from 7.7 to 8.5.

At Bat Creek (sec. 64–22), two assemblages were detected with illite in the lower part, and illite–chlorite in the uppermost part. Samples from the middle part of the section were not available and it is possible that the illite–septochlorite assemblage occurs in this interval as it is present at the same stratigraphic position to the south at Prophet and Besa Rivers. The layer-lattice silicate facies in the upper part at Prophet River is the same as at Bat Creek. Similarly, the same mineral assemblage was encountered in the lower part of the formation at Besa River and Bat Creek. The pH values of all shale units in this section range from 7.4 to 7.7.

The layer-lattice silicate facies of the Gething Formation are shown in Figure 17. The illite assemblage occurs at Besa River and Bat Creek, and possibly at Prophet River. It should be noted that samples were obtained only from the upper part of the formation at Prophet

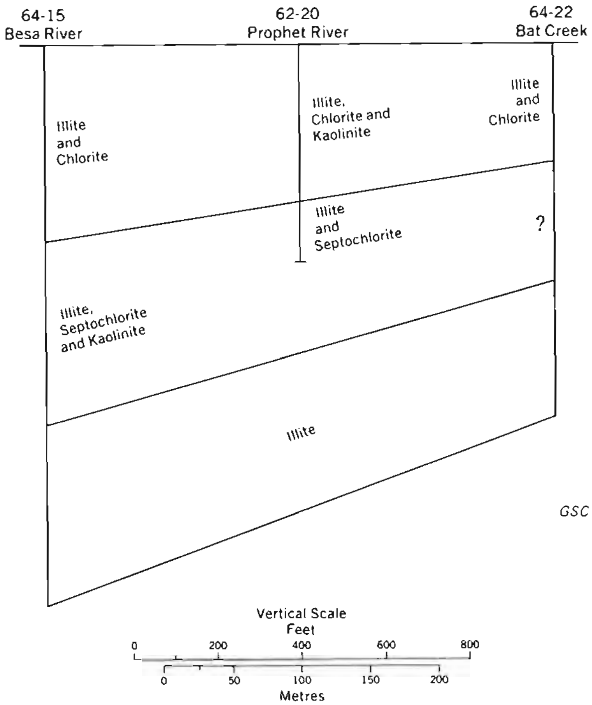

FIGURE 17

Layer-lattice silicate facies of the Gething Formation

River and clays from the lower half were not analyzed. The illite–chlorite or septochlorite, with or without kaolinite, is common to all three formations, extending mainly through the middle part of the formation and also occupying the upper part at Prophet River. The illite–chlorite facies is common to the sections at Besa River and Bat Creek, occurring in the upper part of the formation. Kaolinite is associated with that facies at Prophet River.

Structures

Bedding in the Gething sandstone units ranges from thin, shaly sandstone to massive beds of sandstone and conglomerate. In the southern part of the region, crossbedding and channel structures are common. Farther north, bedding is more uniform and many of the sandstones are finely and regularly laminated.

Bedding is not always evident in the conglomeratic units and may be indicated only by thin lenticles or stringers of sandstone. Imbrication of pebbles occurs in some places. Bedding in the basal part of the thicker and coarser sandstone units is massive or festooned, whereas the finer grained upper part is more commonly ripple-bedded or laminated. Thick-bedded sandstones are more persistent than the thin ones, are generally coarser grained and may contain lenses or beds of conglomerate and also disseminated pebbles. The pebbles are concentrated in the basal part of the sandstone body although they may be scattered also over bedding planes. Composite beds containing a series of units that become progressively finer upward suggest that some thick sandstones are a complex of channel infillings.

Channel deposits occur throughout the succession but are most numerous near Peace River (Pl. X). They vary greatly in width, depth, and cross-section pattern. They occur

PLATE X

Large channel structure in Gething Formation, West Bank section, upper canyon of Peace River.

159753

PLATE XI

Crossbedding in Gething sandstone, Mount Gething.

128326

128431

PLATE XII

Thin, relatively uniform but wavy bedding in Gething Formation south of Chicken Creek. Section 64-18.

159757

PLATE XIII

Ripples in Gething sandstone.

within sequences of finer sediments composed of mainly mudstone and siltstone. Sediments filling these channels include sandstone, siltstone, mudstone, and conglomerate. These may grade laterally into quite different rock types. Cross-strata or horizontal strata occur in the basal part and ripple-laminae become more common toward the top, as has been recorded in other ancient fluvial channels (Allen, 1963; Harms and Fahnestock, 1965). Carbonaceous debris and logs may occur within these deposits.

The bases of many sandstone beds are scoured, disconformable surfaces, and the sandstones themselves grade upward into overlying argillaceous beds. These scoured surfaces are plentiful throughout the Gething Formation. They are sharply discordant and laterally extensive contacts which occur between thick siltstones or mudstones and thick sandstones that commonly have basal conglomerates. The scoured surfaces are uneven, may have a relief from a few inches to several feet; the underlying beds are visibly truncated.

Cross-stratification of large scale is a dominant sedimentary structure in the vicinity of Peace River. Trough or festoon cross-stratification is more common than planar, and the overall dimensions vary considerably; measurements range from inches to feet. The base of each trough-shaped set is an elongate erosional scour, and each set has curved laminae paralleling the base. Fine- to coarse-grained sandstone fills these troughs. Within the smaller troughs, the sandstone is generally fine grained and well sorted. Tabular cross-stratification is less common. The planar and parallel sets are formed of fine-grained, well-sorted sandstone (Pl. XI).

Horizontal stratification occurs most commonly in the well-sorted sandstones north of Halfway River (Pl. XII). Within those beds, the laminae are approximately horizontal and planar, very fine and regular. Within the finer sandstones, small-scale cross-stratification and ripple-lamination are common. The parallel lamination consists mainly of minor variations in grain size and colour.

Ripple-marks occur sporadically throughout the Gething Formation but are most numerous within the fine-grained sandstone and siltstone (Pl. XIII). They are of both the current and oscillation type and are associated with small-scale crossbedding.

AGE AND CORRELATION

Bullhead strata were not well dated by the earliest workers. Selwyn (1877), uncertain about their age, placed them between known Mesozoic rocks of the Plains and Paleozoic rocks that occurred farther west in the mountains. Dawson (1881), followed by some later workers, miscorrelated the beds of Peace River canyon with the younger Upper Cretaceous Dunvegan strata farther east. It was only after McLearn began his studies in the region that the Bullhead succession was correctly assigned to the Lower Cretaceous but, even then, their precise age was open to speculation.

The Bullhead Group lies on the Minnes Group which is mainly of early Neocomian (Berriasian and Valanginian) age (Hughes, 1964, 1967; Stott, 1967a). The youngest fauna from the Minnes strata includes *Buchia* species that were dated by Jeletzky as middle to late Valanginian and that fauna is found from Carbon Creek to as far north as Halfway River. Therefore, the Gething Formation cannot be older than Hauterivian. Furthermore, the development of the unconformity at the top of the Minnes Group indicates a period of erosion during, perhaps, all of Hauterivian and part of Barremian time. The Gething Formation is overlain by marine shale of the Moosebar and Buckinghorse Formations that contains Early to Middle Albian macro- and microfauna (McLearn, 1944a; McLearn and Kindle, 1950; Stelck *et al.*, 1956; Mellon *et al.*, 1963; Chamney, *in* Stott, 1968a; Jeletzky, 1964, 1971a, *in* Stott, 1968a). On the basis of stratigraphic evidence, the Gething can be dated as Hauterivian to earliest Albian.

For many years the Gething flora was assigned an Aptian age (Bell, 1956). Recent work by Stott (1968a) showed that that flora may range into Middle Albian sediments and, therefore, age assignments based on floral evidence are not conclusive. As part of the current study, T. P. Chamney undertook a study of microfauna obtained from Gething sediments and provided data that limit the age of the formation.

Macroflora

The Gething flora was compared by McLearn (1918, 1921, 1923), Berry (1926, 1929), and Bell (1944, 1956) with Cretaceous floras of southwestern Alberta, mainly because the succession there was better known and more collections had been obtained. Three main floral assemblages were recognized by those workers. The oldest one, Kootenay, is a non-dicotyledonous assemblage containing ginkgos, cycads, ferns, and conifers. Two distinct floras of the Blairmore Group, described by Berry (1929) and Bell (1956), have become known as the "Lower Blairmore" and "Upper Blairmore" floras. The "Lower Blairmore" flora has much in common with the underlying Kootenay flora but includes abundant pteridosperms, some additional species of conifers and rare dicotyledons. The upper Blairmore, containing distinctive angiosperms, is younger than the Gething and does not enter into the present discussion.

McLearn (1918, p. 17C), in his first report on the Bull Head Mountain Formation, reported the collection from the upper member of a "few cycads, conifers, etc., and a single specimen of a dicotyledon" and stated that "the plant association of this flora suggests that of the lower part of the Blairmore formation of the Crowsnest district." He assigned the formation to the Lower Cretaceous. McLearn's original collection was examined by E. W. Berry (*see* McLearn, 1921, p. 3B) who considered it to be "a well-defined Kootenay flora of Lower Cretaceous age." As Kootenay strata underlie Blairmore beds, this assignment differed from that of McLearn. However, as pointed out by McLearn and Kindle (1950, p. 71), Berry, when he first examined the flora, was not acquainted with the Blairmore floras. Subsequently, Berry (1926) examined additional collections of the Kootenay and Blairmore floras and then revised his assignment of 1921, comparing the flora of the upper member, by then called Gething, with that of the lower part of the Blairmore Formation of the southern Foothills. The Blairmore flora had been found by McLearn (1916) and dated as uppermost Comanchean, that is Lower Cretaceous. Berry (1929, p. 33) suggested that it represented the "late part of Aptian time and all of Albian time." McLearn (1929, p. 104) dated it as "about Aptian" and in another later report (1932) "as old as Aptian." W. A. Bell (1946), in a later study of the floras from the lower Blairmore and Gething, dated them as "Aptian." In a comprehensive report Bell (1956) stated:

> The composition of the flora from non-marine upper Bullhead strata leads to no other conclusion than that it is of the same age as that of the flora of the Luscar and of the lower flora of the Blairmore, the age of which... is considered to be Aptian.

The writer, during the early years of his investigation of Lower Cretaceous rocks south of Peace River, obtained a large flora from the Gates Member of the Commotion Formation, which is stratigraphically higher and separated from the Gething by the Moosebar shale. That flora, identified by Bell, McGregor, and Hueber (*see* Stott, 1963; 1968a, p. 77), was considered by them to be "Luscar (Aptian)." Bell (1956, p. 10, 11) had stated:

> The flora of the Luscar clearly belongs to the lower flora at Blairmore.... The age of the lower flora cannot be much earlier than that of the upper flora, which with some confidence may be assigned an Albian age. With no breaks in the stratigraphic sequence the earlier flora could be either Albian or Aptian but the extreme rarity of dicotyledons within it, together with the survival of many species occurring in the Kootenay flora, certainly favours the Aptian age.

The lower Commotion flora was shown by Stott (1963, 1968a) to occur in beds equivalent to the upper Moosebar shale and Gates Formation on Peace River from which *Arcthoplites irenense* and *Beudanticeras* were collected. That marine fauna is dated by Jeletzky (1971a, b, c) as late Early Albian. Furthermore, microfauna from Moosebar shale beneath beds containing Commotion flora are dated by Chamney as Early Albian. After the "lower Blairmore–Luscar–Gething" flora was shown to extend upward into rocks of Early to Middle Albian age, Bell assigned an "Aptian and/or Early Albian" age to collections from the Gething Formation.

Although there is a very close similarity between the lower Commotion and Gething floras, the Commotion flora has yielded more species. However, differentiation of the formations on the basis of floral evidence would be difficult. Bell (1956, p. 19) had commented on the lack in the Gething flora of 13 significant species of the Blairmore flora, but the writer obtained two of the missing species—*Cladophlebis parva* and *Elatocladus brevifolia*—in more recent collections. It should be noted that Mellon (1967, p. 72) considered that most of McLearn's collections of "Lower Blairmore" flora were obtained from strata assigned by Mellon to the Beaver Mines Formation (*see* Table I), that is, to beds lying above the Gething equivalent and which are approximately equivalent to the lower Commotion. There is some

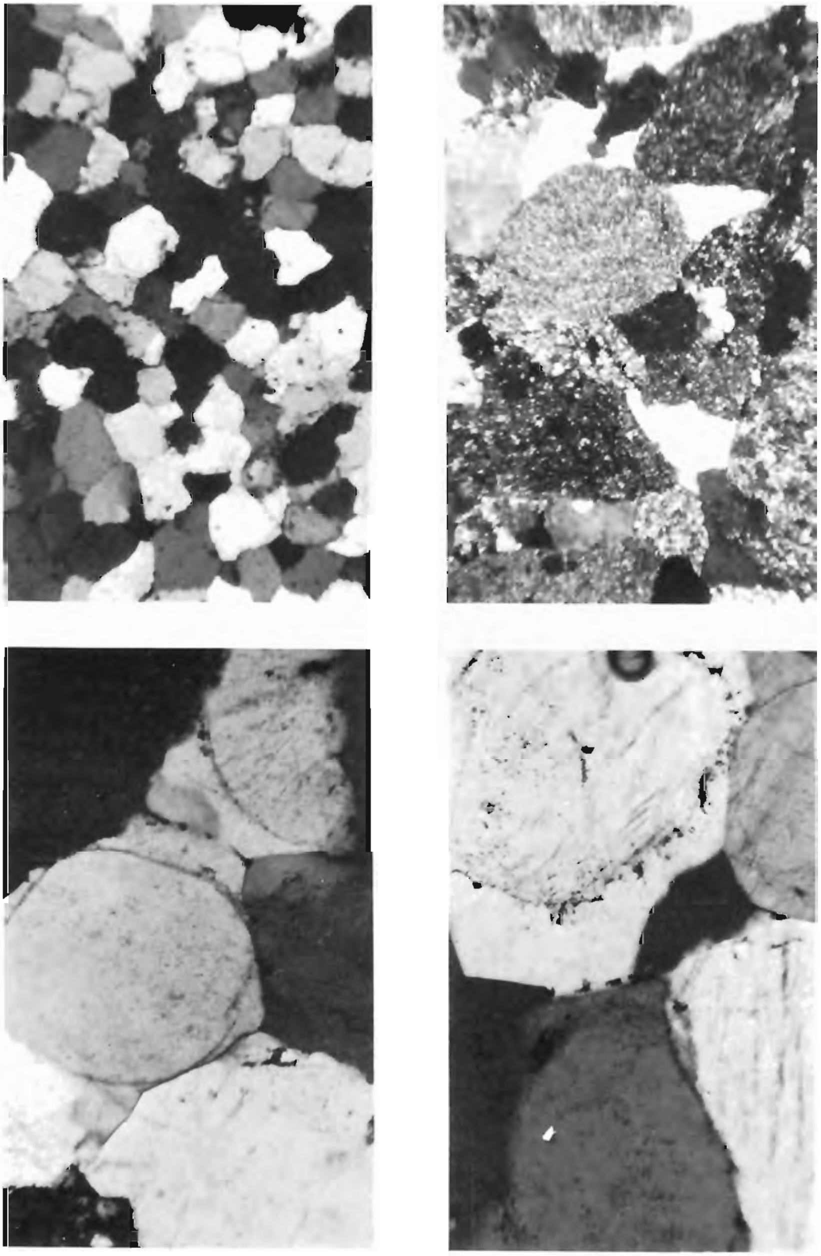

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PLATE XIV Photomicrographs of Gething sandstone.

(a) Fine-grained arenite, consisting mainly of quartz grains with straight to tangential boundaries. Crossed nicols, $\times 90$.

(b) Coarse-grained arenite composed predominantly of chert with some quartz. Crossed nicols, $\times 30$.

(c) Overgrowths on quartz. Crossed nicols, $\times 90$.

(d) Overgrowths on quartz. Crossed nicols, $\times 90$.

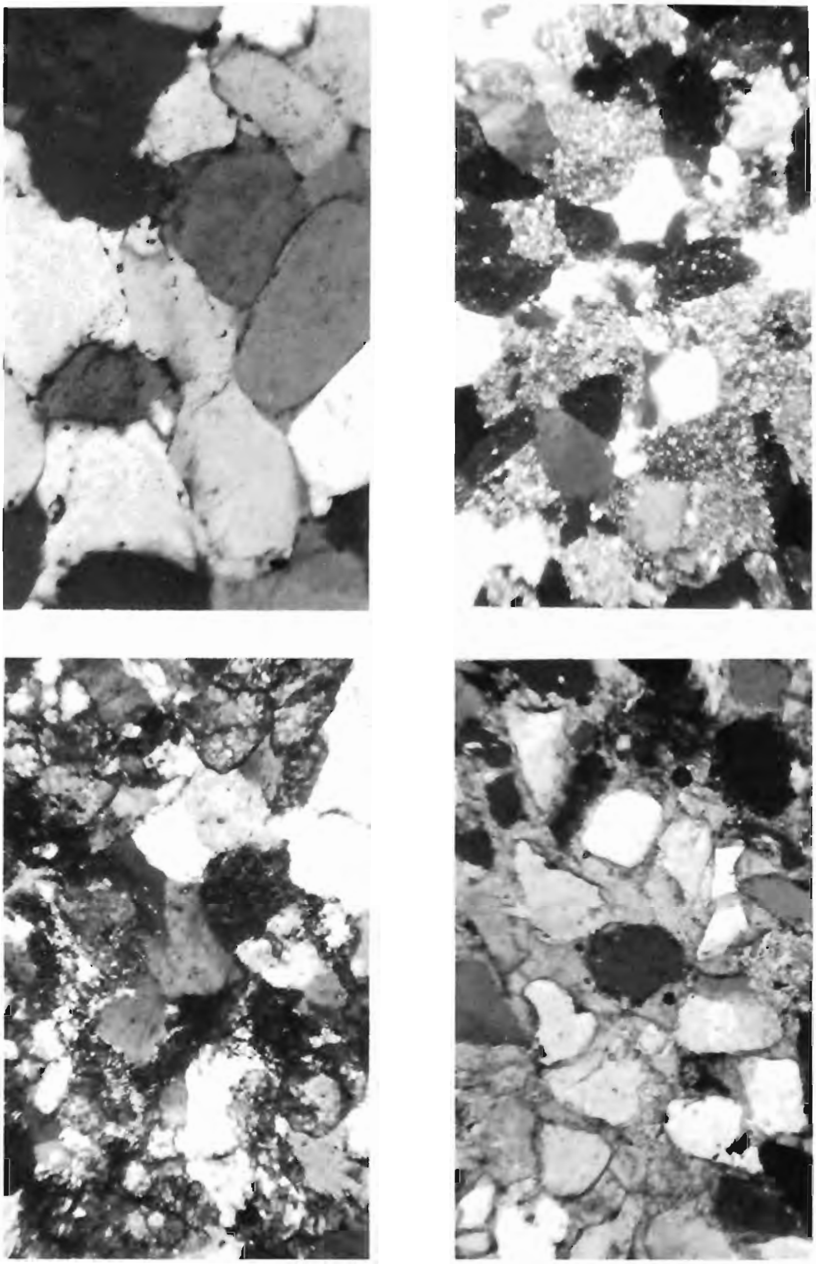

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PLATE XV Photomicrographs of Gething sandstone.

(a) Well-sorted quartz arenite, consisting almost entirely of quartz. Overgrowths of silica fill most of pore space. Crossed nicols, ×90.

(b) Lithic arenite containing abundant chert. Crossed nicols, ×90.

(c) Subrounded carbonate grains with chert and quartz in lithic arenite. Dark rims around carbonate are limonitic. Crossed nicols, ×90.

(d) Quartz arenite with calcite cement. Crossed nicols, ×90.

possibility, therefore, that the lower formation, Gladstone, of the Blairmore Group and the Gething Formation do, in fact, contain fewer species than the typical "Lower Blairmore" assemblage of the Beaver Mines and lower Commotion.

Collections of plants obtained during the present study from the Gething Formation yielded the following species:

Coniopteris brevifolia (Fontaine) Bell
Cladophlebis parva Fontaine
Cladophlebis virginiensis Fontaine
Sphenopteris latiloba Fontaine
Sagenopteris williamsii (Newberry) Bell
Ginkgo pluripartita (Schimper) Heer
Ptilophyllum (Anomozamites) montanense (Fontaine) Bell
Pterophyllum rectangulare Bell
Pterophyllum sp.
Ptilophyllum arcticum (Goppert) Seward
Nilssonia canadensis Bell
Nilssonia yukonensis Hollick
Elatides curvifolia (Dunker) Nathorst
Elatides splendida Bell
Elatocladus brevifolia (Fontaine)
Pityophyllum cf. *P. nordenskioldi* (Heer) Krystofovich
Podozamites lanceolatus (Lindley and Hutton) Schimper

Additional forms identified by Bell (1956) from "Gething Formation or from non-marine strata of the Bullhead Group" include:

Thallites zeilleri (Seward) Harris
Coniopteris berryi Bell
Cladophlebis strictinervis (Fontaine)
Onychiopsis psilotoides (Stokes and Webb) Ward
Baiera cf. *B. gracilis* (Bean) Bunbury
Ginkgo cf. *G. lepida* Heer
Stenorachis striolatus (Heer, pars) Nathorst
Phoenicopsis angustifolia Heer forma *media* Krasser
Pterophyllum plicatum Bell
Pseudocycas dunkeriana (Goppert) Florin
Pseudocycas sp. A cf. *P. unjiga* (Dawson)
Athrotaxites berryi Bell
Elatocladus smittiana (Heer) Seward

Microflora

As previously reported (Stott, 1968a, p. 38), the following plant microfossils were identified by McGregor from samples obtained from the type Gething Formation along Peace River and Aylard Creek:

Abietineaepollenites spp.
Alisporites rotundus Rouse
Alisporites sp. (sensu Rouse)

Appendicisporites tricornitatus Weyland and Greifield
Cibotium junctum Kara-Mursa
Cicatricosisporites dorogensis Potonié and Gelletich
Deltoidospora sp.
?*Eucommiidites* sp.
Ginkgo parva (Naumova) Bolchovitina
Gleicheniidites senonicus Ross
?*Januasporites reticularis* Pocock
Laevigatosporites spp.
Lycopodium clavatoides Couper
Monosulcites sp.
Osmundacidites wellmanii Couper
Pilasporites plurigenus Balme and Hennelly
cf. *Pityosporites similis* Balme
Pityosporites sp.
Podocarpidites sp.
cf. *Protopicea cerina* Bolchovitina
Raistrickia obtusispina Rouse
Sphagnumsporites antiquasporites (Wilson and Webster) Pocock
Todisporites minor Couper
Trilobosporites apiverrucatus Couper
Tsugaepollenites mesozoicus Couper
Vitreisporites pallidus (Reissinger) Nilsson

McGregor dated this assemblage as Valanginian to Aptian, and commented as follows:

> The upper limit of age of the Gething assemblage is established by the absence of any trace of angiosperms, which in most areas of the world enter the record in the lower Albian. In northern Siberia however, the "Lower Cretaceous flora" (i.e., no angiosperms) seems to persist until late Albian or even until the Cenomanian. The Gething microfossils bear a general resemblance to those described by Pocock (1962) from the Mannville Group of Alberta and by Couper (1958) from the Wealden of England. The Gething contains *Appendicisporites tricornitatus* which apparently is no older than Valanginian in North America. The absence of certain species that are common in the English Wealden, and the relatively high percentage of conifer pollen, might be interpreted to mean the Gething is younger than Barremian, but this is only tentative.

The basal formation of the Mannville Group, which appears to be largely equivalent to the Gething, was dated by Pocock (1962) as Valanginian to late Barremian. However, Singh (1964) considered that the microflora at the base of the Mannville Group is not older than late Barremian and indicated that the basal formation was of late Barremian to Early or early Middle Albian age.

Macrofauna

Dinosaurs

Dinosaur tracks, first reported by McLearn (1923), were later examined by Sternberg (1932) who identified eight new species:

Irenesauripus mclearni Sternberg
Irenesauripus acutus Sternberg
Irenesauripus occidentalis Sternberg
Columbosauripus ungulatus Sternberg

Irenichnites gracilis Sternberg
Gypsichnites pacensis Sternberg
Amblydactylus gethingi Sternberg
Tetrapodosaurus borealis Sternberg

Sternberg considered that the tracks were made by both herbivorous and carnivorous dinosaurs.

Invertebrates

A few marine fossils were collected from the Gething Formation and identified by Jeletzky. The writer obtained *Pecten* (*Entolium*) sp. indet., *Thracia*? sp. indet., *Pecten* s. lato? sp. indet., *Lima*, *Donax*?, *Arctica*?, and *Ostrea* (GSC loc. 46521, 52211, 52215). Hughes (1964, p. 25) collected a fauna, 150 feet below the top of the Gething at Fisher Creek, that included *Corbula* sp. indet., *Mactra*? sp. indet., *Astarte*? sp. indet., *Tellina*? sp. indet., and *Unio*? sp. indet. The presence of those marine shells, although of little value for determining age, indicates the occurrence of marine tongues within the continental sediments in the vicinity of Peace River.

Microfauna of Gething Formation

by T. P. Chamney

The microfauna from three field sections was studied in considerable detail and biostratigraphic subdivisions were established by construction of the correlation profile, Figure 18. This correlation profile is but a summary of very detailed data from the three section distribution charts for all classes of fossil organic remains recovered from the rock samples. These subdivisions were required for the purpose of correlation, interpretation of paleoenvironments and, finally, geological age assignments. The three field sections, referred to by number in the micropaleontological part of the report, are related to the bulletin text as follows:

Section No. 1. From the Trutch map-area, British Columbia, collected by D. F. Stott in 1964 and designated as field section 64-15, north of Besa River, east flank of syncline, 57°28′N, 123°31′W (NTS 94J). The section represents 1,330 feet of the Gething Formation which is in abrupt contact with the underlying Jurassic Fernie Formation.

Section No. 2. From Trutch map-area, British Columbia, collected by D. F. Stott in 1964 and designated as field section 62-20, on Prophet River, 57°39′N, 123°34′W (NTS 94G). This section represents the basal 65 feet of the Buckinghorse Formation and the upper 499.5 feet of the Gething Formation.

Section No. 3. From Halfway River and Pine Pass map-areas, British Columbia, collected by D. F. Stott in 1968 and designated as field section 68-18, on the west bank of upper Peace River canyon, 56°01′N, 122°14′W. The section represents 1,660.5 feet of Gething Formation with an estimated additional 150 feet at the top to the overlying Moosebar Formation. The Gething Formation is in contact with 186.5 feet of underlying Cadomin Formation which is terminated at the base by the toe of the Bennett Dam on the Peace River at this location.

A list of microfossils identified from each rock sample is included in the lithological description of the sections in Appendix. An alphabetical generic list of Foraminifera identified from the Gething Formation is included in Table II. Despite the rather coarse clastic nature of the Gething Formation and the abundant material which is indicative of non-marine to swampy, lagoonal environments, foraminiferal recovery was relatively good. There are a few horizons with very abundant Foraminifera and many horizons devoid of any fossil organic remains. Some of the taxa of fossil organic remains include 134 species of Foraminifera from 45 genera. The genus *Haplophragmoides* is represented by the most species and is the most frequently occurring one, along with *Trochammina* and *Glomospirella* (Table II). It should be noted, however, that quantitatively the agglutinated forms represent approximately 90 per cent of the Foraminifera recovered.

AGGLUTINATED		CALCAREOUS	
Genus	Number of species	Genus	Number of species
1 *Ammobaculites*	2	1 *Astacolus*	2
2 *Ammodiscus*	6	2 *Conorbina*	4
3 *Arenobulimina*	1	3 *Conorboides*	2
4 *Bathysiphon*	4	4 *Dentalina*	2
5 *Clavulina*	1	5 *Eponides*	2
6 *Dorothia*	1	6 *Eurycheilostoma*	2
7 *Gaudryina*	6	7 *Gavelinella*	2
8 *Glomospira*	3	8 *Globorotalites*	1
9 *Glomospirella*	7	9 *Globulina*	1
10 *Haplophragmoides*	29	10 *Gyroidina*	1
11 *Hippocrepina* (incl. *Hyperamminoides*)	4	11 *Lenticulina*	1
12 *Hyperammina*	1	12 *Lingulina*	1
13 *Lituotuba*	2	13 *Marginulinopsis*	3
14 *Miliammina*	5	14 *Nodosaria*	1
15 *Reophax (Proteonina)*	1	15 *Paleopolymorphina*	1
16 *Reophax*	2	16 *Pyrulinoides* (*Gulfulina*)	1
17 *Saccammina*	5	17 *Pyrulinoides* (? *Pyrulina*)	1
18 *Siphotextularia*	2	18 *Quadrimorphina* (*Pallaimorphina*)	4
19 *Spiroplectammina*	2	19 *Saracenaria*	2
20 *Textularia*	1	20 *Serovaina*	1
21 *Trochammina*	10	21 *Vaginulinopsis*	1
22 *Trochamminoides*	1		
23 *Thuramminoides*	1		
24 *Verneuilinoides*	1		
Total	98	Total	36

GSC

TABLE II. *Frequency data of Foraminifera genera, by T. P. Chamney*

Other classes of fossil organic remains used in the study include;

Plants, wood, megaspores
Ostracods
Invertebrates; pelecypods, gastropods, echinoids
Radiolaria
Protistids; algae, spheres, chara
Vertebrates; fish-teeth, bones, scales
Coproliths, worm tubes.

Biostratigraphic Subdivisions (Fig. 18)

Five Assemblage Zones have been provisionally recognized for the sequence of strata from the basal Cadomin Formation (conglomerate), through the Gething Formation (sandstone), to the overlying Buckinghorse Formation in the north (mudstone), and the Moosebar Formation in the south (shale and mudstone). The validity of these interpretations can be proven only by a similar study of several additional sequences within the map-area.

Zone 5 *Conorbina norrisi* (Mellon and Wall), 1956
Quadrimorphina albertensis Mellon and Wall, 1956
rare *Serovaina* nov. gen. Sliter, 1968

Zone 4 *Gaudryina nanushukensis* Tappan, 1951
Glomospirella spp. (ref. Chamney, 1956)

Zone 3a *Viviparus* sp. (*operculum*) *Chara* sp. and ostracods (metacyprids) ref. metacyprid ostracods associated with very abundant *Viviparus* sp. (*operculum*) in the Nordegg and Burnt Timber areas of Alberta.

3b *Siphotextularia* ex gr. *S. rayi* Tappan, 1957
polymorphinids (*Pyrulina-Pyrulinoides*), Mountjoy and Chamney, 1969
Serovaina nov. gen. Sliter, 1968, abundant

Zone 2 *Haplophragmoides duoflatis* Chamney, 1969
Quadrimorphina n. sp. (5-chambered ventral)

Zone 1 *Haplophragmoides* sp. G 117 (n. sp. of this report)
Gaudryina sp.

Biochronology

Provisional age assignments have been made for each biostratigraphic division. These age assignments are based on the inferred time-stratigraphic equivalents of the contained microfossils.

Zone 5 Early Albian: Possibly pre-Clearwater Sea (pre-*Arcthoplites mcconnelli* Zone of Mellon and Wall, 1956). This may represent a lateral facies and more open marine environment for Zone 4.

Zone 4 Early Albian undifferentiated: equivalent of lower Torok Formation, Alaska, and Martin House Formation of the Yukon Territory (*see* Tappan, 1951; Chamney, 1964, 1967).

Zone 3a Aptian to Albian/Aptian transition: Blairmore "Calcareous Zone" or the Blairmore Ostracod Zone of the Canadian Western Interior Basin. This is the nonmarine to brackish facies of Zone 3b of this study. The *Viviparus* sp. (*operculum*) is associated with the *M. persulcata* (*Gomphocythere*) spp. of the Blairmore Ostra-

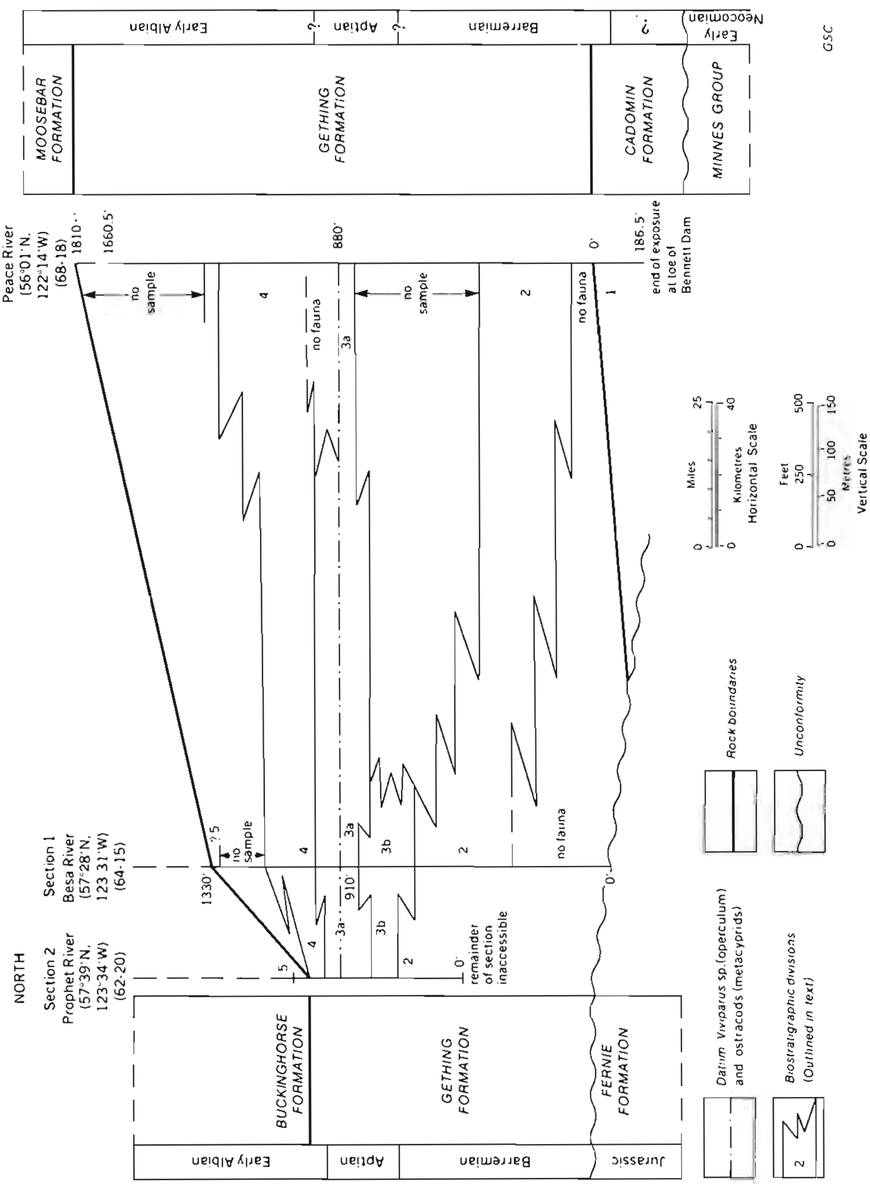

FIGURE 18. Biostratigraphic divisions of Gething Formation, northern foothills, British Columbia by T. P. Chamney

cod Zone of the Central Foothills of Alberta. Palynological studies (pers. com. S. A. J. Pocock, Imperial Oil Ltd.) have indicated a correlation between this depositional interval and the upper part of the Upper Sandstone Division (Jeletzky, 1958); this in turn is similar to the Aptian stage in Europe.

3b Aptian to Aptian/Barremian transition: Recent studies on the Fish River, Yukon Territory (Chamney, 1972), have contributed to the age assignment of the *Serovaina*, *Quadrimorphina*, and *Conorboides* interval of this Zone 3b.

This zone is equivalent in part to the lower half of the "concretionary shale" unit and the underlying sandstones present on Fish River and designated in the field as the "Upper Sandstone Division." These sandstones may in fact be depositional equivalents of the Upper Member of the Upper Shale–Siltstone Division (Mount Goodenough). This correlation is indicated by the similarity of the agglutinated benthonic Foraminifera (*Reophax tundraensis* Chamney Assemblage Zone) found in the "Upper Sandstone Division" and lower "concretionary shale" unit on the Fish River and in the Upper Shale–Siltstone Division on Mount Goodenough. All of the above depositional intervals overlie the Lower Member of the Upper Shale–Siltstone Division assigned by Jeletzky to the Barremian [*Crioceras* (*Haploceras*) cf. *remondi*]. They are in turn overlain by the "bedded ironstone" unit of Early Albian age (*Sonneratia* sp., Jeletzky, pers. com., field, 1971). Zone 3b could also represent the depositional equivalent (condensed) of the basal siltstones of the Martin House Formation (Chamney, 1969a).

Zone 2 Barremian: *Haplophragmoides duoflatis* Chamney, Upper Shale–Siltstone Division of Jeletzky (1958), District of Mackenzie (*see* Chamney, 1969b; Jeletzky, 1960).

Zone 1 Age assignment by stratigraphic position below late Neocomian and above early Neocomian (Valanginian) of the upper part of the Minnes Group (*see* Jeletzky, 1971; *also* Chamney, this report).

Previous studies, including sampled sequence of Moosebar shales above the Gething Formation (Chamney, 1964, 1967), indicate that the basal shale beds of the Moosebar Formation overlying the sandstones of the Gething Formation to the south (section 3) are younger than the basal shales of the Buckinghorse Formation overlying the Gething sandstone to the north (section 2).

Age

(Summary)

The Gething Formation, as previously discussed, can be dated on the basis of stratigraphic position as Hauterivian to earliest Albian. The macroflora was dated by Bell as Aptian and/or Early Albian. The microflora was dated by McGregor as Valanginian to Aptian, and a tentative suggestion was made that the Gething might be younger than Barremian. On the basis of the microfauna, consisting predominantly of Foraminifera, Chamney gives an age assignment of late Neocomian (Barremian–Aptian) to Early Albian.

Because an erosional interval occurred after the deposition of early Neocomian (Valanginian) sediments, and because no definite Hauterivian fossils have been identified, it seems probable that the erosional unconformity at the base of the Bullhead Group at Peace River and the Gething Formation to the north represents most or all of Hauterivian time and possibly also part of Barremian time.

The position of biostratigraphic zone 3a in section 62-20 at Prophet River appears somewhat anomalous. The writer considers that the top of the Gething there and in section 64-15 at Besa River are approximately time equivalent. If so, there is a marked condensation of the interval between the top of the formation and the *Viviparus* horizon between Besa and Prophet Rivers. Although some easterly condensation can be shown (Fig. 14), the rate of thinning is not nearly so great as that indicated by the micropaleontological relationships. This problem remains unresolved.

According to Chamney (this report), the Buckinghorse shales that overlie the Gething Formation in the Prophet River region are older than the Moosebar shales that overlie Gething strata at Peace River and in the area to the south. Chamney's studies to date have not been sufficiently detailed to determine if beds equivalent to the basal Buckinghorse of Prophet River are present within the uppermost Gething at Peace River; that is, whether shoreline sands of the early phase of the Buckinghorse transgression developed to the south. Alternatively, it may be that no equivalents of the basal Buckinghorse shales exist to the south of Peace River, and the Gething–Moosebar contact may represent a hiatus of short duration.

Correlation

The Bullhead Group is correlative with the lower part of the Blairmore Group of the southern Foothills (Table III). Mellon (1967) divided the Blairmore into three formations which are, in ascending order, the Gladstone, Beaver Mines, and Mill Creek Formations. He included the Cadomin conglomerate within his Gladstone, although current practice within the Geological Survey of Canada retains the Cadomin as a separate and most useful mappable formation. The Gladstone Formation includes beds formerly assigned to the lower Luscar of the central Alberta Foothills. At Cadomin, the Gladstone is overlain by dark shale that is reported by Mellon and Wall (1961) to contain ostracods and the *Marginulinopsis collinsi* microfauna which is comparable with the Moosebar microfauna (*see* Chamney *in* Stott, 1968a, p. 55). Thus, the Gladstone and Gething Formations are overlain by beds containing the same fauna. As previously indicated, the flora of both is that of the "lower Blairmore" assemblage. The Bullhead Group of the Peace River region, therefore, is equivalent to the Gladstone and Cadomin Formations of the Blairmore Group.

The Bullhead Group is approximately equivalent to the McMurray Formation of the lower Athabasca River. As indicated previously, these two successions occupy similar stratigraphic positions but are laterally separated north of Fort St. John. A microfaunal assemblage occurring in the uppermost beds of the McMurray Formation was correlated by Mellon and Wall (1956, p. 11) with the lower part of the Moosebar Formation in the Pine River area. Such a correlation indicates that deltaic conditions prevailed longer in the Athabasca region than in the Pine River region. However, it seems probable that the main body of the McMurray succession is equivalent to the Gething and Cadomin Formations of the Foothills. Mellon (1967, p. 77) further indicated that thin units of calcareous shale and limestone, occurring at or near the top of the Gladstone Formation in the Foothills and, therefore, approximately equivalent to beds of the upper Gething Formation, could be traced into the McMurray Formation. The basal McMurray Formation of the Mannville Group is divided into three members which are, from base upward, the Deville, Ellerslie or Quartz Sand, and Calcareous Members. Pocock (1962) dated the Deville Member as Berriasian to Valanginian and considered that it was overlain unconformably by the Quartz Sand Member of Barremian age and that the Calcareous Member was late Barremian. However, Singh (1964) considered that the base of the Mannville Group in east-central Alberta is not

ALBERTA FOOTHILLS	PEACE RIVER TO SMOKY RIVER	PROPHET RIVER B.C.	TETSA RIVER B.C.	SCATTER RIVER B.C.	PEACE RIVER PLAINS	McMURRAY - LOWER ATHABASCA RIVER	CENTRAL PLAINS OF ALBERTA	AGE
BLAIRMORE GROUP: BEAVER MINES FORMATION	FORT ST. JOHN GROUP: COMMOTION FORMATION MOOSEBAR FORMATION	FORT ST. JOHN GROUP: BUCKINGHORSE FORMATION	FORT ST. JOHN GROUP: BUCKINGHORSE FORMATION	FORT ST. JOHN GROUP: SCATTER FORMATION GARBUTT FORMATION	FORT ST. JOHN GROUP: SPIRIT RIVER FORMATION: Notikewin Member Falher Member Wilrich Member	GRAND RAPIDS FORMATION CLEARWATER FORMATION	MANNVILLE GROUP: FORT AUGUSTUS FORMATION	Early Albian
?	BULLHEAD GROUP: GETHING FORMATION	GETHING FORMATION	BUCKINGHORSE FORMATION (continued)	GARBUTT FORMATION (continued)	BLUESKY FORMATION	WABISKAW FORMATION	WABISKAW FORMATION	Early Albian ?
"Calcareous" Member GLADSTONE FORMATION CADOMIN FORMATION or DALHOUSIE sandstone	GETHING FORMATION CADOMIN FORMATION	GETHING FORMATION	?	?	BULLHEAD GROUP: GETHING FORMATION CADOMIN FORMATION	"Calcareous" Member McMURRAY FORMATION	"Calcareous" Member McMURRAY FORMATION	Late Neocomian: Aptian ? Barremian
KOOTENAY or NIKANASSIN FORMATION	MINNES GROUP	MINNES GROUP to TRIASSIC	TRIASSIC	TRIASSIC	JURASSIC to MISSISSIPPIAN	DEVONIAN	MISSISSIPPIAN to DEVONIAN	MESOZOIC and PALEOZOIC

GSC

TABLE III. *Correlation of Lower Cretaceous formations in western Canada* older than late Barremian. On the basis of microfloral evidence, he dated the Deville Member as late Barremian, the middle member as Aptian, and the upper member from its stratigraphic position as Early to early Middle Albian. It has been shown previously that the Gething Formation can be dated, on the basis of microfauna, as Barremian to Early Albian. Singh's dating suggests a much closer relationship between the McMurray and Gething than do Pocock's age assignments. Mellon (1967, p. 68) suggested that the McMurray Formation "disappears in part or in entirety by interfingering to the northwest with the lower part of the Loon River Shale." He indicated that microfauna of the marine Loon River is associated with *Cleoniceras* of Early Albian age. Such an interfingering of marine shales and alluvial-deltaic sediments is similar to that found in the Gething and is entirely consistent with the concept of the advance of a late Neocomian to Early Albian seaway southward from boreal regions. Apparently the seaway spread around a low-lying island forming two narrow troughs; the western one was filled with Gething sediments, the other by deposits of the McMurray Formation.

The extremely glauconitic sandstone and siltstone occurring at the top of the Gething Formation in the region of Sikanni Chief and Prophet Rivers occupy a stratigraphic position similar to the Bluesky Formation of the Peace River Plains. The Bluesky Formation, a unit of fine-grained, well-sorted, glauconitic sandstone, occurs between the Gething Formation and Wilrich marine shale of the Spirit River Formation (Alberta Study Group, 1954, p. 76). A dark shale unit directly beneath the sandstone was tentatively correlated with the "Ostracod zone" (*see* Loranger, 1951; Badgley, 1952). As mentioned previously, beds containing similar ostracods occur at the top of the Gladstone Formation at Cadomin (Mellon and Wall, 1961). Studies of outcrop sections and cores from wells immediately adjacent to the Foothills indicate that the Bluesky extends northwesterly and westerly from the type region near Spirit River and that it is an offshore marine facies of the Gething Formation of the Foothills. In 1959, Workman showed that a thin wedge of marine shale occurred below the Bluesky north of Lesser Slave Lake and disappeared westward into the Gething Formation. In a previous study, the writer (Stott, 1968a, p. 40, Figs. 3, 4, 5) traced the Bluesky southwestward and westward from the Imperial Spirit River No. 1 well into carbonaceous sediments of the Gething Formation. Similar occurrences were described from wells north of Peace River by Pugh (1960) and were found also by the writer in core from Imp. Pac. Altares c–42–A (c–42–A/94–A–8) well, just east of the Foothills. On Hasler Creek, glauconitic sandstone with pebbles occurs 35 feet below the top of the Gething Formation (Stott, 1968a, sec. 60–19). The glauconitic facies of the Gething Formation of the Prophet River region and the Bluesky of the Peace River region appear to mark an extensive nearshore deposit that formed prior to the major transgression now represented by basal Buckinghorse, Moosebar, and Wilrich shales. The Bluesky is equated in part with the Wabiskaw that lies on the McMurray Formation on lower Athabasca River (Chamney, pers. com., June 2, 1971), with the glauconitic sand of the central and southern Plains, and with part of the Cummings Member of the Mannville Group at Lloydminster (*see* Rudkin, 1964; Mellon, 1967).

The Bullhead Group is considered to be equivalent to part or all of the Jackass Mountain Group, lying in the Tyaughton Trough on the west side of the "Nelson High" in central British Columbia (*see* Fig. 19). Jeletzky and Tipper (1968) stated that the only fossils obtained from the Jackass Mountain Group in Taseko Lakes map-area are plant remains of Aptian age. Subsequently, Jeletzky (1971a) reported the occurrence, in an adjoining area, of "apparently" Barremian and Aptian marine fauna from beds which he inferred were, in part, an offshore facies of the conglomeratic Division B or French Bar Formation. Jeletzky and Tipper attributed deposition of Division B, or the French Bar Formation, characterized by coarse boulder conglomerate composed mainly of granitic boulders, to uplift on the northeast. They considered that the overlying Division C, a greywacke-shale sequence, tentatively equated by Jeletzky (1971a) with beds of Early to Late Albian age, developed as "Downwarping of the site of deposition kept pace with the rise of the source area." The Jackass Mountain and Bullhead Groups, of similar age and with similar depositional sequences, obviously record the same tectonic events on opposite flanks of a common source, the Omineca Geanticline.

PALEOGEOGRAPHY

The delineation of the sedimentary environments in which Bullhead sediments were deposited is important in determining areas favourable for both petroleum exploration and potential coal developments. Within the scope of this investigation, it has been possible to outline the main limits of the alluvial-deltaic, coal-bearing deposits and the main occurrences of the delta-front and epineritic, well-sorted sandstones which favour accumulation of oil and natural gas.

One of the earliest interpretations of Cretaceous environments was made by Dawson (1881, p. 113B) who suggested that Paleozoic rocks now exposed in the Rocky Mountains "must have projected as islands, or formed a more or less continuous shore-line at the time of the deposition of the Cretaceous beds here lying to the east of them." He stated also, in writing of the general Cretaceous succession of the Foothills "I see no reason to doubt that it forms the coarse littoral portion of the Cretaceous rocks which spread so widely to the eastward."

Paleogeographic maps, presented by Schuchert (1910, pls. 91–93) depict western Canada as being entirely continental with no marine embayments during Lower Cretaceous time. Dowling's (1915b) maps, based on meagre data and incorrect correlations, combine rocks now known to be of Lower Cretaceous and Upper Cretaceous age, and his reconstruction of paleoenvironments is no longer valid.

McLearn (1923, p. 5B), in his early interpretation of the Gething sediments, stated:

> The abundance of plant remains, the absence of marine fossils, presence of rootlets, absence of boring molluscs in the wood fragments, tracks of land animals—all these, taken together, suggest a non-marine origin for the strata of the Gething member.

