GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PAPER 63-10

TRUTCH MAP-AREA, BRITISH COLUMBIA

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B. R. Pelletier and D. F. Stott

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INTRODUCTION

Two special field projects on the Mesozoic rocks of northeastern British Columbia have been carried out during the past few field seasons: (1) a study of Triassic formations of northeastern British Columbia, begun by Pelletier in 1959 and continued in 1960, 1961 and 1962; and (2) a study of the Lower Cretaceous Bullhead and Fort St. John Groups in outcrop sections, begun by Stott in 1961 and carried on in 1962. This is an interim account of the geology, together with a reconnaissance map based on information gathered in the course of these stratigraphic studies. These projects will eventually lead to publication of detailed studies on the Triassic and Cretaceous rocks respectively. As the field work was slanted towards the Mesozoic, little time was spent on the older rocks, and they are shown on the map as "undivided Palaeozoic".

Some geological mapping was done in the Trutch area by Hage (1944)[1] and much of the earlier work in the region has been summarized by McLearn and Kindle (1950). Muller (1961) mapped the Pine Pass area and Irish (1962) the Halfway River area, both adjacent areas. Detailed stratigraphic studies in the same general area have been made on the Lower Cretaceous by Stott (1962) and on the Triassic by Pelletier (1962). Occurrences of Triassic rocks in the subsurface of central Alberta and northeastern British Columbia east of the Foothills have been described by Hunt and Ratcliffe (1959), Colquhoun (1960, 1962) and Armitage (1962). An interpretation of the effects of the Peace River Arch upon the deposition of Mesozoic strata in the area of the Foothills and Rocky Mountains west of Fort St. John was presented by Williams (1958). Carboniferous stratigraphy and rugose corals occurring in northeastern British Columbia have been described by Sutherland (1958), and the ammonoid faunas of the Pardonet Formation by McLearn (1960). Reports on the Triassic faunas of Western Canada are given by Tozer (1961, 1962). Westermann (1962) gave an account of some Triassic (Norian) pelecypods of the Pine Pass area.

Part of the Trutch area was examined by means of packhorses in 1961. Assistance in the field was given during that summer by M.L. Larson. In 1962 work was continued with a Bell 47 G2 helicopter, piloted by F. Nobels with J. Warden as engineer. Assistance in the field was given by G.L. Goruk, technical officer, and A.R. Clarke, R.E. Ireland, M.J. Osatenko and J.T. Postle. The writers are also indebted to W. Boring, R. Cameron, O. Gauthier, A. Lamont, D. McDougald, R.L. Ross and I. Severson, all of whom worked in base camp or assisted on camp moves.

[1] Dates in parentheses are those of publications listed in the References.

LOCATION AND PHYSIOGRAPHY

The map-area lies on both sides of the Alaska Highway, British Columbia, 87 miles north of Fort St. John and 75 miles south of Fort Nelson. The highway runs north-south through the middle of the area providing easy access to many trails, winter roads, and streams, from which the entire area can be traversed.

Three major physiographic subdivisions are recognized: (1) the Interior Plains in the eastern half of the area, characterized by high buttes and mesas of Cretaceous sandstone in the western and northern parts, and low hills covered by dense vegetation in the southern uplands; (2) the Foothills, west of the Plains, consisting of an eastern part of low rolling hills and low-lying swampy terrain underlain chiefly by Cretaceous shales and a western part which is a typical valley and ridge province, consisting mainly of upper Palaeozoic and Mesozoic strata trending in a northwesterly direction; and (3) the Front Ranges of the Rocky Mountains in the west consisting of Palaeozoic formations. Due to stream dissection and later modification by valley glaciers the physiography of the mountains is expressed in the form of hanging tributaries, U-shaped valleys, sharp peaks, horns, arêtes, high terraces, tarns and cirques. Glaciers and snowfields occur at elevations above 7,000 feet.

