GEOLOGY OF THE CENTRAL QUESNEL BELT, HYDRAULIC, SOUTH-CENTRAL BRITISH COLUMBIA (93A/12)

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KEYWORDS: Regional geology, Quesnel belt, Hydraulic map area, Nicola Group, alkaline volcanic rocks, alkalic intrusions, copper-gold mineralization, QR deposit, propylitic alteration.

INTRODUCTION

An ongoing project to remap and re-interpret the central Quesnel belt was begun in 1986. During the 1987 field season the author mapped an area extending from south of latitude 52°30′ to about latitude 52°45′, covering the central volcanic part of the belt, at a scale of 1:50 000 (Figure 1-13-1). This work was carried out in conjunction with mapping by Panteleyev in the Horsefly area to the south (Panteleyev, 1987; 1988) and by Bloodgood (1987; 1988) to the east. This work is a revision and extension of Preliminary Map 20 (Bailey, 1976), undertaken to update knowledge of the geology of the belt following the discovery of the significant Quesnel River (QR) gold deposit by Dome Exploration (Canada) Limited.

From the south to north the Quesnel belt, formerly known as the Quesnel trough, includes volcanic and sedimentary rocks of the Rossland, Nicola, Takla and Stuhini groups of Middle Triassic to Early Jurassic age. In the central Quesnel belt these Mesozoic strata are included in the Nicola Group as defined in southern British Columbia, and comprise a basal assemblage of generally fine-grained sedimentary rocks overlain by a dominantly volcanic assemblage. The lower sedimentary rocks are in thrust contact with the Precambrian to Lower Paleozoic Snowshoe Group to the east (Struik, 1986). In the west, although the contact of the Quesnel belt with the Cache Creek Group is not exposed, it is considered to be a fault. This fault is probably the southern extension of the Pinchi fault which separates the equivalent Mesozoic Takla Group from the Cache Creek Group north of Prince George.

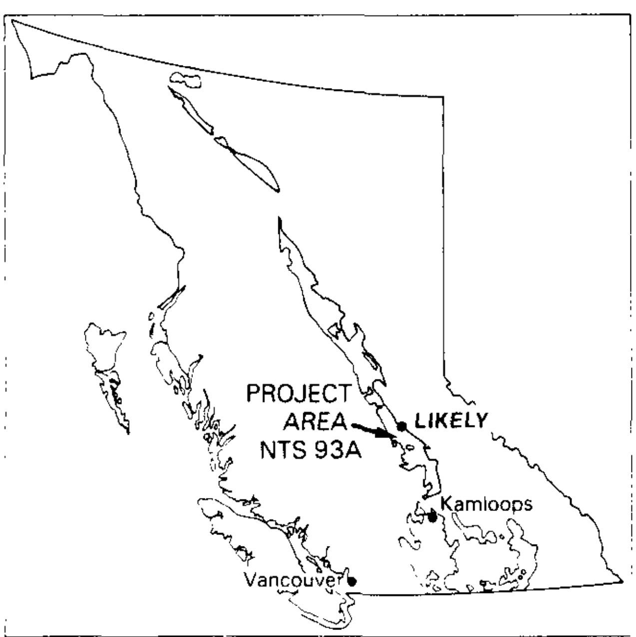


Figure 1-13-1. Location of the project area in Quesnel terrane (outlined area).

Basal sedimentary rocks of the central Quesnel belt range in age from probably Middle Triassic to Late Triassic. Overlying volcanic and associated rocks are Norian (Upper Triassic) to Sinemurian (Lower Jurassic). An essentially nonvolcanic successor basin assemblage of late Lower Jurassic to Middle Jurassic (Pliensbachian to Bajocian) sedimentary rocks overlies the volcanic sequence. The regional Mesozoic geology of the central Quesnel belt and the distribution of major rock types are shown in Figure 1-13-2.

PREVIOUS WORK

The volcanic nature and Mesozoic age of rocks in the map area were first recognized by Amos Bowman in 1887 who named the upper part of the volcano-sedimentary sequence the "Quesnel River Beds". Cockfield and Walker (1934) reexamined Bowman's area and supported his conclusion that the Mesozoic rocks unconformably overlie Paleozoic rocks. Cockfield and Walker also implied that the volcanic rocks of Bowman's Quesnel River Beds were similar to those in the southern part of the Quesnel belt. The area was remapped and mapping extended to the east by Campbell (1961, 1963) and to the south by Campbell and Tipper (1970). These workers considered the Mesozoic volcanic rocks of the central Quesnel belt to be related to the Nicola Group of southern British Columbia (Schau, 1971; Preto, 1979). Subsequently Campbell (1978) renamed the volcanic rocks of the Quesnel River area the Quesnel River Group after Bowman's original name (Bowman, 1887). In this report, however, the name Nicola Group is applied to the Mesozoic strata of the central Quesnel belt.