Schuchert (1923), basing his reconstructions on some of McLearn's work, showed, in a series of paleogeographic maps for North America, that the Lower Cretaceous sea came from the north.

In 1931, McLearn illustrated Lower Cretaceous paleogeography by one map and in 1932, by four maps. In the latter publication, the Gething alluvial plain was mapped as marginal to an early stage of the Clearwater or *Lemuroceras* Sea. Subsequently, McLearn (1944b) presented a revision in which deposits of Lower Blairmore time were shown as a marginal alluvial plain extending along the Rocky Mountain geosyncline (as defined by Schuchert, 1923) into northeastern British Columbia, and the plain was mapped as co-extensive with the McMurray alluvial plain (that is, older than Clearwater). McLearn pointed out (1944b, p. 7) that Lower Blairmore equivalents in north-central Alberta contained "fragmentary evidence of temporary brackish water or restricted marine conditions." He considered that a marine invasion could have flooded the alluvial plain stating:

> This record would most probably be left in the north .... Although this record has not been found, it is possible that further investigations will disclose the presence of Aptian (early Blairmore) deposits in the north.

In final maps by Schuchert (1955) based on work done prior to 1942, the continental Kootenai (Blairmore) Formation is restricted to an area south of Bow River and marine deposition is indicated as extending well south of Peace River. The earlier maps by McLearn (1931, 1932, 1944b) showed more accurately the limits of the alluvial and marine deposits.

In 1950, McLearn (*in* McLearn and Kindle, 1950) summarized his views on the "Gething alluvial plain":

> Deposition was resumed in Gething time... and a wide alluvial plain, with, at times, coal swamps and temporary ponds or 'playas', occupied the site of the Rocky Mountains, Foothills, and Plains as far north as Pocketknife River in northeastern British Columbia and far to the east into Alberta. It was coextensive with the Luscar alluvial plain.

He suggested that these deposits bordered a sea that lay "somewhere in the interior" and that "This sea may have been of Aptian or very early Albian (late Lower Cretaceous) age and perhaps older than the *Lemuroceras* or Clearwater sea."

Although the distribution and thickness of Lower Cretaceous sediments were illustrated by Webb (1951), the depositional environments were not reconstructed. Isopach and lithofacies maps related to the Bullhead Group presented by Rudkin (1964) showed the extensive development of the thick sandstone facies along the Foothills. Ziegler (1967, 1969) showed the paleogeography of Aptian–Albian time on one map and, as a result, the details of Bullhead distribution and environments are obscured by the younger and more extensive deltaic deposits of the Fort St. John Group. Rudkin indicated the presence of a well-developed Omineca Geanticline lying along the western margin of the deltaic complex. The development of a barrier between the Pacific seas of the western Cordillera and the boreal seas of the Western Interior has been attributed previously by Warren and Stelck (1956, 1968a, 1961) to Aptian tectonic movements.

Fitzgerald (1968) showed the northern depositional limit of the Gething Formation as lying south of Muskwa River. Because Gething sections (64–23, 64–24) were measured north of there and since the Gething sandstone can be recognized as far north at Tuchodi River (Taylor and Stott, 1968a), the depositional edge of the Gething lies at least 30 to 40 miles north of the position shown by Fitzgerald.

Studies in the region bordering the western margin of the Omineca Geanticline provide some information on the development of the landmass whose eastern slopes bordered the Early Cretaceous alluvial plains. Campbell (1966) showed the development of emergent areas during Upper Jurassic and Cretaceous time, stating "that by Late Jurassic the central landmass was continuous from north to south." Jeletzky and Tipper (1968, p. 84, Fig. 9) indicated that volcanic and sedimentary rocks of Aptian to Albian age were present in the narrow Tyaughton Trough of central British Columbia. They showed that an influx of coarse conglomerate had been derived from a northeastern source area, termed the "Nelson High", and stated that it "apparently accumulated as a piedmont deposit at the base of a range of granitic mountains that were abruptly uplifted." The Bullhead sediments were derived in part from the eastern flank of that mountainous region.

The writer (Stott, 1968a, Fig. 18a, 18b), in his report on the Bullhead Group south of Peace River, showed alluvial environments extending north of the river and indicated a large area of conglomerate and coarse-grained sandstone centred between Pine and Peace Rivers.

Nelson (1970), in a diagram of Early Cretaceous (Blairmore) seaways, did not incorporate the stratigraphic detail currently available and depicted the northern marine embayments as extending southeastward from the Liard River region across to McMurray, Alberta, and showed much of northeastern British Columbia as a land area. For most of the time interval, a permanent marine embayment extended at least as far south as Peace River and at various times flooded the region southward to Smoky River.

Jeletzky (1971b, Figs. 7, 8), in his reconstruction of Cretaceous paleogeography, did not show any marine incursions into northeastern British Columbia during Hauterivian to Aptian time. He inferred that Hauterivian–Barremian time in the Peace River region was represented only by a regional hiatus and that no Aptian sea extended into the Interior Platform region. Jeletzky maintained that land barriers in central British Columbia had effectively closed off the western marine troughs from the marine basins of the Yukon–Mackenzie region.

Depositional Environments

Four main lithofacies are recognized within the Bullhead Group: alluvial piedmont, alluvial-deltaic, littoral and nearshore (prodelta), and deeper marine (Fig. 15). The main deposits of the alluvial piedmont and some of the alluvial plain were discussed previously (Stott, 1968a).

Alluvial-deltaic Environment

The sequence of Gething strata exposed at Peace River represents an accumulation of sediments deposited in fresh, brackish, and marine environments of a major delta (Fig. 15). The delta, as shown by the isopach map (Fig. 2), probably extended for about 150 miles along the coast and for a similar distance eastward into the basin. Its aerial distribution matches some of the largest Recent deltas (*see* Rainwater, 1966, Fig. 1), including the Mississippi and Nile.

The heterogeneous assemblage of carbonaceous siltstone, coal seams, channel sandstone, thin marine shale, and sheets of fine- to coarse-grained sandstone are characteristic of the deltaic plain deposits. For the purposes of this discussion, the facies is divided into two main subdivisions: (1) the coarser sediments of the alluvial and upper deltaic plain, and (2) the finer sediments of the lower deltaic plain formed in various sub-environments.

Facies of the Alluvial and Upper Deltaic Plain

The massive sandstones and conglomerates of the Bullhead Group in the vicinity of Peace River are interpreted as alluvial deposits, similar in many respects to some of the modern sediments outlined by Allen (1965b). Their textures, sedimentary structures, and stratigraphic succession are similar to those of modern stream sediments described by Fisk (1944), Harms and Fahnestock (1965), and Harms, Mackenzie, and McCubbin (1963). Some of the Bullhead conglomerate and conglomeratic sandstone probably were deposited as alluvial fans. The Bullhead sediments, with their fairly well sorted and stratified nature, lenticular bedding, scoured and channelled lower contacts and festoon cross-stratification are comparable with deposits of moderate streamfloods and streams in wet regions (*see* Trowbridge, 1911; Blissenbach, 1954; McKee, 1954). These conglomeratic deposits grade laterally into siltstones and mudstones which resemble modern flood-plain sediments described by Jahns (1947), Happ, Rittenhouse, and Dobson (1940), McKee (1939), and McKee, Crosby, and Berryhill (1967). The thick basal conglomeratic sediments are similar to stream deposits produced by highly variable flow conditions (Sundborg, 1956; Smith, 1970). The coarse conglomerates and conglomeratic sandstones probably formed by deposition from strong currents and the lateral and vertical changes in size and sorting suggest rapid changes in stream capacities.

Several examples of the channel facies occur in the western section along Peace River (sec. 68–18; Pl. XII). There, the channel sandstone bodies occur within a dominantly carbonaceous and argillaceous facies of overbank and marsh origin. The channel sediments are brownish grey to grey, fine- to coarse-grained, lithic arenites and chert conglomerates. Outcrop surfaces are iron-stained, giving a brown to rusty colour to the surface rock. Organic material includes broken logs and macerated plant debris. The pebble beds at the base of the sandstone units may represent channel lag deposits similar to those described by Allen (1965b, p. 127). The sandstones show large- and small-scale cross-stratification and planar lamination. Trough crossbedding is abundant and current ripple-marks are locally well developed. The large-scale cross-strata and ripple-lamination are similar to those of modern fluvial deposits (Harms *et al.*, 1963, p. 570–575; Harms and Fahnestock, 1965). Each channel truncates dark carbonaceous beds and the upper contact is one of gradation into brown siltstone. The sandstone bodies are commonly lenticular but some interfingering also occurs. The complex character of the thicker sandstones may indicate that they were deposited in meander belts in which main channels were confined for long periods (Allen, 1965b, p. 173).

The sandstones, with their irregular disconformable surfaces, become finer grained upwards from basal conglomeratic beds. There is some cyclicity or rhythm to the succession; the sandstone alternating with dark coloured siltstone, shale, and coal of the overbank and marsh facies. The lower, coarse member represents some type of channel system and the upper fine member represents the flood-plain sediments deposited after the channel system had been abandoned. This type of cyclic occurrence, referred to as a "fining-upward" cycle by Allen (1965a), is considered to be of alluvial origin (Allen, 1962, 1964, 1965b; Beerbower, 1964) and typical of a fluvial environment. Allen (1970) showed by means of a theoretical model that the profiles of sedimentary structures and grain size within such channels could be altered markedly by small changes in the channel depth, width, curvature and slope.

Many of the sandstones may represent point bar deposits built on the inner bank of stream meanders. Such deposits in Recent environments may be as much as 80 feet thick (Fisk, 1944, 1947; Allen, 1964). Downward coarsening of texture, large-scale cross-stratification, flat-bedded sandstone intervals, and drifted plant remains commonly found in many of the Bullhead conglomeratic and coarse-grained sandstones are typical features in modern point bar deposits (Allen, 1965b, p. 140).

Deposits consisting predominantly of cross-stratified sets or large or small troughs, with only a small component of horizontal stratification, were considered by Harms and Fahnestock (1965, p. 108) to be typical of low gradient, meandering, perennial streams with low sediment load and erosion resistant banks. Small-scale cross-lamination is produced by ripple migration. With increased flow regimes, large-scale cross-stratification results from migrating sand waves and stream channel bars.

Facies of the Lower Deltaic Plain

Within this facies are numerous repetitions or cycles which reveal, in vertical sequence, a succession of marine to freshwater sediments that was described as part of the coal-bearing facies. The cycle begins with marine shales containing a microfauna dominated by Foraminifera which, according to Chamney, are representative of environments ranging from fairly open marine to very nearshore restricted. These sediments, becoming siltier upward, represent the distal, prodelta clay to proximal prodelta silt and clay, deposited as the delta front advanced out into the basin. Those beds are overlain by fine- to coarse-grained sandstone, in some places with gradational contacts, in other places with sharp, erosional bases which represent the delta fringe and distributary channel sands. The overlying dark mudstones with abundant plant debris probably accumulated on the deltaic plain in interfluve areas as the result of overbank flood-flow or lacustrine conditions. The coal and coaly shale are deposits of marsh and swamp environments. The many alternations of shallow marine sediments with brackish to freshwater deposits are typical of deltaic successions (Rainwater, 1966; Visher, 1965; Scruton, 1960).

The interdistributary facies consists mainly of the dark grey to brown siltstones, mudstones, and shales with only small amounts of admixed fine sand grains. Many clayey siltstones and silty clays containing abundant organic debris, zones with rootlets, tree roots and stumps are similar to modern flood-basin deposits (*see* Bernard *et al.*, 1962; Allen, 1965b). Laminations are not obvious but are generally uniformly parallel. The poorly stratified argillaceous beds are similar to modern flood-basin deposits. The rhythmic succession is similar to the alluvial cycles described by Wanless and Shepard (1936), Stokes (1954, 1961), Havlena (1957), and Allen (1965a). The siltstones and mudstones contain abundant carbonaceous debris and sideritic concretions, characteristic of modern fluvial sediments. These beds are considered to have developed as interfluve vertical accretion deposits during times of high water. The water-table probably lay close to ground level (poor drainage) resulting in the reduction of the organic content and the development of dark coloration of the sediments.

The marsh environment is represented by dark grey to black carbonaceous shales, clayey siltstones and an abundance of woody fragments, similar to Recent marsh deposits described by Scruton (1955, p. 30–35). Coal beds, developed from peat layers, represent the accumulation of plant debris in a swampy environment. The numerous thick coal seams suggest large marshy areas which can develop most easily and extensively on low-lying coastal plains. The best example of the marsh and swamp facies is found in the Peace River canyon where coal seams, ranging from a few inches to 6 feet, occur throughout some 1,800 feet of Gething sediments. In addition, seams as much as 20 feet thick have been trenched along the John Hart Highway in the Pine River valley. Coal seams occur in the region between Peace and Halfway Rivers although the number of seams appears to decrease markedly northward. The main development of this environment was apparently localized in the region between Pine and Peace Rivers, with southward extension toward Smoky River. However, the marsh environment disappears northward. Fossil flora indicates that conifers were most abundant, cycadophytes were common, and ferns and ginkgos were less numerous (Bell, 1956, p. 18) in the Gething swamps.

Delta-front Environments

The fine-grained sandstone facies of the Gething Formation is mainly of shallow marine origin. The stable composition and good sorting, shown by the low content of matrix and uniform grain size, are indicative of winnowing by currents. This sandstone grades laterally northward into marine siltstone and is associated with intercalated beds of marine shale containing Foraminifera; such sediments are similar to prodelta sediments. To the south, these sediments contain intercalated thin coal seams and beds containing plant fossils, and grade into carbonaceous coal-bearing and conglomeratic sediments (Fig. 15). They represent a transitional deposit between dominantly marine and dominantly alluvial-deltaic environments. Although such sandstones appear to be sheet-like, they may be a composite of smaller sand bodies. Such shallow marine deposits are similar to Recent tidal and barrier island sand bodies (van Straaten, 1954a, b; McKee, 1954; Shepard and Moore, 1955; Potter, 1967), delta-front sands (Moore, 1966) and delta-front sheet sands (Gould, 1970, p. 11).

The succession of sedimentary structures and textures of the Gething sandstones north of Sikanni Chief River are typical of nearshore to offshore sediments. In general, these sandstones are predominantly grey to brownish grey, are relatively well sorted, "clean," and fine grained. Crossbedding is a common feature and oscillation and current ripple-marks are locally abundant. Flow rolls are present. Sediments at the base, which are transitional into sandstone units, are commonly composed of interlaminated siltstones and shales or mudstones. Laminations are wavy to irregular with silt-filled burrows and mottling, typical of reworking by various organisms. Overlying sandstone beds may be structureless to slightly mottled with some discontinuous or broken laminae. The lack of structure or homogeneous nature of the sandstones is attributed to intense burrowing activity. The uniformly laminated to finely cross-laminated units with ripple-marks and some flow rolls are similar to modern beach and offshore sands described by McKee (1957) and to delta-fringe and littoral sands outlined in a deltaic model by Visher (1965, p. 52–53). The sandstones probably include sediments of the strand plain and barrier bar.

Prodelta Environment

The prodelta environment is represented by the dark grey siltstone and mudstone facies. The laminated, argillaceous siltstone and silty mudstone with organic material are characteristic of recent prodelta slope to bottomset beds (Scruton, 1955, p. 35–38; Allen, 1964, p. 31; Donaldson *et al.*, 1970, p. 122; Allen, 1970b, p. 149).

Siltstones of this facies are commonly laminated to very thinly and uniformly bedded and some show fine cross-laminae. Laminations in the mudstones are virtually absent and stratification is indicated only by a few thin silty layers. The mudstones are similar to Recent offshore clays which are generally homogeneous (Scruton, 1955). The dark coloration of these sediments is caused by very fine carbonaceous fragments and disseminated iron sulphides, indicative of reducing conditions below the sediment-water interface. Reddish weathering sideritic concretions are common. The occurrence of glauconite and siderite are indicative of marine deposition (*see* Krumbein and Garrels, 1952; Burst, 1958; Shepard and Moore, 1955; van Andel and Postina, 1954). Similar sediments in ancient rocks were interpreted as prodeltaic and open shelf facies by Wanless *et al.* (1970, p. 221).

The microfauna consisting mainly of Foraminifera, identified by T. P. Chamney, are considered by him to be representative of restricted to open marine conditions. The most persistent open marine conditions, as indicated by the abundance and variety of foraminifers, occur near Prophet River (sec. 62–20) in the upper half of the formation. Thinner shale beds containing similar fauna occur at Besa River (sec. 64–15) and, although numerous repetitions of open marine conditions are indicated by the fauna at Peace River (sec. 68–18), the marine transgressions were short-lived. Agglutinated foraminifers characteristic of restricted to very restricted marine conditions within the cycles give evidence of the oscillating conditions from subaqueous to subaerial deposition in the region of the delta. The dominance of fauna of the restricted environments at Peace River and toward the base of the marine shale at Prophet River indicates that shallow conditions existed during the transgression of the seaway.

Source

The configuration of the embayment in which Gething sediments were deposited is shown in Figure 19. A large island, formed of cuestas of Paleozoic and Triassic rocks dipping gently to the west, bordered the embayment to the east. The development of deltaic and

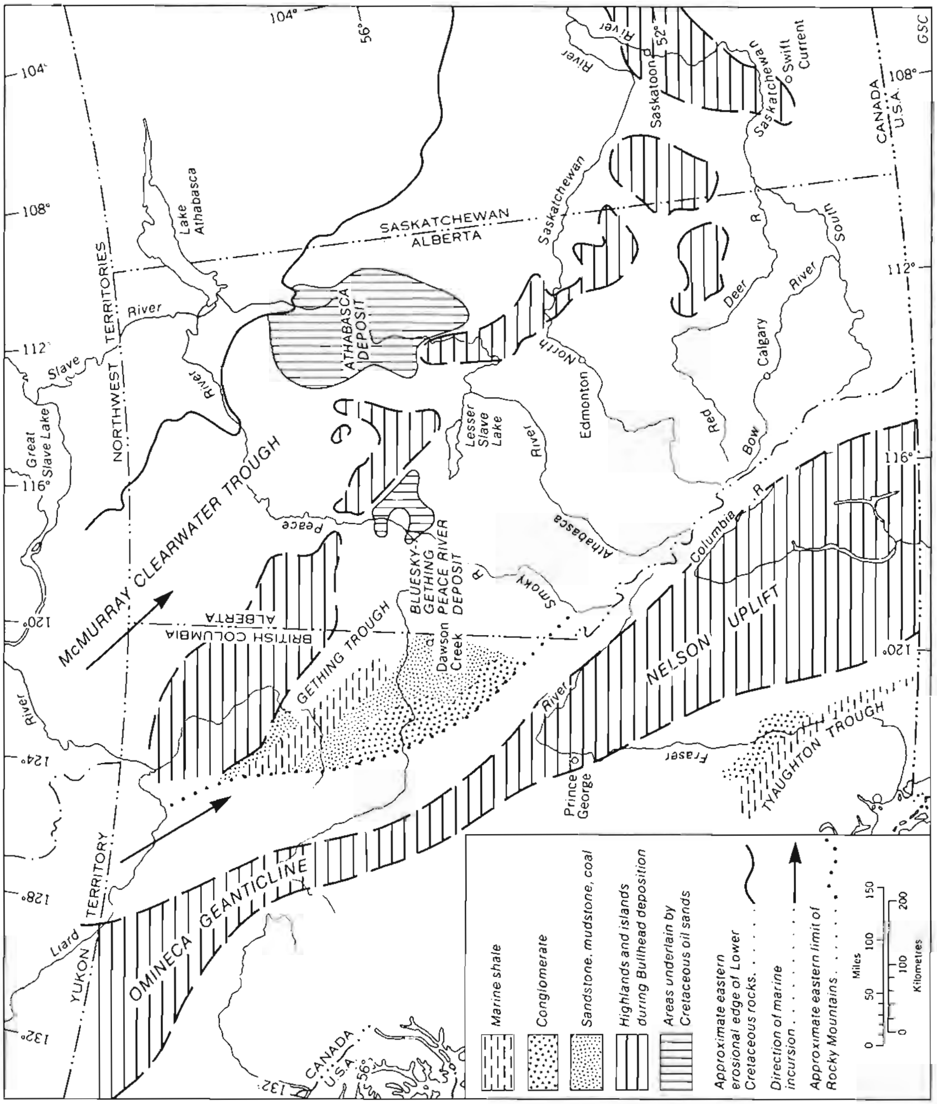

FIGURE 19. Paleogeographic map of Bullhead Group (*modified after* Rudkin 1964)

alluvial environments to the south and southwest of a marine trough indicates a borderland in that direction. The tremendous concentration of sediments, including coarse-grained and conglomeratic sandstones in the Peace River region, points to a major river system debouching from the west. The Gething sediments, therefore, were derived from two principal areas, the low-lying island to the east, and the western borderland. The western flank of the borderland was determined by Jeletzky and Tipper (1968, Fig. 9).

The marked increase in thickness and general increase in coarseness of sediments to the west and southwest points indicate that the main source was in that direction and suggest a relatively high landmass. The westernmost exposures of the Gething lie east of the main ranges of the Rocky Mountains and the source must have been some distance beyond the present outcrops. Therefore, the source could have been located on the present site of the western ranges of the Rocky Mountains or perhaps somewhat farther west across the present Rocky Mountain Trench. The basal coarse-conglomeratic facies is suggestive of marked uplift of the source region, probably related to renewed tectonism in the Omineca Geanticline. Recent investigations by Price and Mountjoy (1970) suggest that the western ranges of the Rockies were being elevated about this time.

The detritus appears to have been derived mainly from a sedimentary terrain. The maturity of the sediments, the sphericity and roundness of the grains all point to previous cycles of erosion. The lack of abundant micaceous detritus, typical metamorphic accessory minerals and absence of igneous detritus (including abundant feldspar), also is indicative of a sedimentary source area. Furthermore, the paucity of heavy minerals and the occurrence of only the most stable assemblage are indicative of derivation from older sediments.

The metasedimentary suite of quartzites, quartzose sandstone, and argillites which form a small proportion of the total detrital component was apparently derived from lower Paleozoic to Precambrian rocks, now well represented in the western ranges of the Rocky Mountains. The stable detrital suite, dominated by grains of quartz and chert, was derived probably from lower Paleozoic and possibly Carboniferous, Permian, and Triassic orthoquartzites, siliceous shales, and cherty and phosphatic carbonates which are present in the Rocky Mountains. Cherts containing traces of organic structures are typical of many Paleozoic carbonate formations; the abundant black chert may have been derived from upper Carboniferous rocks. Phosphatic chert may be derived from Paleozoic carbonate deposits and also from Triassic and Jurassic sediments.

It seems probable that older Paleozoic sediments were being eroded in the western borderland whereas, on the eastern island, upper Paleozoic and Mesozoic sediments were exposed. The re-cycled quartz concentrated on the eastern side of the basin (Fig. 16) probably was derived from lowermost Cretaceous quartzose sandstone exposed on the eastern island.

The main source of the Gething sediments therefore, appears to have been a dominantly sedimentary terrain lying to the west, consisting mainly of latest Precambrian, Cambrian and younger Paleozoic rocks uplifted during early and middle phases of the Columbian Orogeny. Equivalent Blairmore sediments in west-central and southwestern Alberta were considered by Mellon (1967; *see also* Price and Mountjoy, 1970, p. 21) to be derived from Paleozoic carbonates and orthoquartzites widely exposed in the source region. In addition, the large island which formed the eastern margin of the Gething trough was probably contributing detritus from older Mesozoic and possibly Paleozoic rocks.

Tectonism

The elongate trough in which Bullhead sediments were deposited lay along the western margin of the craton and was underlain by a relatively thin sequence of essentially undisturbed Paleozoic and older Mesozoic sediments. To the west, the Omineca Geanticline which had developed during Paleozoic time was once again undergoing deformation during the Columbian Orogeny. Movements along the Omineca Geanticline apparently were not continuous but were episodic, with several strong pulses during Cretaceous time (Wheeler, 1967).

During Devonian or possibly earlier time, a northeasterly trending fault system, probably involving basement blocks, developed a high topographic feature that has become known as the Peace River Arch. Although earliest movements were of a positive nature (Webb, 1951; Sikabonyi, 1957; de Mille, 1958), negative movements starting in Mississippian time were more pronounced (Lavoie, 1958) and continued at sporadic intervals into Cretaceous time. As shown by other workers (Williams, 1958; Rudkin, 1964) and the writer (Stott, 1968a), this fault zone was active during the deposition of Bullhead and Fort St. John sediments, controlling at various times the southern extent of boreal marine advances. The facies relationships determined during the current studies indicate that, during Aptian and earliest Albian time, the shoreline lay somewhat farther north than during Middle Albian time (*see* Stott, 1968a, Figs. 18d, f). During deposition of Bullhead sediments, this fault zone exerted considerable control on the southern advance of the marine embayment and controlled the greatest accumulation of sediments.

The Omineca Geanticline to the west and the Peace River fault system are, therefore, the primary controls of the distribution and development of the various Bullhead facies. The accumulation along the fault zone is at least five times greater than in areas to the south and east, indicating the development of a graben-like structure.

Not many years ago, the common belief was that only two major orogenies occurred in the region and that each was distinctly separate and brief. These were the Nevadan, supposedly occurring at the end of Jurassic time, and the Laramide, dated as latest Cretaceous to Eocene. More recently, views have been modified as evidence accumulated to show that tectonic movements must have occurred at various times throughout the Cretaceous period. Bally *et al.* (1966, p. 365–369) suggested that the crustal movements related to the development of the Rocky Mountains began during Early Cretaceous time and that the Main Ranges were elevated after deposition of the Lower Cretaceous succession. Wheeler (1966, p. 37) suggested that the eastern part of the Western Cordillera was essentially a mobile geanticline during Mesozoic time and was the principal source of Cretaceous sediments deposited to the east in the present site of the Rocky Mountains. He stated (1967, p. 22):

> The culminating deformation of the eastern Cordillera—the Columbian orogeny—began in the southern part of Omineca Geanticline in Later Jurassic time almost contemporaneously with the type Nevadan episode...the deformation migrated eastward and culminated in the mid-Tertiary as a late Laramide episode.

The thick deposits of the Minnes succession of latest Jurassic and earliest Cretaceous age were derived from a rising western source (Stott, 1967a, p. 41) and it becomes evident that late Jurassic movements did not cease abruptly but continued into Cretaceous time. In developing a model for the evolution of the Rocky Mountains, Price and Mountjoy (1970, p. 23) suggested that:

> The Main Ranges and perhaps the western Front Ranges structure emerged as an active zone of thrusting in the Late Jurassic and Early Cretaceous, and the Front Ranges in the Late

Cretaceous. Thus, the overall pattern which emerges is one of progressive development of successively lower and more northeasterly thrust faults during an interval lasting from Late Jurassic to Paleocene or Eocene.

The regional unconformity at the base of the Bullhead Group probably represents a time of stability and relatively slight elevation of the western anticline. If the Omineca belt had been elevated, large quantities of detritus would have been carried out into the basin with resultant deposition rather than erosion. Therefore, during Hauterivian to Barremian time, it seems likely that there was little if any movement along the Omineca Geanticline. Price and Mountjoy (1970, p. 21), commenting on similar relationships in the southwestern region of Alberta stated:

> The hiatus between the Blairmore and Kootenay-Nikanassin may mark a reduced supply of the detritus being discharged into the clastic wedge sequence which reflects a lull in the deformation and uplift to the southwest.

Jeletzky and Tipper (1968, p. 84), in their discussion of the Tyaughton Trough on the western flank of the southern extension of the Omineca Geanticline (termed by them the Nelson High), suggested[1] "the absence of any elevated land barriers between Western Interior and Western Cordilleran depositional basins throughout Hauterivian–Barremian time."

The thick, widespread Cadomin conglomerate is strongly indicative of major uplift along the Omineca Geanticline. The abrupt appearance of those coarse sediments suggests the development of a rapidly rising source during Barremian–Aptian to Early Albian time. The cobbles and boulders found in the Cadomin Formation could be carried only by streams of high gradient. The Nelson batholith, in the southern part of the geanticline, was shown by Beveridge and Folinsbee (1956, p. 41) to have been unroofed and to be a source of Blairmore sediments, which are in part the southern equivalent of the Bullhead Group. According to Price and Mountjoy (1970, p. 23), structures in the Main Ranges near Yellowhead Pass, some 250 miles to the south of Peace River, probably began to develop as early as late Jurassic and:

> are associated with emplacement of a tongue of hot gneissic rock from the infrastructure and with related post-kinematic metamorphic recrystallization which occurred sometime prior to Aptian, or Albian (111 my) according to a K-Ar date on biotite.

Jeletzky and Tipper (1968) demonstrated clearly that tectonic movements, dated by them as Aptian[2], effected a complete and lasting change in the structural pattern of the Omineca Geanticline (Nelson High). They found (op. cit., p. 84), along the eastern margin of Tyaughton Trough bordering the western flank of Omineca Geanticline, that "conglomerate apparently accumulated as a piedmont deposit at the base of a range of granitic mountains that were abruptly uplifted in the northeastern source area of the trough and suffered rapid dissection and degradation."

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[1]Their conclusions were based on similarities of marine fossil assemblages in Neocomian beds. They considered the relationships necessitated direct marine connections between Tyaughton Trough and the Western Interior. Their conclusion may not be entirely valid as such marine connections may have been from the north rather than directly east-west.

[2]The Aptian date is based on floral evidence. Jeletzky and Tipper acknowledge (1968, p. 47) some uncertainty but state that, for the purposes of their report, "the strata containing this flora will be considered Aptian fully realizing that some or all of those rock units may be middle or lower Albian in age." The flora on which they base their determination is similar to the Lower Blairmore and Gething floras discussed elsewhere in this report. More recent work by Jeletzky (1971a) in the adjoining Pemberton area has revealed the presence of Barremian and Aptian marine fossils in rocks considered by him to be equivalent in part to strata yielding the "Aptian" flora.

Thus, there is sedimentary evidence from both the eastern and western flanks of the Omineca Geanticline and also structural evidence that indicated strong positive movements along the Omineca Geanticline during Barremian, Aptian, and Early Albian time.

The gradual decrease in the thickness of the conglomeratic deposits and the size of the clasts in the upper Gething beds and the increase in fine silt, mudstone, and coal beds provide evidence that the highland was being eroded gradually and that progressively smaller amounts of detritus were being carried into the basin. The deposition of alluvial sediments ended as the rate of sedimentation was exceeded by the rate of subsidence within the basin. As the source area was reduced in elevation, ever-decreasing amounts of detritus were being contributed to the continually subsiding basin and eventually the marine embayment transgressed over the flood plain. This transgression, recorded by the Moosebar and Buckinghorse Formations, records another lull in tectonic activity along the Omineca Geanticline during late Early to early Middle Albian time.

Climate

Climatic conditions are determined mainly by the type of plants present but the occurrence of dinosaur tracks shows that those large animals were able to live in the region. According to Colbert (1961, p. 229), Cretaceous dinosaurs probably lived in tropical to subtropical climates or at least in a region of warm and moderate temperatures. Ostrum (1965, p. 40–41) also considered that near-tropical conditions were required for dinosaurs to survive. Sternberg (1933, p. 102), in a rather lyrical description of the Gething scene, envisaged:

> a great swamp on the edge of a lake, filled with ferns and rushes on which several dinosaurs were quietly feeding. Suddenly a huge carnivorous dinosaur appeared... this 40-foot tiger of the everglades. Tranquility was turned to chaos as the herbivorous and smaller carnivorous dinosaurs scattered in every direction and the crocodiles and turtles slipped into the water and swam to the other shore.

The Gething Formation contains an assemblage of ferns, ginkgophytes, cycadophytes, and coniferophytes that is fairly similar to that found in Albian rocks of Alaska. Smiley (1966, 1967) compared the Cretaceous plants of Alaska with their nearest living relatives and stated (1967, p. 853), "Living relatives of Albian plants in northern Alaska are now confined to latitudes south of about 30°N, generally at moderate elevations—humid warmer climatic conditions." He also suggested a warming trend from Early Jurassic to Cretaceous (Albian) time in North America, basing his conclusions on comparisons of shifting Mesozoic vegetational zones between present latitudes 40 degrees and 70 degrees north. Axelrod (1970, p. 285) suggested, "It seems more probable that there was not so much a major trend to greater warmth, but rather a significant increase in equability." He (op. cit., p. 282) suggested also that "montane regions of ever wet climate (e.g. 'montane rainforest', or 'cloud forest')" would support "dank tree fern glades, towering dense stands of coniferophytes and ginkgophytes, and cycadophyte thickets." The numerous and thick coal seams indicate an abundant vegetation requiring humid conditions. Singh (1964, p. 37), in discussing the Mannville Group which is in part equivalent to the Gething Formation and occurs at about the same latitude, stated that the continental microflora "indicated that warm-temperate to sub-tropical humid climate prevailed in east-central Alberta during Early Cretaceous time." It follows that the climate under which Gething sediments were deposited probably ranged from humid-warm temperate to subtropical.

Depositional History

Deltaic sedimentation was initiated during Early Cretaceous time when rivers flowed eastward from a rising source area west of the present Rocky Mountain Foothills. The rivers carried a large detrital load that was in excess of that which the energy conditions within the basin could redistribute and sort. The material was deposited under subaerial to subaqueous conditions on a low-lying plain bordering a narrow marine embayment from the north. The subaerial deltaic plain was poorly drained and, consequently, extensive coastal swamps and marshes formed in the interfluve areas. The Gething Formation comprises several coalescing deltas and represents a deltaic complex or alluvial plain rather than a single delta.

The clastic material was deposited in an elongate trough bounded on the west by the Omineca Geanticline and on the northeast by a cratonic area underlain by relatively flat lying Paleozoic to earliest Cretaceous sediments (Fig. 19). The latter area formed an island or peninsula between two embayments; the western one being filled by Gething sediments and the eastern one by McMurray sediments. The Gething sediments were deposited in an intermittently subsiding depression with greatest thickness being in the order of 2,500 feet or more in the west and only a few hundred feet in the east.

A primary control of the development of the Gething Formation was the structural zone generally referred to as the Peace River Arch. However, that zone was a negative feature during late Paleozoic and Mesozoic time and appears to have been a region of major subsidence during deposition of Gething sediments. During Early Cretaceous time, subsidence continued along the north side of the structure. The fault zone acted in part as a hinge which controlled the margin of the marine embayment and localized the deposition of the clastic material. The continuous subsidence of that region not only funnelled in large volumes of terrigenous material derived from the western highland but also favoured the development of poorly drained, swampy regions ideal for the accumulation of plant debris and development of thick coal seams.

The alluvial, deltaic, and offshore sediments of the Gething Formation were deposited during the initial transgressive phase of the advancing Lower Cretaceous (late Neocomian) sea whose later phases are recorded in the Albian Fort St. John Group. The development of the Gething delta was part of the general progradation which occurred as the basin was filled by the influx of very large quantities of detritus. The development resembles the general pattern of marine regression found in Recent deltas described by Scruton (1960, p. 97). The succession contains many of the physical characteristics outlined in the deltaic model proposed by Visher (1965, p. 51) who considered the deltaic process to be "a hybrid between regressive marine and fluvial processes." The Gething delta is comparable with the "high-constructive" Gulf Coast delta systems of Cretaceous to Eocene age that were described by Fisher (1969). The Gething constructional facies, similar to that of the Gulf systems, contains well-developed and extensive progradational sequences, with thick delta-plain deposits and numerous coal seams. The destructional facies, restricted to the distal part of the delta, is marked by thin marine shales on the basin side. Associated depositional systems, developed by deposition from longshore drift, include strand plain, barrier bar, and lagoonal systems. The delta flank systems are well developed and the prodelta deposits are thick. Progradation ceased when subsidence finally exceeded the rate of deposition and the Gething sediments were overlapped by the mid-basin shales of the Fort St. John Group.

There is abundant evidence that the dominant source of the clastic sediments deposited during Gething time was in the west. The progressive increase of grain size westward within the clastic wedge and the marked increase in thickness of the succession, together with spatial relationships of environmental facies, all point to a western source. However, the positive island or peninsula to the northeast undoubtedly contributed some clastic material. The source terrain had considerable relief as shown by the very coarse detritus in piedmont and inland flood-plain deposits within the Bullhead succession.

With the landward advance of the Gething shoreline, marine conditions gradually spread farther south and the maximum incursion reached approximately to Peace River although the main offshore facies within the Gething does not extend much beyond Sikanni Chief River. The glauconitic beds at the top of the formation record a shoreline which extended southeasterly from Gathto Creek to Peace River in Alberta.

The Gething delta, like the Mississippi delta, reflects the imbalance of rate of sedimentation and rate of subsidence. Yet the Mississippi delta is characterized by a general lack of the sand fraction whereas, in the Gething delta, sand is abundant. The Gething delta can be compared to the Devonian Catskill "tectonic delta complex" as outlined by Friedman and Johnson (1966), in which abundant sand was derived from a nearby mountain front. Friedman and Johnson proposed the term for "a deltaic complex built into a marine basin contiguous to an active mountain front and dominated by orogenic sandstones." The Gething complex, like the Catskill, is dominated by sandstone and conglomerate and was built into a marine embayment. The analogy drawn by Friedman and Johnson between the Catskill complex and present conditions seems applicable also to the Gething complex. They compared the Catskill complex with streams flowing into the Plains from the present Rocky Mountains, pointing out that the load dropped by modern rivers within one to several hundred miles of the mountain front is as sandy as the Catskill complex. Similar relationships of source, base, and rates of sedimentation as found in the Catskill complex are proposed for the Gething complex.

Summary

The Bullhead Group is a deltaic wedge composed of detritus derived from a source area lying west of the front ranges of the Rocky Mountains which was being elevated by an intermediate pulse of the Columbian Orogeny (Mid-Columbian phase) in Barremian–Aptian time. At the base is a sequence of some 500 to 700 feet of chert conglomerate and conglomeratic sandstone which thins in an easterly direction and interfingers with finer clastic sediments (Fig. 15). Those continental sediments were deposited at the margin of an elongate embayment extending from the boreal ocean (Fig. 19). The grey and brownish grey sandstone, siltstone, shale, and conglomerate of this wedge interfinger northward with nearshore and shallow marine sandstone and shale which in turn grade into dark coloured shale and siltstone of the deeper marine environment. The marine shale finally overrode the deltaic sediments. This transgressive relationship was produced as a result of the expanding Albian sea which spread far to the south and southeast and which, in turn, was related to the dwindling clastic supply from the eroded Omineca Geanticline.

In conclusion, Gething sedimentation occurred during the initial transgressive phase of an advancing boreal sea. This transgression resulted from basin margin subsidence bordered on the west by a rising mountainous area and to the east by the craton. Several shoreline oscillations occurred during the transgressive phase which culminated in a major marine advance westward and southward of the mid-basin facies now represented by the dark coloured shale of the Moosebar and Buckinghorse Formations. The sedimentary strike was essentially northwesterly but a strong northeasterly element, related to the ancient Peace River Arch, produced the major deltaic complex in the vicinity of Peace River.

ECONOMIC GEOLOGY

Petroleum and Natural Gas

Many of the world's oil and gas fields are productive from sands which were deposited in deltas, and there can be little doubt that numerous undiscovered accumulations of petroleum are in such deposits (Rainwater, 1966).

Occurrence

The distribution of oil and gas fields and wells producing from the Bullhead Group in northeastern British Columbia is shown on Figure 20. The fields are located near the eastern margin of the deposits, along a broad shelf area probably containing such mixed depositional environments as fluvial, deltaic, and nearshore-marine. Significant fields are absent to the south in the area considered to be the main coal-bearing part of the Peace River delta and in the adjacent alluvial plain. Few wells have been drilled and no production obtained near the northwestern termination of the Gething Formation in the area of the marine shale basin, where reservoir sand bodies would be less numerous.

The producing fields, number of producible wells, parameters, reserves, and production are summarized in Table IV[1]. Oil production is obtained from 21 wells in six fields, with most of the production coming from three fields. Gas production is obtained from 27 wells in eleven fields, the major production coming from seven fields. To date (December 31, 1969), 3,496,000 barrels of oil have been produced from Bullhead sediments and 313 Bscf of raw gas have been obtained. Total reserves in Bullhead strata in northeastern British Columbia are estimated to be 9,365,000 barrels of oil and 727 Bscf of raw gas[2]. Oil and gas accumulations in northeastern British Columbia occur in well-sorted, clean, porous sandstones of the Bullhead Group and are found in both stratigraphic and stratigraphic-structural traps.

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[1]The British Columbia Department of Mines and Petroleum Resources classifies part of the Cretaceous succession as "Dunlevy" stating (1968a):

> The term Dunlevy is derived from the formation of the foothills equivalent to the Cadomin and Nikanassin. It is used in this Schedule to encompass the lower part of the Bullhead sequence which cannot be clearly recognized as Cadomin or Nikanassin. It is used to describe production from the "Buick Creek sand" and "Basal Gething" deposits associated with the pinch-out of the Lower Bullhead formations.

Although the writer has not made a detailed study of the interval in subsurface, he considers quartzose sand assigned to the "Buick Creek Sand" to be equivalent more likely to the quartzose Neocomian Monteith Formation rather than to the Cadomin and Gething Formations. Therefore, data concerning production from the "Dunlevy" may not relate directly to the Bullhead Group.

[2]Oil, Natural Gas and By-products Reserves in British Columbia, Dec. 31, 1969; British Columbia Department of Mines and Petroleum Resources.

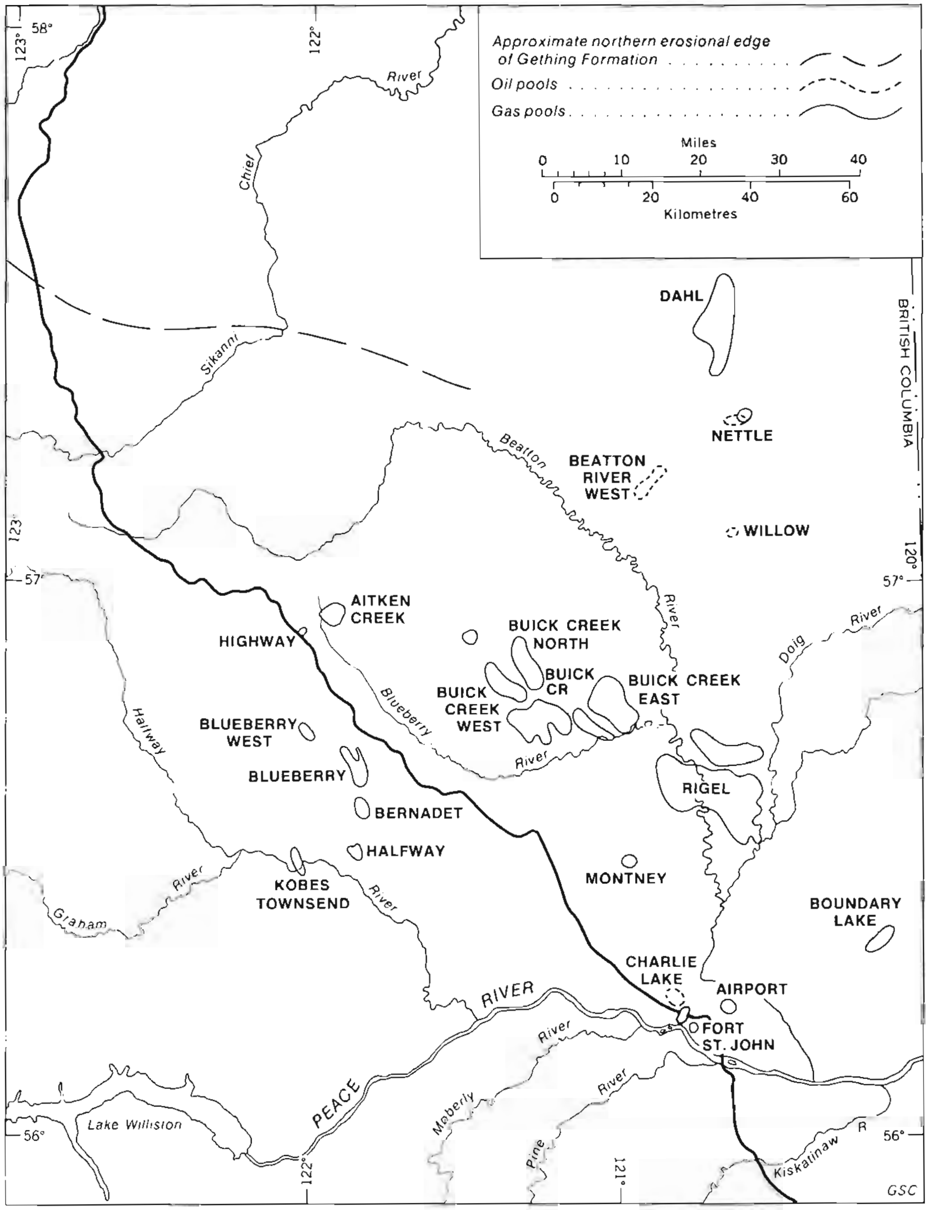

FIGURE 20. Map of oil and gas pools in Gething, Cadomin and Bluesky strata, northeastern British Columbia (from Geological Survey of Canada, Map 1317A)

Field	Stratigraphic producing zone		Number of producible wells		Porosity percentage		Permeability	Production, 1969	
	Oil	Gas	Oil	Gas	Oil	Gas	Md	Oil (bbls.)	Gas (ms.c.f.)
Airport		Cadomin		1		18	NA		104,082
Aitken Creek	Gething	Gething	5	3	12.4		2,835	347,314	3,482,530
Beatton River West	Bluesky-Gething		12		15.1		65	184,589	
Bernadet		Bluesky-Gething		1		8	NA		40,639
Blueberry		Dunlevy		7		11	10		1,026,989
Blueberry West		Dunlevy		2		9	NA		102,654
Boundary Lake	Cadomin	Bluesky-Gething Gething, Cadomin Dunlevy	1	2 2 1	20	13 17	NA NA 75	949	341,518
Buick Creek		Dunlevy		17		26	140		8,003,888
Buick Creek East		Bluesky-Gething Dunlevy		2 8		10 11	NA 125		3,712,453
Buick Creek West	Dunlevy	Gething Dunlevy		1 9		12	165		2,979,030
Buick Creek North		Bluesky-Gething Dunlevy		2 6		12 11	NA NA		280,489 2,011,992
Dahl		Bluesky				16	NA		
Charlie Lake	Gething		1		19.0		NA		
Fort St. John		Cadomin		2		12	421		
Fort St. John S.E.		Cadomin		1		16	64		
Highway		Dunlevy		1		9	85		154,692
Jedney		Gething		1		11	NA		
Kobes Townsend		Dunlevy		3		13	18		688,549
Montney		Bluesky-Gething		1		17	NA		
Nettle	Bluesky-Gething	Bluesky-Gething	3	1	15.3		127		
Rigel	Dunlevy	Dunlevy	7	42	13		330	41,596	15,238,425
Willow	Bluesky-Gething		1		34		150		

GSC

Note: NA – Not available

[1] Annual Report, Minister of Mines and Petroleum Resources, December 31, 1969 British Columbia

TABLE IV. *Production data of fields*[1]

Exploration Potential

Traps in which oil and gas might have accumulated are abundant in the region north of Peace River. Prospective reservoirs occur throughout 500 to 1,000 feet of the sandstone succession and suitable source beds appear to be present, particularly in the marine shales in the vicinity of Prophet River. Source rocks also may include underlying Jurassic marine shale and Triassic rocks.

The well-sorted marine sandstones are believed to have the best reservoir potential. However, the channel deposits and widespread basal conglomerates also are promising. The area directly west of the zero isopach and extending northward from Halfway River (Fig. 2) contains the greatest accumulation of the marine sandstone. Conglomeratic deposits occur along the eastern margin of the deposits and are well developed between Peace and Graham Rivers.

The large amount of siliceous cementation of the sandstones, as observed in the Foothills, militates against development of good porosity and permeability. However, should this siliceous character be less pronounced in the subsurface of the Plains, the well-sorted nature of many of the sandstones would favour the occurrence of porosity and permeability suitable for hydrocarbon reservoirs. Porosity in the producing fields ranges from 13.00 to 34.00 and permeability from 10 to 2,835 Md.

Coal

Interest in the Lower Cretaceous coals of northeastern British Columbia and neighbouring Alberta is much greater now than a few years ago. The development of new markets for coal, the opening of a large mine at Grande Cache, and the building of lines of the Northern Alberta Railway into the region have generated a great amount of prospecting and staking within Cretaceous outcrop belts in the Foothills north of Smoky River. Although Latour and Chrismas (1970, p. 9) suggested that "the resource potential of this area is fairly small," the distribution of coal throughout the region indicates a large potential reserve (Stott, 1968a, p. 123; Irish, 1970). Current exploration and development work by major exploration and mining companies give promise of new mines obtaining production from Gething and Commotion strata between Smoky and Peace Rivers.

Although this report has dealt mainly with Bullhead sediments north of Peace River, it is appropriate at this time to review coal prospects within the succession throughout the Foothills of northeastern British Columbia.

Monkman Pass Region

A major drilling program was underway during 1970 in the Kakwa Syncline between Mount Kay and Mount Minnes and also on the west flank of Saxon Ridge. In addition, several companies were prospecting and staking throughout the region.