Drainage consists of several major river systems which occur in two distinct groups on either side of the highway. Exceptions are Sikanni Chief River which drains from the Rocky Mountains, and Beatton River which originates from the eastern Foothills; both flow easterly across the Cretaceous escarpments of the Plains where they have formed canyons up to 1,000 feet deep. East of the escarpments along the highway the four main rivers are the Trutch in the north and the Buckinghorse, Sikanni Chief and Beatton in the south. In this relatively flat terrain the dominant river pattern is dendritic, but where the stream systems follow local structures it is trellis. In the western part of the map-area the six chief rivers are the Muskwa, Prophet and Minaker in the north, and the Besa, Sikanni Chief, and Halfway in the south. In this terrain underlain by folded rocks the dominant drainage pattern is trellis, with local dendritic pattern in the low swampy country between the western Foothills and Plains region. Small irregularly shaped lakes occur in low-lying and flat areas covered with muskeg. In the Foothills, elongate lakes up to 3 miles long occur parallel to the immediate drainage system. In the mountains, small lakes occupy some of the old cirques, and certain finger lakes extend for several miles along the U-shaped valleys.

Glaciation has had little effect on strata in the eastern half of the area. A thin cover of till on the eastern uplands – but up to 60 feet thick in river valleys – contains a variety of granitic and metamorphic material, indicating a possible origin in the Canadian Shield. Transport of this material was probably by means of thin continental ice-sheets; kames, drumlins and eskers are absent. In the Rocky Mountains and Foothills, valley glaciation is the chief form of erosion by ice. In addition to erosional forms, tills and bedded clays up to 20 feet thick are found in most of the stream valleys west of the highway, and adjacent to the mountains some of these deposits are more than 100 feet thick. The till consists mostly of Palaeozoic limestone, chert, and sandstone derived from outcrops to the west. Hummocky terrain due to deposition of till is common in the upper valleys in the western Foothills, and represents a terminal moraine of either valley glaciers or continental glaciers, or both.

STRATIGRAPHY

All formations are sedimentary in origin except for some of lower Palaeozoic age in the extreme west which have undergone low-grade metamorphism. The oldest rocks (map-unit 1) are Palaeozoic and consist of pelitic limestone, shale, and dolomite; they are probably Cambrian to Silurian in age. Their occurrence is restricted to the Rocky Mountains. Fossiliferous and fine-grained grey crystalline limestone of middle Devonian age overlies the lower Palaeozoic units. The middle and upper Palaeozoic rocks are made up of siliceous black shale, probably upper Devonian and lower Mississippian, overlain by sandstone, cherty limestone, and thick-bedded black chert. The sandstone and cherty beds are Mississippian in age, and the chert beds may be either Mississippian or Permian. In some areas both the Mississippian and Permian cherts are present; in others, due to pre-Triassic erosion, the Permian chert may be absent. These middle and upper Palaeozoic units are exposed along the mountain front, and also within the Foothills where rivers have deeply dissected anticlinal folds and major culminations. The overlying Triassic beds (map-unit 2) in disconformable contact with the chert, are about 3,500 feet thick in eastern sections and 5,500 feet or more in the extreme southwest. They include at least four formations – the Grayling, Toad, Liard, and Pardonet – but are mapped as undivided. Although the lithologies are fairly distinctive they are difficult to map, in certain areas, due to the gradational nature of the formational contacts. The oldest Triassic rocks belong to the Grayling Formation and consist of dark grey non-calcareous shales which weather dark grey and rusty-orange. These beds are absent or not exposed over most of the area, particularly in the east, but may be present in covered recessive intervals in the extreme west. They have been observed in this belt both north and south of the map-area. The Toad Formation, which conformably overlies the Grayling, comprises chiefly black, platy, calcareous siltstones, as well as massive siltstone, minor fine-grained sandstone and dark grey thin limestone. The Liard Formation overlies the Toad conformably and is grey, fine-grained, brown-weathering calcareous sandstone and siltstone with minor thick-bedded limestone and coquinoid beds of brachiopods and pelecypods. The limestones and sandstones commonly