The alkaline composition of most of the volcanic rocks of the central Quesnel belt was documented first by Fox (1975) and later detailed by Morton (1976) and Bailey (1978). Barr *et al.* (1976) described the distribution of the volcanic rocks and discussed the relationships between copper mineralization and alkalic plutonism within the belt. These authors

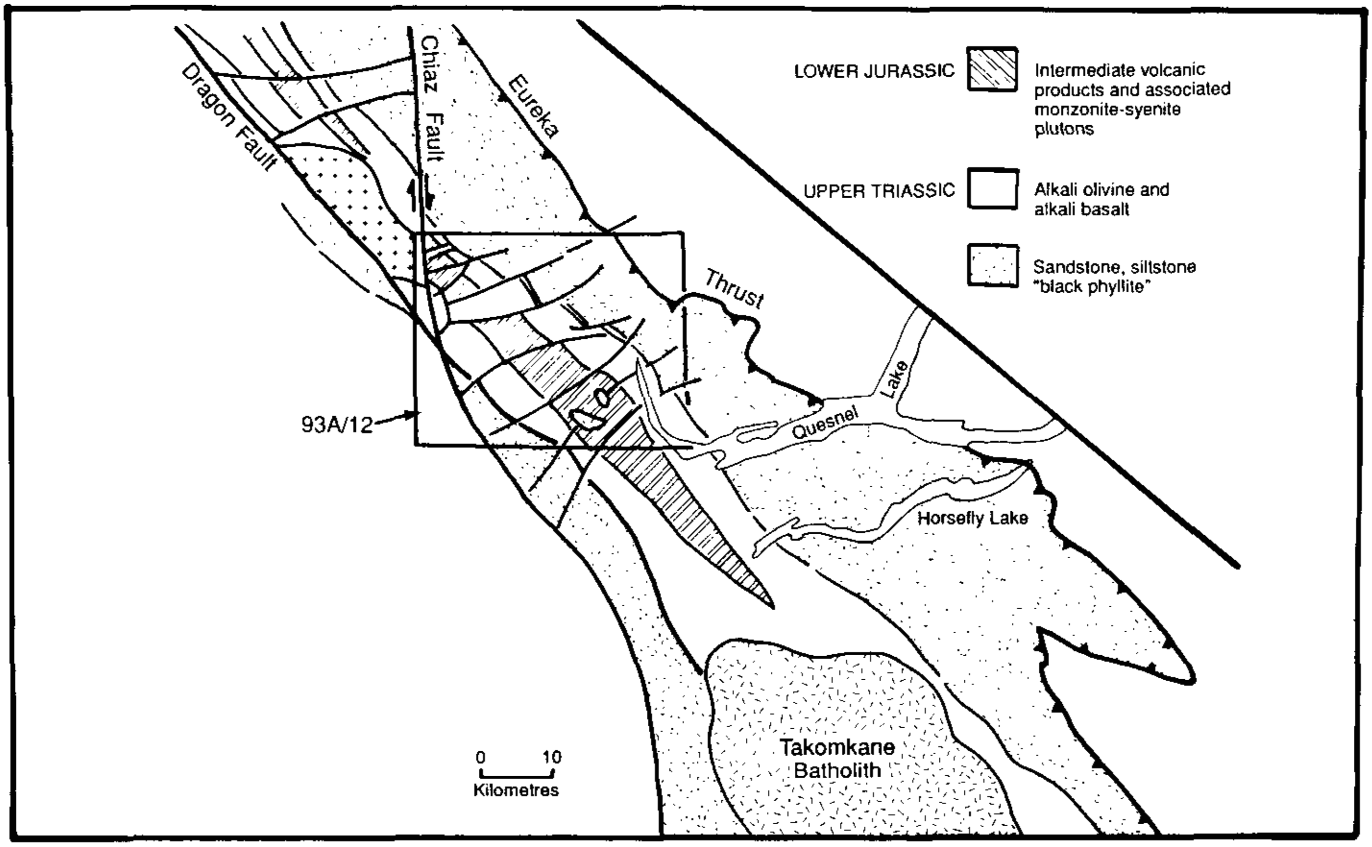


Figure 1-13-2. Simplified Mesozoic geology of the central Quesnel Belt.