Several thick coal seams, ranging from 10 to 25 feet, occur within the Gething Formation between Kakwa and Murray Rivers. Thick coal commonly occurs above prominent beds of conglomerate and is encountered at the top of the Cadomin Formation. However, it may not be correct to assume that the top of the formation is drawn above the same conglomerate at all localities. It follows that the coal seam near the base of the Gething may not be the same one throughout the region and, furthermore, more than one major seam may be present, either locally or regionally.

A seam at least 11 feet thick and possibly thicker at the base of the Gething Formation at Mount Gorman just north of Kakwa River probably extends northward at least as far as Murray River and perhaps farther. Coal occurs just above the Cadomin conglomerate northeast of Secus Mountain, north of Belcourt Creek, in the vicinity of Holtslander Creek, and on the flanks of folds between Red Deer River and Kinuseo Creek. Coal talus occurs across a 35-foot unit just above the Cadomin Formation on the ridge south of Kinuseo Creek and coal is exposed in the valley to the north. On the ridge east of Kinuseo Creek and west of Quintette Mountain, coal occurs above the Cadomin and also 100 feet stratigraphically higher in the section. These coal seams do not appear within the thick succession of conglomerate at Mount Belcourt and Onion Creek (Stott, 1968a, secs. 58-13, 59-9) although other well-developed coal seams occur within the Commotion Formation in that region. Thus, Gething coal may be best developed along the eastern Foothills between Belcourt and Kinuseo Creeks.

Bullmoose Mountain Region

The region around Bullmoose Mountain has been extensively explored recently and a large drilling program is currently underway (1971). Officials of Brameda Resources Limited report that the main seam averages 9 feet in thickness and lies 160 to 190 feet below the top of the formation. Analyses indicate that the coal is of good metallurgical coking quality with an ash content of 5 per cent, volatile material of 24 per cent, sulphur content of 0.5 per cent and Free Swelling Index of 8 per cent. Gething and Commotion strata are essentially flat lying to gently warped at Bullmoose Mountain but become involved in folding both to the north and south. Gething strata are fairly well exposed on the southern end of the mountain (sec. 70-4) but there are many covered intervals. Presumably coal lies within the recessive, covered part near the base of the formation as well as higher in the section.

To the south in the vicinity of Wolverine River, several coal seams are present in the Gething (Stott, 1968a, secs. 59-11, 61-12A) but are poorly exposed. On a syncline east of section 61-12A, two coaly intervals, each about 15 feet thick, occur in the lower part of the Gething Formation.

Hasler Creek–Pine River Region

The coal reserves of the Hasler Creek–Pine River area were outlined by McKechnie (1955) for the British Columbia Department of Mines. The Hasler Mine, 9 miles south of the Hart Highway, produced a small tonnage in 1944 and 1945. McKechnie (1955, p. 11) reported the coal to be of low to medium volatile rank and the coking characteristics to be fair to good. Using a minimum thickness for a mineable seam of 4.0 feet and a restricted area, McKechnie estimated reserves at Hasler Creek to be 8 million short tons; in the Willow Creek area, 23.8 million short tons; and in the Noman Creek area, 9.0 million tons. Two seams 4 feet thick and one seam of 6 feet were reported at Hasler Creek. Nine seams, ranging from 6.5 to 20.3 feet, were reported at Willow Creek, and two major seams more than 20 feet thick were found at Noman Creek. Recent trenching at Noman Creek has exposed several seams in steeply dipping Gething strata.

Gething strata in the Noman Creek region extend northward along the flanks of the Fisher Creek Syncline and eastward around the south plunging anticline as far as Crassier Creek. The coal-bearing succession is partly exposed at the headwaters of Fisher Creek and also to the east in the gullies tributary to Fisher Creek. Large coal seams were not observed there but many intervals are recessive and covered. No large area of Bullhead sediments lies west of Mount Bickford although conglomeratic strata of the Cadomin Formation occur along the axis of the syncline at the headwaters of Big Boulder Creek.

A large area in the vicinity of Hasler Creek appears to be underlain by Gething strata. The belt of coal-bearing beds extends from Beaudette Creek at Pine River across Falling and Hasler Creeks to Sukunka River. Except for the area around Hasler Creek, very little is known about the bedrock because the region is heavily forested. The beds appear to lie within a broad, shallow syncline modified to some extent by smaller folds. The occurrence of thick coal seams at Hasler Creek in the middle of this belt and also at Bullmoose Mountain to the south gives encouragement for further exploration.

Carbon Creek Region

The coals of the Carbon Creek basin, some 20 miles west of Peace River canyon, were examined by Mathews (1947) who assigned the beds to his non-marine Bullhead unit. Recent studies by the writer show that the main coal-bearing succession lies within the Gething Formation and above the conglomeratic sandstone of the Cadomin Formation. Mathews reported ten seams more than 4 feet thick, including one seam of 8 feet 9 inches in the southern part of the basin, and two seams, 17 feet and 9 feet 2 inches respectively, on Eleven Mile Creek. Mathews suggested that the thicknesses of the last three seams may be abnormal owing to structural thickening. Most of the coal in the Carbon Creek basin was classified as medium volatile bituminous.

The coal-bearing succession of the Carbon Creek region is centred around Carbon Creek, lying within a large shallow syncline whose axis is subparallel to the creek. Considerable small-scale but tight folding is evident within the main syncline. The conglomeratic sandstone of the Cadomin Formation lies close to Carbon Creek along the east side of the syncline, so that the total thickness of Gething strata there is not large. As a result of recent mapping by the writer, the distribution of Cadomin and Gething strata at the south end of the syncline has been modified from that outlined by Stott (1967a, 1969b) and their distribution has been extended across McAllister Creek onto the eastern flank of Beattie Peaks. Thus, the area of potential coal deposits is expanded beyond previous boundaries. The main area for possible coal occurrences appears to lie along the lower reaches of McAllister Creek, across Carbon Creek toward The Monach and northward along the western flank of the syncline. The western limit of the coal-bearing beds is determined by the occurrence of the Cadomin Formation which is believed to lie about 4 miles west of Carbon Creek. Gething strata are not recognized on the west flank of the large anticline whose axis extends southeasterly from Mount Cowper and Mount Rochfort.

Peace River Region

Several older mines in the region of Peace River were closed because of uneconomical operations and lack of markets. These included the Peace River mine at Portage Mountain, Packwood and Reschke mines on Butler Ridge, and the King Gething mine on Peace River. All the coal mined in this region was used locally in Hudson Hope, Fort St. John, and Fort Nelson.

The coal seams of the Peace River canyon were described in greatest detail by McLearn (1923, p. 9), additional investigations were made by McLearn and Irish (1944), and summarized by McLearn and Kindle (1950). The maximum seam reported was 5 feet thick and the rank of the coal was reported to be low to medium volatile bituminous. Subsequent studies by the writer (1963, 1968a; this report) have not revealed any thicker seams along the canyon although it is possible that thicker coals might be present in the covered interval near the base of the Gething Formation at the lower end of the canyon.

The coal prospects in the vicinity of Dunlevy Creek and Butler Ridge were described by Irish (1970, p. 88). He reported that two thin seams occurred at the south end of Butler Ridge and two mine workings had been opened, one on either side of the anticlinal structure. He also reported coal seams on Dunlevy and Cust Creeks and along the east side of Butler Ridge, but stated that these were not of mineable thickness.

Halfway River–Sikanni Chief River Region

Exposures between Peace and Halfway Rivers are poor and only the more resistant sandstones outcrop. Large covered intervals, present in sections east of Christina Falls (62-13) and Horseshoe Creek (62-1), may include coal seams but none was observed. Similarly, one of the most complete Gething exposures, Fiddes Creek (sec. 62-11), did not reveal any coal. However, as coal is known to be present at Pink Mountain to the east, it seems likely that some does occur in this region. The most promising areas are the large synclines lying between Graham and Halfway Rivers.

Only thin coaly shale was observed at Mount Wooliever (sec. 62-6) and a few coal seams less than 2 feet thick occur at Marion Lake (sec. 61-6). Farther east at Pink Mountain, a coal seam, thickened by structural complexities, occurs just above the basal conglomerate at the south end of the mountain. However, in the section (62-3) on the west flank, that seam was not observed. Thin coals are present in the upper half of the Gething and one 4-foot unit of coal and coaly shale occurs about 400 feet below the top.

To the north on Sikanni Chief River, a few thin coaly shales occur in the western section (61-5) and to the east at Chicken Creek (secs. 61-3, 61-4) a few seams less than one foot thick are exposed. No coal was observed at the headwaters of Chicken Creek (sec. 64-18) north of the Sikanni Chief River, nor in sections farther north. The northern limit of coal development appears to be Sikanni Chief River, but coal of commercial thickness may be limited to the area south of Halfway River.

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APPENDIX

(Selected measured sections)

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 61–2. Gething Formation, core of anticline north of summit, Pink Mountain, Trutch map-area, British Columbia, 57°02′N, 122°52′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
10	Sandstone, medium- to coarse-grained, with some pebbles, cherty, siliceous, limonitic in part, slightly laminated; poor porosity		
9	Covered interval		
8	Sandstone, very fine to fine-grained, grey, laminated, siliceous, quartzose; thick-bedded; grey to brown weathering; poor porosity; quartz, 98%, chert, 2%	26	272
7	Covered	64	246
6	Sandstone, fine-grained, grey; thick-bedded; some shaly, recessive intervals	37	182
5	Sandstone, fine- to medium-grained, grey; thick-bedded; upper half not well exposed	35	145
4	Sandstone, fine-grained, brown, laminated, quartzose; medium-bedded; not well exposed	35	110
3	Sandstone, coarse-grained to finely conglomeratic, grey to white	10	75
2	Lithic arenite, coarse- to medium-grained, siliceous, white to grey; thick-bedded; cross-laminated; slightly porous, disseminated pebbles; chert grains; quartz, 75%; chert, 17%	25	65
1	Quartz-arenite, very fine grained, siliceous, white; thick-bedded; some pebbles; slightly porous; not well exposed	40	40
	FERNIE FORMATION		
	Shale, black, fissile to platy, hard; some silty beds at top.		

SECTION 61–3. Gething Formation, Sikanni Chief River, west of Chicken Creek, Trutch map-area, British Columbia, 57°17′N, 123°01′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	BUCKINGHORSE FORMATION		
	Contact with continuous Gething section is covered. Shale is exposed about 10 feet above sandstone. Upstream on west side of small anticline, two beds of highly glauconitic concretionary siltstone overlie Gething sandstone.		
	GETHING FORMATION		
107	Sandstone, fine-grained, brown; thick-bedded; light brown weathering	9	890.5
106	Siltstone and sandstone interbedded, grey; light brown to rusty weathering	5	881.5
105	Sandstone, fine-grained, grey, laminated; rusty weathering	3	876.5
104	Shale, platy; interbedded siltstone	1	873.5
103	Sandstone, fine-grained, grey, laminated	1	872.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
102	Shale, platy	1	871.5
101	Sandstone, fine-grained, grey; massive; light brown to rusty weathering	14	870.5
100	Sandstone, fine-grained, fairly well sorted, siliceous, limonitic, brownish grey; thick-bedded but bedding not well developed; light brown to rusty weathering; poor porosity; quartz, 71%; chert, 12%; matrix, 17%	25	856.5
99	Sandstone, fine-grained, argillaceous; some interbedded shale	5	831.5
98	Shale and siltstone interbedded	7	826.5
97	Sandstone, fine-grained, laminated, grey; thick-bedded; light brown to rusty weathering	10	819.5
96	Mudstone, silty, dark grey; some interbedded siltstone	5	809.5
95	Sandstone, fine-grained, laminated, grey; interference ripple-marks	2	804.5
94	Shale, silty, dark grey to black, fissile; some interbedded siltstone	7	802.5
93	Sandstone, fine-grained, laminated; lenticular	2.5	795.5
92	Siltstone and shale interbedded; rusty weathering	6	793
91	Sandstone, fine-grained, brownish grey; medium- to thick-bedded; lenticular; light brown to rusty weathering; interference ripple-marks	5	787
90	Shale, dark grey; interbedded siltstone; some sandier beds in middle; lenses of sandstone	11	782
89	Sandstone, fine-grained, brownish grey, laminated; thick-bedded	5	771
88	Shale and interbedded siltstone	1.5	766
87	Sandstone, fine-grained, laminated, brownish grey; thick-bedded	5	764.5
86	Shale, dark grey; interbedded siltstone, laminated	3	759.5
85	Sandstone, fine-grained, grey, laminated; massive to thick-bedded, light brown to rusty weathering	9	756.5
84	Shale, dark grey, silty, platy; rusty weathering; 3-foot lens of sandstone upslope	16	747.5
83	Sandstone, fine-grained, laminated, grey; rusty weathering	1.5	731.5
82	Shale, rubbly, dark grey, carbonaceous; some reddish brown concretionary beds	10	730
81	Sandstone, fine-grained, laminated, grey; thick-bedded; rusty weathering; interference ripples	4	720
80	Shale, rubbly, dark grey; rusty weathering; siltstone beds at top; some concretions, reddish brown weathering	15	716
79	Covered	29	701
78	Sandstone, fine-grained, laminated, grey; thick-bedded; grey to rusty weathering	4	672
77	Coal, flaky, shaly	0.5	668
76	Sandstone, fine-grained, grey; flaggy; rusty weathering; shaly intervals; very carbonaceous on upper surface	7	677.5
75	Shale, silty, black	1	660.5
74	Sandstone, fine-grained, laminated, grey	4	659.5
73	Shale and siltstone, interbedded	1	655.5
72	Sandstone, very fine grained, sideritic, well-sorted, brownish grey; thick-bedded; grey weathering; ripple-marks; poor porosity	7	654.5
71	Mudstone to shale, rubbly, dark grey; two beds of sandstone near top	8	647.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
70	Mudstone to shale, silty, carbonaceous; dark grey to black; few beds of argillaceous sandstone	2	639.5
69	Sandstone, fine-grained, laminated, grey; flaggy, beds 2″–6″; rusty to grey weathering; ripple-marks	6	637.5
68	Shale, platy, silty, very black at top; rusty weathering	3	631.5
67	Sandstone, fine-grained, laminated, grey; shaly at base	4	628.5
66	Sandstone, fine-grained, grey; flaggy; grey weathering	4	624.5
65	Sandstone, fine-grained, grey; thick-bedded; grey weathering	3	620.5
64	Sandstone, fine-grained, laminated, slightly carbonaceous; flaggy to medium-bedded; grey weathering	7	617.5
63	Siltstone, argillaceous, flaggy; interbedded with shale, black, carbonaceous	3	610.5
62	Covered. Approximate	7	607.5
61	Sandstone. Approximate	12	600.5
60	Covered. Approximate	15	588.5
59	Sandstone, medium-grained, grey, laminated, siliceous, thick-bedded; some is black and carbonaceous; grading upwards into coarse-grained sandstone with disseminated pebbles; becomes cleaner at top; upper 10 feet is finer grained and contains no pebbles; quartz, 55%; chert, 26%; lithic fragments, 15%	33	573.5
58	Siltstone, sandy, black, laminated; flaggy, beds 2″–3″; dark grey weathering; carbonaceous at top; rootlets	5.5	540.5
57	Sandstone, very fine to fine-grained, siliceous, laminated, grey, non-calcareous; beds 4″–6″, slightly irregular; grey weathering; some small-scale slump structures; poor porosity	11	535
56	Sandstone, argillaceous, dark grey, laminated; flaggy, beds 2″–3″; grey weathering	10	524
55	Siltstone, argillaceous, carbonaceous, dark grey to black; flaggy; interbedded shale	6	514
54	Sandstone, fine-grained, grey; with some coarse-grained sandstone; disseminated pebbles, chert, quartzite, subrounded to rounded, maximum 2″	4	508
53	Sandstone, fine-grained, poorly sorted, siliceous, slightly laminated, grey; medium- to thick-bedded; grey weathering; poor porosity; quartz, 80%; chert, 12%	8	504
52	Sandstone, fine- to medium-grained, laminated; thick-bedded; grey to brown weathering	4	496
51	Sandstone, medium- to coarse-grained; grey; thick-bedded; grey weathering; pebbles on upper surface, maximum 1½″ diameter	3	492
50	Conglomerate; pebbles ¼″–½″, grey-white, black, maximum of 2″; lenses and streaks of coarse-grained sandstone, reddish brown weathering; some indication of bedding but mainly massive; basal surface is concretionary	5	489
49	Sandstone, fine- to medium-grained, laminated, well-sorted, slightly limonitic, siliceous, poor porosity; grey; greenish brown weathering; beds 4″–1′ but not well developed. Basal surface has 2″–3″ relief; quartz, 70%; chert, 21%	5	484
48	Sandstone, very fine grained, limonitic, siliceous, laminated, grey; beds 2″–3″; light yellow-brown weathering; some carbonaceous streaks; 2″ coal at top	7.5	479

Unit	Lithology	Thickness (feet)	Height above base (feet)
47	Shale, silty, dark grey; platy; grey to light brown weathering	2	471.5
46	Covered	5	469.5
45	Sandstone, fine-grained; medium-bedded	15	464.5
44	Siltstone and shale interbedded	5	449.5
43	Covered. Approximate	15	444.5
42	Sandstone, fine-grained, grey; thick-bedded	25	429.5
41	Sandstone, fine-grained	8	404.5
40	Siltstone and shale interbedded	5	396.5
39	Covered	5	391.5
38	Siltstone and shale interbedded; some sandstone at top	7	386.5
37	Sandstone, fine-grained	1	379.5
36	Siltstone and shale interbedded; sandstone near top	12	378.5
35	Shale and siltstone interbedded	4	366.5
34	Sandstone, fine-grained; thick-bedded	3	362.5
33	Shale and siltstone, interbedded. Partly covered	15	359.5
32	Sandstone, fine-grained, grey; medium-bedded	3	344.5
31	Shale, silty, black; beds of fine-grained sandstone; not well exposed	9	341.5
30	Sandstone, fine-grained, grey, carbonaceous at base; medium- to thick-bedded	10	332.5
29	Shale; coaly lenses	2	322.5
28	Sandstone, fine-grained, black	6	320.5
27	Shale, silty, carbonaceous, black; siltstone at top	12	314.5
26	Covered	20	302.5
25	Sandstone, fine-grained, homogeneous; medium-bedded	18	282.5
24	Shale	1	264.5
23	Sandstone, fine-grained, laminated; thin-bedded	10	263.5
22	Mudstone; some thin-bedded sandstone	3.5	253.5
21	Sandstone, fine-grained	8	250
20	Siltstone, sandy, dark grey; platy; rusty weathering	6	242
19	Sandstone, fine-grained, grey; medium-bedded	5	236
18	Covered	15	231
17	Sandstone, fine-grained, grey; medium- to thick-bedded	10	216
16	Shale, silty, dark grey	3	206
15	Sandstone, fine-grained, dark grey; medium-bedded	8	203
14	Covered	8	195
13	Sandstone, fine-grained, laminated; thin-bedded; becoming thick-bedded toward top	15	187
12	Covered	10	172
11	Sandstone, fine-grained, laminated; medium-bedded	65	162
10	Shale	1	97
9	Sandstone	1	96
8	Sandstone; partly covered	10	95
7	Covered	10	85
6	Sandstone	20	75
5	Shale, silty	9	55
4	Sandstone, fine-grained; medium-bedded	15	46
3	Covered	15	31
2	Sandstone, fine-grained, dark grey; medium-bedded	14	16
1	Shale, carbonaceous, black	2	2

Underlying beds are folded

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 61–4. Gething Formation, Sikanni Chief River, west flank of anticline, downstream from Chicken Creek, Trutch map-area, British Columbia, 57°02′N, 122°51′W.

Axis of small syncline—no higher exposures

GETHING FORMATION

75	Sandstone, fine-grained, argillaceous; thick-bedded; grey; some interbedded siltstone and carbonaceous shale	20	819.5
74	Sandstone, fine-grained, grey; medium-bedded	6	799.5
73	Mudstone, silty, dark grey to black; thin siltstones and concretions toward top	12	793.5
72	Sandstone, fine-grained, grey; thin-bedded; shaly intervals	20	781.5
71	Mudstone, very silty, and interbedded sandstone, dark grey; rusty weathering	15	761.5
70	Sandstone, fine-grained, laminated to homogeneous, grey; beds 6″–2′; grey weathering; few pebbles on bedding surface	76	746.5
69	Conglomerate; thick-bedded; pebbles $\frac{1}{8}$″–$\frac{1}{4}$″	3.5	670.5
68	Sandstone, medium-grained at base, becoming finer grained towards top, homogeneous, grey; thick-bedded; grey weathering	20	667
67	Conglomerate and coarse-grained sandstone, siliceous, cherty, dark grey; massive; pebbles average $\frac{1}{8}$″–$\frac{1}{4}$″ in diameter	2	647
66	Sandstone, fine-grained, siliceous, cherty, well-indurated, laminated, dark grey; carbonaceous and coaly at base, becoming cleaner at top; poor porosity; quartz, 54%; chert, 27%; lithic fragments, 12%	15	645
65	Siltstone and shale interbedded; mostly covered	7	630
64	Mudstone, very silty; grading upward into siltstone and sandstone	11	623
63	Sandstone, fine-grained, grey, laminated; beds 2″–6″	6	612
62	Shale, silty; platy	1	606
61	Sandstone, silty, laminated	1.5	605
60	Shale, silty, dark grey; platy	1	603.5
59	Sandstone, silty, laminated; beds 4″–6″	5	602.5
58	Siltstone and shale interbedded; platy; dark grey to black; rusty weathering; siltier at top	15	597.5
57	Siltstone and sandstone interbedded; beds 2″–4″	6	582.5
56	Sandstone, fine-grained, laminated; grey; thin- to medium-bedded; grey to rusty weathering	29	576.5
55	Siltstone and sandstone, interbedded; beds 2″–3″; rusty weathering	20	547.5
54	Sandstone, fine-grained, laminated, dark grey, carbonaceous; thick-bedded; grey weathering	15	527.5
53	Covered	16	512.5
52	Sandstone, fine-grained, laminated, grey; medium-bedded; grey weathering	4	496.5
51	Covered	5	492.5
50	Sandstone, fine-grained, grey, laminated; thick-bedded; brownish grey weathering	6	487.5
49	Mudstone, silty, black, carbonaceous	1	481.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
48	Sandstone, fine-grained, laminated, grey; medium- to thick-bedded, brownish grey weathering	8	480.5
47	Mudstone and siltstone, interbedded; black, carbonaceous	9	472.5
46	Sandstone, fine-grained, laminated, grey; rusty weathering	2	463.5
45	Covered	4	461.5
44	Sandstone, very fine grained, dark grey; medium- to thick-bedded; ripple-marks	10	457.5
43	Covered	10	447.5
42	Sandstone, fine-grained, siliceous, laminated, cross-laminated, grey; thick-bedded; grey weathering; thin carbonaceous streaks; poor porosity	34	437.5
41	Sandstone, fine-grained, laminated, grey, slightly carbonaceous; medium-bedded; 6″ coaly shale at top	5	403.5
40	Covered	10	398.5
39	Sandstone, fine-grained, laminated, grey; medium-bedded; grey weathering	17	388.5
38	Shale, silty, black; siltstone at top	5	371.5
37	Sandstone, fine-grained, siliceous, quartzose, light grey; thick-bedded; brown weathering; poor porosity	7	366.5
36	Mudstone, silty, black	7	359.5
35	Sandstone, fine-grained, grey; rusty weathering; shaly interval in centre	3	352.5
34	Covered	10	349.5
33	Sandstone, fine-grained, dark grey, carbonaceous; medium-bedded; ripple-marks	26	339.5
32	Sandstone, fine-grained; wavy bedded	5	313.5
31	Siltstone and sandstone, interbedded	7	308.5
30	Sandstone, fine-grained, laminated, brownish grey; medium-bedded	10	301.5
29	Siltstone, sandy; wavy bedding; beds 2″–3″	12	291.5
28	Sandstone, fine-grained, laminated, dark grey; medium-bedded	3.5	279.5
27	Siltstone and sandstone, interbedded; partly covered	7	276
26	Sandstone, fine-grained, siliceous, quartzose, laminated, grey; wavy bedding	20	269
25	Sandstone, fine-grained, laminated, siliceous, well-indurated, quartzose, brownish grey; beds 3″–8″, uniform; light brown to rusty weathering; poor porosity	24	249
24	Shale, silty, dark grey	1	225
23	Sandstone, fine-grained, grey; beds 4″–8″; grey weathering	5	224
22	Covered. Across river, upper half is sandstone, lower half is silty shale and interbedded siltstone	68	219
21	Sandstone, fine-grained, laminated to homogeneous, grey; medium- to thick-bedded; flaggy at base	20	151
20	Siltstone, shaly, dark grey, laminated; flaggy toward top	5	131
19	Covered	4	126
18	Sandstone, fine-grained, dark grey; thick-bedded	24	122
17	Siltstone, shaly, black; platy; laminated and flaggy at top	2.5	98
16	Sandstone, fine-grained, siliceous, well-sorted, quartzose, grey; thick-bedded; 1′ of coarse-grained sandstone at base with ¼″ pebbles	12.5	95.5
15	Sandstone, fine-grained, grey, laminated; thick-bedded; argillaceous and flaggy at base	6	83

Unit	Lithology	Thickness (feet)	Height above base (feet)
14	Mudstone, silty, black, carbonaceous; some interbedded siltstone	8	77
13	Siltstone, sandy; flaggy; interbedded with silty shale	5	69
12	Sandstone, fine-grained, brownish grey; brown to reddish brown weathering	3	64
11	Siltstone, argillaceous, laminated	2	61
10	Shale, black, carbonaceous, flaky	2	59
9	Covered	9	57
8	Sandstone, fine-grained, laminated, grey	5	48
7	Sandstone, fine-grained, flaggy; interbedded siltstone and shale	5	43
6	Sandstone, fine-grained, brownish grey; thick-bedded	3	38
5	Sandstone, coarse-grained, siliceous, well-indurated, grey; thick-bedded; few pebbles on upper surface; poor porosity	12	35
4	Sandstone, lithic arenite, medium-grained, siliceous, pebbly, black; reddish brown to maroon weathering; quartz, 89%; chert, 5%	3	23
3	Shale, hard, flaky, black, carbonaceous	7	20
2	Covered	6	13
1	Sandstone, medium-grained, grey, siliceous, quartzose, welded, slightly carbonaceous; sugary texture; irregularly bedded; poor porosity; quartz, 100%	7	7

FERNIE FORMATION

Contact is not exposed

Shale, black, platy; lenticular conglomerate

SECTION 61–5. Gething Formation, Sikanni Chief River north of Marion Lake, Trutch map-area, British Columbia, 57°14′N, 123°14′W.

Overlying beds not exposed

GETHING FORMATION

130	Shale, black; platy; thin beds of silty sandstone toward top	6	1,216
129	Sandstone, fine-grained, laminated; thin-bedded; rusty orange weathering	2	1,210
128	Shale, as above; 6″ sandstone in middle	2	1,208
127	Siltstone argillaceous, sandy; some thin beds of shale	2	1,206
126	Sandstone, fine-grained, laminated	1	1,204
125	Siltstone, argillaceous, sandy, laminated; beds 1″–2″; dark grey; few thin shale beds	6	1,203
124	Sandstone, fine-grained, laminated, silty, cross-laminated; interbedded shale, 25%	7	1,197
123	Shale, black; platy	1.5	1,190
122	Sandstone, fine-grained, laminated; rusty weathering	1	1,188.5
121	Shale, black; platy	2	1,187.5
120	Sandstone and interbedded shale; platy; beds 2″–4″	4	1,185.5
119	Shale, black; platy	5	1,181.5
118	Sandstone, fine-grained, laminated, argillaceous	0.5	1,176.5
117	Shale, silty, black; platy	2	1,176

Unit	Lithology	Thickness (feet)	Height above base (feet)
116	Sandstone, very fine grained, silty, laminated, dark grey, calcareous	2	1,174
115	Shale, platy	2	1,172
114	Sandstone, fine-grained, laminated, grey, cross-laminated	1.5	1,170
113	Siltstone and interbedded shale	2	1,168.5
112	Sandstone, very fine grained, cross-laminated; thick-bedded; rusty weathering	3.5	1,166.5
111	Shale and siltstone interbedded	3	1,163
110	Sandstone, fine-grained, laminated, grey; brown weathering	4	1,160
109	Shale; few thin siltstone beds; some sideritic concretions	4.5	1,156
108	Sandstone, fine-grained, laminated, 2″ conglomerate at base; pebbles as much as 1″	2	1,151.5
107	Shale, rubbly	1.5	1,149.5
106	Siltstone and shale interbedded	2	1,148
105	Sandstone, fine-grained, laminated, cross-laminated, grey; thick-bedded	3.5	1,146
104	Shale, platy; rusty weathering	3	1,142.5
103	Sandstone, as above	1	1,139.5
102	Shale, rubbly; rusty weathering	3	1,138.5
101	Mudstone, silty; blocky to platy; interbedded siltstone, 30%; laminated, platy	9	1,135.5
100	Sandstone, fine-grained, laminated	4	1,126.5
99	Covered. Approximate	50	1,122.5
98	Sandstone, fine-grained, siliceous, laminated, brownish grey; bedding not well developed, upslope this unit contains lenses of conglomerate with pebbles as much as 2″ in diameter	8	1,072.5
97	Covered	47	1,064.5
96	Sandstone, fine-grained, laminated, cross-laminated, brown; flaggy; brown weathering	5	1,017.5
95	Covered	12	1,012.5
94	Sandstone, fine-grained, grey; thick-bedded; grey weathering	5	1,000.5
93	Covered	6	995.5
92	Sandstone, fine-grained, laminated	17	989.5
91	Sandstone, fine-grained, siliceous, laminated, grey; thick-bedded; grey weathering; poor porosity	44	972.5
90	Mudstone, becoming silty at top	7	928.5
89	Mudstone, rubbly; grading upward into siltstone	5	921.5
88	Shale, black	1.5	916.5
87	Siltstone, dark grey; some shale	5	915
86	Shale, flaky, dark grey to black	2	910
85	Sandstone and siltstone; interbedded; dark grey; beds 6″–1′; grey weathering	17	908
84	Shale, dark grey; platy; grading upward into siltstone, sandy	7	891
83	Sandstone, fine-grained, dark grey; thin-bedded	3	884
82	Siltstone, sandy, dark grey; flaggy	4	881
81	Sandstone, silty, siliceous, grey; thin-bedded at base, medium-bedded at top; cleaner toward top; grey weathering; poor porosity	21	877
80	Siltstone, sandy	3	856
79	Sandstone, fine-grained; massive; reddish brown weathering	20	853
78	Shale and siltstone; siltier at top	3	833
77	Sandstone, fine-grained, grey	3	830
76	Mudstone, silty, dark grey	2	827

Unit	Lithology	Thickness (feet)	Height above base (feet)
75	Siltstone, sandy, dark grey; massive	15	825
74	Sandstone, with interbedded siltstone and shale; beds 6″ to 1′; some coal toward base; exposed on north side of river	63	810
73	Sandstone, fine-grained, homogeneous to laminated, grey; beds 6″–8″; grey weathering, some silty layers; upper 1′ is very dark and weathers reddish brown	15	747
72	Mudstone, carbonaceous, black	3	732
71	Sandstone; interbedded siltstone and shale	3	729
70	Sandstone, fine-grained, laminated, cross-laminated, grey; medium- to thick-bedded; grey weathering	8	726
69	Siltstone and mudstone	4	718
68	Sandstone, fine-grained; medium-bedded	3	714
67	Siltstone, carbonaceous	1	711
66	Sandstone, fine-grained, grey; medium-bedded; rusty weathering	4	710
65	Shale, silty; coaly in upper part; siltstone at base	3	706
64	Sandstone, fine-grained, laminated, brownish grey; medium-bedded	13	703
63	Sandstone, fine-grained, laminated, brownish grey; medium-bedded; poor porosity	27	690
62	Shale and interbedded siltstone	3	663
61	Sandstone, fine-grained, slightly laminated, brown; medium-bedded	17	660
60	Sandstone, fine- to medium-grained, laminated, siliceous, cherty, cross-laminated, brownish grey; medium- to thick-bedded; grey to brown weathering; poor porosity; quartz, 57%; chert, 26%	16	643
59	Sandstone, medium- to fine-grained, brown, laminated; thick-bedded; channel-fill structures at base	13	627
58	Mudstone and siltstone interbedded, dark grey; blocky	4.5	614
57	Sandstone, fine-grained, laminated; beds 2″–4″; shaly intervals	5	609.5
56	Sandstone and shale interbedded; sandstone increases toward top; beds 2″–4″	4	604.5
55	Sandstone, fine-grained, homogeneous to laminated, brownish grey; medium-bedded; platy at base	11	600.5
54	Covered	3	589.5
53	Sandstone, fine-grained, laminated, siliceous, brownish grey; thick-bedded; platy weathering; poor porosity	10	586.5
52	Sandstone, fine-grained, laminated, brown; grey weathering	5	576.5
51	Covered	7	571.5
50	Sandstone, fine-grained, laminated, brownish grey; platy to flaggy; grey weathering	7	564.5
49	Covered	21	557.5
48	Siltstone and mudstone interbedded; dark grey; platy; rusty weathering; sandstone at top	38	536.5
47	Shale, silty, rubbly to platy; rusty weathering	10	498.5
46	Sandstone and shale interbedded; sandstone, fine-grained, carbonaceous, dark grey, shale, carbonaceous; sandstone increases toward top	16	488.5
45	Sandstone, fine-grained, siliceous, quartzose, grey, homogeneous; thick-bedded; rusty weathering; few coaly shale intervals near base; basal surface has relief of 1′; poor porosity	18	472.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
44	Sandstone, fine-grained; massive; channel-fill at base	4	454.5
43	Shale, coaly, black	2	450.5
42	Sandstone, fine-grained, grey; medium-bedded	3	448.5
41	Shale, coaly, black	1	445.5
40	Sandstone, fine-grained, homogeneous, dark grey; thick-bedded	8	444.5
39	Sandstone, fine-grained; some interbedded siltstone	4	436.5
38	Siltstone, argillaceous, and sandstone, carbonaceous; channel-fill structures	5	432.5
37	Sandstone, fine-grained, homogeneous, grey; thick-bedded	10	427.5
36	Mudstone, silty, black, carbonaceous; platy; yellow efflorescence; siltier at top	12	417.5
35	Coal and carbonaceous shale, black	2	405.5
34	Sandstone, fine-grained, homogeneous, dark grey; thick-bedded; rusty brown weathering	8	403.5
33	Sandstone, fine-grained, laminated, grey; medium-bedded; some shale	3	395.5
32	Shale, black, carbonaceous	2	392.5
31	Sandstone, fine-grained, siliceous, well-sorted, grey, homogeneous; thick-bedded; brown weathering; poor porosity	9	390.5
30	Shale, silty, black, carbonaceous	0.5	381.5
29	Siltstone and shale interbedded (70–30); becoming siltier at top; thin-bedded to flaggy; slightly carbonaceous	22	381
28	Sandstone, fine-grained; silty at base; flaggy; grades upward into medium-bedded; grey weathering	8	359
27	Sandstone, fine-grained, grey; medium-bedded	4.5	351
26	Siltstone, dark grey; wavy bedding	3.5	346.5
25	Sandstone, fine-grained, homogeneous, grey; thick-bedded	5	343
24	Sandstone, fine-grained, grey, homogeneous; beds 1″–4″, thicker at top; grey weathering	25	338
23	Covered	11	313
22	Sandstone, fine-grained, quartzose, siliceous, welded, homogeneous, grey; thin-bedded; grey weathering; poor porosity	10	302
21	Mudstone and siltstone interbedded; mudstone, very silty, black, carbonaceous; siltstone, dark grey, argillaceous, laminated; beds 2″–4″; quartz, 92%; chert, 4%	21	292
20	Covered	7	271
19	Sandstone, fine-grained, siliceous, dark grey to brown; homogeneous; medium- to thick-bedded; grey weathering; poor porosity	18	264
18	Shale and siltstone interbedded; dark grey to black, carbonaceous; wavy bedding; more siltstone at top grades into overlying unit	10	246
17	Sandstone, fine-grained, silty, dark grey, homogeneous; medium- to thin-bedded; grey to rusty weathering	18	236
16	Sandstone, fine-grained, grey; medium-bedded; grey weathering; mostly inaccessible	31	218
15	Sandstone, fine-grained, siliceous, homogeneous, dark grey; medium- to thick-bedded; argillaceous at base	19	187
14	Conglomerate, grey; siliceous, thick-bedded; grey weathering; pebbles $\frac{1}{8}$″–$\frac{1}{4}$″, chert, quartz	2	168
13	Sandstone, fine-grained, grey; thick-bedded; ripple-marks; partly covered	6	166

Unit	Lithology	Thickness (feet)	Height above base (feet)
12	Sandstone, very fine grained, silty, siliceous, black; wavy bedding; thin-bedded to flaggy; cleaner toward top; beds 4″–6″ at top	25	160
11	Sandstone, fine-grained, homogeneous, siliceous, well-sorted, brown at base, grey at top, carbonaceous; grey weathering; some porosity	12	135
10	Siltstone, sandy, argillaceous, dark grey; flaggy to thin-bedded	2	123
9	Sandstone, fine-grained, homogeneous, siliceous, slightly argillaceous, grey; thick-bedded; grey weathering; poor porosity	28	121
8	Covered	10	93
7	Sandstone, fine-grained, homogeneous to slightly laminated, dark grey; thick-bedded; grey to rusty brown weathering; argillaceous at base	11	83
6	Sandstone, fine-grained, homogeneous, siliceous, calcareous, sideritic, dark grey; thick-bedded; dark grey to brownish grey weathering; trace of glauconite	28	72
5	Sandstone, fine- to coarse-grained, siliceous, quartzose, grey; sugary texture; massive; disseminated pebbles and lenses of conglomerate; pebbles have maximum diameter of 2″; quartz, 99%; chert, 1%	17	44
4	Sandstone, fine-grained, homogeneous to laminated, dark grey; thick-bedded to massive; becoming coarser and sugary textured toward top; pebbles $\frac{1}{4}$″–$\frac{1}{2}$″ on basal surface	7	27
3	Sandstone, fine-grained, quartzose, homogeneous, grey; thick-bedded; quartz, 97%; chert, 3%	4	20
2	Conglomerate; pebbles $\frac{1}{8}$″–1″, rounded, grey, white, black, blue, chert, quartzite, and quartz; maximum cobble is 3″; matrix of fine-grained quartz	3	16
1	Sandstone, very fine grained, dark grey, quartzose, siliceous, homogeneous; massive to thick-bedded; poor porosity	13	13
	End of exposure. Although underlying beds are not exposed, the recessive unit is considered to contain shales of the Fernie Formation. Triassic beds occur downstream.		

SECTION 61–6. Gething Formation, ridge east of Marion Lake, Trutch map-area, British Columbia, 57°09′N, 123°07′W.

Overlying beds are not exposed but Buckinghorse Formation must be present within small interval.

GETHING FORMATION

159	Sandstone, fine-grained, laminated, brown	4	1,008.5
158	Covered	5	1,004.5
157	Sandstone, fine-grained, laminated, brownish grey	3	999.5
156	Covered. Some shale at top	5	996.5
155	Sandstone, silty, grey; grey weathering	4	991.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
154	Covered	4	987.5
153	Sandstone, fine-grained, laminated, grey; some shale	11	983.5
152	Covered	18	972.5
151	Sandstone, fine-grained, laminated, grey; thin-bedded; grey weathering	7	954.5
150	Covered. Approximate	15	947.5
149	Sandstone, fine-grained, grey; medium-bedded	7	932.5
148	Covered	6	925.5
147	Sandstone, fine-grained, grey	3	919.5
146	Covered. Approximate	28	916.5
145	Sandstone, fine-grained, argillaceous, carbonaceous; thick-bedded; grey weathering	3	888.5
144	Covered	5	885.5
143	Sandstone, fine-grained, argillaceous, carbonaceous, dark grey; thick-bedded; grey weathering	7	880.5
142	Covered	4	873.5
141	Sandstone, very fine grained, silty to argillaceous, siliceous, quartzose, homogeneous; black and carbonaceous at base, becoming cleaner and grey at top; thick-bedded; grey weathering; poor porosity	22	869.5
140	Covered	23	847.5
139	Sandstone, very fine to fine-grained, siliceous, fairly quartzose, laminated, grey; thick-bedded; light brown weathering; poor porosity	20	824.5
138	Mostly covered. Some siltstone and shale	10	804.5
137	Sandstone, very fine grained, siliceous, grey, homogeneous; thick-bedded to massive; grey to rusty brown weathering; poor porosity	9	794.5
136	Covered	6	785.5
135	Sandstone, very fine to fine-grained, siliceous, laminated, grey; thick-bedded; grey weathering; poor porosity	6	779.5
134	Siltstone, sandy, platy, brown	3	773.5
133	Covered	1.5	770.5
132	Sandstone, fine-grained, laminated	1	769
131	Covered	2	768
130	Sandstone, fine-grained, laminated, brown; bedding not well developed	5	766
129	Covered	4	761
128	Sandstone, fine-grained, siliceous, fairly well sorted, quartzose, laminated, cross-laminated, grey, carbonaceous; thin- to medium-bedded; brown weathering; poor porosity	7	757
127	Shale, silty, carbonaceous, brownish grey	3	750
126	Sandstone, fine-grained, laminated; some carbonaceous shale	2.5	747
125	Sandstone and shale interbedded, carbonaceous; beds 2″–6″	12	744.5
124	Shale, silty, dark grey; some sandstone	4	732.5
123	Sandstone, fine-grained, laminated, cross-laminated, brownish grey; thin-bedded; brown weathering	2	728.5
122	Partly covered. Shale, brown, grading upward into siltstone	6	726.5
121	Sandstone, very fine grained, argillaceous, siliceous, laminated, cross-laminated, grey; medium-bedded; carbonaceous fragments; poor porosity	12	720.5
120	Shale, dark grey; rubbly to platy	1	708.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
119	Sandstone, fine-grained, argillaceous, laminated dark grey to brownish grey; thin-bedded	8	707.5
118	Shale, silty, black to dark grey; siltstone in upper half	19	699.5
117	Sandstone, very fine grained, to silty, siliceous, argillaceous, brownish grey, homogeneous to laminated; thick-bedded; grey weathering; poor porosity	4	680.5
116	Covered	10	676.5
115	Sandstone, fine-grained, laminated, cross-laminated, brownish grey; thin-bedded; brown weathering	5	666.5
114	Shale and siltstone interbedded (60–40); beds 2″–6″; shale, dark grey, platy; siltstone, sandy, laminated	13	661.5
113	Sandstone, fine- to medium-grained, laminated, cross-laminated, brown; thick-bedded; brown weathering	3	648.5
112	Shale and siltstone interbedded; brown, carbonaceous; platy	2	645.5
111	Sandstone, fine-grained, brown	1	643.5
110	Shale, brown, carbonaceous, silty; platy	0.5	642.5
109	Sandstone, fine-grained, brown, laminated	0.5	642
108	Shale, brown, carbonaceous, silty; platy	1	641.5
107	Sandstone, fine-grained, siliceous, brownish grey, laminated, cross-laminated; bedding poorly developed; some cross-bedding; some coarse-grained sandstone at base; channel-fill structure at base with layer of concretionary breccia; quartz, 68%; chert 20%	18	640.5
106	Sandstone, fine-grained, siliceous, cherty, argillaceous, laminated, brown; thin-bedded; slightly carbonaceous; poor porosity	4	622.5
105	Sandstone, fine-grained, laminated, brown	2	618.5
104	Siltstone and shale, interbedded	2	616.5
103	Sandstone, fine-grained, laminated, cross-laminated, brownish grey, carbonaceous; brown weathering	7	614.5
102	Shale, brown, rubbly; cut-and-fill structure	4	607.5
101	Sandstone, fine-grained, laminated, cross-laminated, brownish grey; brown weathering	3	603.5
100	Shale and siltstone interbedded; dark grey to black; platy	3	600.5
99	Sandstone, fine-grained, siliceous, cherty, argillaceous, brown, laminated, cross-laminated, carbonaceous; poor porosity	4	597.5
98	Shale, dark grey	3	593.5
97	Sandstone, fine-grained, laminated, brownish grey	2	590.5
96	Mudstone and siltstone interbedded	5	588.5
95	Sandstone, fine-grained, laminated, cross-laminated, brownish grey; grey weathering, beds 4″–6″	7	583.5
94	Shale and sandstone interbedded	3	576.5
93	Sandstone, fine-grained, brownish grey, laminated, cross-laminated; some shaly layers	9	573.5
92	Shale, dark grey, platy	3	564.5
91	Shale, coaly	1	561.5
90	Sandstone, fine-grained, brown, laminated; medium-bedded; grey to rusty weathering	10	560.5
89	Shale, brownish grey; rubbly at base, platy towards top; brown weathering; grading upward into siltstone	9	550.5
88	Sandstone, silty, laminated, fine-grained; becoming less silty at top; flaggy to thin-bedded	6	541.5
87	Shale, rubbly to platy, brownish grey; grades into overlying unit	6	535.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
86	Sandstone, fine-grained, brownish grey, laminated; medium-bedded	3	529.5
85	Siltstone and shale interbedded; platy; dark grey	3	526.5
84	Sandstone, fine-grained, laminated, brownish grey; medium-bedded	6	523.5
83	Siltstone and shale, black	1	517.5
82	Sandstone, fine-grained, siliceous, cherty, well-sorted, laminated, brownish grey; beds 2″–4″; poor porosity	16	516.5
81	Sandstone, coarse-grained, siliceous, cherty, poorly sorted, homogeneous to laminated, grey; thick-bedded; cut-and-fill structure at base; pebbles in basal beds; quartz, 80%; chert, 15%	8	500.5
80	Siltstone, sandy, platy to flaggy; rusty weathering	6	492.5
79	Sandstone, very fine to fine-grained, siliceous, slightly argillaceous, brownish grey, laminated; thin-bedded; brownish grey weathering; poor porosity	6	486.5
78	Shale, silty brownish grey; platy	2	480.5
77	Sandstone, fine-grained, grey	3	478.5
76	Shale, silty, dark grey; platy; rusty weathering; siltier at top	8	475.5
75	Sandstone, fine-grained, grey	2	467.5
74	Siltstone and shale, interbedded	5	465.5
73	Sandstone, fine-grained, dark grey, homogeneous; medium-bedded	10	460.5
72	Sandstone, fine-grained, grey; flaggy to thin-bedded; some shale	11	450.5
71	Sandstone, fine-grained, grey; flaggy; silty at base	9	439.5
70	Sandstone, very fine grained, brownish grey; thick-bedded; grey to brown weathering	9	430.5
69	Shale, rubbly; rusty weathering	3	421.5
68	Siltstone, sandy, brown	2	418.5
67	Coal and carbonaceous shale	1	416.5
66	Sandstone, fine-grained, grey to brownish grey; medium-bedded; grey weathering	7	415.5
65	Shale, coaly	2	408.5
64	Siltstone, sandy, black; platy; rusty weathering; grades into sandstone	9	406.5
63	Sandstone, fine-grained, dark grey; medium-bedded	4	397.5
62	Siltstone, sandy; platy; rusty weathering; grades into overlying unit	3	393.5
61	Covered	16	390.5
60	Siltstone, sandy, laminated; platy; rusty weathering; grading upward into sandstone	7	374.5
59	Shale, coaly, and coal	1	367.5
58	Sandstone, fine-grained, laminated and cross-laminated, grey; flaggy at base, thicker toward top	21	366.5
57	Shale, coaly, and coal	1	345.5
56	Sandstone, fine-grained, laminated to homogeneous; medium- to thick-bedded; grey weathering	9	344.5
55	Partly covered. Shale and siltstone interbedded	4	335.5
54	Sandstone, fine-grained; medium-bedded	5	331.5
53	Shale, some siltstone and sandstone, dark grey; carbonaceous	5	326.5
52	Sandstone, fine-grained, laminated, brownish grey; thick-bedded; some shaly layers near top	7	321.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
51	Partly covered. Shale and siltstone	5	314.5
50	Sandstone, fine-grained, siliceous, slightly argillaceous; dark grey, laminated, cross-laminated; thick-bedded; grey weathering; poor porosity	10	309.5
49	Covered	16	299.5
48	Sandstone, fine-grained, laminated; flaggy to thin-bedded	4	283.5
47	Siltstone and shale, coaly, black	2	279.5
46	Sandstone, fine-grained, laminated, grey; flaggy to thin-bedded; grey to rusty weathering	7	277.5
45	Shale and siltstone interbedded, dark grey to black; platy; rusty weathering; interference ripple-marks	5.5	270.5
44	Sandstone, fine-grained, slightly carbonaceous, siliceous, silty, laminated, cross-laminated, brownish grey; flaggy to thin-bedded; thick-bedded at top; ripple-marks; poor porosity	3	265
43	Sandstone, fine-grained; flaggy to thin-bedded	3	262
42	Partly covered. Siltstone, sandstone and shale	32	259
41	Siltstone, black; platy; some shale at base; grading upward into sandstone, silty; platy	18	227
40	Sandstone, argillaceous, fine-grained, black; dark brown to grey weathering	2	209
39	Siltstone and shale interbedded (60–40); siltstone, argillaceous, dark grey, block platy; shale, silty, platy to rubbly, rusty weathering; beds 1′–1½′	15	207
38	Partly covered. Shale and siltstone	6	192
37	Sandstone, silty, black, carbonaceous, thin-bedded to flaggy; grey weathering	3	186
36	Sandstone, fine-grained, brownish grey, siliceous, quartzose, well-sorted, laminated to homogeneous; medium-bedded; poor porosity	4	183
35	Mudstone and siltstone, dark grey to black; some sandstone	5	179
34	Sandstone, fine-grained, carbonaceous; brown weathering	6	174
33	Siltstone and shale interbedded; platy; grey to brown weathering	1.5	168
32	Sandstone, fine-grained, grey	0.5	166.5
31	Shale, black; rubbly at base; platy to blocky at top	2	166
30	Sandstone, fine-grained, homogeneous, grey; thick-bedded; grey to brown weathering	5.5	164
29	Coal and coaly shale	1	158.5
28	Sandstone, fine-grained, grey	2.5	157.5
27	Sandstone and shale interbedded; 2″–3″ beds	5	155
26	Sandstone, fine-grained, grey, silty; thick-bedded to massive; rusty brown weathering	8	150
25	Not well exposed. Interbedded siltstone and shale with some sandstone	7	142
24	Partly covered. Shale with some siltstone	6	135
23	Sandstone, fine-grained, grey, homogeneous; thin-bedded at base, thicker at top; rusty brown weathering	7	129
22	Siltstone and shale interbedded; platy	2	122
21	Sandstone, fine-grained, grey, quartzose; rusty weathering	4	120
20	Sandstone, coarse-grained, brownish grey; beds 3″–6″; disseminated pebbles	3	116