TABLE OF FORMATIONS

System	Series	Group	Formation and Thickness (feet)	Lithology
Cretaceous	Upper Cretaceous		Dunvegan (500±)	Fine- to coarse-grained sandstone and conglomerate, mainly non-marine; carbonaceous shales
		Fort St. John	Sully (700±)	Dark grey marine shale with sideritic concretions; prominent marker bed of fish-remains
	Lower Cretaceous		Sikanni (350-380)	Four units of fine-grained, crossbedded marine sandstone separated by sideritic marine shales
			Buckinghorse (3,000 +)	Dark grey marine shale with sideritic concretions; glauconitic sandstone and pebbles near or at base
		Bullhead	Gething (0-1,180)	Fine-grained, cherty, marine sandstone; minor conglomerate and carbonaceous shale; rare thin coal seams
			Regional erosional unconformity; bevels rocks of succeedingly older age northward and eastward	
			Beattie Peaks (0-200?)	Thinly interbedded fine-grained marine sandstone, siltstone, and shale
			Monteith (0-700)	Alternating units of thick-bedded, fine-grained sandstone and silty mudstone; massive, quartzose, fine- to coarse-grained sandstone and minor conglomerate

Jurassic			Fernie (0-650)	Black, calcareous siltstone and shale with phosphatic chert; rusty-weathering marine shales; thinly inter-bedded sandstone, siltstone and mudstone
Triassic	Upper Triassic	Schooler Creek (McLearn, 1921)	Pardonet (0-600)	Bituminous limestones, and dark grey, platy, calcareous siltstones
			"Grey Beds" (460-1,150)	Grey limestones, dolomite and coarse sandstones
	Middle Triassic		Liard (350-920)	Medium-grained sandstones, generally calcareous, minor thick limestones, and calcareous, platy siltstones and shales
			Toad (900-1,200)	Massive and platy, calcareous, dark grey siltstones, and minor thin limestones and shales
	Lower Triassic		Grayling (0-250)	Dark grey, non-calcareous shales, and minor, platy, calcareous siltstones and thin limestones and sandstones
Palaeozoic (undivided)				Shales, chert, limestone and dolomite and sandstones

form ledges. Resting conformably upon the Liard are the "Grey Beds", which consist chiefly of medium-grained grey sandstones, and thick-bedded, finely crystalline, stylolitic and coarsely bioclastic, light grey limestone. Minor white to yellow dolomite and carbonate solutional breccias are also present. Some of the sandstones are black, porous, and highly bituminous. They are ancient offshore bars, and as such are suitable reservoirs for petroleum and natural gas. The Pardonet Formation overlies the "Grey Beds" and consists of dark grey to black thin bituminous limestones and platy siltstones which generally weather brown. In the northern part of the area these beds are absent due to post-Triassic, probably pre-Cretaceous, erosion. The upper Triassic is overlain disconformably by Jurassic rocks in the southern part of the area, and by Lower Cretaceous rocks in the north (Fig. 1).

The Fernie Formation (map-unit 3) lies disconformably upon the Triassic and is gradational into the overlying Cretaceous Monteith Formation (map-unit 4). In the southwesternmost sections the Fernie has a thickness of approximately 600 feet, but due to an erosional unconformity the thickness of the formation approaches zero along the eastern Foothills and north of Prophet River.

The Bullhead Group, as used here, comprises two distinct major units separated by a regional unconformity (Fig. 1). This unconformity is between the older rocks and the Gething Formation and bevels early Cretaceous (Beattie Peaks Formation, map-unit 5) in the southwestern part of the area, then successively the earliest Cretaceous, Jurassic and finally Triassic rocks northeastwards and northward.

The Gething Formation (map-unit 6), in contrast to the coal-bearing succession of the type section on Peace River, is, in this area, dominantly fine-grained cherty sandstone of presumably marine origin. Conglomerate, a minor constituent, is most abundant and coarsest in the westernmost sections. The formation, more than 1,200 feet thick near Sikanni River, grades laterally northwestwards into thinly interbedded sandstone and shale and finally, into shales of the Buckinghorse Formation (map-unit 7).