argued that plutonism and volcanism were essentially comagmatic and coeval and that copper mineralization was both spatially and temporally related to these events, a conclusion supported by Bailey and Hodgson (1979) and Bailes (1977). The Cariboo-Bell porphyry copper deposit is an example of mineralization associated with alkaline intrusive and extrusive rocks; it occurs in the centre of the map area. This deposit has been described by Hodgson *et al.* (1976) and Bailes (1977). The recently defined QR deposit, a gold-copper deposit associated with an alkaline stock (Fox *et al.*, 1986), lies to the north of the Quesnel River.

STRATIGRAPHY

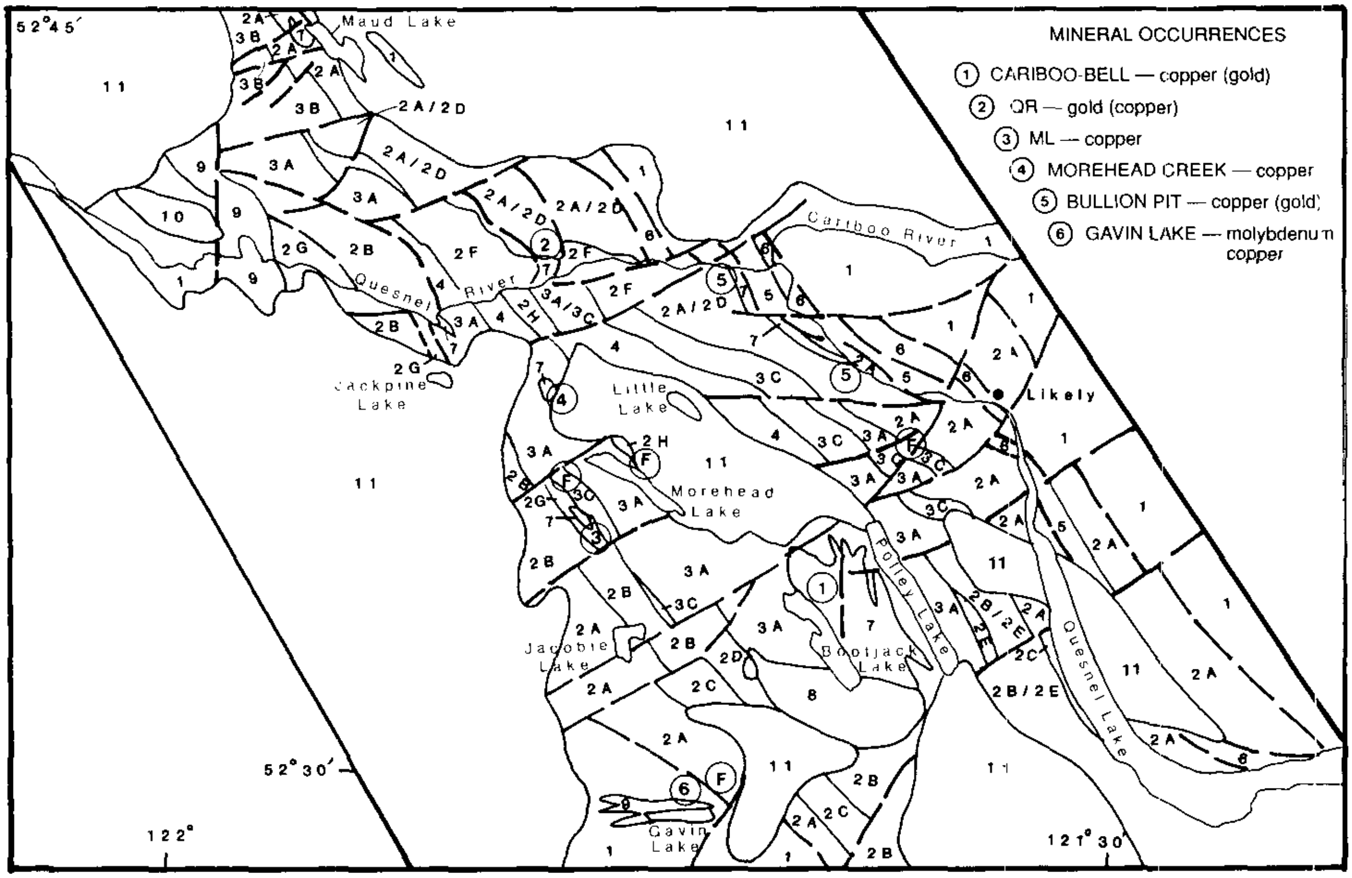
In contrast to the generally faulted and fragmented stratigraphic pattern of the southern part of the Horsefly map area (Panteleyev, 1987; 1988), the stratigraphic units of the Hydraulic map area (Figure 1-13-3) exhibit a bisymmetric, generally regular distribution which varies only in detail along the belt.