Unit	Lithology	Thickness (feet)	Height above base (feet)
19	Sandstone, fine-grained, homogeneous to laminated, well-sorted, siliceous, quartzose; thick- to medium-bedded; rusty weathering; poor porosity	4	113
18	Sandstone, fine-grained; flaggy; some shale	1	109
17	Sandstone, fine-grained, grey; medium- to thick-bedded	11	108
16	Sandstone and shale interbedded	0.5	97
15	Sandstone, very fine grained, bimodal with coarse grains of quartz, grey, homogeneous, siliceous, quartzose medium- to thick-bedded; grey to brown weathering; poor porosity; quartz, 86%; chert, 5%	7	96.5
14	Siltstone, sandy, shaly at base; platy to flaggy	1.5	89.5
13	Sandstone, fine-grained, brownish grey to dark grey	2	88
12	Shale	1	86
11	Sandstone, fine-grained, laminated	1	85
10	Shale	1	84
9	Sandstone, fine-grained, grey; thick-bedded to massive	15	83
8	Sandstone, fine-grained, grey; medium- to thick-bedded; grey to brown weathering	3	68
7	Covered	14	65
6	Sandstone, fine-grained, homogeneous to laminated, grey	2	51
5	Partly covered. Sandstone, fine-grained, grey	9	49
4	Sandstone, fine-grained, grey; thick-bedded	9	40
3	Conglomerate and coarse-grained sandstone; siliceous, laminated; sandstone, quartzose, grey, sugary texture; thick-bedded; pebbles up to 1" in diameter; subangular to rounded, chert, quartz; poor porosity	10	31
2	Mostly covered. Sandstone	6	21
1	Sandstone, coarse-grained, brown, sugary texture; thick-bedded to massive; some disseminated pebbles	15	15
	Contact of Gething and Fernie Formations is not exposed but Fernie scree appears on slope. Measurement probably starts several feet above base of Gething Formation.		
	FERNIE FORMATION		
	Talus covered. Shale and siltstone, black; platy. Contacts not seen	100	100

TRIASSIC

PARDONET FORMATION

Limestone

GSC loc. 52235

Monotis scutiformis pinensis Westermann
Age: Norian, probably *Himavatites* zone

Unit	Lithology	Thickness (feet)	Height above base (feet)
SECTION 61–7.	Gething Formation, south end of Pink Mountain, Trutch map-area, British Columbia, 57°02′N, 122°52′W.		
	Overlying beds not exposed		
	GETHING FORMATION		
22	Sandstone, fine-grained, quartzose, siliceous, well-sorted; massive; brown weathering; vugs, ¼″–4″, smooth but irregular in shape; some poorly developed large-scale cross bedding; some lenses of coarser sandstone; poor porosity	52	
21	Shale and sandstone interbedded; 6″ coal at top	6	
20	Sandstone, fine- to coarse-grained, brown; massive; some lenses of conglomerate	21	
19	Sandstone, mottled, grey	1	
18	Mostly covered. Shale and coaly shale	7	
17	Siltstone, sandy, grey, carbonaceous, beds 4″–6″	6	
16	Sandstone, fine-grained, grey; thick-bedded; few thin shaly layers	13	
15	Mudstone, blocky, black	1	
14	Siltstone, fine-grained, grey	1	
13	Mudstone	1	
12	Sandstone, silty	3	
11	Shale, platy, black, carbonaceous	4	
10	Sandstone, fine-grained, laminated, dark grey; thick-bedded	4	
9	Mudstone, silty, black; platy to blocky; siltstone, 40%, as below	11	
8	Siltstone, sandy, argillaceous, black, carbonaceous; some shale, black carbonaceous, platy	6	
7	Covered. Approximate	25	
6	Sandstone, fine-grained, laminated, pinkish brown; slightly vuggy; quartzose; thick-bedded to massive; yellowish grey weathering	6	
5	Section continues above fold axis and interval containing coal seam; much shaly black mudstone	?	
4	Sandstone, silty, argillaceous, carbonaceous, dark grey to black; siltier at top	3	
3	Sandstone, coarse-grained, siliceous, welded, grey; thick-bedded; disseminated pebbles of chert and quartz; poor porosity	13.5	
2	Sandstone, fine-grained, slightly laminated, grey; grey weathering	2	
1	Siltstone, argillaceous, carbonaceous, black; platy	8	
	End of exposure, underlying beds are most likely those of Fernie Formation		

SECTION 62–1. Gething Formation, headwaters of Horseshoe Creek, Halfway River map-area, British Columbia, 56°36′, 122°54′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Overlying beds are not exposed but are recessive and are considered to be those of the Moosebar Formation		
	GETHING FORMATION		
12	Sandstone, fine-grained, laminated, brown; thick- to thin-bedded; brownish grey weathering	15	1,301
11	Partly covered. Few small outcrops of fine-grained sandstone	45	1,286
10	Conglomerate; pebbles of chert and quartzite, $\frac{1}{8}''$–1″; sandy matrix	2	1,241
9	Sandstone, fine-grained, laminated, brown	25	1,239
8	Covered	45	1,214
7	Sandstone, fine-grained, laminated, brown; massive; platy weathering	25	1,169
6	Covered. Approximate	150	1,144
5	Sandstone, fine-grained, laminated, siliceous, brown; thin- to thick-bedded; grey weathering; quartz, 48%; chert, 21%; carbonate grains, 18%	25	994
4	Covered. Approximate	950	969
3	Sandstone, coarse-grained to conglomeratic, siliceous, laminated to homogeneous, brownish grey; thick-bedded to massive; pebbles as much as 2″ in diameter; quartz, 40%; chert, 59%; partly covered	9	19
2	Covered	6	10
1	Sandstone, medium-grained, brown, laminated, cherty; thick-bedded	4	4
	MINNES GROUP		
	BEATTIE PEAKS FORMATION and (?) younger beds		
74	Covered. Approximate	150	1,453
73	Sandstone, fine-grained, finely laminated, brown; limonitic staining; thin-bedded to flaggy	8	1,303
72	Covered	9	1,295
71	Sandstone, fine-grained, laminated; platy weathering	4	1,286
	For underlying beds, *see* Section 62–1, Stott, 1969		

SECTION 62–3. Gething Formation, Pink Mountain, Trutch map-area, British Columbia, 57°05′N, 122°53′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	BUCKINGHORSE FORMATION		
3	Shale, dark grey to black; rubbly; numerous sideritic concretions	30	219
2	Shale, black; rubbly; few layers of concretions	39	189
1	Covered. Approximate	150	150

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
102	Sandstone, fine-grained, fairly well sorted, siliceous, brown, laminated; thin-bedded; brownish grey weathering; few disseminated pebbles at top; quartz, 62%; chert, 15%; carbonate, 11%; poor porosity	9	1,130
101	Mostly covered. Few small exposures of platy, fine-grained sandstone. Approximate	250	1,121
100	Sandstone, medium- to coarse-grained, siliceous, grey; thick-bedded; brown weathering; poor porosity; quartz, 46%; chert, 44%; carbonate, 2%	29	871
99	Sandstone, very fine grained, silty, black carbonaceous; thin-bedded; few thin layers of coaly shale; 6″ coaly shale 1′ below top	7	842
98	Covered	24	835
97	Sandstone, very fine grained, fairly well sorted, medium-grey, siliceous; thick-bedded; grey weathering; poor porosity; trace of glauconite; quartz, 74%; chert, 15%	5	811
96	Mostly covered. Some sandstone, shale, and coal exposed across creek	29	806
95	Sandstone, very fine grained, brownish grey, carbonaceous; thick-bedded	15	777
94	Mostly covered. Coal and coaly shale	4	762
93	Sandstone, very fine grained, brown; thick-bedded; brownish grey weathering	6	758
92	Covered	5	752
91	Sandstone, fine-grained, laminated, brownish grey; platy, to thick-bedded at top; some interbedded siltstone	14	747
90	Covered	6	733
89	Sandstone, fine-grained, laminated, brownish grey, siliceous, carbonaceous; medium- to thick-bedded; ripple-marks	13	727
88	Covered. Some mudstone at top	4	714
87	Sandstone, very fine grained, brownish grey, carbonaceous; thin-bedded; brownish grey weathering; shaly at base	11	710
86	Mudstone, carbonaceous; rubbly	2	699
85	Sandstone, very fine grained, siliceous, brownish grey, slightly carbonaceous; thick-bedded; brownish grey weathering; dried bitumen; poor porosity	5	697
84	Mudstone, dark grey; blocky; thin bed of coal in middle	3	692
83	Siltstone and sandstone, interbedded, with few thin layers of shale; carbonaceous; brown weathering	4	689
82	Sandstone, very fine grained, argillaceous, brownish grey; thick-bedded; brown weathering	15	685
81	Siltstone, sandy, grey; platy	3	670
80	Coal	1.5	667
79	Siltstone, carbonaceous, black; platy	1	665.5
78	Coal	1.5	664.5
77	Shale, rubbly	1	663
76	Sandstone, very fine grained, laminated, carbonaceous, brown; platy to thin-bedded; brown weathering	9	662
75	Coal and coaly shale	1	653
74	Shale, carbonaceous; blocky	1	652
73	Siltstone to mudstone, black; sandy at top, more argillaceous at base	9	651

Unit	Lithology	Thickness (feet)	Height above base (feet)
72	Coal	0.5	642
71	Shale, dark brown to black; flaky; few silty beds	40	641.5
70	Covered. Small drag-fold. Approximate	10	601.5
69	Mostly covered. Some fine-grained sandstone	15	591.5
68	Sandstone, medium-grained, laminated, siliceous, well-sorted, carbonaceous, brownish grey; thin- to thick-bedded; brown weathering; quartz, 71%; chert 18%	4	576.5
67	Mudstone, dark grey; platy	2	572.5
66	Covered	6	570.5
65	Sandstone, fine-grained, brownish grey, homogeneous; thin- to thick-bedded; grey weathering	15	564.5
64	Coal and coaly shale	1	549.5
63	Sandstone, very fine grained	1.5	548.5
62	Shale, carbonaceous	0.5	547
61	Sandstone, fine-grained, grey, laminated; thin-bedded	1.5	546.5
60	Mudstone, flaky; silty at top	2	545
59	Sandstone, very fine grained, silty, slightly carbonaceous; brownish grey; brown weathering	4	543
58	Mudstone, silty, black; platy	5	539
57	Siltstone, argillaceous, platy; rusty weathering	1	534
56	Mostly covered. Some platy mudstone	16	533
55	Sandstone, silty; rusty brown weathering	2	517
54	Mudstone; platy	2	515
53	Sandstone, very fine grained, silty, laminated to homogeneous, slightly carbonaceous, brownish grey; brownish grey weathering; thin- to thick-bedded; two intervals of shale	31	513
52	Shale, dark grey to black, grading upward into interbedded sandstone and siltstone; platy to flaggy; carbonaceous	22	482
51	Sandstone, fine-grained, carbonaceous, brownish grey; flaggy at base, more thickly and uniformly bedded at top	13	460
50	Mudstone	1	447
49	Sandstone, fine-grained, siliceous, well-sorted, grey, slightly cross-laminated, slightly carbonaceous; poor porosity	17	446
48	Covered	3	429
47	Sandstone, fine-grained	1.5	426
46	Mudstone	1.5	424.5
45	Sandstone, fine-grained, brown	2	423
	FAULT. Small displacement on minor drag-fold		
44	Sandstone, fine-grained, brownish grey	5	421
43	Shale	2	416
42	Sandstone, fine-grained, brownish grey; thin-bedded; grey weathering	7	414
41	Covered	6	407
40	Sandstone, fine-grained	4	401
39	Covered	3	397
38	Sandstone, fine-grained, brown	5	394
37	Covered	17	389
36	Sandstone, fine-grained, slightly carbonaceous, brown; thin-bedded; brownish grey weathering	12	372
35	Covered	18	360
34	Sandstone, fine-grained, brown; platy; brown weathering	2	342
33	Mudstone, rubbly	2	340

Unit	Lithology	Thickness (feet)	Height above base (feet)
32	Sandstone, very fine grained, silty, laminated, dark grey; thick-bedded	3	338
31	Siltstone and sandstone, interbedded; laminated, dark brownish grey; platy to thin-bedded	7	335
30	Covered	13	328
29	Sandstone, fine-grained, silty, brownish grey, laminated, carbonaceous; thick-bedded; brownish grey weathering	5	315
28	Covered	3	310
27	Sandstone, fine-grained, grey, laminated; thick-bedded to massive; coarse-grained at base; sugary texture	26	307
26	Covered	5	281
25	Sandstone, very fine grained, carbonaceous, brownish grey; thin-bedded; flaggy with carbonaceous shale at base; large cut-and-fill structures at base	24	276
24	Sandstone, fine- to medium-grained, grey, well-sorted, siliceous; massive to thick-bedded; grains of white weathered chert; quartz, 86%; chert, 12%	46	252
23	Siltstone, argillaceous, and sandstone, interbedded, some mudstone at base	9	206
22	Sandstone, very fine grained, laminated, brownish grey, quartzitic, carbonaceous; thin-bedded; grey weathering	19	197
21	Sandstone and siltstone interbedded; laminated, brownish grey	3	178
20	Covered	4	175
19	Sandstone, dark grey to black; thin-bedded	4	171
18	Mudstone, silty, dark grey to black	2	167
17	Sandstone, very fine grained, dark grey; thin-bedded; grey weathering	6	165
16	Mudstone, dark grey to black, silty; rubbly	2	159
15	Sandstone, fine-grained, dark grey; thin-bedded	5	157
14	Covered	3	152
13	Sandstone, very fine grained, brownish grey; thin-bedded	4	149
12	Covered	4	145
11	Sandstone, fine-grained, laminated, grey; thin-bedded; grey weathering	4	141
10	Covered. Some sandy siltstone in middle	7	137
9	Sandstone, fine-grained, brownish grey; flaggy to thin-bedded; some thin layers of shale	6	130
8	Sandstone, medium-grained, dark grey, quartzitic; thick-bedded; grey weathering; fairly well sorted, siliceous; poor porosity; dried bitumen; quartz, 93%; chert, 7%	11	124
7	Covered	3	113
6	Sandstone, silty, laminated, carbonaceous, very dark grey; platy to thin-bedded	18	110
5	Sandstone, very silty, to siltstone, argillaceous; platy; rusty weathering	10	92
4	Sandstone, very coarse grained; quartzite chert pebbles and cobbles as much as 3″	1	82
3	Sandstone, coarse-grained, brownish grey, vuggy; thick-bedded to massive	15	81
	FAULT. Probably only underlying platy sandstone is repeated		
2	Sandstone, fine-grained, brownish grey; thin-bedded to platy	11	66

Unit	Lithology	Thickness (feet)	Height above base (feet)
1	Sandstone, very coarse grained to fine conglomerate; grey, siliceous, massive to thin-bedded; grey weathering. Basal 10′ contains lenses and beds of conglomerate; cobbles as much as 3″; quartz, 46%; chert, 50%	55	55
	FERNIE FORMATION		
	Shale, black, calcareous; platy		
	Farther south, just below cairn the Fernie is partly exposed; shale, calcareous, black, with thin platy limestone and siltstone	85 approx.	
	GSC loc. 52225 Poorly preserved imprints of ammonites		
	GSC loc. 14715 (collected by C. O. Hage) ?*Pleuroceras* Age: probably Upper Pliensbachian		
	GSC loc. 14713 (collected by C. O. Hage from conglomeratic limestone) *Oxytoma cygnipes* Phillips Age: Sinemurian; equivalent to upper Nordegg Member		

SECTION 62–6. Gething Formation, ridge south of Mount Wooliever, Trutch map-area, British Columbia, 57°08′N, 123°17′W.

Centre of syncline, top of ridge

	GETHING FORMATION		
45	Sandstone, fine-grained, siliceous, hard, dark grey; thick-bedded to massive; grey weathering; quartz and chert grains	10	947
44	Siltstone, black; platy; some shale	4	937
43	Sandstone, as above	3	933
42	Siltstone, black, coaly	1	930
41	Sandstone, fine-grained, fairly clean and well-sorted, siliceous, hard, dark grey; thick-bedded to massive; grey weathering; poor porosity; quartz, 67%; chert, 22%	17	929
40	Covered. Approximate	60	912
39	Sandstone, medium-grained, laminated, siliceous, grey; thin-bedded; grey weathering	5	852
38	Covered	10	847
37	Sandstone, fine-grained, siliceous, slightly carbonaceous; laminated, grey; thin- to thick-bedded; grey weathering; quartz and chert	25	837
36	Covered. Approximate	35	812
35	Sandstone, very fine grained, brown, ferruginous; thin-bedded; brownish grey weathering; quartz and chert	2	777
34	Mudstone, silty, black; blocky	6	775

Unit	Lithology	Thickness (feet)	Height above base (feet)
33	Sandstone, fine- to medium-grained; laminated, siliceous; thick-bedded to massive; brown to grey weathering; quartz and chert	30	769
32	Mudstone, silty, dark grey to black; blocky; grading into argillaceous siltstone, black; rusty weathering	11	739
31	Sandstone, fine-grained, laminated, grey, siliceous; silty at top; rusty weathering; quartz and chert	6	728
30	Covered	48	722
29	Sandstone, fine-grained; thick-bedded	3	674
28	Covered	5	671
27	Sandstone, medium-grained, laminated, cross-laminated, grey; thick-bedded; rusty brown weathering	7	666
26	Covered	20	659
25	Sandstone, medium-grained, laminated, grey; thick-bedded; rusty brown weathering; quartz and chert	14	639
24	Covered. Some silty sandstone at top	18	625
23	Sandstone, fine-grained, as above	12	607
22	Covered	14	595
21	Sandstone, fine-grained, laminated, grey; thick-bedded; rusty weathering	13	581
20	Mudstone, silty, black, carbonaceous; rusty weathering	9	568
19	Sandstone, fine-grained, clean, well-sorted, siliceous, laminated to homogeneous, grey; quartzose; thick-bedded to massive; more thinly bedded at top	94	559
18	Sandstone, fine-grained, laminated, ferruginous, brown to brownish grey; quartz and chert; thick-bedded to massive; grey weathering	35	465
17	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded; grey to brown weathering	71	430
16	Siltstone, sandy, argillaceous, dark grey; rusty weathering	3	359
15	Sandstone, medium-grained, laminated, cross-laminated, siliceous, grey; quartz and chert; thick-bedded to massive; grey weathering	42	356
14	Siltstone, sandy, argillaceous, laminated, dark grey; beds 1″–3″; grey weathering	8	314
13	Sandstone, fine-grained, laminated to homogeneous, slightly calcareous, siliceous, fairly well sorted, grey; quartz and chert; massive; brown to brownish grey weathering; quartz, 52%; chert, 22%; carbonate, 10%	57	306
12	Sandstone, fine-grained, laminated, calcareous, grey; thick-bedded. Partly covered; some recessive intervals	16	249
11	Mudstone, silty, dark grey to black; blocky	10	233
10	Sandstone, very fine grained, homogeneous, siliceous, grey; thick-bedded to massive; brown weathering	68	223
9	Partly covered. Sandstone, silty, dark grey	6	155
8	Sandstone, fine-grained, siliceous, limonitic, pyritic, homogeneous, brownish grey; massive, brown weathering; 3″ conglomerate at top, pebbles ¼″; quartz, 89%; chert, 7%	40	149
7	Covered	2	109
6	Sandstone, fine-grained, homogeneous, calcareous; massive; brown weathering	49	107

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. 52215 *Pteria (Oxytoma)* ex gr. *camselli* McLearn *Pecten (Entolium)* sp. indet. *Donax*? sp. indet. *Arctica*? sp. indet. Pelecypod, genus and species indet. Gastropod, genus and species indet.		
5	Covered	5	58
4	Sandstone, fine-grained, homogeneous, siliceous, grey; massive; light brown weathering; cleaner at top; 1′ of conglomerate at top, pebbles average ½″, some as much as 3″, chert, quartzite, well-rounded, bluish grey, white, black	44.5	53
3	Shale	1	8.5
2	Sandstone, fine-grained, homogeneous pyritic siliceous, grey; thick-bedded; rusty to maroon weathering; quartz, 94%; chert, 4%	6	7.5
1	Conglomerate; cobbles up to 3″, pebbles average ½″; chert, quartzite; well-rounded, bluish grey, white	1.5	1.5
	FERNIE FORMATION		
13	Sandstone, fine-grained, quartzose, siliceous, homogeneous, black; thin beds of shale; some siltstone at top	11	391
12	Sandstone, as above; thick-bedded	5	380
	For underlying beds, *see* Section 62–6, Stott, 1969.		

SECTION 62–8. Basal Buckinghorse Formation, headwaters of Chicken Creek, Trutch map-area, British Columbia, 57°20′N, 123°08′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	BUCKINGHORSE FORMATION		
	Overlying beds not exposed		
12	Mudstone, dark grey to black; rubbly; rusty weathering; reddish brown weathering concretions, becoming more numerous at top	60	362
11	Mudstone, as above, rubbly; numerous reddish brown weathering concretions, 2″ x 4″–6″	21	302
10	Mudstone, blocky, black; rusty weathering; numerous concretions	20	281
9	Mudstone, dark grey; rubbly; rusty weathering numerous sideritic concretions; 6″ concretionary bed at base	26	261
8	Covered	10	235
7	Mudstone, dark grey; rubbly; rusty weathering	26	225
6	Mudstone, as above; large irregular concretionary masses; 3′x5′	9	199
5	Mudstone, silty, to siltstone, argillaceous; irregularly bedded; concretions; reddish brown weathering	3	190
4	Mudstone, rubbly, dark grey; numerous concretions	80	187

Unit	Lithology	Thickness (feet)	Height above base (feet)
3	Mudstone, rubbly, dark grey to black; numerous concretions, reddish brown weathering, forming beds 2″–3″ thick	58	107
2	Mudstone, silty; blocky	10	49
1	Mudstone to shale, flaky to rubbly, silty, soft; 1′ of sandy siltstone 2′ above base; 6″ of siltstone with lenses of coarse-grained sandstone at base	39	39
	GETHING FORMATION		
16	Sandstone, fine-grained, grey	1	101
15	Shale and siltstone, interbedded; platy	2	100
14	Sandstone, fine-grained; flaggy; rusty weathering	3	98
13	Siltstone and shale interbedded	4	95
12	Sandstone and siltstone interbedded	3	91
11	Sandstone, fine-grained; flaggy; brownish grey	4	88
10	Siltstone and shale	1	84
9	Sandstone, fine-grained	1	83
8	Sandstone, fine-grained, laminated, cross-laminated; platy; some shale	14	82
7	Sandstone, fine-grained, brown, laminated; thick-bedded	10	68
6	Sandstone, as above; 6″ conglomerate at top	5	58
5	Covered	5	53
4	Sandstone, silty, thin-bedded	7	48
3	Sandstone, fine-grained, grey; thin- to thick-bedded; grey weathering	18	41
2	Covered	7	23
1	Sandstone, as above	16	16
	End of exposure		

SECTION 62–9. Gething Formation, large anticlinal structure west of Headstone Creek, Trutch map-area, British Columbia, 57°03′N, 123°15′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
	Top of ridge		
35	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded at base, thick-bedded at top; grey weathering; quartz, 76%; chert, 21%	20	475
34	Covered	15	455
33	Sandstone, fine-grained, laminated, grey; siliceous; thin-bedded, becoming thick-bedded at top; grey weathering; poor porosity; some carbonaceous specks	34	440
32	Sandstone, fine-grained, laminated, grey, well-sorted, siliceous; thick-bedded; grey weathering; quartz, 62%; chert, 28%	47	406
31	Mudstone, silty; platy	3	359
30	Sandstone, fine-grained, laminated, grey; thick-bedded; grey weathering	11	356
29	Mudstone, silty; platy	1	345

Unit	Lithology	Thickness (feet)	Height above base (feet)
28	Sandstone, fine- to medium-grained, siliceous, laminated, grey; thick-bedded; grey weathering; poor porosity	27	344
27	Sandstone, fine-grained, laminated, grey; flaggy; grading into overlying unit	4	317
26	Sandstone, medium- to coarse-grained, grey, laminated to homogeneous; thick-bedded; grey weathering; fair porosity; quartz, 47%; chert, 48%	6	313
25	Partly covered. Mudstone, silty	4	307
24	Sandstone, fine-grained, laminated, siliceous, calcareous, carbonaceous, cross-laminated, grey; crossbedded, thick-bedded to massive; quartz, 53%; chert, 29%	30	303
23	Sandstone, fine-grained, laminated, ferruginous; thick-bedded; reddish brown weathering	7	273
22	Sandstone, fine-grained, laminated, calcareous, grey; thick-bedded; grey weathering	6	266
21	Mostly covered. Sandstone, platy	8	260
20	Sandstone, fine-grained, calcareous, cross-laminated; cross-bedded, platy to thick-bedded	13	252
19	Mostly covered. Mudstone, brown, and some platy sandstone	45	239
18	Sandstone, fine-grained, laminated to homogeneous, siliceous, calcareous, brownish grey; thick-bedded; grey weathering	10	194
17	Covered	16	184
16	Sandstone, fine-grained, brownish grey; thin-bedded to flaggy. Partly covered	17	168
15	Covered	7	151
14	Sandstone, fine-grained, brownish grey; flaggy to platy	4	144
13	Mostly covered. Mudstone, brown; blocky	8	140
12	Conglomerate; pebbles average ¼″–½″, 2″ maximum; much white quartz and chert; sandy matrix; flaggy; brownish grey	2	132
11	Sandstone, fine-grained, quartzose, siliceous, slightly calcareous, silty, well-sorted homogeneous to laminated; thick-bedded to massive; brownish grey weathering; few disseminated pebbles on bedding surfaces; trace of glauconite; quartz, 87%; chert, 7%; carbonate, 4%	40	130
10	Sandstone, fine-grained, silty, brown; flaggy; light brown weathering; grades into overlying unit	18	90
9	Covered	11	72
8	Sandstone, fine-grained, laminated, brown, calcareous; thin-bedded; light brown weathering	5	61
7	Mostly covered. Some brown mudstone	18	56
6	Sandstone, fine-grained, siliceous, bimodal, quartzose, brownish grey; thick-bedded; lenses of coarse-grained, sandstone and conglomerate; pebbles, ¼″–½″, mostly white chert and quartz	5	38
5	Sandstone, as above; massive to thick-bedded; some conglomerate at base	8	33
4	Sandstone, fine-grained, brownish grey, homogeneous; massive; grey weathering; conglomeratic lenses along upper bedding surface	12	25
3	Sandstone, fine-grained, brown, laminated, calcareous; thin-bedded to flaggy; brown weathering	4	13
2	Partly covered. Sandstone, as below; flaggy; lenses of conglomerate	4	9

Unit	Lithology	Thickness (feet)	Height above base (feet)
1	Sandstone, fine-grained, well-sorted, slightly calcareous, siliceous, quartzose, brownish grey; massive; light brown weathering; 6-inch fine conglomerate at top, some cobbles as much as 2″; quartz, 88%; chert, 3%; carbonate, 6%	5	5
	FERNIE FORMATION		
27	Sandstone, fine-grained; interbedded shale, platy, dark grey	25	539
26	Sandstone, fine-grained, siliceous, dark grey; flaggy	7	514
	For underlying beds, *see* Section 62–9, Stott, 1969.		

SECTION 62–11. Gething Formation, headwaters of Fiddes Creek, western flank of westernmost syncline containing Cretaceous rocks, Halfway River map-area, British Columbia, 56°51′N, 123°21′W.

Axis of syncline

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
59	Conglomerate; massive; pebbles ½″–1″, chert, quartz, quartzite; well-rounded, grey, bluish grey, white, green	10	1,317
58	Sandstone, fine-grained, grey; massive; brown weathering	35	1,307
57	Covered. Approximate	140	1,272
56	Sandstone, fine-grained, brown; platy	2	1,132
55	Covered. Approximate	100	1,130
54	Sandstone, argillaceous, laminated, brown; thin-bedded	6	1,030
53	Mudstone and siltstone, brown	2	1,024
52	Sandstone, fine-grained, brownish grey; thick-bedded	24	1,022
51	Partly covered. Mudstone, silty, and some sandstone	5	998
50	Sandstone, fine-grained, laminated, calcareous, brown; massive; argillaceous at base	7	993
49	Sandstone, fine-grained, laminated, siliceous, slightly calcareous, brown; brown weathering; poor porosity; quartz, 60%; chert, 30%; carbonate, 2%	15	986
48	Sandstone, fine-grained, slightly calcareous, ferruginous, brownish grey; thick-bedded; brownish grey weathering	6	971
47	Covered	10	965
46	Sandstone, as above; massive	5	955
45	Mudstone, rubbly, dark brown to dark olive-brown; silty at top	13	950
44	Sandstone, very fine grained, laminated, siliceous, calcareous, argillaceous, carbonaceous, cross-laminated, brown; thick-bedded; brown weathering; poor porosity; quartz, 45%; chert, 18%; carbonate, 23%	4	937
43	Siltstone, argillaceous, laminated; brown; platy; brown weathering	4	933
42	Mudstone, brownish grey, silty	2	929
41	Sandstone, fine-grained, brown; brown weathering; some siltstone	5	927

Unit	Lithology	Thickness (feet)	Height above base (feet)
40	Siltstone, sandy, laminated, brown; platy; brown weathering	5	922
39	Mudstone, silty, brownish grey	7	917
38	Sandstone, fine-grained, laminated, cross-laminated, grey	3	910
37	Mudstone, olive-brown to dark grey; blocky. Not well exposed	20	907
36	Sandstone, fine-grained, laminated, grey; thin-bedded	4	887
35	Covered. Some mudstone	12	883
34	Sandstone, fine-grained, brown; flaggy to thin-bedded	4	871
33	Siltstone, argillaceous, olive-brown; splintery to blocky	7	867
32	Partly covered. Mudstone, dark grey, blocky	15	860
31	Sandstone, silty, very fine grained, laminated, cross-laminated, platy; wavy bedded; brown weathering	5	845
30	Siltstone, argillaceous, blocky, brownish grey; silty mudstone, black at top	8	840
29	Sandstone, fine-grained, carbonaceous, brown; flaggy	2	832
28	Mudstone, silty, sandy, black	5	830
27	Sandstone, fine-grained, brownish grey; thin-bedded; silty at base	22	825
26	Sandstone, fine-grained, homogeneous, siliceous; grey; massive; grey weathering; poor porosity	30	803
25	Sandstone, fine-grained, laminated, argillaceous, siliceous, carbonaceous, grey; thin- to thick-bedded; cross-laminated; poor porosity; quartz, 66%; chert, 17%; carbonate, 3%	19	773
24	Sandstone, fine-grained, laminated, grey; thin- to thick-bedded; trace of plant fragments	14	754
23	Shale and siltstone, interbedded; brown	3	740
22	Sandstone, fine-grained, laminated, grey, siliceous; massive; cross-laminated; grey weathering; poor porosity	25	737
21	Sandstone, fine-grained, laminated, brownish grey; thick-bedded; grey weathering; slightly calcareous; poor porosity	52	712
20	Covered	45	660
19	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded to massive; poor porosity	29	615
18	Shale, black; rubbly	2	586
17	Sandstone, fine-grained, brownish grey; thin-bedded; laminated	17	584
16	Covered	35	567
15	Sandstone, fine-grained, homogeneous, siliceous, white, calcareous; thick-bedded; light brown weathering; poor porosity	47	532
14	Covered	53	485
13	Sandstone, fine- to medium-grained, siliceous, grey; massive; grey weathering; well-sorted; poor porosity; quartz, 49%; chert, 37%	38	432
12	Sandstone, fine-grained, laminated, dark grey; thick-bedded to massive; grey weathering; few pebbles on bedding surfaces	19	394
11	Sandstone, fine-grained, laminated; flaggy to thin-bedded; some platy siltstone at base	15	375
10	Sandstone, fine-grained, laminated, calcareous, brownish grey; thick-bedded; grey to brown weathering	23	360
9	Sandstone, fine-grained, grey, laminated; massive to thick-bedded; grey weathering	41	337

Unit	Lithology	Thickness (feet)	Height above base (feet)
8	Sandstone, fine-grained, laminated, calcareous, brownish grey; massive; more thinly bedded at top	62	296
7	Sandstone, fine-grained, laminated, siliceous, ferruginous, brown; grey, fairly well sorted; traces of glauconite; poor porosity; quartz, 63%; chert, 18%; carbonate, 6%	18	234
6	Covered	44	216
5	Sandstone, coarse-grained, laminated, conglomeratic; massive; conglomerate at base; pebbles of chert, quartz, quartzite, black, white, bluish grey and green	39	172
4	Shale, brown, to mudstone; blocky	2	133
3	Sandstone, fine-grained, laminated; massive; thin lenses of fine conglomerate; pebbles ¼"–½"; blue, black, white	41	131
2	Conglomerate; pebbles averaging ¼"; sandy matrix	1	90
1	Sandstone, very fine grained, laminated, brownish grey, siliceous, calcareous, carbonaceous; massive; grey-weathering; poor porosity; quartz, 67%; chert, 25%; carbonate, 6%	89	89

Minnes Group

BEATTIE PEAKS FORMATION

15	Covered	165	1,520
14	Sandstone, fine-grained, brownish grey, laminated	3	1,355
13	Covered	80	1,352
12	Sandstone, fine-grained, laminated, brownish grey; platy	24	1,272

For underlying beds, *see* Section 62–11, Stott, 1969.

SECTION 62–12. Gething Formation, east flank of syncline, south of Halfway River, Halfway River map-area, British Columbia, 56°56′N, 123°14′W.

Top of ridge

GETHING FORMATION

12	Sandstone, fine-grained, homogeneous, brownish grey; thick-bedded; grey weathering	30	348
11	Siltstone and shale interbedded; brown; platy	35	318
10	Sandstone, fine-grained, homogeneous, brownish grey; thick-bedded; grey weathering	12	283
9	Siltstone, argillaceous; platy	2	271
8	Sandstone, fine-grained, quartzose, siliceous, well-sorted; thick-bedded; poor porosity; carbonaceous fragments; quartz, 96%; chert, 3%	28	269
7	Sandstone, fine-grained, homogeneous, quartzose, siliceous, brownish grey to grey; thick-bedded to massive; grey weathering; 15′ of medium-grained sandstone about 20′ below top; poor porosity; pyrobitumen; quartz, 89%; chert, 7%	95	241

Unit	Lithology	Thickness (feet)	Height above base (feet)
6	Covered	5	146
5	Sandstone, fine-grained, cherty, laminated, cross-laminated; thick-bedded to massive; grey weathering; poor porosity	44	141
4	Covered	14	97
3	Sandstone, fine-grained, cherty, laminated, cross-laminated, grey, thick-bedded; grey weathering; partly covered at top	29	83
2	Covered	24	54
1	Sandstone, fine- to medium-grained, laminated, siliceous, argillaceous, carbonaceous, calcareous, cherty, grey; thick-bedded to massive; grey weathering; poor porosity	30	30
	MINNES GROUP		
	BEATTIE PEAKS FORMATION		
4	Covered	60	
3	Mudstone, silty, brownish grey; platy	8	
2	Sandstone, very fine grained, laminated, brown; platy; brown weathering	2	
1	Covered	325	
	MONTEITH FORMATION		
1	Sandstone, fine-grained, homogeneous, siliceous, grey; thick-bedded; brownish grey weathering	52	

SECTION 62–13. Gething Formation, west flank of anti cline, south of Chowade River, Halfway River map-area, British Columbia, 56°40′N, 123°04′W.

Overlying beds not exposed

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
30	Sandstone, fine-grained, laminated, brown; platy; cross-bedded; ferruginous, carbonaceous	3	457
29	Partly covered. Some sandstone and siltstone	5	454
28	Sandstone, very fine grained, argillaceous, siliceous, brown; thick-bedded; poorly sorted; poor porosity; quartz, 58%; chert, 24%	8	449
27	Sandstone, silty; platy; crossbedded; some siltstone	17	441
26	Sandstone, fine-grained, laminated; thick-bedded; reddish brown weathering	5	424
25	Covered. Some platy sandstone at base	52	419
24	Sandstone, fine-grained, cross-laminated; crossbedded; platy	8	367
23	Covered	75	359
22	Sandstone, as above	3	284
21	Covered	15	281
20	Sandstone, fine-grained; platy; reddish brown weathering	12	266
19	Covered	3	254
18	Sandstone, fine-grained, laminated, carbonaceous, ferruginous	3	251

Unit	Lithology	Thickness (feet)	Height above base (feet)
17	Covered	70	248
16	Sandstone, fine-grained, laminated, brownish grey; flaggy; grey weathering	5	178
15	Covered	30	173
14	Sandstone, as above	8	143
13	Siltstone, sandy, dark grey; platy; grey weathering	5	135
12	Covered	6	130
11	Sandstone, fine-grained, laminated, brownish grey; flaggy; grey weathering	3	124
10	Covered	9	121
9	Sandstone, as above	5	112
8	Covered	19	107
7	Sandstone, fine-grained, laminated, brown; flaggy	7	88
6	Covered	5	81
5	Sandstone, fine-grained, laminated, cross-laminated, brown; flaggy; calcareous	5	76
4	Covered	25	71
3	Sandstone, medium- to coarse-grained; massive; grey weathering	23	46
2	Covered	13	23
1	Sandstone, medium- to coarse-grained; siliceous; some conglomeratic lenses; massive; cross bedded; poor porosity	10	10
	MINNES GROUP		
	BEATTIE PEAKS FORMATION		
80	Covered	85	1,580
79	Sandstone, fine-grained, homogeneous, siliceous, brownish grey, ferruginous; massive	18	1,495
78	Covered	45	1,477
77	Sandstone, fine-grained, quartzose, white, siliceous; thin-bedded to platy; grey weathering	27	1,432
	For underlying beds, *see* Section 62–13, Stott, 1969.		

SECTION 62–16. Fernie, Monteith, and Gething Formations, south of Nevis Creek, Trutch map-area, British Columbia, 57°20′N, 123°23′W.

Top of ridge

	GETHING FORMATION		
5	Sandstone, fine-grained, quartzose, siliceous well-sorted, clean; some beds of conglomerate. Partly covered quartz, 66%; chert, 33%. Approximate	150	401
4	Sandstone, fine-grained, laminated, grey; thick-bedded to massive. Approximate	120	251
3	Shale, brown; rubbly	5	131

Unit	Lithology	Thickness (feet)	Height above base (feet)
2	Sandstone, fine-grained, quartzose, siliceous, well-sorted, laminated at base, homogeneous at top; thick-bedded to massive; poor porosity; quartz, 94%; chert, 5%	61	126
1	Sandstone, fine-grained, quartzose, well-sorted, siliceous, homogeneous, greyish white; thick-bedded to massive; grey weathering; poor porosity; quartz, 97%; chert, 3%	65	65

Minnes Group

MONTEITH FORMATION

Unit	Lithology	Thickness (feet)	Height above base (feet)
24	Covered, recessive	35	356
23	Sandstone, fine-grained, brownish grey, slightly calcareous; rusty brown weathering; thick-bedded	33	321
22	Mudstone, dark grey; blocky; some interbedded sandstone	14	288
21	Sandstone, fine-grained, brown; thick-bedded; rusty weathering	4	274
20	Mudstone, dark grey; blocky	5	270
19	Sandstone, fine-grained, laminated to homogeneous, brownish grey; thick-bedded to massive, slightly calcareous; rusty brown to grey weathering	21	265
18	Mudstone, dark grey; rubbly to blocky; covered in upper part	15	244
17	Sandstone, fine-grained, laminated, brownish grey, calcareous; thick-bedded to massive; rusty to grey weathering	35	229
16	Mudstone, dark grey, blocky; rusty weathering	1	194
15	Sandstone, fine- to medium-grained, slightly laminated, grey; thick-bedded to massive; slightly calcareous; rusty to grey weathering	12	193
14	Mostly covered. Mudstone, blocky, dark grey to black	46	181
13	Sandstone, fine-grained, grey siliceous; thick-bedded; rusty to grey weathering	12	135
12	Covered	30	123
11	Mudstone; rubbly to blocky; dark grey	10	93
10	Sandstone, fine-grained, laminated, light brownish grey; thick-bedded; siliceous; brown weathering	21	83
9	Siltstone, sandy, dark grey; platy; some interbedded mudstone	9	62
8	Mudstone, dark grey; rubbly	3	53
7	Sandstone, fine-grained, laminated; platy to flaggy; rusty brown weathering	2.5	50
6	Mudstone, dark grey; rubbly; dark grey; rusty weathering	1.5	47.5
5	Sandstone, fine-grained, quartzose, siliceous, light brownish grey; rusty weathering	5	46
4	Mudstone, rubbly; rusty weathering	2	41
3	Sandstone, fine-grained, quartzose, light brownish grey; thick-bedded	15	39
2	Mudstone, silty; rusty weathering	1	24
1	Sandstone, fine-grained, quartzose, laminated to homogeneous, light brownish grey; thin-bedded at base with some siltstone; more thickly bedded at top; siliceous, ferruginous; light brown weathering	23	23

Unit	Lithology	Thickness (feet)	Height above base (feet)
	FERNIE FORMATION		
25	Shale and interbedded siltstone, 25%, black; platy; rusty weathering	17	346
24	Shale and interbedded siltstone, 30%; platy; rusty weathering; capped by 2′ of argillaceous siltstone, blocky	16	329
23	Shale, black; rubbly; rusty weathering; yellow efflorescence; talus covered	28	313
22	Shale, much as below; talus covered	25	285
21	Shale, black; rubbly; slightly rusty weathering; yellow efflorescence; siltier at top	39	260
20	Shale, black, rubbly; slightly rusty weathering; siltier at top; few thin beds of siltstone	47	221
19	Shale, black, platy, calcareous; some thin platy siltstone, 25%; some large concretions	24	174
18	Shale, black, slightly calcareous; rubbly; slightly rusty weathering	4	150
	Nordegg Member		
17	Siltstone, laminated, calcareous, black, phosphatic; brown weathering; beds 1″–2″	3	146
16	Shale, black, calcareous, silty	1	143
15	Siltstone, laminated, calcareous, black; some calcareous shale; 1″–2″ beds	3	142
14	Shale, black, calcareous; fissile	1	139
13	Siltstone, black, calcareous, phosphatic; some black, calcareous, platy shale	2	138
12	Shale, black; platy; calcareous; interbedded siltstone, 25%; platy to platy	12	136
	GSC loc. 52222 pectinids Age: Early Jurassic		
11	Mostly covered. Platy shale and siltstone, black, calcareous	25	124
10	Siltstone, platy to flaggy	1	99
9	Partly covered. Shale and siltstone, calcareous, black; platy	16	98
8	Siltstone, argillaceous, calcareous, laminated; platy	1	82
7	Shale and interbedded siltstone; calcareous, black; platy	2	81
6	Siltstone, calcareous, phosphatic, laminated; flaggy; grey weathering	1	79
5	Shale and siltstone interbedded; siltier at top, black, calcareous; platy	18	78
	GSC loc. 52231 pectinids Age: Early Jurassic		
4	Shale, flaky; rusty weathering; yellow efflorescence	1	60
3	Shale, black, calcareous; platy; interbedded with siltstone (25%) towards top	39	59
2	Sandstone, very fine grained, dark grey, calcareous	1	20
1	Mostly covered. Shale and siltstone interbedded; calcareous, black, platy	19	19

Unit	Lithology	Thickness (feet)	Height above base (feet)
	TRIASSIC		
	PARDONET FORMATION		
	Limestone, dense, bluish grey; fossiliferous; brown weathering; capped by bone bed		
	GSC loc. 52234 *Monotis scutiformis pinensis* Westermann Age: Norian, probably *Himavatites* zone		

SECTION 62–17. Fernie and Gething Formations, south of Nevis Creek, Trutch map-area, British Columbia, 57°20′N, 123°21′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Broad, flat synclinal valley—Buckinghorse beds are exposed farther north. Exposures of Gething must be at or just below top of formation.		
	GETHING FORMATION		
42	Sandstone, medium-grained, siliceous, fairly well sorted, laminated, cherty, grey; thick-bedded; poor porosity; quartz, 44%; chert, 47%. Approximate	40	1,149
41	Covered. Approximate	150	1,109
40	Mudstone, black, hard; rubbly to blocky; some beds of black siltstone	20	959
39	Sandstone, fine-grained, cherty, well-sorted	5	939
38	Covered	15	934
37	Sandstone, fine-grained, cherty, well-sorted, siliceous; thick-bedded; grey to brown weathering	34	919
36	Covered	23	885
35	Sandstone, fine-grained, quartzose, grey, siliceous; thin-bedded; grey weathering	24	862
34	Covered. Some sandstone	31	838
33	Sandstone, fine-grained, quartzose, siliceous, homogeneous; thin-bedded; grey weathering	31	807
32	Covered	15	776
31	Sandstone, medium-grained, quartzose, siliceous, grey, homogeneous; thick-bedded; grey weathering; some coarse-grained sandstone; some large crossbeds; becoming finer grained towards top; poor porosity; quartz, 84%; chert, 13%	66	761
30	Covered	5	695
29	Sandstone, poorly bedded	3	690
28	Siltstone and interbedded sandstone; platy	7	687
27	Sandstone, fine-grained, laminated, grey, siliceous, well-sorted; thick-bedded; 2′–3′ recessive in middle	21	680
26	Siltstone; platy	4	659
25	Sandstone, fine-grained, laminated, grey	5	655
24	Covered	18	650
23	Sandstone, fine-grained, laminated, grey, quartzose; thin- to thick-bedded	8	632
22	Covered, recessive	5	624

Unit	Lithology	Thickness (feet)	Height above base (feet)
21	Sandstone, fine-grained, laminated, quartzose, grey, siliceous, well-sorted; thin- to thick-bedded; grey weathering; poor porosity	15	619
20	Covered. Appears to be mostly sandstone	25	604
19	Sandstone, fine-grained, well-sorted; thin-bedded	9	579
18	Covered, recessive	10	570
17	Sandstone, fine-grained, well-sorted, brownish grey; thin-bedded	10	560
16	Covered. Mostly sandstone across gully	40	550
15	Sandstone, fine-grained, quartzose, siliceous, well-sorted, greyish white; thin-bedded; grey weathering; poor porosity	26	510
14	Covered. Appears to be platy sandstone	8	484
13	Sandstone, fine-grained, quartzose, well-sorted, siliceous, dark grey; thick-bedded; grey weathering; poor porosity; quartz, 94%; chert, 5%	115	476
12	Partly covered. Appears to be mainly sandstone as below; more thinly bedded	45	361
11	Sandstone, fine-grained, grey, siliceous, well-sorted; thick-bedded; recessive at base	22	316
10	Sandstone, fine-grained, grey, cherty, siliceous, well-sorted; thick-bedded; grey weathering	39	294
9	Covered	15	255
8	Sandstone, fine-grained, argillaceous, siliceous, carbonaceous, dark grey to brown, fairly well-sorted, laminated to homogeneous; thick-bedded; poor porosity; quartz, 51%; chert, 27%	32	240
7	Covered, recessive	20	208
6	Sandstone, fine-grained, argillaceous, quartzose, siliceous, brownish grey, homogeneous; thick-bedded; well-sorted; grey weathering; poor porosity; some carbonaceous specks; quartz, 80%; chert, 7%	30	188
5	Covered	18	158
4	Sandstone, fine-grained, quartzose, siliceous, brown; thick-bedded; brownish grey weathering; poor porosity	20	140
3	Covered	4	120
2	Sandstone, very fine grained, quartzose, siliceous, greyish white; thick-bedded; grey weathering; fair porosity	16	116
1	Sandstone, very fine grained, quartzose, siliceous, white, homogeneous; thick-bedded; fair porosity (partly talus covered); quartz, 92%; chert, 8%	100	100
	FERNIE FORMATION		
1	Mostly covered. Black calcareous shale, platy toward top	85	85

TRIASSIC

PARDONET FORMATION

Limestone, brown weathering; upper beds platy to shaly

GSC loc. 52233

Buchites cf. *B. modestus* (Buch)
Proclydonautilus natosini McLearn
Monotis scutiformis pinensis Westermann
Age: Norian, *Himavatites* zone

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 62–20. Basal Buckinghorse and Gething Formations, Prophet River, Trutch map-area, British Columbia, 57°39′N, 123°34′W.