The Buckinghorse Formation of the Fort St. John Group, underlying a large area between the Foothills and Alaska Highway, in the north includes beds that are older than those of the type region. These marine shales are more than 3,000 feet thick. The Sikanni Formation (8), as presently restricted, consists of four sandstone units which have a thickness of about 380 feet. These beds form a prominent escarpment extending across the map-area. Overlying shales, approximately 700 feet thick, are assigned to the Sully Formation (9) and are gradational into the Dunvegan Formation (10).

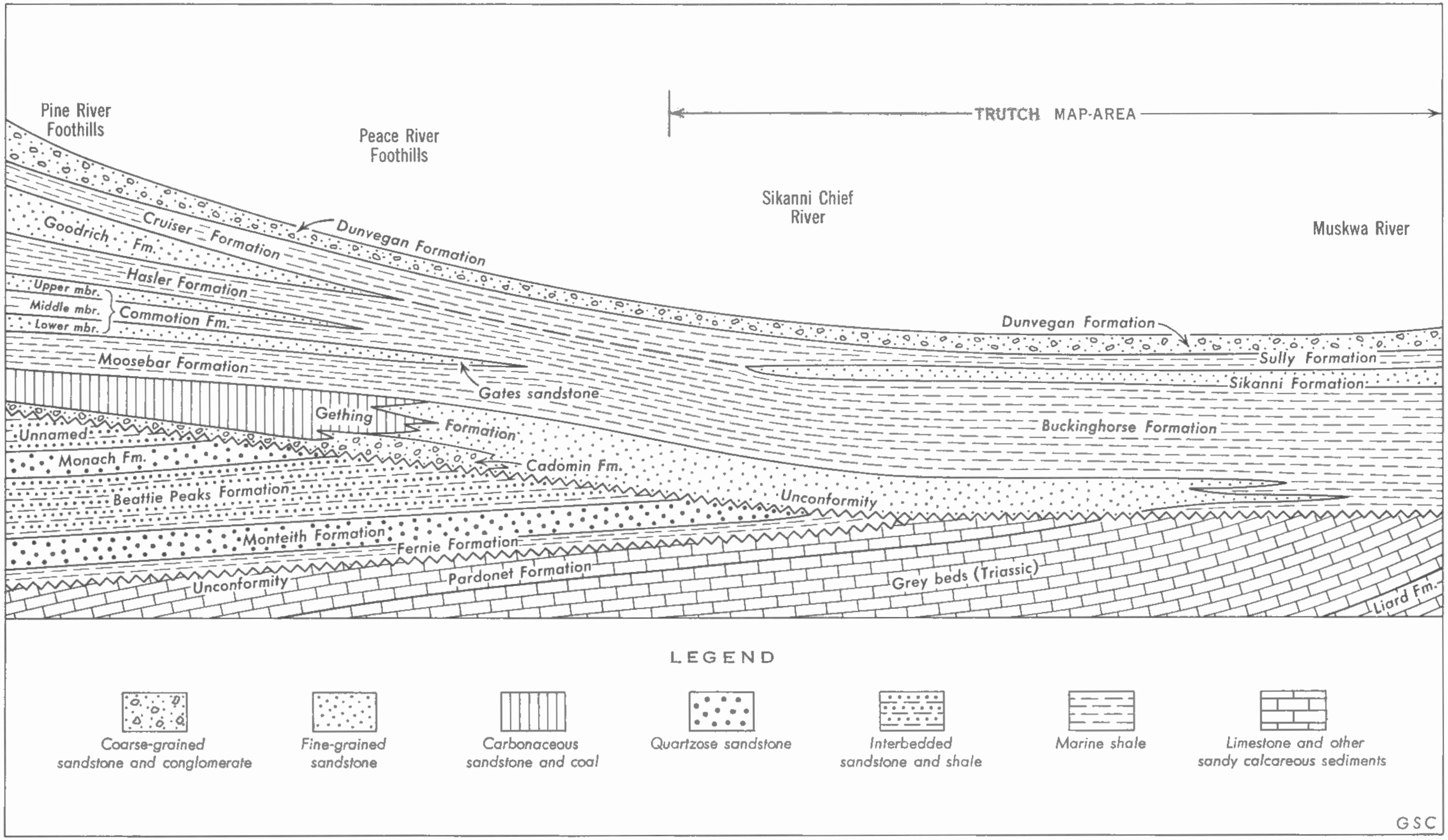

Figure 1. Schematic diagram illustrating relationships and unconformities of Upper Triassic, Jurassic, and Cretaceous formations, northeastern British Columbia