SEDIMENTARY AND VOLCANIC ROCKS

UNIT 1: The basal strata of the Mesozoic assemblage, both in the eastern and western parts of the belt, are fine-grained epiclastic sedimentary rocks. The eastern sedimentary assemblage is described by Bloodgood (this volume) and comprises her Unit 7. In the west this basal sedimentary unit is poorly exposed. Where observed it consists of phyllite, grading up into much less deformed siltstone, minor limestone, sandstone and greywacke. Toward the top of the unit mafic volcanic debris becomes common within the sedimentary rocks. This volcanic detritus is similar in composition to that of the overlying basaltic rocks, suggesting that early mafic volcanism and late sedimentation were essentially contemporaneous. Mafic dykes, interpreted to be feeders to the overlying volcanic rocks, cut the upper sedimentary sequence.

The age of Unit 1 in the eastern part of the belt has been determined from conodonts to range from Middle Triassic to Late Triassic (Struik, 1986). To the west, a Carnian fauna was collected from limestone within Unit 1 south of Gavin Lake (R.B. Campbell, personal communication, 1976) while *Monotis* sp. was collected from rocks immediately overlying Unit 1 near Gavin Lake (Bailey, 1978). Thus both the eastern and western sedimentary rocks exhibit a similar stratigraphic succession and are the same age. Therefore, it is concluded that the basal sedimentary rocks underlie the Quesnel belt and form the lowermost part of the Mesozoic volcano-sedimentary assemblage.

UNIT 2: Unit 2 comprises the products of mafic volcanism. It consists of green-grey pyroxene-phyric pillow lava, pillow breccia and autobrecciated flows, all of alkali olivine-basalt composition, at the base (2a), overlain by maroon to grey alkali basalt flows and breccia (2b). These two subunits comprise the bulk of Unit 2. In addition, mafic polylithic breccias, considered to have formed by laharic activity (2c), crop out in the central part of the map area.



LEGEND

	SEDIMENTARY AND VOLCANIC ROCKS		INTRUSIVE ROCKS	
PLEISTOCENE	11	*Glacial, fluvioglacial material*		
MIOCENE	10	*Alkali olivine plateau basalt*		
CRETACEOUS			9	*Granodiorite, quartz monzonite*
			8	*Nepheline syenite*
JURASSIC – PLIENSBACHIAN			7	*Monzonite, monzodiorite, syenite*
	6	*Chert, limestone and sandstone cobble conglomerate, shale, sandstone*		
	5	*Interbedded sandstone, siltstone*		
JURASSIC – SINEMURIAN	4	*Maroon alkali olivine basalt – analcite bearing*		
	3C	*Feldspathic sandstone, siltstone*		
	3B	*Monolithic latite tuff and breccia*		
	3A	*Polylithic breccia with feldspathic clasts*		
	2H	—		
TRIASSIC – NORIAN	2G	*Massive grey limestone and calcareous sandstone*		
	2F	*Interbedded mafic siltstone and sandstone*		
	2E	*Analcite-bearing maroon and grey basalt*		
	2D	*Hornblende-bearing pyroxene basalt*		
	2C	*Polylithic mafic breccia*		
	2B	*Maroon alkali basalt*		
	2A	*Green and grey alkali and alkali olivine basalt*		
	1	*Dark grey and green siltstone, sandstone, mafic tuff, minor conglomerate*		

SYMBOLS

- Fault
- Geological contact
- (1) Significant mineral occurrence
- (F) Fossil locality

Figure 1-13-3. Geology of Hydraulic area.

Hornblende-bearing pyroxene-phyric alkali basalt (2d) and analcite-bearing pyroxene-phyric alkali basalt that commonly contains plagioclase phenocrysts (2e) occur locally within rocks of Subunit 2a, that is, toward the base of Unit 2. A thick unit of siltstone and minor sandstone overlies and is interbedded with pyroxene basalt of Subunit 2a adjacent to the QR deposit.