Overlying beds not exposed

BUCKINGHORSE FORMATION

2	Mudstone, very silty, black, blocky, few concretions, thin seams of bentonite near top; traces of glauconite...........	58	65

GSC loc. C-7222 (57–65)

Quadrimorphina (*Pallaimorphina*) cf. *Q. albertensis* Mellon and Wall, few
Nodosaria sp., rare
Haplophragmoides sp. G91, common
H. sp. G117, common
Gaudryina nanushukensis Tappan, few
Verneuilinoides sp., few
Saccammina (*Pelosina*) sp., rare
Glomospira sp. 8, few
Glomospirella sp. 2, rare
G. ex gr. *G. eucalla* (McGill and Loranger), few

Age: Early Albian; environment: marine, open

GSC loc. C-7223 (52′–57′)

?*Serovaina* sp., rare
Dentalina sp., rare
Marginulinopsis sp., rare
?*Conorbina* sp., rare
?*Lenticulina* sp., rare
?*Verneuilinoides* sp., few
Haplophragmoides sp. G117, common
H. sp. G91, common
Ammodiscus sp. G16, rare
Miliammina sp. 11, rare
Glomospirella sp. 2, few
Saccammina sp. 4, rare
Hyperammina sp., few

Age: Early Albian; environment: marine, open

GSC loc. C-7224 (47′–52′)

Globulina cf. *G. prisca* Reuss, few
Vaginulinopsis ex gr. *V. grata* (Reuss), common
?*Lenticulina* sp., rare
?*Saracenaria* sp., few
Conorbina norrisi (Mellon and Wall), common
Saccammina (*Pelosina*) sp., rare
Serovaina sp., few
Haplophragmoides sp. G91, common
H. sp. G128, common
H. ex gr. *H. collyra* Nauss, few
Ammodiscus sp. G16, rare

Unit	Lithology	Thickness (feet)	Height above base (feet)

Miliammina sp. 11, common
Gaudryina nanushukensis Tappan, few
Textularia sp., few
Bathysiphon sp.
Inoceramus sp. prisms, common

Age: Early Albian; environment: marine, open

GSC loc. C-7225 (42′–47′)

Globulina cf. *G. prisca* Reuss, common
Astacolus (*Saracenaria*) sp., rare
Vaginulinopsis (sp. 3), rare, ex gr. *V. grata* (Reuss)
Saracenaria sp., rare
Conorbina norrisi (Mellon and Wall), common
?*Serovaina* sp., few
Trochammina sp., few
Haplophragmoides sp. G127, few
H. sp. G128, common
H. ex gr. *H. collyra* Nauss, few
Trochamminoides sp., rare
Glomospira sp. 8, rare
Glomospirella ex gr., *G. scaphoidea* McGill and Loranger, few
Miliammina sp. 11, common
Saccammina (*Pelosina*) sp., few
?*Gaudryina* ex gr. *G. nanushukensis*
Bathysiphon sp.
?*Ammobaculites* sp., few
Inoceramus sp. prisms, few
?spine, rare
?ostracods, few

Age: Early Albian; environment: marine, open

GSC loc. C-7226 (37′–42′)

Saccammina (*Pelosina*) sp., few
Haplophragmoides sp. G127, common
H. sp. G128, few
Spiroplectammina ex gr. *S. koveri* Tappan (small), few
Gaudryina cf. *G. nanushukensis* Tappan (small), few
Miliammina sp. 11, rare
?*Eponides* sp., few

Age: Early Albian; environment: marine, restricted

GSC loc. C-7227 (32′–37′)

?*Conorbina* sp., few
?*Eponides* sp., rare
Saccammina sp. 4, rare
Haplophragmoides sp. G122, common
H. ex gr. *H. collyra* Nauss, few
Ammodiscus sp. A Wickenden, few
A. sp. G16, rare
Miliammina sp. 11, common
Gaudryina nanushukensis Tappan, few

Unit	Lithology	Thickness (feet)	Height above base (feet)

G. ex gr. *G. tailleuri* Tappan, few
?*Reophax* sp., few

Age: Early Albian; environment: marine, intermittent open

GSC loc. C-7228 (27′–32′)

?*Eponides* sp., few
?*Saracenaria* sp., rare
?*Conorbina* sp., few
?*Lenticulina* sp., few
Haplophragmoides cf. *H.* sp. G117, common
H. sp. G115, common
H. sp. G126, few
Glomospira sp. 3, rare
?*Glomospirella* sp., rare
Miliammina sp. 11, few
Ammodiscus G16, rare
Ammobaculites sp., few
Gaudryina nanushukensis Tappan, few
Inoceramus sp. prisms, few

Age: Early Albian; environment: marine, intermittent open

GSC loc. C-7229 (22′–27′)

?*Clavulina* sp. 9, few
Marginulinopsis ex gr. *M. reticulosa* ten Dam, rare
?*Conorbina* sp., few
?*Globorotalites* sp., rare
?*Eponides* sp., few
Haplophragmoides sp. G115, abundant
H. sp. G125, common
H. sp. G126, common
Miliammina sp. 11, few
Gaudryina ex gr. *G. tailleuri* Tappan, few
?*Spiroplectammina* ex gr. *S. ammovitrea* Tappan, rare
Ammobaculites sp., few
vertebrate bone (?fish), rare

Age: Early Albian; environment: marine, open

GSC loc. C-7230 (17′–22′)

Lenticulina sp., few
Saracenaria sp., few
Conorbina ex gr. *C. norrisi* (Stelck and Wall), few
?*Quadrimorphina* cf. *Q. albertensis* Mellon and Wall, few
gyroid calcareous sp., few
Miliammina sp. 11, few
?*Lituotuba* sp., few
Saccammina sp., 4, few
Hyperammina sp., common
Bathysiphon sp., common
Verneuilinoides sp., common

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Gaudryina sp. 13c=ex gr. *G. nanushukensis* Tappan, abundant *G.* cf. *G. cushmani* Tappan, rare *Reophax* sp., common ?*Ammobaculites* sp., rare *Haplophragmoides* sp. G115, very abundant *H.* ex gr. *H. volubilis* Romanova, abundant *H.* sp. G125, abundant *H.* sp. G125, (Cse), very abundant *H.* sp. G126, few ?*Trochamminoides* sp., rare Age: Early Albian; environment: marine, open		
	GSC loc. C-7231 (12′–17′) agglutinated Foraminifera, abundant Age: Early Albian; environment: marine, intermittent open		
	GSC loc. C-7232 (7′–12′) *Haplophragmoides* spp., abundant *Hyperammina* sp., rare *Gaudryina* sp. 13c, rare ?*Verneuilinoides* sp. indet., few ?*Glomospirella* sp., rare *Lenticulina* sp., rare Age: Early Albian; environment: marine, intermittent open		
1	Covered	7	7
	GETHING FORMATION		
47	Mudstone, very silty, glauconitic; topped by reddish brown weathering concretionary layer	3	499.5
46	Sandstone, very argillaceous, dark grey, glauconitic; thick-bedded to massive	9	496.5
45	Siltstone, sandy, pebbly, concretionary; abundant glauconite; poorly bedded; greenish grey weathering	7	487.5
44	Sandstone, very fine grained, argillaceous, calcareous, brownish grey, siliceous; thick-bedded; brownish grey weathering; some mudstone at base	31	480.5
43	Covered	60	449.5
42	Mudstone, silty, dark grey to black; some silty beds	5	389.5
	GSC loc. C-7233 *Saccammina* cf. sp. 4, few *Haplophragmoides* ex gr. *H. collyra* Nauss, common *H.* ex gr. *H. multiplus* Stelck and Wall, abundant *H.* sp. G115, very abundant ?*Trochamminoides* sp., common *Haplophragmoides* ex gr. *H. spissum* Stelck and Wall *H.* sp., common		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	?*Conorbina* sp., rare ?*Trochammina* sp., few ?*Dentalina* sp., rare ?ostracods (casts), common Age: Early Albian, ?Aptian Biostratigraphic equivalent: Bluesky Fm. Environment: marine, intermittent open		
41	Mudstone and siltstone	3	384.5
	GSC loc. C-7234 *Pyrulinoides* sp., common *Conorbina* (*Discorbis*) ex gr. *C. norrisi* (Stelck and Wall), common *Gyroidina* cf. *G. nitida* (Reuss) fide Stelck and Wall, common *Astacolus* cf. *A. schlonbachi* (Reuss), few *Eurycheilostoma* ex gr. *E. robinsonae* Tappan, few *Haplophragmoides* sp. G119, common *H.* n. sp., few Age: Early Cretaceous, ?Aptian Biostratigraphic equivalent: Bluesky Fm. Environment: marine, open		
40	Mudstone	17	381.5
	GSC loc. C-7235 (377′–381.5′) *Astacolus* sp., rare *Conorbina* (*Discorbis*) ex gr. *C. norrisi* (Stelck and Wall), common *Pyrulinoides* sp., few ?*Lenticulina* sp. indet., rare *Saccammina* sp. 4, rare *Haplophragmoides* sp. G115, common *H.* G117, abundant *Trochammina* sp. G126, few Age: Early Cretaceous, ?Aptian Biostratigraphic equivalent: Bluesky Fm. Environment: marine, open		
	GSC loc. C-7236 (373′–377′) *Conorbina* (*Discorbis*) ex gr. *C. norrisi* (Stelck and Wall), common ?*Saracenaria* sp. indet., few *Haplophragmoides* sp. G115, abundant *H.* sp. G117, very abundant *Trochammina* sp. G126, few *Reophax* sp. indet., rare *Ammobaculites* sp., few *Saccammina* sp. 4, few Age: Early Cretaceous, ?Aptian Biostratigraphic equivalent: Bluesky Fm. Environment: marine, open		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-7237 (369′–373′) *Gavellinella* ex gr. *G. awunensis* Tappan, few *Saccammina* sp. 4, rare *Haplophragmoides* sp. G121, few *H.* sp. G118, Age: Early Cretaceous, ?Aptian Biostratigraphic equivalent: Bluesky Fm. Environment: marine, intermittent		
	GSC loc. C-7238 (364′–369′) *Haplophragmoides* sp. G121, common *H.* sp. G118, common *H.* sp. G117, abundant *Gavelinella* ex gr. *G. awunensis* Tappan, few (silicified) *Conorbina* (*Discorbis*) ex gr. *C. norrisi* (Stelck and Wall), few ?*Ammodiscus* sp. G14, few Age: Early Cretaceous, ?Aptian Biostratigraphic equivalent: Bluesky Fm. Environment: marine, open		
39	Sandstone and mudstone, 40%; beds 2″–8″	52	364.5
	GSL loc. C-7240 (361′–364′) *Haplophragmoides* ex gr. *H. gigas minor* Nauss, few Age: Early Cretaceous, Aptian; environment: marine, restricted		
	GSC loc. C-7241 (357′–361′) *Haplophragmoides* ex gr. *H. barremicus* Myatliuk, few *Saccammina* sp. 4, few Age: Early Cretaceous, Aptian; environment: marine, restricted		
	GSC loc. C-7242 (352′–357′) ?pelecypod shell (deep ribbed), few Age: Mesozoic undifferentiated (stratigraphic position Aptian); environment: ?marine undifferentiated		
	GSC loc. C-7243 (347′–352′) vertebrate bone (?fish), few Megaspore: IA var. sp. 1, rare Age: indeterminate (stratigraphic position Aptian); environment: ?freshwater		
	GSC loc. C-7244 (342′–347′) *Haplophragmoides* ex gr. *H. gigas minor* Nauss, rare *H.* sp. indet., few ?*Lituotuba* sp. indet., rare *Conorbina* ex gr. *C. norrisi* (Mellon and Wall), few Age: Early Cretaceous, Aptian; environment: marine, intermittent open		

Unit	Lithology	Thickness (feet)	Height above base (feet)

GSC loc. C-7245 (337′–342′)

Haplophragmoides sp. G117, common
H. ex gr. *H. cushmani* Leoblich and Tappan, common
H. ex gr. *H. barremicus* Myatliuk, few
Trochammina sp. G130, few
?*Glomospirella* sp. indet., few
?*Reophax* sp. indet., few

Age: Early Cretaceous, Aptian; environment: marine, restricted

GSC loc. C-7246 (332′–337′)

Haplophragmoides ex gr. *H. barremicus* Myatliuk, few
H. sp. G115, rare

Age: Early Cretaceous, Aptian; environment: marine, restricted

GSC loc. C-7247 (327′–332′)

Haplophragmoides sp. G117, few
H. ex gr. *H. gigas minor* Nauss, few
Reophax sp. indet. (fragment), rare

Age: Early Cretaceous, Aptian; environment: marine, restricted

GSC loc. C-7248 (322′–327′)

Haplophragmoides sp. G115, few
?pelecypod fragments (pyritic), few
?gastropod fragments (pyritic) few

Age: Early Cretaceous, Aptian; environment: marine, restricted to brackish water

GSC loc. C-7249 (317′–322′)

Lituotuba sp. indet., rare
?*Glomospirella* sp. 4, few
Saccammina sp. 4, rare
?*Reophax* sp., few
Trochammina sp. 39, common
T. sp. G130, common
Haplophragmoides sp. G121, common
H. sp. G115, common
Ostracoda sp. indet., rare

Age: Early Cretaceous, Aptian; environment: marine, restricted

GSC loc. C-7250 (312.5′–317′)

Pyrulinoides (?*Pyrulina*) sp. 2, few (silicified)
Trochammina sp. G126, abundant (silicified "*Conorbina*" form)
T. sp. G131, abundant (silicified "*Gyroidina*" form)
T. ex gr. sp. G126, common (wafer-thin trochoid)
Haplophragmoides sp. G121, very abundant

Unit	Lithology	Thickness (feet)	Height above base (feet)
	H. sp. G115, very abundant *Miliammina* ex gr. sp. B Stelck and Wall, rare ?*Glomospirella* cf. sp. 4, common *Hippocrepina* (*Hyperamminoides*) ex gr. *barksdalei* (Tappan), few *Ammobaculites* spp. indet., common ?Ostracoda: ?*Candona* sp., rare Age: Early Cretaceous, Aptian; environment: marine, intermittent open		
38	Mudstone	3	312.5
	GSC loc. C-7251 *Saccammina* sp. 4, few *Trochammina* sp., few *Conorbina* ex gr. *C. norrisi* (Mellon and Wall), abundant *Haplophragmoides* sp. G121, abundant *H.* sp. G115, very abundant *H.* n. sp., rare *Dorothia* (*Marssonella*) ex gr. *D. oxycona* (Bartenstein and Brand), few *Gaudryina* ex gr. *G. topagorukensis* Tappan, few *Reophax* sp. indet., rare *Serovaina* sp., abundant *Cypridea* cf. *C. wyomingensis* Peck, rare Age: Early Cretaceous, Aptian; environment: marine, intermittent open		
37	Mudstone and sandstone; 2"-4" beds	17	309.5
	GSC loc. C-7252 (307.5'–309.5') *Marginulinopsis* (*Lenticulina*) ex gr. *M. sigali* (Bartenstein and Bettenstaed, 1957), rare sp. G18 *Trochammina* sp. G131, few *Haplophragmoides* sp. G121, common *H.* sp. G115, abundant *Dorothia* (*Marssonella*) ex gr. *D. oxycona* (Bartenstein and Brand), few *Conorbina* ex gr. *C. norrisi* (Mellon and Wall), few *Serovaina* sp. Age: Early Cretaceous, Aptian; environment: marine, open		
	GSC loc. C-7253 (302.5'–307.5') *Saccammina* sp. 4, rare *Trochammina* ex gr. *T. minuta* Crespin, few *T.* var. sp. G131, common *Haplophragmoides* sp. G119, abundant *Siphotextularia* sp., few megaspore: IB var. sp. 1, rare Age: Early Cretaceous, Aptian; environment: marine, restricted, nearshore		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-7254 (297.5′–302.5′) *Astacolus* cf. *A. schlonbachi* (Reuss), rare *Pyrulinoides* (?*Pyrulina*) sp. 2, common (mineralized) ?*Thuramminoides* ex gr. *T. septagonalis* Chamney (fragments) few *Trochammina* var. *T.* sp. G131, abundant *T.* ex gr. *T. connicominuta* Chamney, few *Haplophragmoides* sp. G119, common *Trochammina* ex gr. *T. minuta* Crespin, few ?*Verneuilinoides* sp., few *Conorbina* sp., common Age: Early Cretaceous, Aptian; environment: marine, open		
	GSC loc. C-7255 (292.5′–297.5′) *Trochammina* ex gr. *T. minuta* Crespin, few *T.* ex gr. *T. connicominuta* Chamney, few *Haplophragmoides* sp. G119, abundant Age: Early Cretaceous, Aptian; environment: marine, restricted		
36	Mudstone, silty; platy; some concretions................................	12	292.5
	GSC loc. C-7256 (290′–292.5′) *Trochammina* ex gr. *T. connicominuta* Chamney, common *Thuramminoides* ex gr. *T. septagonalis* Chamney, few ?*Reophax* sp., few ?*Ammodiscus* sp., few *Haplophragmoides* ex gr. *H. duoflatis* Chamney, abundant Age: Early Cretaceous, Aptian; environment: marine, restricted		
	GSC loc. C-7257 (287′–290′) *Trochammina* sp. G131, few *T.* ex gr. *T. connicominuta* Chamney, few *Haplophragmoides* sp. G120, common *Serovaina* sp., few Age: Early Cretaceous, Aptian; environment: marine, restricted		
	GSC loc. C-7258 (284′–285′) *Trochammina* sp. G131, common *T.* ex gr. *T. connicominuta* Chamney, common *Haplophragmoides* sp. G121, common *H.* sp. G87, few ?*Glomospira* sp., few *Hyperammina* sp., few megaspore: IIIE sp. (*Microcarpolithes* sp.), few pelecypod shell prisms, few ?*Hamulus* sp. tube fragments, few Age: Early Cretaceous, Aptian; environment: marine, restricted, nearshore		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-7259 (280.5′–284′) ?*Trochammina* sp. G131, common ?*Conorbina* ex gr. *C. norrisi* (Mellon and Wall), few *Serovaina* sp. spine ? echinoderm, few Age: Early Cretaceous, Aptian; environment: marine, open		
35	Mudstone; some sandy siltstone; concretionary layers...........	18	280.5
	GSC loc. C-7260 (277′–280.5′) *Astacolus* cf. *A. schlonbachi* (Reuss) fide Bartenstein *Trochammina* sp. G131 ?*Siphotextularia* sp., rare *Conorbina* ex gr. *G. norrisi* (Mellon and Wall), abundant *Serovaina* sp. ?*Siphotextularia* ex gr. *S. rayi* Tappan, few Age: Early Cretaceous, Aptian; environment: marine, open		
	GSC loc. C-7261 (272.5′–277′) *Trochammina* sp. 39, few *Haplophragmoides* sp. G121, abundant *H.* sp. G119, very abundant *Trochammina* var. sp. 39, rare *Serovaina* sp., common Age: Early Cretaceous, Aptian; environment: marine, intermittent open		
	GSC loc. C-7262 (267.5′–272.5′) *Saccammina* sp. 4, few *Trochammina* sp. 39, abundant *Haplophragmoides* sp. G121, abundant *H.* sp. G119, very abundant *Miliammina* sp. G10, few *Glomospirella* sp. 4, few ?*Verneuilinoides* sp., few *Reophax* sp., rare *Serovaina* sp., common Age: Early Cretaceous, Aptian; environment: marine, intermittent open		
	GSC loc. C-7263 (262.5′–267.5′) *Haplophragmoides* sp. G119, very abundant *Haplophragmoides* sp. G121, abundant *Saccammina* sp. 4, abundant *Glomospirella* var. sp. 4, common *Miliammina* sp., rare *Lituotuba* sp., common *Siphotextularia* sp., common ?*Reophax* sp., few		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Lingulina sp., rare ?ostracod sp. (limonitic replacement of shell), rare megaspores: black carbon cases; common *Conorbina* ex gr. *C. norrisi* (Mellon and Wall), abundant Age: Early Cretaceous, Aptian; environment: marine, intermittent open, nearshore		
34	Mudstone and sandstone, 20%; siderite concretions	5	262.5
	GSC loc. C-7265 ?*Verneuilinoides* sp. indet., few *Saccammina* (*Thurammina*) sp. 4, few *Trochammina* sp. indet., few *Haplophragmoides* sp. G119, very abundant *Siphotextularia* sp., few Age: Early Cretaceous, Aptian; environment: marine, restricted		
33	Siltstone and mudstone, 40%	6	257.5
	GSC loc. C-7266 *Saccammina* (*Thuramminoides*) sp. 4, few *Trochammina* sp. 39, very abundant ?*Lituotuba* sp., few ?*Siphotextularia* sp., few Age: Early Cretaceous, Aptian; environment: marine, restricted		
32	Mudstone, rubbly	3	251.5
	GSC loc. C-7267 *Trochammina* sp. 39, few *Haplophragmoides* sp. G121, abundant *H.* sp. G120, abundant *Siphotextularia* sp., common ?*Lituotuba* sp., few *Hyperammina* sp., few *Serovaina* sp., abundant echinoid fragments (?ambulacral segments), common pelecypod umbo, rare Age: Early Cretaceous, Aptian; environment: marine, mixed open and restricted		
31	Mudstone and sandstone, 30%; some sideritic layers	6	248.5
	GSC loc. C-7268 (245′–248.5′) *Saccammina* sp. 4, few *Trochammina* sp. 39, abundant *Haplophragmoides* sp. G119, abundant *H.* sp. G87, few *Glomospirella* sp. 4, common		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	?*Siphotextularia* sp. indet., few ?*Gaudryina* sp. indet., few Ostracoda sp. (?*Candona* sp.), rare Age: Early Cretaceous, Aptian; environment: marine, restricted		
	GSC loc. C-7269 (242.5′–245′) *Hyperammina* sp., few ?pelecypod shell frags., few plant rootlets, common Age: indeterminate (stratigraphic position Aptian); environment: marine, very restricted, nearshore		
30	Mudstone: some sideritic layers	20	242.5
	GSC loc. C-7270 (237.5′–242.5′) *Saccammina* sp. 4, common *Trochammina* sp. 39, common *Haplophragmoides* sp. G119, very abundant *H.* sp. G120, abundant *Glomospirella* sp. 4, rare ?*Siphotextularia* sp. indet., few *Ammobaculites* sp., few *Conorbina* ex gr. *C. norrisi* (Mellon and Wall), abundant *Hyperammina* sp., rare Age: Early Cretaceous, Aptian; environment; marine, intermittent open, nearshore		
	GSC loc. C-7001 (232.5′–237.5′) *Globulina* ex gr. *G. topagorukensis* Tappan, few *Saracenaria* (sp. 10A) ex gr. *valanginiana* Bartenstein and Brand, few *Marginulinopsis* sp. 5, rare *Trochammina connicominuta* Chamney, common *Haplophragmoides* sp. G119 n. sp., abundant *H.* sp. G117, abundant *H.* sp. G120 n. sp., very abundant *H.* sp. G115, common *H.* sp. G87, few *Saccammina* (*Thuramminoides*) sp. 4, common *Gaudryina* sp., rare Age: Early Cretaceous, Neocomian (?Barremian); environment: marine, open		
	GSC loc. C-7000 (227.9′–232.5′) *Haplophragmoides* sp. G87, common *H.* cf. *H. postis* Stelck and Wall, common *H.* spp., abundant *Trochammina* sp., few ?*Glomospirella elongata* Chamney, few *Hippocrepina barksdalei* Tappan, few		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	?*Pyrulinoides* (*Gutulina*) sp., few *Paleopolymorphina* sp., rare ?*Lenticulina* sp., rare Age: Early Cretaceous, Neocomian (?Barremian); environment: marine, open		
	GSC loc. C-6999 (222.5′–227.5′) *Trochammina* sp., rare *Haplophragmoides* sp. G116, common *H.* cf. *H. postis* Stelck and Wall (sp. G56), common *H. gigas minor* Nauss, common *Bathysiphon* sp. G26, few *Reophax* sp., rare Age: Early Cretaceous, Neocomian (?Barremian); environment: marine, restricted		
29	Covered	5	222.5
28	Mudstone and interbedded sandy siltstone	12	217.5
	GSC loc. C-6997 (209.5′–213.5′) *Haplophragmoides* sp. G115, few *H.* sp. G116, rare ?*Gaudryina* sp., rare ?*Trochammina* sp., rare Age: Early Cretaceous, Neocomian; environment: marine, restricted		
	GSC loc. C-6996 (205.5′–209.5′) ?*Lituotuba* sp. 6, rare *Glomospira* sp., rare *Trochammina* sp., few *Haplophragmoides* sp. G117, common Age: Early Cretaceous, Late Neocomian (?Barremian); environment: marine restricted		
27	Sandstone, very argillaceous, laminated; some shale	9	205.5
	GSC loc. C-6995 (201.5′–205.5′) *Conorboides* ex gr. *C. umiatensis* Tappan, rare ?*Quadrimorphina* sp., rare ?*Ammodiscus–Glomospirella* sp., rare *Haplophragmoides* cf. *H.* sp. G116, common ?*Proteonina* sp., few Age: Early Cretaceous, Late Neocomian; environment: marine, intermittent open		
	GSC loc. C-6994 (196.5′–201.5′) *Conorboides* ex gr. *C. umiatensis* Tappan, few ?*Globlina* ex gr. *G. prisca* Reuss, rare *Haplophragmoides* sp., rare		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Ammodiscus sp. G15, rare Age: Early Cretaceous, Late Neocomian; environment: marine, open		
26	Shale and interbedded sandstone, 40%....................................	9	196.5
	GSC loc. C-6992, C-6993 (192.5′–196.5′) *Saracenaria* ex gr. *S. valanginiana* Bartenstein and Brand, rare *Lenticulina* sp., rare *Dentalina* sp. indet. (fragment), rare *Astacolus* sp., rare ?*Arenobulimina* sp., rare *Gavelinella*, few *Quadrimorphina* ex gr. *Q. albertensis* Mellon and Wall, few *Conorboides* ex gr. *C. umiatensis* Tappan, abundant *C.* sp. (minute), common ?*Eponides morani* Tappan, few ?*Ammobaculites* sp., rare ?*Hyperammina* sp., few *Haplophragmoides* sp. G116, few (very dwarf) *H.* sp. G117, few *H.* sp., few *H.* cf. sp. G67, rare *H.* cf. sp. G115, common *Miliammina* sp. G10, rare Age: Early Cretaceous, Late Neocomian (new assemblage); environment: marine, open		
	GSC loc. C-6991 (187.5′–192.5′) ?*Haplophragmoides* sp., rare ?*Hyperammina* sp., rare Age: indeterminate (stratigraphic position Late Neocomian); environment: ?marine, very restricted		
25	Sandstone, fine-grained, laminated, brown................................	15	187.5
	GSC loc. C-6990 (182.5′–187.5′) *Conorbina* sp., abundant *C.* sp. (minute), common *Haplophragmoides* sp. G117, abundant *H.* G116, common *H.* sp., few *Glomospirella* sp. 4, common *Saccammina* sp. 4, few *Hippocrepina* (*Hyperamminoides*) *barksdalei* Tappan, rare *Gaudryina* ex gr. *G. topagorukensis* Tappan, rare spine, rare Age: Early Cretaceous, Late Neocomian (new assemblage) environment: marine, open		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-6989 (177.5′–182.5′) *Haplophragmoides* sp. G118, few Age: Early Cretaceous, Late Neocomian; environment: marine, restricted		
	GSC loc. C-6988 (172.5′–177.5′) *Haplophragmoides* ex gr. *H. duoflatis* Chamney, few ?*Glomospirella* sp., few ?*Saccammina* sp., rare Age: Early Cretaceous, Late Neocomian (?Barremian); environment: marine, restricted		
24	Shale and siltstone, 30%	4	172.5
	GSC loc. C-6987 *Haplophragmoides* cf. *H.* G117, few *Saccammina* sp. 4, rare Age: Early Cretaceous, Late Neocomian; environment: marine, restricted		
23	Sandstone and shale, 40%	7	168.5
	GSC loc. C-6986 radiolaria cf. sp. 42 *Haplophragmoides* cf. sp. G116, few *H.* sp., few Age: Early Cretaceous, Late Neocomian; environment: marine, intermittent open		
22	Shale, rubbly	3	161.5
	GSC loc. C-6985 ?*Quadrimorphina–Conorbina* sp., fragmentary *Haplophragmoides* ex gr. *H. duoflatis* Chamney, common *H.* sp. G116, common ?*Trochammina* sp. 39, rare Age: Early Cretaceous, Late Neocomian (?Barremian); environment: marine, intermittent open		
21	Mudstone and siltstone; some sandstone; platy	15	158.5
	GSC loc. C-6984 (153′–158′) *Quadrimorphina* ex gr. *Q. albertensis* Mellon and Wall, common ?*Trochammina* sp. 39, few *Haplophragmoides* sp. G111, few *H.* sp. Age: Early Cretaceous, ?Late Neocomian; environment: marine, open		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-6983 (148′–153′)		
	?*Proteonina* sp.—are agglutinated fragments		
	?no microfossils		
	Age: indeterminate (stratigraphic position Late Neocomian); environment: ?non-marine		
	GSC loc. C-6982 (143′–148′)		
	Haplophragmoides sp. G116, few		
	H. sp. G117, common		
	H. cf. *H. postis* Stelck and Wall, few		
	?radiolaria sp. 9, rare		
	Age: Early Cretaceous, Late Neocomian; environment: marine, intermittent open		
20	Sandstone, lenticular	2.5	143.5
19	Shale; lenticular sandstone	11	141
	GSC loc. C-6981 (136′–143′)		
	Haplophragmoides sp. G117, few		
	H. cf. *H. postis* Stelck and Wall, few		
	Age: Early Cretaceous, Late Neocomian; environment: marine, restricted		
	GSC loc. C-6980 (30′–136′)		
	Haplophragmoides sp. G116, common		
	H. sp. G115, few		
	Saccammina sp. 4, common		
	Age: Early Cretaceous, Late Neocomian; environment: marine, restricted		
18	Mudstone and sandstone	3	130
17	Sandstone, fine-grained	2	127
16	Mudstone and siltstone; some sandstone	14	125
15	Sandstone, fine-grained	1	111
14	Mudstone and sandstone, 10%	6	110
	GSC loc. C-6975		
	Haplophragmoides cf. *H. postis* Stelck and Wall, few		
	Age: Early Cretaceous; environment: marine, very restricted		
13	Sandstone, very fine grained, laminated	1	104
12	Mudstone and siltstone; some sandstone	6	103
	GSC loc. C-6974		
	Haplophragmoides sp. G117, rare		
	Age: ?Early Cretaceous; environment: ?marine		
11	Mudstone and siltstone	4	97
10	Mudstone and interbedded sandstone; beds 2″–6″	15	93
	GSC loc. C-6971 (83′–88′)		
	Haplophragmoides cf. *H.* sp. G117, few		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	?lagenid fragment "polymorphinid" sp., rare *Inoceramus* prisms, few		
	Age: Early Cretaceous; environment: marine, restricted		
	GSC loc. C-6970 (78′–83′)		
	?arenaceous serial, rare ?ostracod, rare		
	Age: indeterminate; environment: indet.		
9	Mudstone, platy	5	78
	GSC loc. C-6969		
	Haplophragmoides sp. G115, abundant *H.* sp. G116, few *H.* cf. *H. postis* Stelck and Wall, common *Ammodiscus* sp. G14, few *Saccammina* cf. *S. schwageri* Zittel, few *Hippocrepina barksdalei* Tappan, rare *Hyperammina* sp., rare		
	Age: Early Cretaceous, Late Neocomian; environment: marine, restricted		
8	Mudstone, rubbly to platy; some sandstone in upper 5′	9	73
	GSC loc. C-6968		
	Haplophragmoides sp. G115, few		
	Age: Early Cretaceous; environment: marine, very restricted		
7	Shale and interbedded sandstone	3	64
6	Sandstone, platy to thin-bedded	4	61
5	Shale, platy	5	57
4	Sandstone and interbedded shale	7	52
3	Mudstone, to argillaceous siltstone	11	45
2	Covered	33	34
1	Conglomerate; pebbles ¼″–½″ chert, quartzite, well-indurated	1	1
	Sandstone, fine-grained		
	Remainder of formation is inaccessible		

SECTION 64–7. Fernie, Monteith, and Gething Formations, Trutch map-area, British Columbia—syncline north of Trimble Lake, 57°19′N, 123°33′W.

GETHING FORMATION

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Top of ridge, end of exposure		
15	Sandstone, fine-grained, grey, siliceous	5	563
14	Covered	40	558
13	Sandstone, fine-grained, grey, siliceous; thick-bedded	15	518

Unit	Lithology	Thickness (feet)	Height above base (feet)
12	Mostly covered. Mudstone and platy siltstone	35	503
11	Conglomerate, massive; grey weathering; pebbles ¼"–½"; matrix of sandstone	63	468
10	Sandstone, fine- to medium-grained, grey; thick-bedded; laminated; poor porosity	75	405
9	Sandstone, fine- to medium-grained, grey; thick-bedded; grey weathering; conglomerate at top; poor porosity	39	330
8	Sandstone, fine-grained, laminated; platy to thick-bedded; partly talus covered	80	291
7	Sandstone, fine-grained, laminated; thick-bedded to massive; some recessive covered intervals	69	211
6	Covered. Appears to be mainly sandstone	30	142
5	Sandstone, fine-grained; thick-bedded; recessive at base	19	112
4	Sandstone, fine-grained; platy	8	93
3	Covered	8	85
2	Sandstone, fine-grained, grey, siliceous; massive to thick-bedded; conglomeratic in upper 1'	36	77
1	Sandstone, fine-grained, laminated, siliceous; thick-bedded to massive; grey weathering; quartz, 67%; dolomite, 3%; chert, 17%; carbonaceous fragments, 4%; matrix, 9%; poor porosity	41	41

MINNES GROUP

MONTEITH FORMATION

Unit	Lithology	Thickness (feet)	Height above base (feet)
68	Covered	10	977
67	Sandstone, fine-grained, laminated; platy; brown weathering	16	967
66	Covered	10	951
65	Sandstone, fine-grained, laminated; platy; grey weathering	20	941
64	Covered	50	921
63	Sandstone, fine-grained, quartzose, laminated to homogeneous, grey; flaggy to thick-bedded; grey weathering; few streaks of fine conglomerate	24	871
62	Mudstone, dark grey to black; rubbly to blocky	8	847
61	Sandstone, fine-grained, quartzose, laminated to homogeneous, siliceous; some interbedded shale	6	839
60	Covered. Some mudstone and siltstone	60	833
59	Sandstone, fine-grained, homogeneous, siliceous, grey; thick-bedded; brown weathering	10	773
58	Covered	15	763
57	Mudstone, dark grey; platy; some interbedded siltstone; few concretions	17	748
56	Sandstone, fine-grained, laminated, grey; flaggy; brownish grey weathering	2	731
55	Partly covered. Siltstone and mudstone, interbedded; few concretions, reddish brown weathering	35	729
54	Mostly covered. Mudstone and some siltstone	18	694
53	Mudstone, dark grey, rubbly; interbedded siltstone, 40%	25	676
52	Covered	8	651
51	Siltstone, argillaceous, laminated, grey; platy	5	643
50	Covered	9	638
49	Sandstone, fine-grained, laminated	1	629

Unit	Lithology	Thickness (feet)	Height above base (feet)
48	Mudstone, rubbly; some interbedded siltstone	5	628
47	Siltstone, argillaceous, laminated, grey; platy; wavy bedding; brownish grey weathering	27	623
46	Mudstone, silty, dark grey; rubbly to blocky	20	596
45	Siltstone, sandy, platy, brownish grey; brown weathering; thinly interbedded shale, 20%	4	576
44	Mudstone, dark grey, silty, rubbly; 6″ sandstone in middle	9	572
43	Mudstone and siltstone interbedded; siltstone, argillaceous to sandy, platy, brownish grey weathering; few concretionary layers; 5 feet of channel sandstone at top	19	563
42	Mudstone, silty, dark grey, rubbly to blocky; interbedded siltstone, 30%, platy, argillaceous; many lenticular channel sandstones, 2′–4′ thick	36	544
41	Sandstone, fine-grained, laminated, siliceous; thick-bedded; brownish grey weathering	3	508
40	Siltstone, very argillaceous, greyish brown; platy to poorly bedded; some interbedded shale	13	505
39	Mudstone, silty; rubbly, becoming platy at top	20	492
38	Sandstone and siltstone interbedded, platy to flaggy; brown weathering	3	472
37	Mudstone, silty, dark grey; rubbly; some interbedded siltstone	11	469
36	Mudstone and siltstone, interbedded	7	458
35	Mudstone, silty; rubbly to platy	15	451
34	Sandstone, as above	3	436
33	Mudstone, silty; platy	3	433
32	Mudstone and siltstone, interbedded; striped appearance	4	430
31	Sandstone, fine-grained, thick-bedded; siliceous; ripple-marks	4	426
30	Mudstone, rubbly; some concretions	8	422
29	Sandstone, fine-grained, siliceous; brown weathering	4	414
28	Mudstone and siltstone (40%); platy, striped appearance	14	410
27	Sandstone, fine-grained; siliceous; thick-bedded; brown weathering	5	396
26	Mudstone, silty, blocky; interbedded sandstone and siltstone (30%); some small channel sandstones	30	391
25	Sandstone, fine-grained, grey, siliceous; brown weathering	2	361
24	Shale, rubbly, black; some thin siltstones and sandstones; becoming much sandier at top	15	359
23	Siltstone, and sandstone (40%) interbedded, argillaceous, grey; platy; some concretions	9	344
22	Mudstone, silty; blocky; much siltier at top; some orange weathering concretions; tracks and trails	12	335
21	Siltstone, argillaceous, sandy; sandstone, fine-grained, laminated; thin-bedded; brown weathering; some mudstone	9	323
20	Mudstone, rubbly to platy; becoming much siltier at top, dark grey; some channel sandstone; large concretions and siltstone at top	23	314
19	Siltstone, argillaceous, dark grey, laminated; irregularly bedded; interbedded silty mudstone; concretions	10	291
18	Mudstone, dark grey, rubbly to blocky	7	281
17	Mudstone, silty, dark grey; platy to blocky; grading upward into argillaceous laminated siltstone, poorly bedded; 2′ laminated sandstone near top; concretions	10	274
16	Mudstone, silty; grading upward into siltstone, argillaceous, poorly bedded; some sandstone and concretions	9	264

Unit	Lithology	Thickness (feet)	Height above base (feet)
15	Sandstone, fine-grained, argillaceous; medium-bedded; brownish grey weathering	2	255
14	Covered	15	253
13	Sandstone, fine-grained, siliceous; thick-bedded ripple-marks	8	238
12	Shale, black, silty; blocky	4	230
11	Sandstone, fine-grained, siliceous; brown; thick-bedded; concretionary; few shaly intervals	15	226
10	Covered	55	211
9	Sandstone, fine-grained, laminated; platy to flaggy	9	156
8	Covered	40	147
7	Sandstone, fine-grained, argillaceous, grey; medium-bedded to flaggy; grey to rusty weathering; some shaly intervals	19	107
6	Covered	19	88
5	Sandstone, fine-grained; platy to flaggy	5	69
4	Covered	10	64
3	Sandstone, very fine grained, dark grey; slightly laminated; platy to flaggy; grey weathering	9	54
2	Covered	28	45
1	Sandstone, fine-grained, argillaceous, black; platy; grey weathering	17	17
	FERNIE FORMATION		
1	Mostly covered. Few beds of black shale (Nordegg) are present in gully	350	350
	Contact not exposed		
	TRIASSIC		
	PARDONET FORMATION		
	Limestone, fossiliferous to dense; brown weathering		

SECTION 64–8. Gething Formation, north of Mount Stearns, Trutch map-area, British Columbia, 57°06′N, 123°29′W.

	GETHING FORMATION		
	Top of ridge, end of exposure		
8	Sandstone, fine-grained, well-sorted, quartzose, siliceous, brown; thick-bedded; grey weathering; quartz, 88%; chert, 8%; matrix, 4%; poor porosity	30	431
7	Covered	33	401
6	Sandstone, medium- to coarse-grained, homogeneous, grey; massive to thick-bedded; grey weathering	30	368
5	Covered	90	338
4	Sandstone, fine-grained, laminated to homogeneous, grey; massive to thick-bedded; light brown to brownish grey weathering; some conglomerate	35	248
3	Covered	175	213

Unit	Lithology	Thickness (feet)	Height above base (feet)
2	Conglomerate, massive; grey weathering; pebbles, $\frac{1}{8}''-\frac{1}{2}''$; some matrix of sandstone	1	38
1	Sandstone, fine-grained, laminated to homogeneous, grey; massive to thick-bedded; light brown weathering; some fine conglomerate; quartz, 82%; chert, 12%; matrix, 6%; poor porosity	37	37
	MINNES GROUP		
	BEATTIE PEAKS FORMATION		
1	Covered, recessive	237	237
	MONTEITH FORMATION		
	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded to massive	22	

SECTION 64–10. Gething Formation, east flank of syncline, north of Nevis Creek, Trutch map-area, British Columbia, 57°23′N, 123°23′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
	End of exposure		
99	Mudstone, silty, black	6	1,100
98	Sandstone, silty; platy; brownish grey weathering	1	1,094
97	Mudstone, black; rubbly; some siltstone; few concretions	33	1,093
96	Mudstone, dark grey; rubbly; siltstone, 30%; $\frac{1}{2}''-1''$ beds; some concretions; sandier at top	21	1,060
95	Mudstone, black; rubbly to platy; platy concretionary siltstone and sandstone, 30%	5	1,039
94	Mudstone, black; rubbly to platy; some beds of silty sandstone	24	1,034
93	Siltstone, dark grey; platy; shale, dark grey, platy, 50%; fine-grained, laminated sandstone increasing toward top	16	1,010
92	Covered	26	994
91	Mudstone, silty; blocky to platy	2	968
90	Covered, recessive	25	966
89	Poorly exposed. Sandstone, fine-grained, very silty; flaggy to thin-bedded; some interbedded shale	10	941
88	Covered	8	931
87	Sandstone, fine-grained, grey; thin-bedded; grey weathering	3	923
86	Covered	3	920
85	Sandstone, medium-grained, siliceous, grey; thick-bedded to flaggy; grey to brownish grey weathering; some conglomerate and disseminated pebbles; poor porosity	39	917
84	Sandstone, coarse-grained to conglomeratic, siliceous, grey; medium-bedded; grey weathering; quartz, 58%; chert, 36%; lithic fragments, 7%	9	878
83	Covered, recessive	18	869

Unit	Lithology	Thickness (feet)	Height above base (feet)
82	Sandstone, fine-grained, slightly argillaceous, grey, siliceous, homogeneous; thick-bedded to flaggy; grey weathering; some platy siltstone; quartz, 85%; chert, 9%; matrix, 6%; poor porosity	13	851
81	Covered, recessive	20	838
80	Sandstone, very argillaceous, silty, black; wavy bedding; siltstone, 40%, argillaceous, black, platy	13	818
79	Sandstone, fine- to medium-grained, homogeneous, cherty, siliceous, grey; thick-bedded; grey to brownish grey weathering; quartz, 63%; chert, 21%; matrix, 10%; carbonaceous fragments, 5%; poor porosity	23	805
78	Siltstone, sandy; wavy bedding; irregular bedding	3	782
77	Covered; some mudstone at top	1.5	779
76	Sandstone, argillaceous, dark grey; thick-bedded; brownish grey weathering	3	777.5
75	Covered, recessive	5	774.5
74	Sandstone, fine-grained, siliceous; platy to flaggy, with some thick beds in middle	7	769.5
73	Mudstone	0.5	762.5
72	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded, flaggy at top; brownish grey weathering; quartz, 91%; chert, 3%; matrix, 6%; poor porosity	8	762
71	Mudstone, silty, platy	1	754
70	Sandstone, very argillaceous to silty, dark grey; platy, wavy bedding; brown weathering	4	753
69	Sandstone, fine-grained, grey, siliceous	3	749
68	Covered	18	746
67	Sandstone, argillaceous, silty; platy to flaggy; some interbedded platy sandstone	6	728
66	Sandstone, fine-grained, grey, siliceous	5.5	722
65	Covered, recessive	8.5	716.5
64	Sandstone, fine- to medium-grained, fairly well sorted, homogeneous, grey, siliceous; thin- to thick-bedded; grey weathering; few thin siltstones; quartz, 73%; chert, 22%; matrix, 5%; poor porosity	16	708
63	Covered, recessive	4	692
62	Sandstone, fine-grained, laminated, siliceous, grey; medium-bedded; grey weathering, some platy siltstone in upper half	7	688
61	Partly covered, recessive. Platy siltstone at top	6	681
60	Sandstone, fine-grained, argillaceous, flaggy; grey weathering	4	675
59	Sandstone, medium- to coarse-grained, dark grey, siliceous; thick-bedded; grey weathering; some conglomeratic beds; quartz, 59%; chert, 40%; pyrobitumen	18	671
58	Conglomerate; thick-bedded; brown weathering; pebbles $\frac{1}{8}''$–$\frac{1}{2}''$; matrix of coarse-grained sandstone	2	653
57	Sandstone, fine- to medium-grained, laminated, siliceous, grey; thin- to thick-bedded; some crossbedding; brown weathering; quartz, 67%; chert, 28%; matrix, 5%; pyrobitumen	19	651
56	Sandstone, fine-grained, quartzose, homogeneous, siliceous, light grey; thick-bedded; grey to brown weathering; quartz, 86%; chert, 11%; matrix, 3%; poor porosity	30	632

Unit	Lithology	Thickness (feet)	Height above base (feet)
55	Sandstone, medium- to coarse-grained; in part conglomeratic; cherty, brown to grey; siliceous; thick-bedded; grey to brown weathering; finer grained at top; quartz, 56%; chert, 44%; poor porosity	5	602
54	Sandstone, fine-grained, siliceous, brownish grey; thick-bedded; brown to grey weathering	10	597
53	Sandstone, fine-grained, argillaceous; flaggy; interbedded mudstone and siltstone, 30%; platy	5	587
52	Mudstone, silty, black, carbonaceous; interbedded platy, lenticular siltstone and sandstone, 40%	9	582
51	Sandstone, fine-grained, grey	1	573
50	Covered, recessive	13	572
49	Sandstone, fine-grained, argillaceous to silty, carbonaceous, black; flaggy to thick-bedded; some wavy bedding; some black, shaly siltstone	15	559
48	Covered, recessive	17	544
47	Sandstone, fine- to medium-grained, bimodal, siliceous, homogeneous, quartzose, light grey; thick-bedded; quartz, 93%; chert, 7%; poor porosity; pyrobitumen	15	527
46	Covered, recessive	4	512
45	Sandstone, fine-grained, homogeneous, siliceous, quartzose, light grey; thick-bedded; light brown weathering; well-sorted; quartz, 93%; chert, 5%; matrix, 2%; poor porosity; pyrobitumen	37	508
44	Mudstone, silty	0.5	471
43	Sandstone, fine-grained, homogeneous, siliceous, grey; medium-bedded; brownish grey weathering	9	470.5
42	Mudstone, silty, dark grey; platy; rusty weathering	1.5	461.5
41	Sandstone, fine-grained, argillaceous, thin-bedded; grey weathering	5	460
40	Covered, recessive. Mudstone exposed at top of slope	7	455
39	Sandstone, fine-grained, laminated, thin-bedded; rusty brown to grey weathering	4	448
38	Covered, recessive	4	444
37	Sandstone, argillaceous, silty, dark grey; flaggy; wavy bedding; rusty to grey weathering; some better sorted layers	8	440
36	Sandstone, fine-grained, laminated to homogeneous, grey, siliceous; medium-to thick- bedded; grey weathering	25	432
35	Sandstone, silty, argillaceous, black; flaggy; wavy bedding	2	407
34	Mudstone, black; rubbly to flaky; rusty weathering	4	405
33	Sandstone, fine-grained, grey	1.5	401
32	Covered, recessive	3.5	399.5
31	Sandstone, fine-grained, quartzose, well-sorted, laminated to homogeneous, siliceous, grey; thick-bedded; grey weathering; quartz, 94%; chert, 6%; poor porosity	20	396
30	Sandstone, fine-grained, black, carbonaceous; wavy bedding; thick-bedded; greenish rusty weathering	5	376
29	Mudstone, black, carbonaceous; siltstone, argillaceous, increasing toward top	2	371
28	Siltstone, argillaceous, black; platy	2	369
27	Mudstone, black, silty; platy; platy channel siltstone	4	367
26	Sandstone, fine-grained, grey, siliceous; thick-bedded	5	363
25	Covered. Appears to be sandstone	3	358

Unit	Lithology	Thickness (feet)	Height above base (feet)
24	Sandstone, fine-grained, quartzose, well-sorted, grey, siliceous, laminated to homogeneous; thin- to thick-bedded; quartz, 82%; chert, 14%; matrix, 4%; poor porosity......	36	355
23	Siltstone, argillaceous to sandy, coaly; irregularly bedded......	1	319
22	Mudstone to argillaceous siltstone..	0.5	318
21	Sandstone, fine-grained, very argillaceous; brownish grey weathering..	1	317.5
20	Mudstone to argillaceous siltstone, blocky................................	1	316.5
19	Sandstone, fine-grained, quartzose, clean, well-sorted, grey, siliceous, laminated to homogeneous; thick-bedded; grey weathering; considerable crossbedding and channel-fill; quartz, 93%; chert, 7%; poor porosity........................	45	315.5
18	Mudstone, black, silty..	0.5	270.5
17	Sandstone, fine-grained, homogeneous to laminated, grey, siliceous; thin-bedded; grey weathering; quartz, 75%; chert, 17%; poor porosity...	9	270
16	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded; grey weathering..	9	261
15	Mudstone, silty...	1	252
14	Sandstone, very fine grained, black, siliceous; thin-bedded; bluish grey weathering...	5	251
13	Sandstone, fine- to medium-grained, bimodal, siliceous, homogeneous to laminated; thin- to thick-bedded; bluish grey weathering; quartz, 83%; chert, 16%; poor porosity..	10	246
12	Sandstone, very fine grained, silty at base, becoming fine-grained at top, grey; flaggy to thin-bedded; grey weathering...	13	236
11	Sandstone, fine-grained, fairly well sorted, grey, homogeneous, siliceous; thin- to thick-bedded; grey weathering, quartz, 77%; chert, 15%; matrix, 8%; poor porosity........	6	223
10	Siltstone, very argillaceous; blocky; rusty weathering.............	3	217
9	Mudstone, silty, dark grey; rubbly; rusty weathering................	2	214
8	Sandstone, fine-grained, silty to argillaceous at base, better sorted at top; thin- to thick-bedded; rusty weathering......	23	212
7	Sandstone, fine- to medium-grained, well sorted, siliceous, cherty, dark, grey; thick-bedded; grey to brownish grey weathering; quartz, 66%; chert, 30%; matrix and carbonaceous fragments, 4%; poor porosity.....................	34	189
6	Sandstone, coarse-grained, cherty, dark grey, siliceous, becoming fine-grained at top; thick-bedded; grey weathering; quartz, 45%; chert, 49%; lithic fragments, 5%; matrix, 1%; poor porosity...	5	155
5	Sandstone, fine- to medium-grained, laminated, slightly calcareous and argillaceous, siliceous, grey; thick-bedded; grey to brownish grey weathering; dolomite, 9%; quartz, 65%; chert, 12%; matrix and carbonaceous fragments, 14%; poor porosity..	15	150
4	Sandstone, fine-grained, cherty, siliceous, argillaceous, laminated, dark grey; thick-bedded; brownish grey to rusty weathering; quartz, 56%; chert, 24%; matrix and carbonaceous fragments, 20%; poor porosity...........................	27	135
3	Partly covered. Mudstone, silty, grading upward into silty sandstone..	8	108

Unit	Lithology	Thickness (feet)	Height above base (feet)
2	Sandstone, fine-grained, homogeneous, quartzose, siliceous, well-sorted, brownish grey to dark grey; slightly calcareous and limonitic; thick-bedded to massive; grey to rusty brown weathering; quartz, 83%; chert, 4%; dolomite, 7%; matrix, 6%; poor porosity	84	100
1	Sandstone, fine-grained, slightly carbonaceous; thick-bedded; rusty to greenish brown weathering	16	16
	JURASSIC?		
	NORDEGG MEMBER		
1	Covered. Some talus similar to black calcareous sediments of Nordegg Member	60	
	TRIASSIC		
	PARDONET FORMATION		
	Limestone, dense to coquinoid, brown weathering; siltstone, calcareous		
	GSC loc. 66027 *Monotis pinensis* Westermann (in siltstone) In coquinoid limestone *Halobia* sp. *Proclydonautilus natosini* McLearn *Distichites*, 2 spp. *Phormedites* cf. *juvavicus* Mojsisovics Age: Middle Norian, *Columbianus* zone		

SECTION 64–14. Fernie and Monteith Formations, east flank of syncline, north of Besa River, Trutch map-area, British Columbia, 57°30′N, 123°35′W.