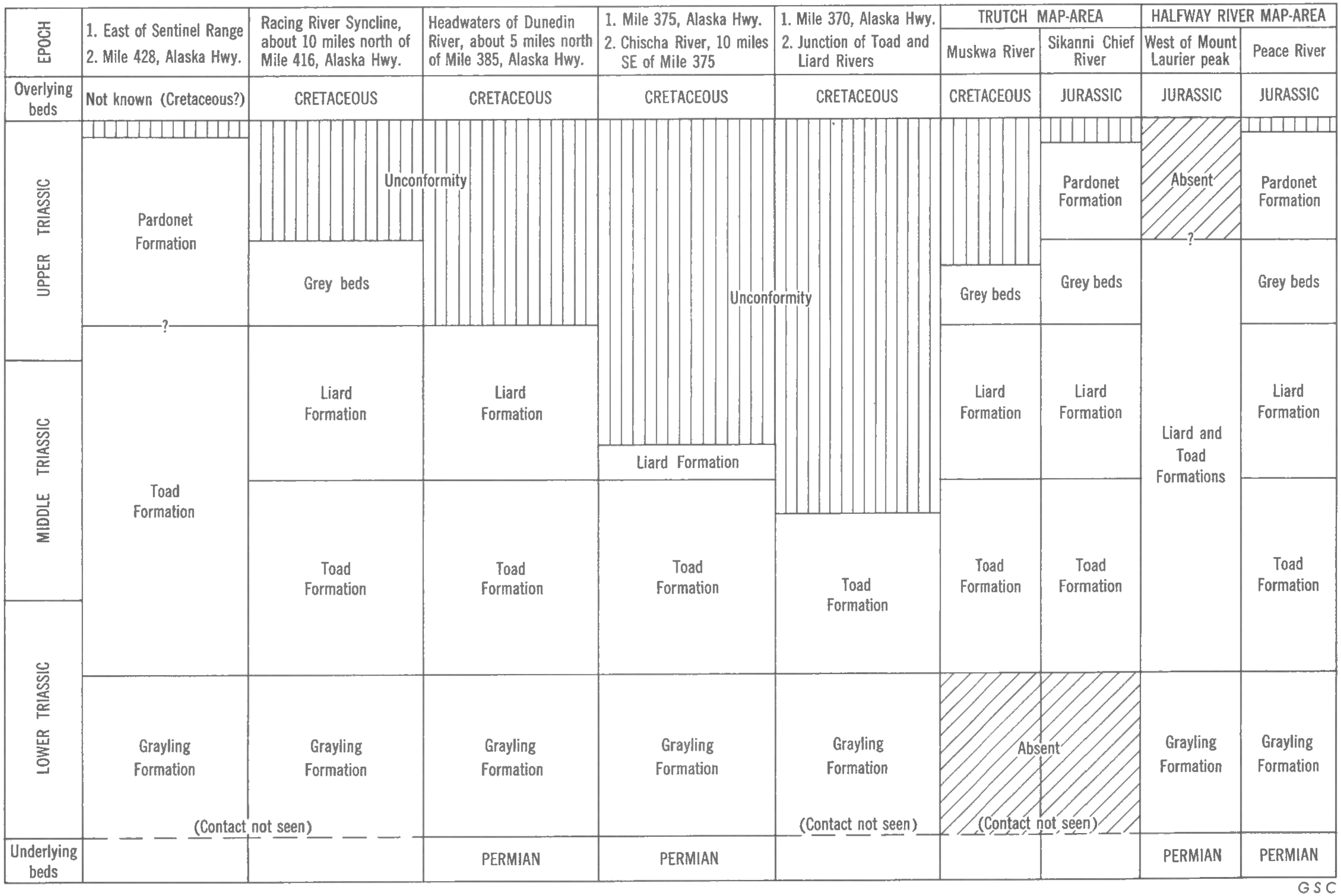

Figure 2. Correlation of Triassic formations in the Rocky Mountain Foothills, northeastern British Columbia

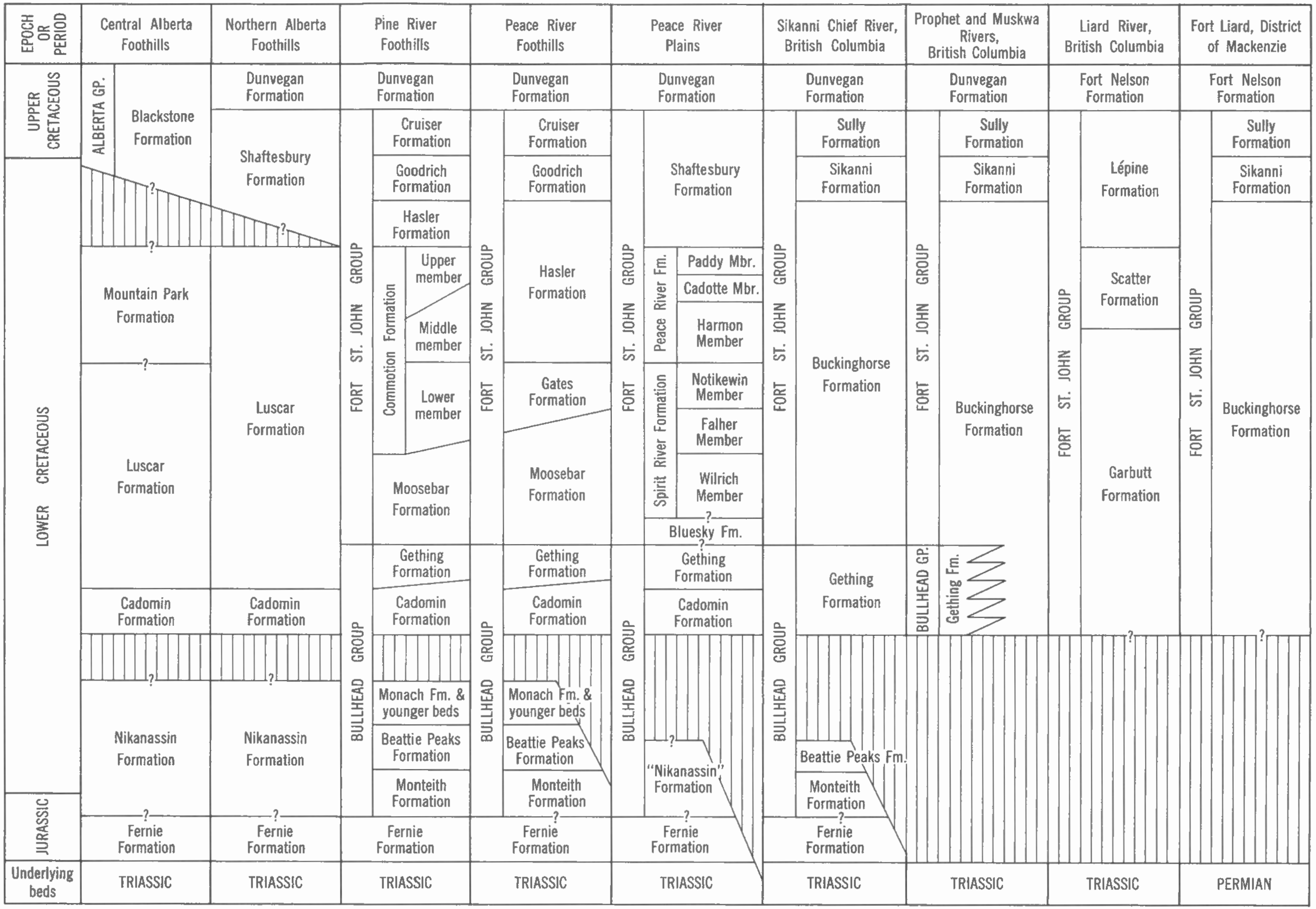

Figure 3. Correlation of Cretaceous formations of northeastern British Columbia

The Dunvegan sandstones and conglomerates form massive cliffs in the canyons of Buckinghorse and Sikanni Rivers and also along the large erosional remnants north of the canyons. The thickness of the formation is probably in the order of 500 feet.

STRUCTURE

Structure is the fundamental control of the physiography. Major and minor fold axes trend northwesterly so that trends of valleys and ridges may coincide with those of fold axes. Many of the folds extend across 10 to 20 miles of the map-area as single or en échelon compound structures.

Beds underlying the Plains regions are almost flat lying. Along the escarpment adjacent to the highway, several broad open folds with dips of a few degrees have been mapped. Beds underlying the low country in the eastern Foothills between the Plains region in the east and Klingzut and Pink Mountains on the west are gently to moderately folded, with dips varying up to 45 degrees. Several folds occur within this belt; the most prominent is the Pocketknife anticline south of Prophet River. These folds approximately parallel the trend of the Foothills. In the western Foothills where compound folding is well developed, the strata are openly folded with moderate to very steep dips, and show mild asymmetry. Where faulted the beds are contorted and generally overturned to the east. As the faults disappear along the strike, the folds assume normal open attitudes. The faults occur at only a few places, are generally west-dipping and rarely more than 10 to 15 miles in extent.