	GETHING FORMATION		
	Top of ridge		
3	Sandstone, medium-grained, grey, siliceous; thick-bedded; grey weathering; quartz, few chert, 18%; poor porosity	30	215
2	Mostly covered; appears to be mainly sandstone	65	185
1	Sandstone, fine-grained, grey; thick-bedded; grey weathering; few thin recessive intervals	120	120
	Contact is not exposed but definite angularity is visible between Gething and Monteith sandstones		
	MONTEITH FORMATION		
57	Covered	11	501

Unit	Lithology	Thickness (feet)	Height above base (feet)
56	Sandstone, fine-grained, grey; light rusty weathering, flaggy to thin-bedded	6	490
55	Mostly covered. Mudstone, blocky; rusty weathering	26	484
54	Sandstone, fine-grained; few layers of medium-grained sandstone, grey	3	458
53	Sandstone, fine-grained, laminated, siliceous, brownish grey; brown weathering	4	455

For remainder of section, *see* GSC Paper 67–19B

SECTION 64–15. Gething Formation, north of Besa River, east flank of syncline, Trutch map-area, British Columbia, 57°28′N, 123°31′W.

GETHING FORMATION

End of exposure

Unit	Lithology	Thickness (feet)	Height above base (feet)
95	Mudstone, siltstone, and sandstone interbedded, beds 1″–3″; grading upward into sandstone, fine-grained, grey, laminated; thin-bedded; brown weathering	23	1,330

GSC loc. C-6959

Gavelinella cf. *G. awunensis* Tappan, 1960, rare
Conorbina sp. 3, common
?*Glomospirella* var. sp. 4, rare
Haplophragmoides sp. G117, abundant
Gaudryina ex gr. *G. topagorukensis* Tappan, common

Age: Early Albian; environment: open marine

Unit	Lithology	Thickness (feet)	Height above base (feet)
94	Mudstone, dark grey, rubbly to platy; some sandstone and concretionary layer	17	1,307
93	Mudstone, and siltstone, platy, 30%; beds 2″–6″	21	1,290
92	Mudstone, dark grey, rubbly to blocky; some channel sandstone	13	1,269
91	Mudstone and sandstone, interbedded; 2″–3″ beds	5	1,256
90	Mudstone and platy siltstone	10	1,251
89	Mudstone, dark grey, silty; interbedded sandstone, 30%	11	1,241
88	Mudstone, rubbly to blocky; some siltstone 20%, and concretions	13	1,230
87	Mudstone, rubbly to blocky; sandstone, fine-grained; platy; rusty weathering; sandstone increased toward top	22	1,217
86	Covered	30	1,195
85	Mudstone; thin platy sandstone increases toward top	16	1,165
84	Mudstone, rubbly to blocky; interbedded platy siltstone; few thin sandstones	23	1,149

GSC loc. C-6958

?*Ammobaculites* sp., rare
?arenaceous serial (*Gaud.-Vern.*)
?*Inoceramus* sp.

Age: Cretaceous undifferentiated (stratigraphic position Early Albian); environment: restricted marine

Unit	Lithology	Thickness (feet)	Height above base (feet)
83	Sandstone, fine-grained, laminated; brown weathering	2	1,126
82	Mudstone, dark grey; rubbly to blocky; interbedded platy siltstone	7	1,124
	GSC loc. C-6957		
	?*Haplophragmoides* var. sp. G116, rare		
	Age: Cretaceous, ?Early Albian; environment: ?marine undifferentiated		
81	Mudstone, rubbly; interbedded fine-grained, platy sandstone, increasing to 60% at top	13	1,117
80	Mudstone, dark grey, rubbly to blocky	17	1,104
79	Mudstone, blocky; thin platy sandstone, 20%	13	1,087
78	Mudstone, dark grey, blocky; some thin platy siltstone	15	1,074
77	Sandstone, platy; rusty brown weathering	3	1,059
76	Covered	15	1,056
75	Mudstone, rubbly to platy; seven beds of platy sandstone, 6″–1′ thick	18	1,041
74	Mudstone, rubbly; some platy siltstone, rusty brown weathering	11	1,023
73	Siltstone and interbedded mudstone; poorly exposed	7	1,012
72	Covered	13	1,005
71	Sandstone, very fine grained, silty; platy; rusty brown weathering; interbedded mudstone	4	992
70	Covered	13	988
69	Mudstone, black; platy; siltstone at top	6	975
	GSC loc. C-6956		
	Haplophragmoides sp. G115, few		
	H. ex gr. *H. canui* Cushman, few		
	H. sp. G116, few		
	Age: Early Cretaceous (Albian/Aptian boundary); environment: marine, predominantly restricted		
68	Sandstone, very fine grained, argillaceous; flaggy; wavy bedded; grey weathering; conglomeratic in upper 1′	9	969
67	Sandstone, fine-grained, argillaceous, siliceous, flaggy to thin-bedded; brown weathering; quartz, 71%; chert, 12%; matrix, 17%	23	960
66	Siltstone, argillaceous; platy; some mudstone; grades into overlying beds	10	937
65	Mudstone, silty; grading upward into argillaceous sandstone; flaggy; rusty weathering	8	927
64	Sandstone, fine-grained, laminated; thin-bedded; some interbedded mudstone at base	6	919
63	Mudstone, dark grey; rubbly; rusty weathering; siltier and blocky at top	8	913
	GSC loc. C-6955		
	ostracod sp. indet, rare		
	?gastropod fragment, rare		
	Age: Early Cretaceous, Aptian; environment: ?freshwater		

Unit	Lithology	Thickness (feet)	Height above base (feet)
62	Mudstone, silty; platy; rusty weathering; some sandstone at top	12	905
61	Sandstone, fine-grained, laminated	2	893
60	Mudstone, silty, platy	4	891
59	Sandstone, argillaceous, dark grey; poorly bedded	7	887
58	Mudstone, dark grey; rubbly; rusty weathering	10	880
	GSC loc. C-6954 ?*Ammobaculites* sp., rare Age: indeterminate; environment: ?marine undifferentiated		
57	Siltstone, argillaceous, to mudstone, blocky, dark grey; platy; rusty weathering	13	870
56	Sandstone, argillaceous, dark grey; poorly bedded; grey weathering	8	857
55	Sandstone, fine-grained, grey, laminated; crossbedded; channel sandstone	4	849
54	Sandstone, fine-grained, grey, siliceous; flaggy to thick-bedded; brownish grey weathering; large scale channelling at base	15	845
53	Sandstone, fine- to medium-grained, siliceous dark grey; thick-bedded; brownish grey weathering	25	830
	SHEAR		
52	Mudstone, black, silty	3	805
51	Sandstone, fine-grained, siliceous; brownish grey weathering; thick-bedded	5	802
50	Mudstone, dark grey, silty; platy; rusty weathering	6	797
49	Sandstone, argillaceous, dark grey; flaggy	8	791
48	Mudstone, dark grey, hard, rubbly	11	783
47	Sandstone, fine-grained, light grey, fairly well sorted, quartzose, siliceous, homogeneous to laminated; thick-bedded to massive; brownish grey weathering; not entirely accessible; quartz, 90%; chert, 8%	198	772
46	Covered	4	574
45	Sandstone, fine-grained, laminated, grey; platy; crossbedded; grey weathering; some mudstone	9	570
44	Partly covered. Mudstone, silty; platy; interbedded siltstone, platy, 30%, siltier at top	27	561
	GSC loc. C-6953 *Haplophragmoides* sp. G115, few megaspore sp. IC var. sp. 8, rare Age: Early Cretaceous (?Aptian/Late Neocomian boundary); environment: marine restricted		
43	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; grey to brown weathering	4	534
42	Covered, recessive	19	530
41	Sandstone, fine-grained, laminated; flaggy; brownish grey weathering	13	511

Unit	Lithology	Thickness (feet)	Height above base (feet)
40	Siltstone, argillaceous, dark grey; platy; dark grey weathering; interbedded platy mudstone, 30%, dark grey, rusty weathering	19	498
39	Partly covered. Mudstone, rubbly to platy; some platy siltstone	18	479
38	Sandstone, fine-grained, grey, siliceous; flaggy; grey weathering	5	461
37	Mudstone, black, rubbly to platy; rusty weathering; interbedded platy siltstone, 30%; siltier at top	28	456
36	Sandstone, fine-grained, argillaceous, siliceous, brownish grey; flaggy; dark brownish grey weathering	16	428
35	Partly covered. Mudstone; interbedded platy siltstone; rusty weathering	5	412
34	Sandstone, fine-grained, laminated to homogeneous, siliceous; thick-bedded to massive; brownish grey weathering	49	407
	SHEAR		
33	Sandstone, fine-grained, poorly sorted, quartzose, pyritic, laminated to homogeneous, siliceous, grey, thick-bedded; rusty brown weathering; quartz, 86%; chert, 6%; matrix, 8%	21	358
32	Siltstone, argillaceous; platy; some mudstone; channel sandstone; across gully, much of this interval is platy mudstone	12	337
31	Mudstone, silty; platy; rusty weathering	2	325
	GSC loc. C-6951 *Haplophragmoides* sp. G115, rare *H.* sp. G115, rare, inflated Age: Early Cretaceous (stratigraphic position Late Neocomian); environment: marine, restricted		
30	Sandstone, fine-grained, homogeneous, siliceous, dark grey; thin- to thick-bedded; rusty brown to greenish weathering; some crossbedding and channelling; medium-grained in upper 5′	23	323
29	Sandstone, fine-grained, grey, siliceous; small channelling at base	29	300
28	Sandstone, fine-grained, fairly well sorted, grey, laminated, siliceous; thick-bedded; rusty to brown weathering; poor porosity; quartz, 86%; chert, 11%; matrix, 2%	46	271
27	Sandstone, argillaceous, fine-grained; flaggy; rusty weathering	3	225
26	Covered, recessive	6	222
25	Sandstone, argillaceous at base, better sorted at top, fine-grained, grey, siliceous; flaggy to thin-bedded; rusty brown weathering	9	216
24	Sandstone, fine-grained, fairly well sorted, laminated to homogeneous, siliceous, grey; thick-bedded; weathers flaggy; rusty to greenish weathering; poor porosity; quartz, 93%; chert, 3%; matrix, 4%	31	207
23	Sandstone, fine-grained, argillaceous; thin-bedded; some mudstone	4	176

Unit	Lithology	Thickness (feet)	Height above base (feet)
22	Partly covered. Mudstone, platy; rusty weathering	5	172
21	Sandstone, fine-grained, argillaceous, pyritic, limonitic, slightly calcareous, laminated, siliceous, grey; thick-bedded; rusty brown weathering; becoming flaggy in upper 4′ with thin layers of mudstone; poor porosity; quartz, 86%; chert, 4%; dolomite, 5%; matrix, 5%	15	167
20	Mudstone, dark grey, silty; blocky; rusty weathering; yellow efflorescence; some thin, platy siltstone	5	152
19	Partly covered. Sandstone, argillaceous; flaggy; rusty brown weathering; some mudstone	7	147
18	Covered, recessive	13	140
17	Sandstone, fine-grained, argillaceous, siliceous, slightly calcareous, grey; thin- to thick-bedded; brown to rusty weathering; quartz, 75%; chert, 6%; dolomite, 11%; matrix, 8%; poor porosity	9	127
16	Mudstone, dark grey; rubbly to flaky; rusty weathering; thin siltstone and sandstone near top	7	118
15	Sandstone, fine-grained, laminated, grey, siliceous; flaggy; rusty to greenish weathering	2	111
14	Mudstone, dark grey; rubbly to platy; rusty weathering; some thin platy siltstone	12	109
13	Sandstone, fine-grained, siliceous, calcareous, pyritic, limonitic; flaggy; lenticular; some mudstone, brownish grey to rusty weathering; quartz, 74%; chert, 5%; dolomite, 12%; matrix, 10%; poor porosity	8	97
12	Mudstone, silty; interbedded siltstone, 40%; dark grey; platy; rusty weathering	5	89
11	Sandstone, silty, fine-grained; flaggy	2	84
10	Mudstone and interbedded siltstone; platy; rusty weathering	2	82
9	Sandstone, fine-grained, laminated, grey, siliceous; platy to flaggy; brown to rusty weathering	4	80
8	Mudstone, silty; platy; rusty weathering	5	76
7	Sandstone, fine-grained, laminated, grey, siliceous; rusty weathering	3	71
6	Mudstone, silty; flaky to platy; dark grey; rusty weathering	6	68
5	Sandstone, fine-grained, laminated, lenticular; thick-bedded; brown weathering; channel sandstone	4	62
4	Mudstone, silty, dark grey to black; flaky to rubbly; rusty weathering	13	58
3	Mudstone, silty, dark grey; platy; some sandstone, argillaceous, platy; rusty weathering	12	45
2	Sandstone, slightly argillaceous, flaggy to thin-bedded; some siltstone at base; rusty weathering	10	33
1	Sandstone, fine-grained, laminated; thick-bedded to massive; weathers platy to flaggy; rusty to greenish weathering	23	23
	Contact abrupt		

FERNIE FORMATION

12	Shale, black, calcareous	15	180
11	Shale, black, calcareous; grading upward into siltstone, platy, black, calcareous; yellow efflorescence	7	165
10	Mudstone, phosphatic, black	1	158

Unit	Lithology	Thickness (feet)	Height above base (feet)
9	Shale, black, calcareous; flaky to platy	5	157
8	Mudstone, phosphatic, black	2	152
7	Shale, black, calcareous; flaky; grading upward into siltstone, platy, black, calcareous	21	150
6	Siltstone, argillaceous, black, calcareous; platy; phosphatic layers	5	129
5	Shale, black, calcareous; flaky to platy; few thin layers of rusty weathering shale; phosphatic at base	13	124
4	Sandstone, argillaceous, platy to flaggy; some shale; light brown weathering	8	111
3	Shale, black, calcareous; flaky to platy	18	103
2	Mostly talus covered. Shale, black, calcareous, flaky to platy; some platy siltstone	55	85
1	Mostly talus covered. Shale, as above; harder siltstone at top	30	30

TRIASSIC

PARDONET FORMATION

Limestone, argillaceous to dense; brown weathering

SECTION 64–16. Gething Formation, west flank of anticline, Besa River, Trutch map-area, British Columbia, 57°27′N, 123°19′W.

GETHING FORMATION

End of exposure in creek

117	Sandstone and mudstone; grades upslope into large channel sandstone	11	1,075
116	Mudstone, dark grey to black; rubbly to flaky; rusty weathering; seven beds of sandstone, platy; concretionary; rusty brown weathering	23	1,064
115	Sandstone, fine-grained, silty; rusty brown weathering; platy; concretionary	4	1,041
114	Mostly covered. Mudstone, rubbly; rusty weathering; grading upward into silty, blocky mudstone	35	1,037
113	Siltstone and interbedded mudstone; topped by well indurated sandy siltstone, greenish grey weathering	9	1,002
112	Siltstone, sandy; poorly bedded; green weathering	1	993
111	Mudstone, black, flaky; interbedded platy sandstone, 10%	15	992
110	Partly covered. Sandstone, fine-grained, lenticular; flaggy; interbedded mudstone, 40%	32	977
109	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded	8	945
108	Siltstone, argillaceous, platy; sandstone, flaggy	5	937
107	Mudstone, silty, platy	2	932
106	Sandstone, fine-grained, laminated, flaggy to thin-bedded; interbedded silty mudstone, 20%; interbedded siltstone and mudstone at base	7	930
105	Siltstone, platy	2	923

Unit	Lithology	Thickness (feet)	Height above base (feet)
104	Sandstone, very argillaceous and flaggy at base; becoming better sorted and thin-bedded at top	26	921
103	Mudstone, black; rubbly	3	895
102	Covered	11	892
101	Sandstone, with interbedded mudstone at base; grading upward into thin-bedded to flaggy sandstone; fine-grained, grey, siliceous	25	881
100	Sandstone, fine-grained, laminated to homogeneous, siliceous; flaggy to thin-bedded; some crossbedding	9	856
99	Mudstone, black; blocky	3	847
98	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded	17	844
97	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded at top	10	827
96	Covered	12	817
95	Sandstone, very silty to argillaceous at base; becoming better sorted, flaggy to thin-bedded at top	9	805
94	Mudstone, rubbly to platy	5	796
93	Sandstone, fine-grained, grey, siliceous; flaggy; few silty intervals	19	791
92	Mudstone, black; rubbly to blocky; rusty weathering	6	772
91	Covered, recessive	9	766
90	Sandstone, fine-grained, flaggy; some thin layers of mudstone	6	757
89	Sandstone, fine-grained, laminated, siliceous; thinly and uniformly laminated	5	751
88	Sandstone, fine-grained, laminated, siliceous; grey; poorly to wavy bedded; flaggy	11	746
87	Mudstone, rubbly	1	735
86	Sandstone, fine-grained, laminated, poorly bedded, flaggy to thin-bedded; grey weathering	15	734
85	Sandstone, fine-grained; flaggy	5	719
84	Siltstone, argillaceous, dark grey; platy; rusty weathering	3	714
83	Siltstone, very sandy; grading upward into fine-grained sandstone, laminated, siliceous, flaggy, grey weathering	13	711
82	Sandstone, fine-grained, grey, siliceous; flaggy; grey	6	698
81	Mudstone, platy; grading into argillaceous siltstone, platy, rusty weathering	5	692
80	Covered	12	687
79	Sandstone, fine-grained, laminated; flaggy; brownish grey weathering	14	675
78	Sandstone, fine-grained, laminated; flaggy; interbedded mudstone, 30%; beds $\frac{1}{2}''$–1″	15	661
77	Siltstone, platy; wavy bedding; grey weathering; some sandstone	4	646
76	Mudstone, very silty; siltstone, platy	5	642
75	Sandstone, fine-grained, laminated to homogeneous, siliceous, grey; thin-bedded, to thick-bedded at top; brownish grey weathering	10	637
74	Siltstone, sandy; platy	2	627
73	Sandstone, silty; platy to flaggy	11	625
72	Mudstone, platy; grading upward into argillaceous siltstone	4	614
71	Sandstone, silty; platy to flaggy	5	610
70	Siltstone, platy	1	605
69	Sandstone, fine-grained, laminated, silty; platy	15	604
68	Mudstone, very silty; platy	3	589

Unit	Lithology	Thickness (feet)	Height above base (feet)
67	Sandstone, fine-grained, laminated to homogeneous; flaggy to thin-bedded; brownish grey weathering	11	586
66	Mudstone, very silty; platy; grading upward into argillaceous platy to flaggy siltstone	13	575
65	Sandstone, fine-grained, silty and flaggy at base; better sorted and thin-bedded at top; brownish grey weathering	8	562
64	Mudstone, dark grey, rubbly; becoming siltier and blocky at top with some siltstone	17	554
63	Sandstone, fine-grained; thick-bedded; brownish grey weathering	2	537
62	Siltstone and interbedded sandstone; platy to flaggy	5	535
61	Mudstone, dark grey, rubbly	5	530
60	Siltstone, sandy; platy; rusty weathering	4	525
59	Sandstone, argillaceous; platy to flaggy	5	521
58	Sandstone, very argillaceous and silty at base; becoming better sorted at top; flaggy to thin-bedded; brownish grey weathering	10	516
57	Sandstone, fine-grained, laminated, grey; flaggy to thin-bedded	4	506
56	Mudstone, silty; grading into sandy siltstone	4	502
55	Sandstone, fine-grained, laminated, grey; flaggy to thin-bedded	8	498
54	Mudstone, silty; platy	1	490
53	Siltstone, argillaceous, platy; sandier at top	5	489
52	Mudstone, rubbly to blocky	9	484
51	Sandstone, fine-grained, argillaceous, laminated; flaggy; brownish grey weathering	2	475
50	Mudstone, dark grey to black; rubbly	1	473
49	Siltstone, platy; rusty weathering	4	472
48	Mudstone, black; rubbly; rusty weathering; yellow efflorescence; siltier at top	10	468
47	Mudstone, rubbly; some platy siltstone at top	4	458
46	Mudstone, siltstone, and sandstone, thinly interbedded; platy; rusty weathering; sandier at top	5	454
45	Sandstone, fine-grained, siliceous, laminated; poorly sorted; flaggy to thin-bedded; grey weathering; poor porosity; quartz, 83%; chert, 5%; matrix, 10%	6	449
44	Mudstone, silty; platy; grading upward into platy siltstone and sandstone	9	443
43	Siltstone, sandy; grading upward into platy sandstone, fine-grained, grey weathering	4	434
42	Covered, recessive	3	430
41	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded; grey weathering	13	427
40	Sandstone, fine-grained	3	414
39	Mudstone, very silty, platy	3	411
38	Sandstone, fine-grained; flaggy to platy; wavy bedding; grey weathering	11	408
37	Mudstone, very silty, to siltstone, argillaceous, platy, dark grey, brownish grey weathering; sandier at top	15	397
36	Siltstone, sandy; flaggy to platy; some interbedded mudstone, grading upward into flaggy sandstone	14	382
35	Sandstone, fine-grained, laminated, siliceous; thin-bedded; grey weathering	4	368

Unit	Lithology	Thickness (feet)	Height above base (feet)
34	Mudstone, black, rubbly	1	364
33	Sandstone, fine-grained, siliceous; flaggy to thin-bedded	5	363
32	Partly covered. Mudstone, silty, black; rusty weathering	7	358
31	Sandstone, silty, fine-grained, laminated; flaggy, to thin-bedded at top; grey weathering; some interbedded mudstone	8	351
30	Mudstone, very silty; platy; grading upward into siltstone	5	343
29	Sandstone, fine-grained, laminated, siliceous; thin-bedded; grey weathering	34	338
28	Mudstone, very silty, to siltstone, platy	5	304
27	Sandstone, silty; platy to flaggy; some mudstone	3	299
26	Sandstone, silty; platy to thin-bedded; grey weathering; cleaner at top; some mudstone at base	22	296
25	Mudstone, silty, blocky; rusty weathering	4	274
24	Sandstone, fine-grained, laminated, siliceous; flaggy to thin-bedded; grey weathering; some interbedded siltstone	5	270
23	Mudstone, black, flaky to platy; rusty weathering; some thin beds of argillaceous platy siltstone	17	265
22	Mudstone, very silty, black; rusty weathering, grading upward into siltstone, sandy, platy; silty sandstone at top	15	248
21	Siltstone, argillaceous at base; grading upward into platy sandstone; rusty weathering	7	233
20	Sandstone, fine-grained, grey, siliceous, rusty brown to grey weathering; thin-bedded	8	226
19	Siltstone, sandy, dark grey; platy to flaggy; grading upward into sandstone, fine-grained, laminated, thin-bedded, rusty weathering	27	218
18	Siltstone, sandy, dark grey, siliceous; platy to flaggy; grading upward into thin-bedded sandstone, rusty weathering	18	191
17	Covered	29	173
16	Sandstone, flaggy; interbedded mudstone	2	144
15	Sandstone, fine-grained, quartzose, clean, well-sorted, grey, siliceous; thick-bedded; some crossbedding; grey to rusty brown weathering; pyrobitumen	42	142
14	Covered, recessive	6	100
13	Sandstone, fine-grained, grey; platy to flaggy; some ½″–1″ beds of mudstone near base	10	94
12	Sandstone, fine-grained, grey, laminated, siliceous; thin-bedded; brownish grey weathering	3	84
11	Mudstone, silty; platy	3	81
10	Sandstone, silty, platy; some interbedded mudstone	5	78
9	Partly covered. Some platy to flaggy sandstone near base	14	73
8	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; thin beds of mudstone	6	59
7	Mudstone, black, flaky to platy; interbedded sandstone at base	7	53
6	Sandstone, fine-grained, siliceous, laminated; thin-bedded; grey weathering	5	46
5	Mudstone and interbedded siltstone; platy	2	41
4	Sandstone, fine-grained, laminated, grey; flaggy	2	39
3	Mudstone, silty; platy	2	37
2	Sandstone, fine-grained, argillaceous; platy; some mudstone at base	3	35

Unit	Lithology	Thickness (feet)	Height above base (feet)
1	Sandstone, fine-grained, brownish grey; laminated to homogeneous, siliceous; thick-bedded; several beds of coarse-grained sandstone in lower half; some fine conglomerate	32	32
	Contact is abrupt but with no apparent angularity		
	TRIASSIC		
	Limestone, dense to argillaceous; some shale; brown weathering		

SECTION 64–17. Gething Formation, east flank of syncline, Nevis Creek, Trutch map-area, British Columbia, 57°24′N, 123°18′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	BUCKINGHORSE FORMATION		
	End of exposure		
1	Mudstone, dark grey to black; rubbly; rusty weathering; some thick concretionary layers; thin seam of bentonite at middle and top	32	32
	GETHING FORMATION		
156	Mudstone, silty; rubbly to platy; thin beds of siltstone, 20%, and some sandstone	7	1,321
155	Mudstone, dark grey; rubbly to platy; interbedded platy siltstone, 30%; lenticular sandstone	24	1,314
154	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded; rusty brown weathering	3	1,290
153	Mudstone, rubbly; few thin beds of siltstone; becoming siltier at top with 1″–3″ beds of sandstone, fine-grained; laminated	14	1,287
152	Sandstone, and interbedded mudstone, 40%	8	1,273
151	Mudstone, rubbly; channel sandstone, 20%	10	1,265
150	Sandstone, fine-grained, grey, laminated; rusty brown weathering	4	1,255
149	Mudstone, dark grey; rubbly; rusty weathering	6	1,251
148	Sandstone, as above; some mudstone	7	1,245
147	Mudstone, dark grey to black; rubbly; some thin beds of platy siltstone	11	1,238
146	Sandstone, fine-grained, grey, laminated; platy to thick-bedded; rusty brown weathering; interbedded mudstone, 30%; rubbly	12	1,227
145	Siltstone and mudstone, interbedded; striped appearance; concretions	7	1,215
144	Mudstone, black; rubbly; rusty weathering	3	1,208
143	Sandstone and mudstone, thinly interbedded; beds 1″–3″; striped appearance; some concretions	10	1,205
142	Sandstone, fine-grained, laminated, brownish grey; platy to flaggy; rusty brown weathering; mudstone, 50%, rubbly	11	1,195

Unit	Lithology	Thickness (feet)	Height above base (feet)
141	Sandstone, fine-grained, laminated rusty brown weathering; channel sandstone; concretionary at base; some mudstone	3	1,184
140	Mudstone, rubbly; 1″–4″ beds of sandstone, 30%, rusty brown weathering; some concretions	9	1,181
139	Mudstone, rubbly; dark grey; rusty weathering; two concretionary beds and some channel sandstone	20	1,172
138	Concretionary bed, orange to reddish brown weathering; grades into channel sandstone	1	1,152
137	Mudstone, dark grey; rubbly	4	1,151
136	Mudstone, rubbly; grading upward into flaggy sandstone	5	1,147
135	Sandstone, fine-grained, laminated, siliceous; thin-bedded to flaggy; rusty brown weathering; mudstone, 50%, platy; beds 4″–12″	14	1,142
134	Mudstone, rubbly; rusty weathering	4	1,128
133	Mudstone, dark grey; rubbly; few thin beds of siltstone; sandier at top; few concretions	12	1,124
132	Sandstone, very argillaceous, dark grey; mudstone, blocky; some concretions	5	1,112
131	Sandstone, argillaceous; green to rusty weathering	1	1,107
130	Mudstone, silty, dark grey to black; rusty weathering	3	1,106
129	Mudstone, very silty, platy; sandy with some platy siltstone at top; greenish weathering on upper surface; some concretions	10	1,103
128	Sandstone, fine-grained, laminated, siliceous; flaggy	6	1,093
127	Mudstone, black; rubbly	4	1,087
126	Sandstone, fine-grained, laminated, siliceous; flaggy	14	1,083
125	Partly covered. Interbedded sandstone, siltstone, and mudstone	14	1,069
124	Sandstone, fine-grained; platy to flaggy	17	1,055
123	Siltstone, platy; rusty weathering	3	1,038
122	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded	16	1,035
121	Covered. Mudstone	8	1,019
120	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded	11	1,011
119	Mudstone, dark grey; rubbly; some siltstone; platy, rusty weathering; some concretions	5	1,000
118	Sandstone, fine-grained, laminated, grey; flaggy to thin-bedded; grey weathering	5	995
117	Siltstone to sandstone, platy; rusty grey weathering	9	990
116	Sandstone, fine-grained, laminated, grey, siliceous; platy to thin-bedded; some silty argillaceous intervals	10	981
115	Mudstone, dark grey; rubbly to platy	1.5	971
114	Sandstone, fine-grained, grey	1.5	969.5
113	Covered	8	968
112	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded; grey weathering	10	960
111	Mudstone, silty; platy	5	950
110	Sandstone, fine-grained; flaggy	3	945
109	Covered	5	942
108	Sandstone, fine-grained, laminated; interbedded silty mudstone	7	937
107	Sandstone, fine-grained, laminated, grey, siliceous; thin- to thick-bedded	13	930
106	Covered	10	917

Unit	Lithology	Thickness (feet)	Height above base (feet)
105	Sandstone, fine-grained; thin-bedded; grey weathering; argillaceous siltstone at base	14	907
104	Sandstone, fine-grained, laminated, siliceous; flaggy to thin-bedded; crossbedded; grey weathering; more thickly bedded at top	82	893
103	Siltstone, sandy, platy, dark grey; grey weathering	12	811
102	Sandstone, fine-grained, grey, siliceous; flaggy	16	799
101	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; grey weathering	25	783
100	Sandstone, silty; platy; some siltstone; rusty brown weathering	10	758
99	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded; grey weathering	24	748
98	Sandstone, silty to argillaceous; platy to flaggy	6	724
97	Sandstone, fine-grained, laminated, grey; flaggy	4	718
96	Sandstone, argillaceous; platy; some siltstone	4	714
95	Sandstone, fine-grained, laminated, grey siliceous; platy to flaggy; some crossbedding; grey weathering	20	710
94	Mudstone, dark grey; rubbly; rusty weathering	3.5	690
93	Siltstone, sandy; platy; rusty weathering	2.5	686.5
92	Covered	7	684
91	Sandstone, fine-grained, platy to flaggy; rusty weathering	6	677
90	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded; grey weathering	10	671
89	Siltstone to sandstone, argillaceous; platy; some mudstone at top	8	661
88	Siltstone, argillaceous; platy; rusty weathering	7	653
87	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded; grey weathering	16	646
86	Mudstone, dark grey, silty; grades upward into argillaceous platy siltstone	4	630
85	Sandstone, argillaceous and platy at base; grading upward into thin-bedded sandstone, fine-grained, laminated, grey, siliceous	16	626
84	Covered	7	610
83	Sandstone, silty; platy to flaggy, thin-bedded at top; rusty weathering; few shaly intervals	15	603
82	Mudstone, dark grey to black; rubbly; rusty weathering	12	588
81	Siltstone, platy; some interbedded mudstone at base; grading into flaggy sandstone	5	576
80	Mudstone, rubbly to platy; rusty weathering	6	571
79	Siltstone, sandy; platy; rusty weathering; some mudstone at base	7	565
78	Sandstone, poorly bedded	1	558
77	Mudstone, very silty	2	557
76	Sandstone, fine-grained, laminated, grey, siliceous; platy to flaggy; grey weathering	5	555
75	Mudstone, silty; platy	1	550
74	Siltstone, platy; grading upward into sandstone, fine-grained, laminated, siliceous, flaggy; brownish grey weathering	13	549
73	Sandstone, fine-grained, grey, laminated, crossbedded; grey weathering	2	536
72	Mudstone, dark grey; rubbly; becoming blocky at top	12	534
71	Siltstone, argillaceous; platy; grading upward into platy to flaggy sandstone	5	522

Unit	Lithology	Thickness (feet)	Height above base (feet)
70	Covered	7	517
69	Sandstone, fine-grained, silty, grey; platy to flaggy; rusty brown weathering	3	510
68	Mudstone and interbedded siltstone; platy; rusty weathering	4	507
67	Sandstone, fine-grained; flaggy to thin-bedded; some cross-bedding	2	503
66	Covered	14	501
65	Sandstone, fine-grained, laminated, grey; platy to flaggy	3	487
64	Mudstone, silty, dark grey; platy	5	484
63	Siltstone, sandy, laminated, dark grey; platy; rusty weathering	3	479
62	Sandstone, fine-grained, laminated, grey, siliceous; flaggy	3	476
61	Mudstone, very silty, platy; dark grey; rusty weathering	4	473
60	Siltstone, sandy, dark grey; platy	2	469
59	Mudstone, black; rubbly to platy; rusty weathering	1	467
58	Sandstone, silty, grey; rusty to grey weathering	7	466
57	Partly covered. Rubbly mudstone at top	6	459
56	Sandstone, fine-grained, grey, laminated, siliceous; thin-bedded; grey weathering	6	453
55	Sandstone, very silty; platy; grey weathering	3	447
54	Sandstone, fine-grained, laminated, siliceous, grey; thin- to thick-bedded; grey weathering; poorly bedded at base; ripple-marks; some crossbedding	27	444
53	Covered	17	417
52	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded	6	400
51	Mudstone, silty; grading upward into siltstone, argillaceous, platy, grey	5	394
50	Sandstone, fine-grained, laminated, siliceous, grey; platy at base, thin-bedded at top; ripple-marks	8	389
49	Sandstone, argillaceous; flaggy; some interbedded mudstone	5	381
48	Sandstone, silty and platy at base; better sorted and thin-bedded at top	5	376
47	Mudstone, very silty; grading upward into sandy, platy, dark grey siltstone	6	371
46	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; some crossbedding; brownish grey weathering	7	365
45	Mudstone, silty; rubbly, to platy at top	4	358
44	Sandstone, fine-grained, laminated; flaggy	1	354
43	Covered	5	353
42	Partly covered. Mudstone, with flaggy sandstone at top	6	348
41	Sandstone, silty, grey; platy; rusty weathering	3	342
40	Sandstone, fine-grained, laminated, grey; thin- to thick-bedded	10	339
39	Covered	6	329
38	Sandstone, fine-grained, laminated; platy to flaggy; grey weathering	3	323
37	Mudstone, dark grey; rubbly to platy	2	320
36	Mudstone, silty, dark grey; platy; grading upward into argillaceous platy siltstone; sandy at top	8	318
35	Sandstone, fine-grained, laminated, siliceous	2	310
34	Mudstone; grading upward into argillaceous platy siltstone	4	308
33	Sandstone, fine-grained, laminated; flaggy to thin-bedded	4	304
32	Mudstone, silty; platy	4	300
31	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded	3	296

Unit	Lithology	Thickness (feet)	Height above base (feet)
30	Mudstone, silty, black; platy; rusty weathering; grading upward into sandy siltstone	9	923
29	Mudstone, very silty, dark grey; grading upward into platy argillaceous, black siltstone	10	284
28	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded	8	274
27	Mudstone, very silty, black; platy; few concretionary layers	13	266
26	Sandstone, fine-grained, laminated, grey, siliceous	1	253
25	Mudstone, dark grey, rubbly; rusty weathering	5	252
24	Siltstone, argillaceous; platy; some mudstone; few thin beds of sandstone at top	11	247
23	Sandstone, silty; platy at base, thin-bedded at top	3	236
22	Sandstone, fine-grained, laminated, grey; flaggy; grey weathering	4	233
21	Siltstone, sandy to argillaceous; black; platy; grey weathering	5	229
20	Sandstone, fine-grained, laminated, grey, siliceous, thin-bedded; some crossbedding; brownish grey weathering	5	224
19	Siltstone, very argillaceous, to mudstone at base; grading upward into platy, sandy siltstone	9	219
18	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; grey weathering	3	210
17	Mudstone, dark grey, silty	2	207
16	Siltstone, argillaceous, black to dark grey; becoming sandy at top; grey weathering	4.5	205
15	Sandstone, argillaceous, dark grey, siliceous, platy to flaggy; some platy siltstone; thin-bedded sandstone at top	6.5	200.5
14	Sandstone, fine-grained, laminated, siliceous; uniformly thin-bedded	23	194
13	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded to flaggy; crossbedded; grey weathering	18	171
12	Sandstone, fine-grained, laminated, quartzose, siliceous, grey; thin-bedded, uniformly bedded; grey weathering; quartz, 93%; chert, 7%	34	153
11	Mudstone, very silty, dark grey; platy	1.5	119
10	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded; grey weathering	4.5	117.5
9	Siltstone, argillaceous, dark grey; platy; grey weathering	4	113
8	Sandstone, fine-grained, quartzose, well-sorted, slightly pyritic, siliceous, argillaceous; grading upward into better sorted sandstone	3	109
7	Sandstone, fine-grained, laminated, well-sorted, siliceous, grey; medium-bedded; grey weathering; quartz, 97%; chert, 1%; matrix, 2%	12	106
6	Siltstone, argillaceous, dark grey; platy; grey weathering; some 1″–2″ beds of sandstone argillaceous, wavy bedded; grey weathering	22	94
5	Sandstone, fine-grained, siliceous, grey; thin- to thick-bedded; grey weathering; argillaceous in upper 1′	5	72
4	Siltstone, argillaceous, dark grey; platy to flaggy; grey weathering	4	67
3	Sandstone, fine-grained, laminated, siliceous, brownish grey; thin-bedded; grey weathering	8	63

Unit	Lithology	Thickness (feet)	Height above base (feet)
2	Sandstone, fine- to medium-grained, quartzose, siliceous, clean; some silty and argillaceous beds at base; quartz, 97%; chert, 3%	35	55
1	Sandstone, as above; thin- to thick-bedded; brownish grey weathering	20	20
	Contact is not exposed		
	TRIASSIC		
	Limestone and shale; brown weathering		

SECTION 64–18. Gething Formation, east flank of anticline, south of headwaters of Chicken Creek, Trutch map-area, British Columbia, 57°18′N, 123°07′W.