There are several culminations in which Palaeozoic rocks are exposed. The largest of these occurs in the north, extending from Tuchodi River, 25 miles north of the area, south across Muskwa and Prophet Rivers and terminating 2 or 3 miles south of Richards Creek. Another such culmination occurs 2 miles due east of Mount Trimble and northeast of Mount Stearns. It extends from Besa River south where it disappears about 6 miles north of Halfway River. In the western Foothills, synclinal valleys are normally occupied by Cretaceous shales and sandstones, and the anticlinal valleys by the Liard sandstones and older siltstones and shales of the Triassic. The Front Ranges of the Rocky Mountains are severely contorted and dislocated where Palaeozoic rocks are in fault contact with the Mesozoic Formations of the Foothills.

ECONOMIC GEOLOGY

Sedimentation trends in the Triassic sandstones in the Plains regions and eastern Foothills are probably parallel to isopachs and shore-zone trends, as indicated by ripple-marks and other primary structures in these sediments where they are exposed in the Foothills.

Consideration of these trends and their relationship to proven gas fields may indicate areas for profitable petroleum exploration. As the post-Triassic unconformity has removed several potential reservoirs to the north, the most favourable areas would lie to the east and southeast of the western Foothills belt toward the vicinity in which wells are now producing.

Although no petroleum or natural gas is obtained at present from Cretaceous strata, these rocks are productive farther south and east, and are considered potential reservoirs in this area.

The nature of the several folds in the Triassic and Cretaceous beds in the eastern Foothills suggests that middle Palaeozoic and older strata may be involved in folds of a magnitude comparable to those observed in the Foothills belt that reach culminations in the vicinity of those evident at the surface.

Sandstones of the Dunvegan and Sikanni Formations have been quarried extensively for road metal along the Alaska Highway.

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