	GETHING FORMATION		
	End of exposures		
112	Sandstone, fine-grained, laminated, grey, siliceous; brownish grey weathering	5	1,059
111	Covered	75	1,054
110	Sandstone, fine-grained, laminated, grey, siliceous; brownish grey weathering	3	979
109	Covered	8	976
108	Sandstone, fine-grained, laminated, grey; rusty weathering; interbedded mudstone, 40%	15	968
107	Mudstone, dark grey, rubbly; interbedded siltstone, 30%, some concretionary layers	23	953

GSC loc. C-6963

Haplophragmoides sp. G116, few
H. sp. G117, few
Reophax sp. 5, common
Ammobaculites, sp., few
algal oogonia sp. 1, few

Age: Early Cretaceous; environment: marine, restricted

GSC loc. C-6961

Saccammina sp. 4, rare
Haplophragmoides sp. G116, few, (*H.* cf. *H. neocomiana* Chapman)
H. sp. G117, few
H. sp. G118, few
?*Ammobaculites* sp., rare (pyritized)
algal oogonia sp. 1, common

Age: Early Cretaceous; environment: marine, restricted

106	Sandstone, fine-grained, laminated grey; rusty weathering; beds 1″–6″; interbedded mudstone, 30%	9	930

Unit	Lithology	Thickness (feet)	Height above base (feet)
105	Covered	65	921
104	Sandstone, argillaceous at base, cleaner at top; flaggy to thin-bedded; grey weathering	25	856
103	Mudstone, dark grey; rusty weathering	1	831
102	Sandstone, very argillaceous; platy to flaggy; brownish grey weathering	7	830
101	Mudstone, silty; blocky	4	823
100	Sandstone, fine-grained, slightly argillaceous, dark grey; thin-bedded; brownish grey weathering	12	819
99	Covered	3	807
98	Sandstone, very fine grained, argillaceous, dark grey; flaggy to thin-bedded; grey weathering	8	804
97	Mudstone, dark grey, silty; platy; rusty weathering	4	796
96	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded; grey weathering	3	792
95	Covered	6	789
94	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded; brownish grey weathering	5	783
93	Sandstone, medium- to coarse-grained, grey; thick-bedded; grey to brownish grey weathering; some conglomerate; quartz, 41%; chert, 51%; matrix, 8%	12	778
92	Sandstone, fine-grained, laminated, siliceous, grey; thin- to thick-bedded; grey weathering	34	766
91	Covered	4	732
90	Sandstone, fine-grained; poorly bedded	1	728
89	Covered, recessive	2	727
88	Sandstone, fine-grained, laminated, siliceous; thin-bedded; grey weathering	7	725
87	Covered, recessive	14	718
86	Mostly covered. Sandstone at top	12	704
85	Sandstone, fine-grained, argillaceous, siliceous, dark grey; flaggy to thin-bedded; grey weathering; some mudstone..	17	692
84	Covered	10	675
83	Sandstone, fine-grained, dark grey, siliceous; flaggy; cross-bedded; rusty weathering	10	665
82	Mudstone, very silty, black; platy; rusty weathering	4	655
81	Sandstone, argillaceous; thin- to thick-bedded; brownish grey weathering; limonitic	6	651
80	Mostly covered. Platy mudstone	8	645
79	Sandstone, argillaceous, very fine grained, dark grey to black; flaggy to thin-bedded; grey weathering	11	637
78	Mudstone, silty, dark grey; platy; rusty weathering; some interbedded platy siltstone	13	626
77	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded; some platy silty sandstone	14	613
76	Mudstone, black; rubbly; rusty weathering	5	599
75	Mudstone, silty; grading into siltstone, platy; rusty weathering	8	594
74	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded; grey weathering	6	586
73	Mudstone, silty; platy; rusty weathering	3	580
72	Siltstone, sandy, black; flaggy; grey weathering	3	577
71	Mudstone, very silty, to siltstone, argillaceous, black; blocky to rubbly; rusty weathering	13	574

Unit	Lithology	Thickness (feet)	Height above base (feet)
70	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded; grey weathering	9	561
69	Mudstone, rubbly, dark grey; rusty	5	552
68	Sandstone, fine-grained, grey, siliceous, laminated; flaggy to thin-bedded; some recessive intervals	9	547
67	Covered	5	538
66	Sandstone, fine-grained, laminated, siliceous; poorly to thin-bedded; grey weathering	20	533
65	Mudstone	1.5	513
64	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded; crossbedded	9	511.5
63	Mostly covered, recessive. Mudstone	10	502.5
62	Mudstone and sandstone, thinly interbedded; rusty weathering	4	492.5
61	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded; rusty weathering	8	488.5
60	Mudstone, rubbly to platy; siltier at top	2	480.5
59	Sandstone, fine-grained, siliceous, grey; flaggy to thin-bedded	6	478.5
58	Mudstone, dark grey, platy; grades upward into siltstone, platy, rusty weathering	8	472.5
57	Sandstone, fine-grained, laminated, grey; flaggy; grey weathering	4	464.5
56	Mudstone	0.5	460.5
55	Sandstone, fine-grained, laminated, grey; flaggy; grey weathering	6	460
54	Covered. Some sandstone upslope	20	454
53	Sandstone, fine-grained, siliceous, grey; thin-bedded; grey weathering	14	434
52	Siltstone, argillaceous to sandy; platy	4	420
51	Sandstone, fine-grained, siliceous, grey; thin-bedded; grey weathering	5	416
50	Covered	24	411
49	Sandstone, argillaceous; platy to flaggy; dark grey weathering	9	387
48	Sandstone, fine-grained, siliceous, grey, slightly argillaceous; flaggy to thin-bedded; grey weathering; some platy siltstone	11	378
47	Covered, recessive	1	367
46	Sandstone, fine-grained, siliceous, grey, silty; flaggy at base, thin-bedded at top	10	366
45	Covered	2	356
44	Sandstone, fine-grained, siliceous, grey; thin-bedded; grey weathering	3	354
43	Sandstone, fine-grained; platy to flaggy; grey weathering	4	351
42	Sandstone, fine-grained, argillaceous; channel-fill	2	347
41	Covered	10	345
40	Partly covered. Appears to be sandstone	17	335
39	Covered	1	318
38	Sandstone, fine-grained, grey, siliceous	3	317
37	Mudstone, very silty, black; platy; siltstone at top	3	314
36	Sandstone, fine-grained, grey, siliceous; thin-bedded; grey weathering	11	311
35	Covered	5	300
34	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded; grey weathering	15	295

Unit	Lithology	Thickness (feet)	Height above base (feet)
33	Sandstone, argillaceous to silty; platy; grey weathering	3	280
32	Covered	22	277
31	Sandstone, fine-grained, grey, siliceous; flaggy	5	255
30	Sandstone, fine-grained, grey, siliceous; thin-bedded; grey weathering	5.5	250
29	Sandstone, fine-grained; platy; grey weathering	1.5	244.5
28	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded, grey weathering, some crossbedding	25	243
27	Covered	12	218
26	Sandstone, very fine grained, slightly argillaceous, dark grey, siliceous, flaggy to thin-bedded; grey weathering	20	206
25	Sandstone, very fine grained, slightly argillaceous, dark grey, siliceous; flaggy to thin-bedded; grey weathering	5	186
24	Covered	65	181
23	Sandstone, medium-grained, grey, siliceous; thick-bedded; slightly porous; grey weathering; quartz, 87%; chert, 12%	3	116
22	Sandstone, fine-grained, laminated; interbedded with mudstone	3	113
21	Covered	3	110
20	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded; grey weathering; few thin beds of mudstone	9	107
19	Mudstone, silty, black; platy	2	98
18	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded; grey weathering	6	96
17	Sandstone, medium- to coarse-grained, grey, siliceous; thick-bedded; grey weathering; disseminated pebbles, quartz, 95%; chert, 5%	4	90
16	Sandstone, fine-grained, siliceous, grey; thin- to thick-bedded; grey weathering	10	86
15	Covered	5	76
14	Sandstone, fine-grained, quartzose, siliceous, slightly laminated, light grey to light brown; thin- to thick-bedded; grey weathering; quartz, 92%; chert, 4%; matrix, 4%	6	71
13	Covered, recessive	3	65
12	Sandstone, very argillaceous at base; thin-bedded; grey weathering; some mudstone	3	62
11	Sandstone, fine-grained; flaggy	1.5	59
10	Covered, recessive	2.5	57.5
9	Sandstone, fine-grained, laminated to homogeneous, grey; flaggy to thin-bedded; grey weathering	4	55
8	Sandstone, silty, dark grey; platy; rusty to grey weathering	4	51
7	Sandstone, very argillaceous at base; some mudstone	2	47
6	Sandstone, fine-grained, grey, siliceous; thin-bedded; grey weathering	4	45
5	Covered	5	41
4	Sandstone, fine-grained, siliceous, brownish grey, slightly porous; thick-bedded; grey weathering	9	36
3	Partly covered. Sandstone and interbedded mudstone	5	27
2	Sandstone, fine- to medium-grained, brownish grey, porous, quartzose, siliceous; thick-bedded; grey weathering; quartz, 99%	13	22
1	Sandstone, medium- to coarse-grained, brown, porous, quartzose, siliceous; thick-bedded; grey weathering; quartz, 99%	9	9

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Contact not exposed		
	JURASSIC		
	Covered interval. Approximate	25′–35′	
	Contact not exposed		
	TRIASSIC		

SECTION 64–19. Gething Formation, west flank of anticline, north of Prophet River, Trutch map-area, British Columbia, 57°42′N, 123°33′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
	End of exposure		
91	Mudstone, black; rubbly; some siltstone at top; few concretions; poorly preserved belemnite	12	847
90	Mudstone, flaky to rubbly; thin beds of platy sandstone, 20%; concretionary layer at top	12	835
89	Mudstone, dark grey to black; rubbly; few platy siltstones; rusty weathering	8	823
88	Mudstone, rubbly, and siltstone, 40%; platy; rusty weathering	8	815
87	Sandstone, fine-grained, silty, platy; interbedded mudstone; rusty weathering; one foot of sandstone at top	11	807
86	Mudstone, dark grey; rubbly to platy; rusty weathering	11	796
85	Mudstone, rubbly; becoming silty and platy at top; rusty weathering	35	785
84	Mudstone, very silty, and interbedded siltstone, rusty weathering; few thin beds of rubbly shale; some concretions	14	750
83	Mudstone, dark grey to black; rubbly; very silty and platy near base; rusty weathering; some platy siltstone, 20%	28	736
82	Sandstone, conglomeratic, grey, rusty weathering; pebbles $\frac{1}{8}$″–$\frac{1}{2}$″, well-rounded	1	708
81	Siltstone, platy; rusty weathering	4	707
80	Sandstone, fine-grained, laminated, slightly argillaceous; flaggy; rusty weathering	10	703
79	Mudstone, silty; some platy sandstone	3	693
78	Sandstone, fine-grained, grey, siliceous	3	690
77	Mudstone, rubbly at base; grading upward into siltstone, argillaceous, platy; some sandstone	12	687
76	Sandstone, fine-grained, grey, siliceous	3	675
75	Mudstone, black; rubbly	3	672
74	Sandstone, fine-grained, grey, siliceous, argillaceous at base; flaggy to thin-bedded; grey weathering	5	669
73	Siltstone, very argillaceous at base; sandy and flaggy at top	3	664
72	Sandstone, very argillaceous at base; better sorted and thin-bedded at top	12	661
71	Mudstone, platy	4	649
70	Sandstone, fine-grained, laminated; flaggy	5	645

Unit	Lithology	Thickness (feet)	Height above base (feet)
69	Mudstone, very silty, platy; interbedded siltstone	9	640
68	Sandstone, fine-grained, laminated; flaggy; thinly interbedded mudstone, 40%	15	631
67	Covered	5	616
66	Sandstone, fine-grained, laminated, grey, siliceous; thick-bedded; brownish grey weathering	6	611
65	Sandstone, fine-grained, conglomeratic; thick-bedded	2	605
64	Sandstone, fine-grained, laminated, siliceous, brownish grey; thin- to thick-bedded; brown weathering	10	603
63	Covered, recessive	7	593
62	Siltstone, sandy; flaggy	5	586
	SHEAR		
61	Siltstone, sandy; flaggy; some mudstone at base. Part may be repeated beds below shear	13	581
60	Sandstone, fine-grained, silty, siliceous; flaggy; rusty brown weathering	22	568
59	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded; grey weathering	6	546
58	Mudstone, very silty, black; blocky	2	540
57	Siltstone, sandy; platy; grading upward into fine-grained, flaggy sandstone	8	538
56	Mudstone, rubbly to platy; becoming very silty to blocky at top; some platy siltstone, 20%	18	530
55	Siltstone, argillaceous, platy; rusty weathering; some channel sandstone	4	512
54	Sandstone, fine-grained, laminated, grey, siliceous, lenticular; flaggy to thin-bedded; rusty weathering	5	508
53	Mudstone, black, rubbly to platy; rusty weathering	3	503
52	Sandstone, fine-grained, laminated, grey; flaggy	2	500
51	Mudstone, black, very silty; platy; rusty weathering	5	498
50	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded, crossbedded; brownish grey weathering	7	493
49	Mudstone, very silty; platy	1	486
48	Sandstone, fine-grained, grey, siliceous	2	485
47	Siltstone, argillaceous, platy; interbedded sandstone and mudstone	3	483
46	Sandstone, fine-grained, laminated, grey, siliceous; thin-bedded; brownish grey weathering	3	480
45	Mudstone, very silty; some sandstone	4	477
44	Sandstone, fine-grained, laminated; thin-bedded	4	473
43	Covered, recessive	1	469
42	Sandstone, fine-grained, laminated; flaggy at base, thin-bedded at top; grey weathering	12	468
41	Sandstone, fine-grained, laminated, grey; flaggy; wavy bedding; grey weathering	9	456
40	Sandstone, fine-grained, grey, laminated, siliceous; thick-bedded; weathers slightly flaggy; brown weathering	49	447
39	Mudstone, very silty, dark grey; platy	4	398
38	Sandstone, fine-grained, grey, siliceous; poor to wavy bedding; flaggy; brownish grey weathering	9	394
37	Mudstone, silty, black; rubbly to platy; few thin beds of very argillaceous black siltstone, rusty weathering; 6″ channel sandstone at base	11	385

Unit	Lithology	Thickness (feet)	Height above base (feet)
36	Sandstone, fine- to medium-grained, quartzose, clean, well-sorted, grey, homogeneous, siliceous, grey; thin-bedded; some crossbedding; rusty brown weathering; quartz, 99%; poor porosity	34	374
35	Sandstone, fine- to medium-grained, quartzose, well-sorted, clear laminated to homogeneous, grey, siliceous; flaggy; grey weathering; some wavy to poor bedding; some thin-bedded, greenish weathering sandstone and siltstone at top	21	340
34	Sandstone, fine-grained, laminated, siliceous, grey; flaggy; grey weathering	22	319
33	Partly covered. Mudstone, rubbly	5	297
32	Sandstone, very argillaceous; platy to flaggy; some argillaceous siltstone; better sorted sandstone at top	13	292
31	Sandstone, fine-grained, grey, laminated to homogeneous; siliceous; thick-bedded; grey weathering	7	279
30	Sandstone, fine-grained, laminated; flaggy	2	272
29	Mudstone, platy, black	0.5	270
28	Sandstone, fine-grained, laminated; flaggy	1.5	269.5
27	Siltstone, very argillaceous, black, carbonaceous	3	268
26	Sandstone, fine- to medium-grained, quartzose, well-sorted, siliceous, grey, flaggy to thin-bedded; some crossbedding, thicker bedded at top; grey weathering; quartz, 91%; chert, 7%; matrix, 2%; poor porosity	31	265
25	Sandstone, fine-grained, argillaceous; flaggy	7	234
24	Siltstone, argillaceous, grey; platy; some platy mudstone	4	227
23	Sandstone, fine-grained, laminated, grey, siliceous, very argillaceous at base; flaggy; grey weathering; some mudstone near top	7	223
22	Mostly covered. Mudstone	4	216
21	Sandstone, fine- to medium-grained, quartzose, well-sorted, laminated, siliceous, slightly ferruginous, brownish grey; flaggy to thin-bedded; rusty to grey weathering; quartz, 94%; chert, 6%; poor porosity	32	212
20	Mudstone, very silty; platy; rusty weathering	1	180
19	Sandstone, fine-grained, siliceous, laminated; flaggy; brownish grey weathering	2.5	179
18	Mudstone, rubbly to platy; rusty weathering	1.5	176.5
17	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded	6	175
16	Mudstone, black; rubbly to platy; rusty weathering; gritty concretionary layers in middle	7	169
15	Mudstone, very silty; grading upward into argillaceous platy siltstone with flaggy sandstone	7	162
14	Sandstone, argillaceous, dark grey; flaggy; very silty mudstone, 20%	8	155
13	Sandstone, fine-grained, laminated, siliceous, grey; flaggy; rusty to grey weathering; few thin beds of argillaceous siltstone with some interbedded mudstone	25	147
12	Sandstone, fine-grained, laminated, siliceous; thin-bedded; grey weathering	5	122
11	Covered, recessive	1	117
10	Sandstone, fine-grained, siliceous; thin-bedded	3	116
9	Covered, recessive	1	113

Unit	Lithology	Thickness (feet)	Height above base (feet)
8	Sandstone, fine-grained, laminated, siliceous; poorly bedded at base, flaggy at top; grey weathering	19	112
7	Sandstone, fine-grained, laminated, siliceous, grey; flaggy; grey weathering	8	93
6	Sandstone, fine-grained, laminated; argillaceous at base; coarse-grained at top	4	85
5	Sandstone, fine-grained, quartzose, laminated, grey, siliceous; flaggy to poorly bedded, more thickly bedded at top; brownish grey weathering; quartz, 96%; chert, 4%; poor porosity	22	81
4	Sandstone, fine-grained, laminated, siliceous; platy to flaggy, thin-bedded at top; rusty to grey weathering	9	59
3	Sandstone, fine-grained, quartzose, well-sorted, bimodal, laminated, siliceous; brownish grey; flaggy; capped by 3″ coarse-grained, conglomeratic sandstone; quartz, 84%; chert, 14%; matrix, 2%	8	50
2	Sandstone, medium- to coarse-grained, laminated, siliceous, cross-laminated; thin-bedded; crossbedded; brown weathering; very friable at base	6	42
1	Sandstone, fine-grained, siliceous, laminated to homogeneous, brown, slightly ferruginous; thick-bedded; brown weathering; slightly irregular bedding at base with large concretionary masses; basal 6″ contains fragments of Triassic limestone; quartz, 92%; chert, 5%; matrix, 3%; poor porosity	36	36
	Contact is abrupt but beds appear to be parallel on either side		
	TRIASSIC		
	Very argillaceous, shaly beds with some dense limestone rest on grey weathering, coarsely crystalline limestone		
	GSC loc. 65931 *Halobia* sp. *Gryphaea* sp. *Oxytoma* cf. *mojsisovicsi* Teller Age: Late Triassic		

SECTION 64–20. Gething Formation, north of Besa River, on west flank of syncline, Trutch map-area, British Columbia, 57°36′N, 123°24′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	BUCKINGHORSE FORMATION		
	End of exposure		
6	Mudstone, dark grey to black; rubbly; very rare small concretions	50	530
5	Covered. Approximate	75	480
4	Mudstone, black; rubbly; large reddish brown weathering concretions	95	405

Unit	Lithology	Thickness (feet)	Height above base (feet)
3	Covered	105	310
2	Mudstone, black; rubbly; large reddish brown weathering concretions	75	205
1	Mostly covered. Mudstone	130	130
	GETHING FORMATION		
78	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded; rusty weathering	8	867
77	Mudstone, black; rubbly; rusty weathering	15	859
76	Sandstone, fine-grained, laminated, siliceous, grey; thick-bedded; rusty weathering	8	844
75	Mudstone, black; rubbly; rusty weathering; sandstone, 10%, 1″–2″ beds; striped appearance	21	836
74	Sandstone, fine-grained, calcareous, laminated, brownish grey; ⅛″ pebbles on basal surface; channel sandstone	9	815
73	Mudstone, black, rubbly; rusty weathering; some interbedded and channel sandstone, 10%, reddish brown weathering	30	806
72	Sandstone, fine-grained, laminated, brownish grey, siliceous, concretionary; orange weathering; platy to thin-bedded; interbedded mudstone, 40%	11	776
71	Mudstone, dark grey; rubbly; grading upward into interbedded siltstone and mudstone; small channel sandstones	53	765
70	Mudstone, silty at base; platy; rusty weathering; some siltstone and sandstone, 25%, at top	33	712
69	Sandstone, fine-grained; silty and flaggy at base; better sorted and thick-bedded at top; ripple-marks	10	679
68	Sandstone, silty, coaly, black; thin-bedded; dark grey to black weathering	8	669
67	Siltstone, sandy, dark grey; poorly bedded, flaggy to thin-bedded; dark grey weathering	5	661
66	Covered, recessive	1	656
65	Sandstone, argillaceous, grey, siliceous; platy to flaggy	7	655
64	Recessive, covered	2	648
63	Inaccessible. Sandstone, flaggy to thin-bedded; few 1′–2′ beds of mudstone	45	646
62	Inaccessible. Mostly sandstone, as above; about 10′ of mudstone or siltstone at top	57	601
61	Inaccessible. Sandstone, fine-grained, siliceous; flaggy to thin-bedded; grey weathering; rare beds of mudstone	55	544
60	Sandstone, fine- to medium-grained, siliceous, homogeneous; thick-bedded; grey weathering	18	489
59	Sandstone, very coarse grained to conglomeratic, siliceous, grey; thick-bedded; grey weathering; quartz, 49%; chert, 49%; lithic grains, 2%	10	471
58	Mudstone, black; rubbly	3	461
57	Sandstone, fine-grained, laminated, siliceous; flaggy, to thin-bedded at top; grey weathering	9	458
56	Partly covered. Mudstone, rubbly; becoming platy and silty at top; rusty weathering	15	449
55	Sandstone, argillaceous, laminated, black; interbedded mudstone, 20%	5	434

Unit	Lithology	Thickness (feet)	Height above base (feet)
54	Sandstone, silty, grey; platy to flaggy; some mudstone	5	429
53	Covered	20	424
52	Sandstone, fine-grained; poorly bedded	3	404
51	Interbedded sandstone, siltstone, and mudstone; poorly exposed	4	401
50	Sandstone, fine-grained, laminated to homogeneous, siliceous, grey; flaggy to thin-bedded; brownish grey weathering; few beds of platy, argillaceous sandstone, rusty weathering	42	397
49	Mudstone	1	355
48	Sandstone, argillaceous; platy to flaggy	2	354
47	Mudstone, platy	2	352
46	Sandstone, fine-grained, grey, siliceous; flaggy to poorly bedded	5	350
45	Mudstone, silty; rubbly; becoming blocky; partly covered at top	17	345
44	Sandstone, fine-grained, siliceous; poorly bedded	1	328
43	Mudstone, black, rubbly; few 1″ beds of sandstone	6	327
42	Sandstone, fine-grained, siliceous; flaggy; interbedded mudstone, 30%	4	321
41	Sandstone, fine-grained, siliceous; flaggy; some interbedded mudstone and siltstone at base	8.5	317
40	Mudstone, dark grey; rubbly; rusty weathering	3	308.5
39	Sandstone, as above	2	305.5
38	Mudstone, dark grey; rubbly; rusty weathering	1.5	303.5
37	Sandstone, fine-grained, laminated to homogeneous, siliceous; flaggy to thin-bedded at top; grey weathering	7	302
36	Sandstone, fine-grained, laminated, siliceous; platy to flaggy; some platy siltstone	7	295
35	Partly covered. Sandstone and interbedded mudstone	6	288
34	Covered, recessive. Some mudstone	20	282
33	Sandstone, fine-grained, grey, siliceous; platy to flaggy; grey weathering	5	262
32	Mostly covered, recessive. Platy mudstone	12	257
31	Sandstone, silty; flaggy to platy; wavy bedding; brownish grey weathering	5	245
30	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded; grey weathering	10	240
29	Siltstone, very argillaceous; platy; rusty weathering	12	230
28	Sandstone, fine-grained, laminated, siliceous, grey; thin- to thick-bedded; brownish grey weathering	12	218
27	Sandstone, as above; interbedded platy siltstone	3	206
26	Sandstone, fine-grained, laminated, grey, siliceous; flaggy to thin-bedded; brownish grey weathering	8	203
25	Siltstone, argillaceous at base; platy and sandy at top	3	195
24	Sandstone, concretionary; reddish brown weathering	1	192
23	Mudstone, silty at base; mostly rubbly; rusty weathering; some argillaceous siltstone at top	20	191
22	Sandstone, fine-grained, brownish grey; flaggy, to thin-bedded at top; brownish grey weathering	16	171
21	Mudstone and siltstone. Poorly exposed	1.5	155
20	Sandstone, fine-grained, silty; platy to flaggy	0.5	153.5
19	Mudstone, rubbly; rusty weathering	1	153
18	Sandstone, argillaceous, laminated, grey; poorly bedded	6	152

Unit	Lithology	Thickness (feet)	Height above base (feet)
17	Mudstone, black; rubbly; rusty weathering; some argillaceous sandstone at base	5	146
16	Mudstone, silty; platy; rusty weathering; some interbedded siltstone, argillaceous, platy	25	141
15	Siltstone, very argillaceous; platy; some interbedded silty mudstone; rusty weathering	17	116
14	Mudstone, platy; grading upward into flaggy sandstone	6	99
13	Sandstone, fine-grained, laminated; flaggy to thin-bedded	9	93
12	Sandstone, argillaceous at base; flaggy; grey weathering	7	84
11	Sandstone, argillaceous at base; platy to flaggy; grading upward into thin-bedded sandstone; concretionary layer	5	77
10	Sandstone, fine-grained, grey, laminated, siliceous; thick-bedded; grey weathering	7	72
9	Interbedded siltstone and mudstone	1	65
8	Sandstone, very argillaceous, black; flaggy	1	64
7	Mudstone	1	63
6	Sandstone, fine-grained; flaggy to thin-bedded; grey weathering; mudstone at base	14	62
5	Sandstone, fine-grained; argillaceous and platy at base; flaggy to thin-bedded at top; grey weathering	10	48
4	Sandstone, fine-grained, laminated; flaggy to thin-bedded	9	38
3	Mudstone, silty; platy; some flaggy sandstone	3	29
2	Sandstone, fine-grained, laminated, siliceous, grey; flaggy to thin-bedded; grey weathering	11	26
1	Sandstone, fine-grained, quartzose, siliceous, grey; thick-bedded to massive; grey weathering. Approximate	15	15
	Contact not exposed		
	TRIASSIC		
	Limestone, crystalline; shaly at top; grey to brown weathering		

SECTION 64–21. Gething Formation, east flank of anticline, north of Prophet River, Trutch map-area, British Columbia, 57°41′N, 123°26′W.

BUCKINGHORSE FORMATION

End of exposure

6	Mudstone, dark grey to black; rubbly; rusty weathering; few thin beds of concretions at base and rows of large concretions toward top	35	240
5	Mudstone, dark grey to black; rubbly to blocky; reddish brown weathering concretions; bentonite seam at 36′	46	205
4	Mudstone, as above; large concretions in rows; bentonite at top	47	159
3	Mudstone, black; rubbly; large reddish brown weathering concretions; bentonite at top	12	112
2	Mostly covered. Mudstone. Approximate	90	100
1	Mudstone, silty, black; rubbly; few concretionary layers; glauconitic	10	10

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
74	Sandstone, fine-grained, grey, siliceous; thick-bedded; rusty brown weathering; glauconitic; traces of wood fragments	6	841
73	Mudstone, silty, dark grey to black; rubbly to blocky; interbedded platy siltstone; few concretions; striped appearance	33	835
72	Mudstone, silty, as above; rusty weathering; few thin beds of concretionary sandstone	34	802
71	Sandstone and interbedded mudstone; grading upward into sandstone, fine-grained, laminated, siliceous; thin-bedded; rusty brown weathering	18	768
70	Sandstone, as above, platy; mudstone, 25%	5	750
69	Mudstone, dark grey; platy	2	745
68	Sandstone, fine-grained, grey, siliceous; rusty brown weathering	2	743
67	Mudstone, dark grey to black; rubbly to blocky; some sandstone as above, 20%, beds 1"–2"	24	741
66	Sandstone, fine-grained, grey, siliceous; rusty brown weathering; small pebbles on basal surface	1	717
65	Mudstone, dark grey to black	8	716
64	Sandstone, fine-grained, laminated, siliceous; thin- to thick-bedded; rusty brown weathering; interbedded mudstone, 10%	10	708
63	Mudstone, dark grey; rubbly; few thin beds of sandstone, some concretions	7	698
62	Mudstone and interbedded lenticular sandstone, 40%	15	691
61	Mudstone, blocky; capped by channel sandstone, fine-grained, laminated; brown weathering	18	676
60	Covered	15	658
59	Mudstone, dark grey to black; rubbly to blocky	50	643
58	Siltstone, argillaceous to sandy; blocky to platy; rusty weathering	10	593
57	Sandstone, fine-grained, laminated	2	583
56	Siltstone to sandstone, very argillaceous, black; platy; mudstone, 10%	8	581
55	Siltstone, argillaceous; platy	3	573
54	Sandstone, fine-grained, argillaceous; flaggy	10	570
53	Mudstone, dark grey to black, rubbly to platy; silty at top	14	560
52	Sandstone, fine-grained, dark grey, siliceous; flaggy to thin-bedded; crossbedded; thick-bedded at top; rusty brown weathering; poor porosity	33	546
51	Mudstone, dark grey to black; rubbly to blocky; rusty weathering; some siltstone near base; siltier at top	13	513
50	Sandstone, very argillaceous and platy at base; becoming fine-grained, grey, siliceous; flaggy to thin-bedded; rusty brown weathering	13	500
49	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; rusty weathering	3	487
48	Mudstone, silty; platy	2	484
47	Sandstone, fine-grained, siliceous; thin-bedded	2	482
46	Mudstone, rubbly; interbedded sandstone, 30%	4	480
45	Sandstone, fine-grained, grey, siliceous; flaggy	7	476
44	Sandstone, argillaceous; flaggy; some mudstone at base	5	469

Unit	Lithology	Thickness (feet)	Height above base (feet)
43	Sandstone, argillaceous at base; becoming fine-grained, siliceous; thin-bedded at top	9	464
42	Sandstone, very fine grained, silty, siliceous; thin-bedded; some mudstone at base	4	455
41	Mudstone, dark grey to black; rubbly to platy	11	451
40	Sandstone, fine-grained, grey, homogeneous, siliceous, thin- to thick-bedded; brown weathering, poor porosity	25	440
39	Sandstone, fine- to medium-grained, cherty, argillaceous, carbonaceous, siliceous, grey, homogeneous; thin- to thick-bedded; brown weathering; finer grained at top; poor porosity, quartz, 52%; chert, 28%; dolomite, 2%; matrix, 13%; carbonaceous fragments, 5%	18	415
38	Mudstone, silty; thin beds of sandstone in middle	5	397
37	Sandstone, fine-grained, siliceous, grey; flaggy to thin-bedded; brownish grey weathering; few thin beds of mudstone	12	392
36	Siltstone, sandy, dark grey; platy to flaggy; rusty brown weathering	7	380
35	Sandstone, fine-grained, grey, slightly argillaceous; flaggy to thin-bedded	10	373
34	Sandstone, fine-grained, grey, siliceous; rusty brown weathering	5	363
33	Mudstone, black; very silty; platy	2	358
32	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; some interbedded mudstone, 10%	12	356
31	Mostly covered. Mudstone	28	344
30	Partly covered. Sandstone	9	316
29	Covered	5	307
28	Sandstone, fine-grained, grey, siliceous; thick-bedded; rusty brown weathering	9	302
27	Poorly exposed. Mudstone	5	293
26	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded	5	288
25	Siltstone, argillaceous, blocky; grading upward into argillaceous sandstone	7	283
24	Sandstone, silty, dark grey; thin-bedded; rusty weathering	3	276
23	Mudstone, silty; blocky; rusty weathering	15	273
22	Sandstone, fine-grained, laminated, grey; ripple-marks	3	258
21	Mudstone, silty, dark grey; platy; rusty weathering	3	255
20	Sandstone, fine-grained; flaggy; mudstone	2	252
19	Sandstone, very argillaceous, black; flaggy, with mudstone, at base; grading upward into cleaner, thin-bedded sandstone; ripple-marks	19	250
18	Sandstone, very argillaceous, black; flaggy; rusty weathering	10	231
17	Mudstone, dark grey; rubbly; rusty weathering	18	221
16	Sandstone, argillaceous; flaggy	5	203
15	Mudstone, poorly exposed	17	198
14	Sandstone, as above	5	181
13	Mostly covered. Some mudstone	55	176
12	Sandstone, fine-grained, grey; thin-bedded; rusty brown weathering	10	121
11	Mudstone, poorly exposed	25	111
10	Sandstone, fine-grained, grey, slightly argillaceous; thin-bedded; rusty brown weathering	6	86

Unit	Lithology	Thickness (feet)	Height above base (feet)
9	Mudstone, very silty, dark grey; rusty weathering; interbedded siltstone, 30%	6	80
8	Siltstone, sandy, argillaceous; platy; grading upward into sandstone, fine-grained, thin-bedded; some rubbly mudstone	7	74
7	Mudstone, very silty, platy; interbedded sandy siltstone and sandstone, 40%, platy; rusty weathering	7	67
6	Sandstone, fine-grained, argillaceous, dark grey; flaggy to thin-bedded; rusty weathering; some argillaceous siltstone at base	9	60
5	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; rusty brown weathering; 6 inches of mudstone at base	10	51
4	Sandstone, fine-grained, high quartzose, siliceous, black, coaly; poorly bedded; poor porosity; pyrobitumen	2	41
3	Sandstone, fine-grained, homogeneous, grey, siliceous, thin-bedded; grey weathering	17	39
2	Sandstone, fine-grained; becoming medium- to coarse-grained, quartzose, grey, siliceous; thin-bedded; brownish grey weathering; quartz, 98%; chert, 2%; poor porosity	10	22
1	Mudstone, silty, black; platy; rusty weathering; interbedded sandstone, 30%, argillaceous, platy to flaggy	12	12
	Upper beds of Triassic rocks are truncated by the overlying Gething beds. More than 6 feet of additional Triassic beds are present upslope from where measurement begins		
	TRIASSIC		
	Limestone, dense, grey weathering, and interbedded calcareous black shale		
	GSC loc. 66028		
	Halobia sp.		
	Gryphaea sp.		
	Age: Late Triassic		

SECTION 64–22. Gething Formation, east flank of anticline, south of Bat Creek, Trutch map-area, British Columbia, 57°46′N, 123°31′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	BUCKINGHORSE FORMATION		
	Several hundred feet of mudstone with large reddish brown weathering concretions are exposed above measured beds, but are sheared and folded		
1	Mudstone, dark grey to black; rubbly; large reddish brown weathering concretions	75	75
	SHEAR, underlying sandstone is repeated		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
64	Sandstone, fine-grained, concretionary, greenish grey, highly glauconitic; thick-bedded; rusty to greenish weathering..	6	887
63	Mudstone, black; rubbly; rusty weathering; few large concretions	20	881
62	Mudstone, black; rubbly; some large concretions; 1 foot of concretionary sandstone at top	23	861
61	Mudstone, dark grey to black, rubbly; rusty weathering; grading upward into mudstone and interbedded sandstone, 30%; 2 feet of sandstone at top	22	838
60	Mudstone, black; rubbly; rusty weathering; platy sandstone, 25%, very fine grained, ferruginous, rusty weathering	15	816
59	Mudstone, black; rubbly; rusty weathering	6	801
58	Mudstone, silty, black; blocky; sandstone, 20%, platy, concretionary	14	795
57	Mudstone, silty, black; blocky to platy; some siltstone and concretions	9	781
56	Mudstone, black; rubbly; rusty weathering; sandstone, 20%, silty, laminated, rusty brown weathering; beds 1″–2″	11	772
55	Mudstone, as above; rubbly at base, silty and blocky at top; concretionary layers	20	761
54	Mudstone, black; rubbly; rusty weathering; silty at top; few concretionary layers	32	741
53	Sandstone, fine-grained, ferruginous, siliceous; thin- to thick-bedded; rusty weathering; mudstone, 40%, rubbly, rusty weathering	22	709
52	Sandstone, fine-grained, siliceous, ferruginous; thick-bedded; rusty weathering	13	687
51	Mudstone, black; rubbly; rusty weathering; few concretions..	27	674
50	Mudstone, black; rubbly; channel sandstone, 25%, at base, middle, and top	7	647
49	Mudstone, rubbly to blocky; few concretionary layers	20	640
48	Mudstone, black, rubbly; siltstone, 30%, platy; channel sandstone at top	13	620
47	Siltstone, argillaceous, platy; mudstone, 40%; some platy, fine-grained sandstone, rusty weathering	9	607
46	Mudstone, dark grey to black; rubbly to platy; siltier at top; rusty weathering; few 4″–6″ sandstone beds, concretionary	80	598
45	Mudstone, very silty; platy to blocky; rusty weathering	5	518
44	Siltstone, argillaceous; platy; interbedded sandstone, 25%; rusty weathering	13	513
43	Siltstone, sandy to argillaceous; platy to flaggy; some interbedded sandstone and mudstone	45	500
42	Sandstone, fine-grained, argillaceous, dark grey; flaggy to thin-bedded; some interbedded mudstone	15	455
41	Mudstone, black; rubbly to platy	12	440
40	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded; grey weathering	11	428
39	Mudstone, black; rubbly to blocky	3	417
38	Sandstone, fine-grained, grey, siliceous; thick-bedded; rusty to grey weathering	25	414
37	Mudstone, black; rubbly	2	389

Unit	Lithology	Thickness (feet)	Height above base (feet)
36	Sandstone, fine-grained, laminated to homogeneous, siliceous, grey; thin- to thick-bedded; rusty brown weathering	9	387
35	Mudstone, very silty, to siltstone, argillaceous, platy; rusty weathering; interbedded 1"–4" beds of sandstone at top	12	378
34	Sandstone, fine-grained, brownish grey; flaggy at base becoming thick-bedded at top	32	366
33	Sandstone, fine-grained, brownish grey; thick-bedded; grey weathering	33	334
32	Mudstone, silty, platy, black	1	301
31	Sandstone, fine-grained, siliceous, grey; platy to flaggy at base, becoming thick-bedded at top; rusty brown weathering	12	300
30	Mudstone, platy; some argillaceous sandstone at base	9	288
29	Sandstone, fine-grained, as above	2	279
28	Mudstone, black; platy	3	277
27	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded; some mudstone at base	5	274
26	Sandstone, fine-grained, grey, siliceous, thin- to thick-bedded; grey to rusty weathering	13	269
25	Sandstone and interbedded mudstone	2	256
24	Sandstone, fine-grained, siliceous, grey; flaggy, to thin-bedded at top; grey weathering	26	254
23	Mudstone, rubbly, dark grey	1	228
22	Sandstone, fine-grained, grey, siliceous; flaggy to thin-bedded	3	227
21	Mostly covered. Mudstone	11	224
20	Sandstone, fine- to medium-grained, cherty in parts, siliceous, homogeneous, dark grey at base, brownish grey at top; thin-bedded; rusty brown weathering; quartz, 57%; chert, 37%; matrix, 6%; poor porosity	19	213
19	Mostly covered. Mudstone	31	194
18	Sandstone, argillaceous to silty; dark grey to black; platy to flaggy; interbedded silty, platy mudstone, 30%	13	163
17	Sandstone, fine-grained, grey, siliceous, laminated; flaggy; grey weathering	3	150
16	Covered	8	147
15	Sandstone, fine-grained, grey, siliceous; thick-bedded; rusty to grey weathering	6	139
14	Mudstone, dark grey; platy	7	133
13	Sandstone, fine-grained, grey, siliceous, laminated; flaggy to thin-bedded; rusty weathering	5	126
12	Mudstone, silty; grading upward into silty, platy sandstone	8	121
11	Mudstone, silty; grading upward into sandstone, silty, laminated, platy to flaggy	5	113
10	Sandstone, silty, grey, siliceous, thin-bedded; rusty to grey weathering	3	108
9	Mudstone, black; rubbly at base; grading upward into siltstone, very argillaceous, black, rusty weathering	8	105
8	Mudstone, very silty at base; platy; grading upward into argillaceous and silty sandstone, flaggy to thin-bedded; dark grey, rusty to dark grey weathering	6	97
7	Sandstone, silty, laminated, siliceous, argillaceous at base; flaggy to thin-bedded; rusty to dark grey weathering	5	91
6	Sandstone, fine-grained, siliceous; flaggy at base, becoming thin-bedded at top; rusty weathering	5	86
5	Mudstone, silty, dark grey; platy	1	81

Unit	Lithology	Thickness (feet)	Height above base (feet)
4	Sandstone, silty, grey, siliceous; platy to flaggy; grey weathering	2	80
3	Siltstone, sandy, dark grey, siliceous; flaggy; interbedded mudstone, 20%; grades into overlying unit	5	78
2	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded, flaggy at base and in middle; grey to brownish grey weathering	43	73
1	Sandstone, fine-grained, grey, siliceous, homogeneous; thick-bedded; grey weathering	30	30

Contact is not well exposed but beds appear to be parallel on either side

TRIASSIC

Limestone, dense, dark grey; grey weathering

GSC loc. 65934
Halobia sp.
Age: Late Triassic

SECTION 64–23. Gething Formation, east flank of anticline, between Kluachesi and Muskwa Rivers, Trutch map-area, British Columbia, 57°59′N, 123°40′W.

BUCKINGHORSE FORMATION

End of exposure

Unit	Lithology	Thickness (feet)	Height above base (feet)
6	Mudstone, black; rubbly; large concretions at base, fewer toward top; rusty weathering	149	494
5	Covered	20	345
4	Mudstone, black; rubbly; rusty weathering; some rows of large concretions	18	325
3	Mudstone, black; rubbly; rusty weathering; few concretions at base	119	307
2	Mudstone, dark grey to black; rubbly; rusty weathering; rare concretion	113	188
1	Mudstone, black; rubbly to blocky; rusty weathering; concretions at base	75	75

GETHING FORMATION

Unit	Lithology	Thickness (feet)	Height above base (feet)
34	Sandstone, fine-grained, siliceous, thick-bedded; becoming very argillaceous at top; few thin beds of mudstone, glauconitic	22	744
33	Sandstone, fine-grained, siliceous, brownish grey; interbedded mudstone, 40%	9	722
32	Sandstone, fine-grained, siliceous, brownish grey; thick-bedded; brown weathering; some crossbedding; some interbedded siltstone and mudstone, 25%	42	713

Unit	Lithology	Thickness (feet)	Height above base (feet)
31	Sandstone, fine-grained, laminated, siliceous, brownish grey; thick-bedded; brownish grey weathering	25	671
30	Mostly covered. Appears to be mudstone. Approximate	70	646
29	Sandstone, fine-grained, laminated, silty, siliceous, ferruginous; flaggy; interbedded mudstone, 50%; rusty weathering	25	576
28	Mostly covered, recessive. Mudstone	75	551
27	Sandstone, fine-grained, laminated, siliceous, ferruginous; platy to thick-bedded; rusty brown weathering; interbedded platy, silty mudstone, 40%	33	476
26	Not well exposed. Mudstone, dark grey to black; rubbly to blocky; rusty weathering; few thin beds of argillaceous sandstone; sandy concretions toward top	72	443
25	Mudstone, dark grey to black, silty; blocky; rusty weathering; becoming very silty at top	38	371
24	Sandstone, fine-grained, argillaceous; poorly bedded; rusty weathering	1	333
23	Mudstone, as above	40	332
22	Sandstone, as above	1	292
21	Mudstone, dark grey, silty; blocky; rusty weathering	11	291
20	Sandstone, fine-grained, argillaceous; poorly bedded; rusty weathering	2	280
19	Mudstone, very silty, to siltstone, argillaceous; blocky; rusty weathering; few beds of argillaceous sandstone	17	278
18	Sandstone to siltstone; argillaceous; dark grey; some interbedded mudstone at base; becoming cleaner and thicker bedded at top	21	261
17	Sandstone and mudstone, thinly interbedded	15	240
16	Sandstone, silty, flaggy, dark grey; interbedded silty, platy mudstone	18	225
	(The above three units are folded and sheared; some repetition of beds may be present but section appears to continue normally on either side)		
15	Mudstone, black; rubbly to blocky	12	207
14	Sandstone, very fine grained, argillaceous, dark grey; flaggy to thin-bedded; interbedded mudstone, 25%	11	195
13	Mostly covered, recessive; mudstone	7	184
12	Sandstone, fine-grained, laminated, siliceous; thin-bedded; mudstone at base	5	177
11	Sandstone, fine-grained, laminated, grey, siliceous; slightly porous; thin-bedded; grey weathering	8	172
10	Mudstone, grading upward into interbedded mudstone and sandstone, argillaceous, flaggy; grades into overlying unit	14	164
9	Sandstone, fine-grained, thin- to thick-bedded; some mudstone at base	4	150
8	Sandstone, fine-grained, laminated, siliceous, grey; thin- to thick-bedded, grey weathering	24	146
7	Sandstone, as above; interbedded mudstone, 30%, platy	3	122
6	Sandstone, fine-grained, siliceous, grey; thin-bedded; grey weathering	7	119
5	Covered, recessive	15	112

Unit	Lithology	Thickness (feet)	Height above base (feet)
4	Sandstone, fine- to medium-grained, cherty, laminated, brownish grey, siliceous, slightly ferruginous; thin- to thick-bedded; grey weathering; poor porosity	14	97
3	Covered, recessive	36	83
2	Sandstone, fine-grained, laminated, siliceous, brownish grey; slightly ferruginous; thick-bedded; brown weathering. Poorly exposed	25	47
1	Covered	22	22
	TRIASSIC		
	Sandstone, very fine grained, grey, highly calcareous; thick-bedded; light brownish grey weathering		

SECTION 64–24. Gething Formation, east flank of anticline, tributary of Gathto Creek, Fort Nelson map-area, British Columbia, 58°03′N, 123°50′W.

	BUCKINGHORSE FORMATION		
	Overlying beds are sheared and folded		
13	Mudstone, black; rubbly; rusty weathering; some reddish brown weathering concretions	80	776
12	Mudstone, black; rubbly to blocky; rusty weathering; rare concretions	85	696
11	Mudstone, black; rubbly; few rows of concretions	30	611
10	Mudstone; black; rubbly; rare concretions	80	581
9	Mudstone, black; rubbly; rusty weathering; large concretions, reddish brown weathering	70	501
8	Mudstone, black; rubbly; rusty weathering; large concretions, reddish brown weathering; 2″ bentonite seam at top	48	431
7	Mudstone, black; rubbly; seam of bentonite at 4′	30	383
6	Mudstone, as above; rare concretions; 2″ bentonite at top	57	353
5	Mudstone, black; rubbly; rusty weathering	90	296
4	Mudstone, as above; rare large concretions, reddish brown weathering	45	206
3	Mostly covered. Mudstone	150	161
2	Siltstone, argillaceous, black; massive	3	11
1	Mudstone, very silty, black; blocky; glauconitic	8	8
	GETHING FORMATION		
51	Sandstone, fine-grained, grey, siliceous; thick-bedded; strongly concretionary at top, reddish brown weathering; impressions and coaly fragments of logs; glauconite	4	517
50	Partly covered. Sandstone and mudstone	5	513
49	Sandstone, fine-grained, siliceous; thick-bedded; brown weathering	5	508
48	Partly covered. Sandstone, as above; interbedded mudstone, 25%	7	503
47	Sandstone, very fine grained, siliceous; bluish grey; thick-bedded; brown weathering	13	496

Unit	Lithology	Thickness (feet)	Height above base (feet)
46	Sandstone, fine-grained, grey, siliceous, laminated; thin-bedded; interbedded mudstone, 30%	4	483
45	Sandstone, fine-grained, grey, siliceous, laminated; thin- to thick-bedded; brownish grey weathering	8	479
44	Sandstone, fine-grained, laminated, siliceous, grey; interbedded mudstone, 20%	6	471
43	Mudstone, dark grey to black; rubbly	1	465
42	Sandstone, fine-grained, laminated, siliceous, grey; thin-bedded; rusty brown weathering; interbedded mudstone, 20%	9	464
41	Mudstone, dark grey to black; rubbly; few small concretions	29	455
40	Sandstone, fine-grained, laminated, siliceous; rusty weathering	2	426
39	Mudstone, dark grey; rubbly	15	424
38	Poorly exposed. Sandstone and mudstone	4	409
37	Covered, recessive. Mudstone	16	405
36	Mudstone, black; rubbly; rusty weathering; few sandy concretions	13	389
35	Mudstone, black; rubbly; interbedded sandstone, 25%, fine-grained, laminated, grey, siliceous, flaggy, rusty weathering	9	376
34	Mudstone, black; rubbly; rusty weathering large reddish brown weathering concretions	23	367
33	Mudstone, black; rubbly; siltier at top; few concretions	24	344
32	Covered	25	320
31	Sandstone, fine-grained, brownish grey, slightly ferruginous	2	295
30	Partly covered. Mudstone, blocky to rubbly; rusty weathering	49	293
29	Mudstone, black; silty; platy; interbedded sandy siltstone, 30%, platy to flaggy, rusty weathering	19	244
28	Mudstone, black, silty; platy; rusty weathering	8	225
27	Mudstone, silty; platy; rusty weathering; grading upward into argillaceous platy siltstone	8	217
26	Covered, recessive. Mudstone	15	209
25	Sandstone, fine-grained, silty, dark grey	3	194
24	Siltstone, very sandy, dark grey; platy	3.5	191
23	Sandstone, argillaceous, dark grey; dark grey weathering	1.5	187.5
22	Sandstone, argillaceous, laminated, dark grey; flaggy; interbedded silty mudstone, 25%, platy	6	186
21	Mudstone, silty; platy; interbedded sandy siltstone	4	180
20	Sandstone, argillaceous, dark grey; thin-bedded; grey weathering	4	176
19	Siltstone, sandy, dark grey; grading upward into silty sandstone, flaggy to poorly bedded, grey weathering	6	172
18	Mudstone, very silty; platy	4	166
17	Sandstone, fine-grained, silty, dark grey; flaggy to thin-bedded; grey weathering	8	162
16	Mudstone, silty; platy; some interbedded siltstone	3	154
15	Sandstone, fine-grained, silty to argillaceous, dark grey; platy to flaggy; grey weathering	7	151
14	Mudstone, silty; platy	2	144
13	Sandstone, argillaceous, dark grey; thin-bedded	3	142
12	Sandstone, fine-grained, homogeneous, grey, siliceous; thin- to thick-bedded; grey weathering	10	139

Unit	Lithology	Thickness (feet)	Height above base (feet)
11	Mudstone, silty; grading upward into siltstone, sandy, grey; platy; grey weathering	4	129
10	Sandstone, fine-grained, argillaceous; platy to flaggy; grey weathering	5	125
9	Siltstone, sandy; platy; grading upward into overlying unit	15	120
8	Sandstone, fine-grained, silty; thin-bedded; interbedded siltstone and mudstone at base	8	105
7	Sandstone, fine-grained, silty, grey; thin-bedded, few thin beds of mudstone	7	97
6	Sandstone, fine-grained, homogeneous, siliceous, brownish grey; slightly friable; thick-bedded	5	90
5	Sandstone, coarse-grained, friable, grey; thick-bedded	3	85
4	Sandstone, fine-grained, homogeneous to laminated, siliceous; thick-bedded; grey to rusty brown weathering	20	82
3	Sandstone, fine-grained, grey, siliceous; thin interbeds of platy siltstone	3	62
2	Sandstone, fine-grained, grey, laminated to homogeneous, siliceous, thick-bedded; grey to rusty brown weathering; few beds of medium-grained sandstone	54	59
1	Covered	5	5
	TRIASSIC		
	LIARD FORMATION		
	Sandstone, fine-grained, calcareous, grey, porous; thick-bedded; brown to light orange weathering	—	—

SECTION 68–9. Monteith and Gething Formations, south of Halfway River, east flank of anticline, Halfway River map-area, British Columbia, 56°58′N, 123°12′W.

Axis of syncline

Beds appear to be mudstone and must be within Buckinghorse Formation or within a few tens of feet of it

	GETHING FORMATION		
71	Sandstone, fine-grained, laminated, grey, thin- to thick-bedded; grey weathering	5	1,318
70	Covered	10	1,313
69	Sandstone, fine-grained, laminated, grey; thin- to thick-bedded; rusty weathering; partly covered at top	15	1,303
68	Mudstone; some platy siltstone and sandstone, 30%; orange weathering	9	1,288
67	Covered	11	1,279
66	Mudstone, silty, dark grey; interbedded siltstone and platy, argillaceous sandstone at top	43	1,268
65	Sandstone, fine-grained, laminated, siliceous, grey; medium-bedded; grey weathering	5	1,225

Unit	Lithology	Thickness (feet)	Height above base (feet)
64	Sandstone, fine-grained, laminated, limonitic; platy; argillaceous; thin beds of silty mudstone	12	1,220
63	Mudstone, silty; interbedded platy siltstone; some beds of platy to flaggy sandstone	20	1,208
62	Mostly covered. Appears to be mainly platy siltstone and sandstone, brown weathering, at top; silty mudstone at base	25	1,188
61	Sandstone, fine-grained, slightly argillaceous, grey; thin- to medium-bedded; grey weathering; some wavy bedding	14	1,163
60	Mudstone, silty; concretionary sandstone beds; banded appearance	16	1,149
59	Partly covered. Appears to be medium-bedded sandstone at base and thin, flaggy sandstone at top	39	1,133
58	Covered, recessive. Interbedded siltstone and shale at top	37	1,094
57	Sandstone, fine-grained, medium-bedded. Partly covered	17	1,057
56	Mudstone, silty; argillaceous, platy siltstone; some thin, platy to flaggy sandstone, 15%, toward top	40	1,040
55	Partly covered, recessive at base; thin platy sandstone at top	11	1,000
54	Sandstone, fine-grained, siliceous, brown to grey, laminated; medium-bedded; grey weathering	14	989
53	Covered, recessive	38	975
52	Sandstone, fine-grained, laminated, grey, siliceous; medium-bedded; grey weathering	19	937
51	Covered, recessive	49	918
50	Mostly covered. Sandstone at top	50	869
49	Sandstone, medium-grained, grey, siliceous; thick-bedded; grey weathering	24	819
48	Sandstone, coarse-grained, chert, siliceous, conglomeratic; brown; thin- to thick-bedded; brown weathering; carbonaceous fragments	18	795
47	Covered	10	777
46	Mostly covered. Sandstone, argillaceous; thin-bedded	17	767
45	Mostly covered. Mudstone, grading upward into sandstone.	10	750
44	Partly covered, recessive at base. Flaggy sandstone at top	18	740
43	Sandstone, fine-grained, argillaceous, laminated, brown; thin-bedded; brown weathering; cleaner and medium-bedded at top	18	722
42	Covered, recessive	12	704
41	Sandstone, fine-grained, grey, laminated, siliceous; flaggy at base, thick-bedded at top; grey weathering	36	692
40	Mudstone, silty, dark grey; grading upward into interbedded siltstone and sandstone, with flaggy sandstone at top	10	656
39	Sandstone, fine-grained, grey; thick-bedded to massive, grey weathering	11	646
38	Sandstone, fine-grained, laminated, brown; flaggy; brown weathering	10	635
37	Mostly covered. Appears to be mainly argillaceous sandstone.	27	625
36	Sandstone, fine-grained, grey, siliceous; thick-bedded; ripple-marks	12	598
35	Covered, recessive	29	586
34	Sandstone, fine-grained, laminated, grey, siliceous; thick-bedded; brownish grey weathering	9	557
33	Partly covered, recessive. Mudstone, silty, dark grey; some platy siltstone and sandstone	30	548

Unit	Lithology	Thickness (feet)	Height above base (feet)
32	Sandstone, fine-grained, laminated, grey, siliceous; thick-bedded; grey weathering	5	518
31	Mostly covered. Lower half appears to be mudstone; the upper half, interbedded platy sandstone and siltstone	34	513
30	Sandstone, fine-grained, grey, cherty, siliceous, laminated; thick-bedded; grey weathering; poor porosity	28	479
29	Partly covered. Appears to be mainly sandstone, fine-grained, flaggy to thin-bedded; grey to brown weathering	39	451
28	Mudstone, silty, black; some interbedded siltstone; few concretionary layers; grades into overlying beds	10	412
27	Mostly covered, recessive. Appears to be mudstone with thin beds of sandstone and some siltstone	70	402
26	Sandstone, fine-grained; platy to flaggy; rusty brown weathering	5	332
25	Mudstone, silty, and siltstone, platy; some fine-grained sandstone	21	327
24	Sandstone, fine-grained, laminated, brownish grey, siliceous; thin- to thick-bedded; grey to brownish grey weathering	33	306
23	Mudstone, silty, dark grey; interbedded platy sandstone; some channel sandstone; coaly at top	12	273
22	Sandstone, very fine grained, poorly sorted, argillaceous, laminated, brownish grey; thin-bedded, brownish grey weathering; interbedded argillaceous siltstone and some mudstone, 20%; ripple-marks; poor porosity	27	261
21	Mudstone, silty, dark grey	6	234
20	Sandstone, fine-grained, brownish grey; flaggy, becoming thick-bedded at top; grey weathering	7	228
19	Covered, recessive	8	221
18	Sandstone, fine-grained, laminated, brownish grey; flaggy to thick-bedded; grey to brown weathering; wavy bedded; ripple-marks	14	213
17	Partly covered. Sandstone, silty, platy, and argillaceous siltstone	19	199
16	Sandstone, fine-grained, grey, laminated, argillaceous; thin- to thick-bedded; grey weathering	8	180
15	Sandstone, argillaceous, silty; flaggy to thin-bedded; some mudstone; recessive with coaly shale at top	12	172
14	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded; grey weathering; ripple-marks	7	160
13	Covered, recessive	13	153
12	Sandstone, fine-grained, grey, finely laminated; limonitic; thin- to thick-bedded; grey weathering	10	140
11	Covered, recessive	4	130
10	Sandstone, fine-grained, grey; thick-bedded; grey weathering; ripple-marks	5	126
9	Covered, recessive	12	121
8	Sandstone, fine-grained, laminated, grey; thick-bedded; grey weathering	3	109
7	Covered, recessive	1	106
6	Sandstone, silty at base; flaggy; wavy bedded; brownish grey; brownish grey weathering	18	105
5	Covered, recessive	10	87
4	Sandstone, fine-grained; recessive at base; thick-bedded at top	12	77

Unit	Lithology	Thickness (feet)	Height above base (feet)
3	Sandstone, fine-grained, slightly calcareous, cherty, brownish grey, laminated; thin- to thick-bedded; grey weathering; poor porosity	23	65
2	Covered, recessive	25	42
1	Sandstone, fine-grained, argillaceous, grey, siliceous; thin-bedded at base, becoming thick-bedded at top, rusty grey weathering; some wavy bedding; ripple-marks; limonitic, laminated	17	17
	MONTEITH FORMATION		
23	Siltstone, argillaceous, platy; some interbedded mudstone; becoming sandier at top	26	421
22	Sandstone, fine-grained, grey, siliceous, laminated; thin-bedded, massive weathering; grey weathering; cleaner and thick-bedded toward top; few thin beds of argillaceous siltstone	36	395
21	Covered	8	359
20	Sandstone, fine-grained, argillaceous; flaggy to thin-bedded; grey weathering	12	351
19	Sandstone, fine-grained to silty, argillaceous, grey, siliceous; flaggy to thick-bedded; wavy bedded; grey weathering; cleaner at top	23	339
18	Covered, recessive	36	316
17	Sandstone, fine- to medium-grained, grey, cherty, siliceous; thick-bedded to massive; grey weathering; well-indurated.	33	280
16	Covered, recessive	34	247
15	Sandstone, fine-grained, siliceous, grey; some limonitic spots; thick-bedded to massive; grey weathering	24	213
14	Covered, recessive	11	189
13	Sandstone, fine-grained, grey, siliceous; thin- to thick-bedded; grey weathering	27	178
12	Covered	13	151
11	Sandstone, fine-grained, grey, siliceous; thin-bedded; brownish grey weathering	2	138
10	Covered	8	136
9	Sandstone, fine-grained, quartzose, siliceous, pyritic, limonitic, grey to brownish grey; thick-bedded; grey weathering	8	128
8	Sandstone, fine-grained, siliceous, grey; poorly bedded; brown weathering	13	120
7	Covered, recessive	15	107
6	Sandstone, fine-grained, brownish grey, siliceous; thick-bedded, poorly bedded to massive; grey weathering	12	92
5	Sandstone, fine-grained, slightly silty, grey, siliceous; thick-bedded to massive; grey weathering; some crossbedding; poorly bedded	34	80
4	Covered, recessive	4	46
3	Sandstone, fine-grained, grey, siliceous; grey weathering	9	42
2	Covered, recessive	3	33
1	Sandstone, fine-grained, grey, quartzose, well-sorted, siliceous, laminated to homogeneous; thick-bedded; grey to brownish grey weathering; poor porosity; glauconite	30	30

Unit	Lithology	Thickness (feet)	Height above base (feet)
	FERNIE FORMATION		
	Covered	300	300
	(Basal contact is not exposed and interval might be thicker)		
	TRIASSIC PARDONET FORMATION		
	Limestone, dense, brown weathering; some siltstone and shale; beds of *Monotis*		

SECTION 68–18. Gething Formation, west bank of upper Peace River canyon, Halfway River and Pine Pass map-areas, British Columbia, 56°01′N, 122°14′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GETHING FORMATION		
	Overlying beds are inaccessible. Eighty to one hundred feet of beds are exposed and include at least two coal seams		
223	Coal	2.5	1,660.5
222	Mudstone, grading upward into fine-grained sandstone	19	1,658
221	Sandstone, fine-grained, laminated, brownish grey	5	1,639
220	Mudstone	2	1,634
219	Coal and coaly shale	2	1,632
218	Mudstone	10	1,630
217	Mudstone, grading upward into argillaceous sandstone	12	1,620
216	Sandstone, fine-grained, laminated, concretionary, yellowish brown weathering	3	1,608
215	Mudstone, olive-brown	2	1,605
214	Coal, with large sandy concretionary bodies; lenses of mudstone	3	1,603
213	Mudstone, blocky, sandy	16	1,600
212	Mudstone, sandy at top; rusty brown weathering	7	1,584
211	Sandstone, fine-grained, argillaceous; platy in part, flaggy to thin-bedded; some silty carbonaceous beds	17	1,577
210	Partly covered. Coal at 15′. Appears to be mainly mudstone with some sandstone	18	1,560
209	Coal	1.5	1,542
208	Mudstone, carbonaceous in part	3	1,540.5
207	Sandstone, fine-grained, laminated, brownish grey, slightly calcareous; flaggy to thin-bedded	10	1,537.5
206	Mudstone, dark grey to black; rubbly to blocky	10	1,527.5
205	Sandstone, fine-grained, grey, laminated; flaggy	3	1,517.5
204	Mudstone	2	1,514.5
203	Coal	1	1,512.5
202	Sandstone, fine-grained, grey, laminated; flaggy	7	1,511.5
201	Siltstone, argillaceous, sandy, laminated; brownish grey; platy to flaggy	10	1,504.5
200	Coal; thin layer of sandstone in middle	1.5	1,494.5
199	Mudstone, carbonaceous, black; thin lenses of coal	3	1,493
198	Sandstone, fine-grained, brown, calcareous, brown weathering	5	1,490

Unit	Lithology	Thickness (feet)	Height above base (feet)
	SHEAR		
197	Mudstone, carbonaceous in part	7	1,485
196	Sandstone, fine-grained, laminated, grey	4	1,478
195	Mudstone, dark grey; blocky	2	1,474
194	Coal; 6″ mudstone at base	2	1,472
193	Sandstone, fine-grained, argillaceous, carbonaceous; flaggy to medium-bedded; brownish grey weathering; ripple-marks	7	1,470
192	Siltstone, sandy, argillaceous, brownish grey; flaggy	10	1,463
191	Mudstone, silty; blocky; 6″ lenticular coal near base	3	1,453
190	Sandstone, fine-grained, laminated, slightly calcareous, grey; interbedded mudstone; few thin lenses of coal	13	1,450
189	Sandstone, fine-grained, laminated, slightly calcareous, grey; medium-bedded; rusty brown weathering	12	1,437
188	Siltstone, argillaceous, brown; blocky	1	1,425
187	Coal	1.5	1,424
186	Mudstone, silty; blocky; grading into argillaceous sandstone	3	1,422.5
185	Coal	1	1,419.5
184	Partly covered. Mudstone and some sandstone	7	1,418.5
183	Mudstone, blocky; thin coal at base	2	1,411.5
182	Sandstone, fine-grained, laminated, grey; flaggy	3	1,409.5
181	Coal	1	1,406.5
180	Mudstone, dark grey; blocky	1	1,405.5
179	Sandstone, fine-grained, grey, laminated; recessive at base; thin-bedded to massive	9	1,404.5
178	Siltstone, sandy to argillaceous; grading into argillaceous sandstone, laminated grey weathering; cleaner sandstone at top; ripple-marks	27	1,395.5
177	Sandstone, fine-grained, laminated, brownish grey, slightly calcareous; medium-bedded; brown weathering; dinosaur tracks	5	1,368.5
176	Mudstone, splintery; black at base, becoming brownish grey and blocky; thin coal at base	20	1,363.5
175	Sandstone, fine-grained, laminated, calcareous, ripple-marks	3	1,343.5
174	Mudstone, carbonaceous, coaly	1	1,340.5
173	Sandstone, fine-grained, laminated, calcareous, brownish grey; medium-bedded; brownish grey weathering	3	1,339.5
172	Mudstone, carbonaceous, blocky; thin seam of coal in middle	3	1,336.5
171	Sandstone, fine-grained, laminated, calcareous, brownish grey; medium-bedded; brownish grey weathering	6	1,333.5
170	Mudstone, brownish grey; blocky	1.5	1,327.5
169	Coal, black	2	1,326
168	Mudstone, carbonaceous, brown to black; flaky	2	1,324
167	Siltstone, argillaceous, sandy, laminated, brown; brown weathering	5	1,322
166	Mudstone, brown; blocky	3	1,317
165	Sandstone, fine-grained, laminated, grey, calcareous, flaggy to thin-bedded; brownish grey weathering; ripple-marks	8	1,314
164	Coal; few sandy lenses	4	1,306
163	Sandstone, fine-grained, laminated, grey; flaggy	2	1,302
162	Mudstone, blocky; argillaceous siltstone, brown	6	1,300
161	Sandstone, fine-grained, laminated, slightly calcareous, argillaceous; brownish grey; medium-bedded; brownish grey weathering	12	1,294

Unit	Lithology	Thickness (feet)	Height above base (feet)
160	Siltstone, argillaceous; becoming very sandy and grading into overlying beds	4	1,282
159	Coal, black, bituminous	1	1,278
158	Mudstone, dark grey to black; rubbly to blocky; three subunits with argillaceous sandstone at top	20	1,277
	GSC loc. C-6945 *Haplophragmoides* sp. G117, common Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		
157	Sandstone, fine-grained, laminated, brownish grey; flaggy to thin-bedded; light rusty brown weathering	11	1,257
156	Mudstone, dark grey to black; platy at base, becoming sandy at top; 6 inches of coal about 2 feet above base	5	1,246
155	Sandstone, argillaceous, fine-grained, laminated, calcareous, carbonaceous; flaggy, ripple-marks	3	1,241
154	Sandstone fine-grained, grey, laminated, carbonaceous; medium-bedded; brownish grey weathering; few beds of mudstone (20%); ripple-marks; thin coaly bed near top	11	1,238
153	Mudstone, silty; platy to blocky; 6-inch coaly bed near base	8	1,227
	GSC loc. C-6944 ?*Haplophragmoides* sp. indet., rare Age: indeterminate (stratigraphic position Early Albian); environment: brackish to restricted marine		
152	Sandstone, fine-grained, laminated, grey, slightly calcareous; crossbedded; flaggy to thin-bedded; grey weathering	5	1,219
151	Mudstone, silty, grey, carbonaceous in part; blocky	14	1,214
	GSC loc. C-6941 ?*Haplophragmoides* sp. indet., rare Age: indeterminate; environment: ?restricted marine		
150	Coal, with thin coaly mudstone in middle	1	1,200
149	Mudstone, brownish grey, silty; grading into argillaceous, laminated siltstone; argillaceous sandstone at top	7	1,199
148	Sandstone, fine-grained, laminated, argillaceous, brownish grey; poorly bedded; brownish grey weathering	5	1,192
	(section continues on north side of Gething Creek)		
147	Mudstone, black, carbonaceous; platy; 4 inches of coal near top and thin seam near base, thickens along slope	4	1,187
146	Concretionary sandy layer; yellow weathering	1	1,183
145	Mudstone, dark grey to black, silty, thin coal at top	4	1,182
	GSC loc. C-6942 *Haplophragmoides* sp. G67, rare *Hippocrepina barksdalei* Tappan, few (dwarf) ?*Miliammina* ex gr. *M. sproulei* Nauss, rare ?*Ammodiscus* sp., rare		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Ostracoda sp., few Megaspore: IIA var. sp. 10 Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		
144	Sandstone, concretionary, rusty brown weathering	1	1,178
143	Mudstone, dark grey	3	1,177
	GSC loc. C-6939 *Hippocrepina* cf. *H. barksdalei* Tappan, few (dwarf) *Haplophragmoides* sp. G117, few *Haplophragmoides* sp. G67, rare ?*Ammobaculites* sp., few Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		
142	Coal, black, bituminous; carbonaceous mudstone in middle	4	1,174
141	Mudstone, grey, silty; argillaceous carbonaceous sandstone	2	1,170
140	Sandstone, fine-grained, laminated, calcareous, brownish grey; flaggy to thin-bedded, massive appearance; brownish grey weathering; wavy bedding; 1 foot of brown mudstone in middle	4	1,168
	GSC loc. C-6937 ?*Haplophragmoides* sp., few Age: indeterminate (stratigraphic position Early Albian); environment: ?marine		
139	Sandstone, very argillaceous, laminated, grey, poorly bedded; thin beds of mudstone	5	1,164
138	Mudstone, brown to olive-brown, blocky; brownish grey weathering; few thin beds of argillaceous, silty sandstone	4	1,159
	GSC loc. C-6938 *Hippocrepina* (*Hyperamminoides*) *barksdalei* Tappan, common *Haplophragmoides* ex gr. *H. gigas* Nauss minor *Haplophragmoides* ex gr. *H. umbonatus* Romanova Age: Early Cretaceous, Early Albian; environment: marine, restricted		
137	Sandstone, fine-grained, laminated, carbonaceous, brownish grey; flaggy to thin-bedded; 1″–2″ beds of olive-brown mudstone	5	1,155
136	Talus covered	10	1,150
135	Sandstone, fine-grained, grey, calcareous, carbonaceous in part; flaggy to thin-bedded, brownish grey weathering; massive appearance; cross-laminated; plant fragments on bedding surfaces	11	1,140
134	Mudstone, silty, brownish grey; blocky; some interbedded argillaceous siltstone; few large oval concretions; less sandy at base with thin concretionary beds	15	1,129

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-6935 (1,124′–1,129′) *Haplophragmoides* ex gr. *H. postis* Stelck and Wall, few ?calcareous Foraminifera, rare Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		
	GSC loc. C-6936 (1,114′–1,119′) *Trochammina* sp. G130, few *Haplophragmoides* sp. G116, abundant *Miliammina* sp. G10, few ?*Ammodiscus* sp., rare *Hyperammina* sp., rare ?*Gaudryina* sp., rare calcareous Foraminifera, rare megaspore IB, sp. 11, few pelecypod shell prism, few Age: Early Cretaceous, Early Albian; environment: marine, access to open marine		
133	Coal and coaly mudstone	1	1,114
132	Talus covered	4	1,113
131	Sandstone, fine-grained, calcareous, cherty, poorly sorted, laminated, brownish grey; flaggy to thin-bedded; some crossbedding and channel structures; 4% dolomite; poor porosity	13	1,109
130	Mudstone, dark grey; rubbly to blocky; few concretions; some carbonaceous mudstone and thin coal seam at base	10	1,096
	GSC loc. C-6934 ?*Bathysiphon* sp. 3, rare *Haplophragmoides* sp. G117, common *Haplophragmoides* sp. G67, rare *Hippocrepina barksdalei* Tappan, rare spine, siliceous, sp. 1, rare Age: Early Cretaceous, Early Albian; environment: marine, restricted		
129	Mudstone, dark grey, carbonaceous; rusty weathering; thin 1″ to 2″ coal seam at base	5	1,086
128	Sandstone, fine-grained, laminated, slightly calcareous; flaggy to medium-bedded; light brownish grey; grading into underlying unit	5	1,081
127	Mudstone, silty, brownish grey, brown weathering; some interbedded argillaceous siltstone; becoming sandier at top	9	1,076
	GSC loc. C-6933 *Haplophragmoides* sp. G116, common *Haplophragmoides* sp. G118, few *Hippocrepina* sp., few Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		

Unit	Lithology	Thickness (feet)	Height above base (feet)
126	Sandstone, fine-grained, laminated, brownish grey; thin-bedded; rusty brown weathering	5	1,067
125	Mudstone, dark olive-brown; blocky; platy at base; some thin beds of sandstone	8	1,062
	GSC loc. C-6930 *Haplophragmoides* ex gr. *H. duoflatis* Chamney, few *Hippocrepina* sp., rare Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		
124	Sandstone, fine-grained, laminated, brownish grey; flaggy to thin-bedded; brown weathering	7	1,054
123	Mudstone, black, carbonaceous; blocky to platy and flaky	4	1,047
	GSC loc. C-6931 *Bathysiphon* sp., rare *Haplophragmoides* sp. G117, common *Haplophragmoides* sp. G67, few *Haplophragmoides* ex gr. *H. duoflatis* Chamney, few *Hippocrepina* sp., common Age: Early Cretaceous, Early Albian; environment: marine, restricted, nearshore		
122	Coal; mudstone at base	1.5	1,043
121	Sandstone, fine-grained, laminated, poorly sorted, cherty, grey, siliceous; thick-bedded, light brownish grey weathering; cross-laminated, some crossbedding; poor porosity	9	1,041.5
120	Mudstone, olive-brown to black; blocky; concretionary layer in middle	5	1,032.5
	GSC loc. C-6928 *Haplophragmoides* cf. *H. postis* Stelck and Wall, few *Haplophragmoides* sp. G115, few *Haplophragmoides* sp. G67, rare *Saccammina* sp. 4, rare Age: Early Cretaceous, Early Albian; environment: marine, very restricted, nearshore		
119	Sandstone, fine-grained, laminated, argillaceous; flaggy to thin-bedded; brown weathering; interbedded mudstone	10	1,027.5
118	Covered	5	1,017.5
117	Partly covered. Sandstone, fine-grained, laminated, argillaceous in part, carbonaceous in part, grey; interbedded silty mudstone (25%)	10	1,012.5
116	Sandstone, fine-grained, laminated, cross-laminated, carbonaceous; thin- to medium-bedded; light brownish grey weathering	7	1,002.5
115	Mudstone, silty, dark olive-brown to grey; brown weathering; small concretions	3	995.5
114	Coal, black, bituminous	4	992.5
113	Mudstone, argillaceous, dark brownish grey, sandy at base; concretionary at base	2	988.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
112	Sandstone, argillaceous, laminated, dark grey, poorly bedded; grey weathering	8	986.5
111	Mudstone, dark grey; rubbly at base blocky toward top; brown weathering	3	978.5
110	Coal, black, bituminous	2	975.5
109	Mudstone, dark grey to black, carbonaceous; two coal seams, 2" to 3"	4	973.5
108	Sandstone, fine-grained, laminated, cross-laminated, grey; medium-bedded; rusty brown weathering	8	969.5
107	Siltstone, argillaceous, laminated; interbedded silty mudstone (30%); covered in lower half	14	961.5
106	Sandstone, fine-grained, grey; poorly bedded to massive; grey weathering	7	947.5
105	Mudstone, very silty; 3" coal at top	1	940.5
104	Sandstone, very fine grained, laminated, calcareous, argillaceous, grey; medium-bedded to massive; brownish grey weathering; more argillaceous and shaly toward base, poor porosity	20	939.5
103	Coal; some mudstone at top	1.5	919.5
102	Mudstone, dark brownish grey; blocky; argillaceous siltstone to sandstone at top; reddish brown weathering concretionary layer in middle	10	918
101	Mudstone, dark grey; siltier at top; rusty weathering	8	908
100	Sandstone, fine-grained, laminated; flaggy to thin-bedded; brown to rusty weathering	3	900
99	Siltstone, argillaceous and mudstone, thinly interbedded; few concretionary layers; thin coal seam at base	6	897
	GSC loc. C-6920 ?*Haplophragmoides* sp. G115, few Age: ? Early Cretaceous; environment: ?marine		
98	Sandstone, fine-grained, lenticular; mudstone; some lenses of coal	6	891
97	Sandstone, fine-grained, laminated, grey; flaggy	3	885
96	Mudstone, dark grey; some sandy siltstone; concretionary layer	15	882
	GSC loc. C-6919 *Bathysiphon* sp., rare ?*Trochammina* sp., common *Haplophragmoides* sp. G116, common *Haplophragmoides* sp. G117, abundant *Haplophragmoides* sp. G115, common shell fragments (*Viviparus* sp. operculum), common Age: Early Cretaceous, Aptian; environment: marine, restricted, some brackish, nearshore		
95	Mudstone, dark brown; rubbly to blocky; sandstone, fine-grained, laminated, argillaceous, grey, carbonaceous (40%)	15	867
94	Coal and coaly shale	0.5	852

Unit	Lithology	Thickness (feet)	Height above base (feet)
93	Sandstone, fine- to medium-grained; cherty, slightly calcareous, thick-bedded; grey weathering; large channel sandstone, crossbedded; poor porosity	31	851.5
92	Sandstone, fine-grained, laminated; channel sandstone with 6″ coal and coaly shale at top	6	820.5
91	Coal; mudstone at top	3	814.5
90	Mudstone, silty; laminated sandstone (25%)	8	811.5
89	Mudstone, silty, brownish grey; blocky to rubbly; two beds of argillaceous sandstone, brownish grey, laminated, carbonaceous	20	803.5
88	Sandstone, fine-grained, calcareous, brownish grey; crossbedded; flaggy	4	783.5
87	Mudstone, blocky	1.5	779.5
86	Coal and coaly shale	1	778
85	Sandstone, fine-grained, grey, laminated; flaggy; interbedded mudstone (30%)	6.5	777
84	Sandstone, fine-grained, argillaceous, carbonaceous, brown; brownish grey weathering	1	770.5
83	Mudstone, brownish grey; blocky to rubbly	2	769.5
82	Partly covered. Mainly mudstone, dark olive-brown to grey; some coal about 20 feet above base; concretionary bed at top	34	767.5
81	Sandstone, fine- to medium-grained, grey; thick-bedded; grey weathering; large channel sandstone	24	733.5
80	Partly covered. Mainly mudstone, dark brown to grey; two beds of sandstone, 2′ to 4′, and 1 foot of coal near middle	51	709.5
79	Sandstone, fine-grained, laminated, argillaceous, carbonaceous	2	658.5
78	Mudstone, silty, brownish grey; some fine-grained sandstone	5	656.5
77	Sandstone, argillaceous, brownish grey; flaggy to thin-bedded; brown weathering	4	651.5
76	Sandstone, fine-grained, grey; grey weathering	3	647.5
75	Mudstone, dark brown; sandstone (30%), fine-grained, lamiated, argillaceous	12	644.5
74	Mudstone, dark brown to brownish grey; blocky; few thin beds of sandstone	15	632.5
73	Sandstone, fine-grained, laminated; interbedded mudstone (40%); some crossbedding	9	617.5
72	Mostly covered, recessive. Mudstone	17	608.5
71	Mudstone, dark brownish grey	2	591.5
70	Sandstone, fine-grained, laminated, brownish grey; crossbedded	3	589.5
69	Mudstone; some platy sandstone	4	586.5
68	Sandstone, fine-grained, laminated, grey; grey weathering	3	582.5
67	Mudstone. Partly covered	7	579.5
66	Sandstone, fine-grained, interbedded mudstone (25)%	10	572.5
65	Sandstone, fine-grained, laminated; flaggy; some crossbedding; interbedded mudstone, silty, blocky (40%)	11	562.5
64	Mudstone, silty; blocky	2	551.5
63	Coal; coaly shale at top	3	549.5
62	Mudstone, dark brown, carbonaceous; sandstone (30%) in 1′ to 2′ beds	8	546.5
61	Mudstone, brown; grading into sandstone at top	8	538.5
60	Coal; some mudstone	1.5	530.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
59	Mudstone, brown; blocky to rubbly; carbonaceous	3	529
58	Sandstone, fine-grained, argillaceous; interbedded mudstone (40%)	4	526
57	Coal	1	522
56	Sandstone, fine-grained, laminated, argillaceous, carbonaceous; some mudstone at top	5	521
55	Coal	3.5	516
54	Mudstone, brownish grey; blocky to rubbly	9	512.5
53	Sandstone, fine-grained, argillaceous, carbonaceous; flaggy to poorly bedded	5	503.5
52	Mudstone, dark brown to olive-brown, very carbonaceous at top; argillaceous, carbonaceous sandstone (20%); rusty weathering	39	498.5
51	Sandstone, fine-grained, laminated, grey; upper part of channel sandstone which replaces underlying mudstone along slope; total thickness of channel sandstone is 10 feet	3	459.5
50	Sandstone, very fine grained, argillaceous, calcareous, laminated; interbedded mudstone in 6″ to 1′ beds	15	456.5
49	Sandstone, argillaceous, laminated, fine-grained; brownish grey weathering	2	441.5
48	Mudstone, dark brown to brownish grey; blocky to rubbly; few harder sandy beds at top	25	439.5
47	Sandstone, argillaceous, laminated, fine-grained; flaggy to thin-bedded	4	414.5
46	Mudstone, black, carbonaceous; coal, lenticular	2	410.5
45	Mudstone; talus covered	4	408.5
44	Sandstone, argillaceous, laminated, fine-grained, dark brownish grey; large yellow weathering concretionary bodies at base	5	404.5
43	Mudstone, dark brown; blocky to rubbly	3	399.5
42	Sandstone, argillaceous, carbonaceous, brownish grey; poorly bedded; some mudstone	3	396.5
41	Mudstone, dark brown to olive-grey; blocky to rubbly; sandier at top	5	393.5
	GSC loc. C-6914 *Ammodiscus* sp., few Age: ?Early Cretaceous; environment: marine, restricted		
40	Sandstone, fine-grained, laminated, brownish grey; brownish grey weathering	3	388.5
39	Mudstone, to argillaceous siltstone, olive-grey to black	4	385.5
38	Sandstone, fine-grained, laminated, carbonaceous, calcareous, brownish grey; crossbedded; mudstone at base	4	381.5
	GSC loc. 8025 (talus, may have come from higher beds) *Cladophlebis virginiensis* Fontaine emend. Berry *Sagenopteris williamsi* (Newberry) Bell *Ginkgo pluripartita* (Schimper) Heer *Pterophyllum rectangulare* Bell *Elatides curvifolia* (Dunker) Nathorst *Nilssonia yukonensis* Hollick *Pityophyllum* cf. *P. nordenskioldi* (Heer) Krystofovich Age: Aptian and/or early Albian		

Unit	Lithology	Thickness (feet)	Height above base (feet)
37	Mudstone, dark brownish grey; interbedded sandstone (20%) with 1′ to 2′ sandstone at top, lenticular, fine-grained	4	377.5
	GSC loc. C-6915		
	?*Haplophragmoides* sp. G115, few		C-6915
	Age: ?Early Cretaceous; environment: ?marine, restricted, nearshore		
36	Mudstone, dark brownish grey; blocky to platy	7	373.5
	GSC loc. C-6913		
	?*Bathysiphon* sp. G15, rare		
	Age: ?Early Cretaceous; environment: ?marine to brackish		
35	Sandstone, fine-grained to argillaceous siltstone	8	366.5
	GSC loc. C-6911		
	?*Trochammina* sp., rare		
	Age: Early Cretaceous; environment: ?marine to brackish		
34	Mudstone, dark brownish grey; few thin beds of sandstone	4	358.5
33	Sandstone, fine-grained, argillaceous, laminated; flaggy to thin-bedded; rusty weathering; interbedded mudstone (25%)	6	354.5
32	Mudstone, dark brownish grey; blocky to rubbly	5	348.5
31	Coal, black, bituminous	2	343.5
30	Sandstone, fine-grained, argillaceous, carbonaceous, brown, laminated; some mudstone, with thin lenticular coal seams	10	341.5
29	Coal; some mudstone at base	1.5	331.5
28	Sandstone, argillaceous, brown, cross-laminated; thin-bedded; some mudstone	4	330
27	Mudstone, silty, olive-grey; blocky; interbedded argillaceous siltstone; becoming sandier at top with laminated sandstone	10	326
	GSC loc. C-6908		
	?*Hippocrepina* sp., rare		
	Age: Early Cretaceous; environment: ?brackish to fresh water		
26	Sandstone, very fine grained, laminated, carbonaceous, poorly sorted, calcareous, argillaceous, grey; thin-bedded to massive; few thin coaly lenses; poor porosity	19	316
25	Mudstone; 6″ coal at top	1	297
24	Sandstone, fine-grained, silty, argillaceous, laminated; thick-bedded to massive; grey weathering; 4″ coal at 6 feet, 2″ coal at 7 feet	10	296
23	Mudstone, olive-brown, carbonaceous; rubbly; 10″ coal near base and 1′ seam 6 inches from top	19	286

Unit	Lithology	Thickness (feet)	Height above base (feet)
	GSC loc. C-6906 ?*Bathysiphon* sp. G26, rare *Chara* sp. 1A oogonia, common *Chara* sp., rare Age: Early Cretaceous; environment: fresh to brackish water		
22	Sandstone, argillaceous, laminated; crossbedded, thin-bedded; grey to brown weathering; channel structure; some mudstone	12	267
21	Partly covered. Mainly mudstone with few thin beds of sandstone	50	255
	GSC loc. C-6904 (245′–255′) ?*Hippocrepina* sp., rare Age: ?Mesozoic, undifferentiated; environment: ?marine		
	GSC loc. C-6902 (210′–220′) ?*Haplophragmoides* sp. G117 Age: Early Cretaceous; environment: ?marine		
20	Sandstone, fine-grained, laminated, slightly calcareous, grey, carbonaceous; brownish grey weathering	5	205
19	Mudstone, silty, dark grey	7	200
18	Siltstone, argillaceous, dark brown, laminated; thin-bedded, wavy bedded; thin coal layer in middle	4	193
17	Mudstone, dark brown, silty; some argillaceous siltstone	5	189
	GSC loc. C-6900 *Bathysiphon* sp. G26, rare Age: Early Cretaceous; environment: marine, restricted, nearshore		
16	Siltstone, argillaceous, to sandstone, argillaceous, laminated; brown weathering	5	184
15	Mudstone, dark brownish grey, silty; argillaceous, laminated sandstone in middle	10	179
	GSC loc. C-6899 *Chara* sp. oogonia, few Age: indeterminate; environment: brackish to fresh water		
14	Mudstone, carbonaceous, olive-brown to brownish grey; 1′ coal seam in middle	3	169
13	Mudstone, dark brown to olive-grey; blocky to rubbly; some beds of fine-grained and laminated sandstone, 6″ to 12″ (35%); few thin lenses of coal; some channel structure	13	166
	GSC loc. C-6998 megaspore: *Microcarpolithes* sp., rare Age: Early Cretaceous; environment: fresh to brackish water		

Unit	Lithology	Thickness (feet)	Height above base (feet)
12	Talus covered	33	153
11	Sandstone, fine-grained, laminated, cross-laminated, brownish grey, flaggy to thin-bedded; some interbedded siltstone; mudstone, blocky (30%)	7	120
	GSC loc. C–6897 *Haplophragmoides* sp. G117, few ?*Gaudryina* sp., rare Age: Early Cretaceous; environment: marine, restricted		
10	Sandstone, medium-grained, grey, slightly calcareous, laminated, some cross-laminated; small coal lenses; some channel structure with mudstone	8	113
9	Mudstone, grey; rubbly to blocky; coaly lenses in basal 2′; some argillaceous siltstone	11	105
8	Mudstone, dark brownish grey; rubbly to blocky; sandstone (40%), fine-grained, laminated; thin-bedded; some coaly mudstone	9	94
7	Siltstone, argillaceous, brown; sandstone, argillaceous, laminated; mudstone, blocky (25%)	31	85
6	Sandstone, very argillaceous, to siltstone, brown; poorly bedded to flaggy; brownish grey weathering	8	54
5	Mudstone, dark olive-brown; argillaceous siltstone at base; thin lenticular coal	2	46
4	Coal	3	44
3	Mudstone, dark brownish grey; rubbly to blocky; partly talus covered	15	41
2	Mudstone, dark brown to olive-grey; blocky; sandstone, fine-grained, laminated; flaggy to thin-bedded	15	26
1	Sandstone, fine- to medium-grained, grey; channel structure; grades into mudstone and shale	11	11
	CADOMIN FORMATION		
15	Sandstone, medium-grained, calcareous, cherty, grey; massive; brownish grey weathering; becoming somewhat finer grained toward top; poor porosity	43	186.5
14	Sandstone, fine- to medium-grained, laminated, cross-laminated, grey; topped by 4″ to 6″ mudstone	1.5	143.5
13	Mudstone, dark olive-brown, carbonaceous at base; rusty brown weathering sandstone in middle	3	142
	GSC loc. C–6890 ?*Haplophragmoides* sp., rare *H.* sp. G117, rare Age: Early Cretaceous (similar assemblage as Late Neocomian); environment: ?marine, restricted		
12	Coal, 9″ to 1′ at base, 6″ at top; carbonaceous mudstone to siltstone in middle	2.5	139
11	Sandstone, fine-grained, laminated, grey, cross-laminated; thin- to medium-bedded; grey weathering; interbedded rubbly to blocky grey mudstone (30%) in 1″ to 4″ beds	17	136.5

Unit	Lithology	Thickness (feet)	Height above base (feet)
10	Sandstone, coarse-grained to conglomeratic at base, becoming medium-grained at top, grey, slightly calcareous, laminated, cross-laminated; thick-bedded to massive; grey weathering; some channel structure; poor porosity	26	119.5
9	Sandstone, fine grained, laminated, grey; thin- to medium-bedded; grey weathering; interbedded mudstone in 1′ to 2′ beds, silty, blocky; 6″ coal seam at top	18	93.5
8	Mudstone, dark grey; blocky	2	75.5
	GSC loc. C–6889 *Haplophragmoides* sp. G117, common *Gaudryina* sp., rare Age: Early Cretaceous (similar assemblage as Late Neocomian); environment: marine, restricted		
7	Sandstone, fine-grained, laminated, grey; thick-bedded to massive; grey weathering	14	73.5
6	Sandstone, fine-grained, laminated, grey, calcareous; grey weathering; interbedded silty, blocky mudstone (25%)	9	59.5
5	Sandstone, medium-grained, calcareous, cherty, laminated, cross-laminated, grey; crossbedded, medium- to poorly bedded; grey weathering; thin, crossbedded sandstone at base; poor porosity	30	50.5
4	Sandstone, fine- to medium-grained, laminated, cross-laminated, calcareous, grey, thin-bedded to poorly bedded; grey weathering	15	20.5
3	Sandstone, fine- to coarse-grained; streaks of small chert pebbles; poorly bedded to crossbedded; rusty brown weathering	3	5.5
2	Mudstone, dark grey to black, carbonaceous; 2″ to 3″ coal at top	0.5	2.5
1	Sandstone, fine-grained, grey, argillaceous in part; grey weathering	2	2
	End of exposed beds at toe of dam		

SECTION 70–1. Cadomin, Gething, Moosebar, and Commotion Formations, east flank of large syncline east of Kinuseo Creek, Monkman Pass map-area, British Columbia, 54°51′N, 121°02′W.

Overlying shales of Hasler Formation are exposed in small cirque on north side of ridge in centre of syncline

COMMOTION FORMATION

Boulder Creek Member (375 feet)

28	Sandstone, thick-bedded to massive; approximate	25	1,492
27	Sandstone, fine- to medium-grained, crossbedded, flaggy; grey weathering	25	1,467

Unit	Lithology	Thickness (feet)	Height above base (feet)
26	Covered	65	1,442
25	Sandstone, as above	25	1,377
24	Covered	40	1,352
23	Sandstone, fine- to medium-grained, crossbedded, flaggy; grey weathering	29	1,312
22	Mostly covered, recessive. Flaky shale at base and some mudstone	75	1,283
21	Conglomerate, thick-bedded; grey weathering; pebbles, ½″–1″; some medium-grained sandstone in middle	46	1,208
20	Sandstone, fine-grained, finely laminated; thick-bedded, flaggy weathering; grey weathering	45	1,162
	Hulcross Member (328 feet)		
19	Siltstone, argillaceous, platy, grey, and mudstone; becoming much siltier and sandy at top	80	1,117
18	Snow covered. Silty shale, grey	75	1,037
17	Covered	73	962
16	Siltstone, argillaceous, platy; dark grey to rusty weathering; silty mudstone	100	889
	Gates Member (789 feet)		
15	Sandstone, argillaceous, carbonaceous, platy; plant fragments	35	789
14	Mostly covered, recessive. Dark brownish grey mudstone and coaly talus at base	45	754
13	Sandstone, fine-grained, laminated, crossbedded, flaggy; brownish grey weathering; plant fragments	27	709
12	Mostly covered, recessive. Black flaky shale and mudstone	42	682
11	Sandstone, fine-grained, laminated, cross-laminated; crossbedded, flaggy; brownish grey weathering; plant fragments	10	640
10	Covered	45	630
9	Covered. Coaly talus	33	585
8	Sandstone, fine-grained, laminated, platy, argillaceous; brown weathering; some interbedded mudstone; plant fragments	39	552
7	Partly covered. Sandstone, very fine argillaceous; platy, wavy bedded; brownish weathering; thick recessive interval at top with coaly talus	76	513
6	Mostly covered. Talus of dark mudstone with traces of coal	245	437
5	Sandstone, medium-grained, grey; thin-bedded, crossbedded	17	192
4	Conglomerate, massive, grey weathering; pebbles average ½″ to 1″, some are 2″; green, grey, chert, quartzite, quartzitic sandstone	64	175
3	Sandstone, fine-grained, argillaceous, laminated; wavy to nodular appearance; brown weathering; flaggy to thin-bedded	60	111
2	Mostly covered. Mudstone at base and sandstone toward top	35	51
1	Sandstone, fine-grained, finely and uniformly laminated, argillaceous, platy to thin-bedded; brown weathering; coaly talus at top	16	16

Unit	Lithology	Thickness (feet)	Height above base (feet)
	MOOSEBAR FORMATION (373 feet)		
3	Mostly covered. Interbedded mudstone and sandstone	40	373
2	Partly covered. Appears to be mainly fine-grained, finely laminated sandstone with interbedded mudstone	40	333
1	Covered	293	293
	GETHING FORMATION (346 feet)		
3	Mostly covered. Fine-grained, finely laminated sandstone, brown weathering, platy; coaly talus at base and higher	158	346
2	Sandstone, medium-grained, grey; flaggy to thin-bedded; grey weathering; some fine-grained, laminated, platy sandstone in middle	38	188
1	Covered. Coaly talus in basal 30 feet. Some fine-grained platy sandstone in talus and toward top	150	150
	CADOMIN FORMATION (306 feet)		
6	Conglomerate, massive, dark grey; pebbles average 1″; some 3″–4″; few recessive intervals	70	306
5	Covered	24	236
4	Conglomerate, massive, dark grey; pebbles average ½″–1″	25	212
3	Partly covered. Appears to be mainly conglomerate, massive, grey, crossbedded with thin lenses of sandstone; pebbles average 1″–2″, some are 6″–7″	125	187
2	Covered, recessive	17	62
1	Sandstone, very coarse grained to conglomeratic; crossbedded; finer grained toward top; pebbles average ½″–1″, some are 3″; channelling at base	45	45
	MINNES GROUP		
	Fine-grained sandstone, laminated, brown, thin- to thick-bedded; interbedded mudstone		

SECTION 70–4. Cadomin and Gething Formations, south side of Bullmoose Mountain, Dawson Creek map-area, British Columbia, 55°11′N, 121°28′W.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Overlying shales of the Moosebar Formation are exposed in cliffs along south side of main peak.		
	For descriptions of Moosebar Formation elsewhere on Bullmoose Mountain, *see* Sections 60–8, 60–10, 60–13, Stott, 1968.		
	Contact between Moosebar and Gething Formations is abrupt and distinct		
	GETHING FORMATION		
51	Conglomerate and conglomeratic sandstone, dark grey to reddish brown; concretionary in part; pebbles ⅛–½ inch in diameter	5	1,265

Unit	Lithology	Thickness (feet)	Height above base (feet)
50	Sandstone, fine-grained, argillaceous, laminated, siliceous, calcareous, grey; massive; platy to flaggy weathering; brown weathering; some small-scale crossbedding	58	1,260
49	Sandstone, fine-grained, laminated, siliceous, calcareous, grey; platy to flaggy; small-scale crossbedding	70	1,202
48	Covered	95	1,132
47	Sandstone, fine-grained, laminated, cross-laminated, calcareous, brownish grey; flaggy; crossbedded; brown weathering; poor porosity	33	1,037
46	Covered, recessive	15	1,004
45	Sandstone, fine-grained, laminated, grey; crossbedded, platy to flaggy; brown weathering; poor porosity	20	989
44	Covered	50	969
43	Sandstone and mudstone, interbedded, grading upward into sandstone, fine-grained, laminated, calcareous; platy to flaggy; rusty brown weathering; partly covered at base	33	919
42	Covered	119	886
41	Sandstone, fine-grained, laminated, cross-laminated; rusty brown weathering	3	767
40	Covered	48	764
39	Sandstone, fine-grained, laminated, cross-laminated; rusty brown weathering; interbedded mudstone	5	716
38	Covered	75	711
37	Sandstone, fine-grained, laminated, crossbedded; rusty brown weathering; poor porosity	28	636
36	Covered, recessive	35	608
35	Sandstone and interbedded mudstone	8	573
34	Sandstone, fine-grained, laminated, cross-laminated, grey; some trough crossbedding; brown weathering; few thin interbeds of mudstone; channel structure near top	16	565
33	Mostly covered. Mudstone, silty with some coal in lower part	107	549
32	Sandstone, fine-grained, argillaceous, grey; grey weathering; interbedded mudstone	4	442
31	Mudstone, black, carbonaceous; concretionary layer near top; some coaly talus	10	438
30	Sandstone, silty, grey, laminated	2	428
29	Mostly covered. Talus of black mudstone and coal	15	426
28	Sandstone, silty, argillaceous, grey, calcareous, laminated; blocky; some concretionary zones; thin interbeds of silty mudstone	14	411
27	Mudstone, black, flaky, carbonaceous; olive-brown mudstone at top; some coaly talus	17	397
26	Sandstone, fine-grained, laminated, calcareous; rusty brown weathering; channel structure	3	380
25	Mudstone, in cyclic units; olive-brown, black and carbonaceous; few thin beds of sandy siltstone and thin coal seams	29	377
24	Sandstone, fine-grained, laminated; crossbedded; brownish grey; interbedded mudstone, brownish grey to black	5	348
23	Mostly covered. Mudstone	13	343
22	Sandstone, fine-grained, laminated, cross-laminated, grey; crossbedded; grey weathering	3	330
21	Partly covered. Mudstone, dark grey	6	327

Unit	Lithology	Thickness (feet)	Height above base (feet)
20	Sandstone, silty, argillaceous, laminated, calcareous; some trough crossbedding; rusty brown weathering	4	321
19	Partly covered. Mudstone, black, flaky, carbonaceous, becoming olive-brown at top	5	317
18	Sandstone, fine-grained, argillaceous, laminated, cross-laminated, some slump structures; plant fragment	5	312
17	Mostly covered, recessive. Black, carbonaceous mudstone and some coaly talus	23	307
16	Sandstone, fine-grained, laminated; flaggy to thin-bedded; brown weathering	3	284
15	Mostly covered. Appears to be mainly mudstone; some coaly talus and rare thin sandstone	54	281
14	Partly covered. Mudstone, black, carbonaceous; coaly talus	18	227
13	Sandstone, silty, calcareous, finely laminated, cross-laminated, brown; flaggy; brown weathering; interbedded, argillaceous siltstone and mudstone; crossbedding; ripple-marks; plant fragments	17	209
12	Sandstone, silty, argillaceous, carbonaceous, laminated, brownish grey; interbedded mudstone; partly covered in upper part	15	192
11	Partly covered. Mudstone, silty, carbonaceous, black; platy	7	177
10	Covered. Some coaly talus and mudstone	20	170
9	Sandstone, fine-grained, laminated; thin-bedded to flaggy; grey weathering	3	150
8	Mudstone, very silty at base, dark grey; grading upward into platy laminated sandstone	9	147
7	Siltstone, sandy, grey, laminated; grading upward into laminated, fine-grained sandstone	8	138
6	Conglomerate, massive, brown; crossbedded; brownish grey weathering; pebbles average 1″ in diameter, maximum of 4″; coarse-grained sandstone in upper 2′	26	130
5	Conglomerate, massive, brown; crossbedded; brownish grey weathering; pebbles average ½″–1″; maximum of 2″; recessive at top	15	104
4	Partly covered. Platy sandstone	23	89
3	Covered. Coaly talus	14	66
2	Partly covered. Sandy siltstone at base; mudstone and platy, laminated sandstone at top	12	52
1	Covered. Approximate	40	40

Section continues on cliffs to east of gully. Possibility of small gap in measurement.

CADOMIN FORMATION

Unit	Lithology	Thickness (feet)	Height above base (feet)
13	Sandstone, medium-grained, brownish grey; crossbedded; brownish grey weathering; flaggy weathering	20	276
12	Conglomerate, massive, grey; coarse-grained matrix; bedding obscure; pebbles average 1½″–2″, maximum 8″; largest cobbles mainly white quartzose sandstone or quartzite	30	256
11	Partly covered. Conglomerate, massive, grey weathering; pebbles average 1″–1½″	25	226
10	Partly covered. Conglomerate and conglomeratic sandstone; crossbedded; brown weathering	24	201

Unit	Lithology	Thickness (feet)	Height above base (feet)
9	Conglomerate, grey, massive; bedding obscure; some imbrication; pebbles average 1″–1½″, maximum 5″	23	177
8	Partly covered. Sandstone, fine- to medium-grained; crossbedded; grey, brown weathering; lenses and streaks of conglomerate; some conglomerate beds in upper part	32	154
7	Sandstone, fine- to medium-grained, grey; rusty brown weathering; crossbedded, thick-bedded	18	122
6	Conglomerate, grey, massive; bedding obscure; some crossbedding and channel structures; pebbles average 1″, maximum of 4″	50	104
5	Covered	6	54
4	Conglomerate, grey, massive; brownish grey weathering; pebbles average 1″–1½″, maximum 6″; lenses of coarse-grained to conglomeratic sandstone	13	48
3	Sandstone, very coarse grained to conglomeratic, grey, massive; platy, crossbedded sandstone at base; some channel structures; lenses and streaks of conglomerate; becoming more conglomeratic along slope; pebbles average 1″, maximum 3″	12	35
2	Conglomerate, grey, massive; pebbles average ¾″–1″; maximum of 2″	17	23
1	Conglomerate, grey; massive; grey weathering; obscure bedding; lenses of coarse-grained sandstone; matrix of coarse sand; pebbles average ½″, maximum 1″; chert, quartz, quartzite and quartzose sandstone	6	6
	End of exposure. Slope below is covered and recessive.		

INDEX

BULLETINS

Geological Survey of Canada

Bulletins present the results of detailed scientific studies on geological or related subjects. Some recent titles are listed below (Information Canada No. in brackets):

192 Contributions to Canadian paleontology, *by* A. E. H. Pedder, *et al.*, $6.00 (M42-192)

193 Petrology and structure of Poplar Creek map-area, British Columbia, *by* Peter B. Read, $4.00 (M42-193)

194 Triassic petrology of Athabasca-Smoky River region, Alberta, *by* D. W. Gibson, $2.00 (M42-194)

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