Unit 2 is probably entirely of Late Triassic age (Norian). A thin red sandstone at the top of the unit in the Horsefly area contains a Norian fauna (R.B. Campbell, personal communication, 1976) and a limestone lens immediately overlying maroon basalt on the Morehead Lake–Beaver Valley road, 2.5 kilometres southwest of Morehead Lake resort, contains a Norian conodont fauna (H.W. Tipper, personal communication, 1987). *Monotis* sp. has been collected from a sedimentary lens within basalt at the base of Unit 2.

UNIT 3: Most of this unit consists of polylithic breccias (3a). These apparently formed by submarine slumping down oversteepened slopes during a second phase of volcanism. The compositions of rocks of this second phase of volcanic activity are mainly latite, trachyandesite and trachyte; breccias formed during this period of volcanism contain numerous clasts of these rocks. Where the breccias are proximal to volcanic centres, they contain more feldspar-rich clasts. Monolithic breccias, commonly of latitic composition (3b), with accompaying tuff, lie close to vent areas, now represented by syenite-monzonite plutons which formed within the volcanic edifices.

In the northern part of the map area monolithic latite breccia and immature tuffaceous sandstone predominate over polylithic breccias of 3a, while the polylithic breccias predominate in the southern and central parts of the map area.

Reasonably extensive feldspathic volcaniclastic and epiclastic siltstone deposits are poorly to well bedded and probably represent reworked tuffs (3c). These rocks are interpreted to be distal deposits related to major volcanic centres. The stratigraphic position of Subunit 3c is probably similar to that of 3a; Subunits 3a and 3c appear to lie on the uppermost basalt of Unit 2.

Unit 3 is probably Sinemurian in age. Strata deposited in a local sedimentary basin (2h), which appears to be partially covered by the volcanic products of Unit 3, are exposed in Morehead Creek and at Morehead Lake. Lower sediments in this basin contain Late Triassic fauna and they are overlain with apparent conformity by beds containing the Early Sinemurian index fossil *Badouxia canadense* (Frebold). These beds contain abundant mafic volcanic detritus suggesting a source in Unit 2, but no felsic volcanic detritus has been recognized in sediments of this basin. This suggests that felsic volcanism was later than Early Sinemurian and indicates a hiatus in volcanic activity of at least 4 to 5 million years duration. While spanning the stratigraphic gap between Unit 2 and Unit 3, sediments of this basin are included with Unit 2 because of the mafic composition and Norian age of the lower beds.

Thin discontinous sedimentary lenses occur within Unit 3 elsewhere in the map area. These sedimentary lenses are commonly calcareous and in places fossiliferous, but fossils obtained from them indicate only a general early Jurassic age (Bailey, 1978).

UNIT 4: This unit, which occurs only in the central part of the map area, consists of maroon alkali olivine basalt with characteristic small pink analcite grains present both as phenocrysts and as a matrix mineral. Generally highly amygdaloidal, the unit was probably erupted subaerially and represents the last stage of Nicola volcanism in the central Quesnel belt.

Unit 4 is younger than Subunit 3a on which it appears to sit unconformably and, thus, is probably younger than early Sinemurian.

UNIT 5: This unit, and overlying sedimentary rocks of Unit 6, represent a successor basin sedimentary assemblage which was deposited after late Triassic–early Jurassic volcanism had ceased. It comprises a sequence of dark to medium grey, commonly calcareous sandstone and siltstone which, although feldspathic, does not appear to contain detritus which can be directly attributed to a volcanic origin. In places these rocks are difficult to distinguish from rocks of Unit 1; their depositional environments appear to have been similar and they appear to occupy a similar structural position with respect to Unit 2. However, a Pliensbachian ammonite (*Arieticeras* sp.) has been collected from Unit 5 (R.B. Campbell, personal communication, 1976), demonstrating the younger age of these strata.

UNIT 6: Rocks of Unit 6 form a semi-continuous belt extending from near Horsefly Peninsula in the south (Panteleyev, 1987) to north of Quesnel River where the Mesozoic rocks of the belt become hidden by Pleistocene cover. Along the eastern margin of the Mesozoic volcanic belt, this unit is characterized by mature, generally clast-supported conglomerate. Clasts comprise dark grey chert, limestone, argillite, sandstone and, in places, greenstone presumed to be of basaltic composition. The Cache Creek Group which lies west of the Quesnel belt contains similar lithologies and represents the most likely source of the conglomerate beds. Fining-upward sequences of conglomerate, sandstone and carbonaceous shale are well developed within the unit.

The age of Unit 6 is probably Pliensbachian but there is no direct evidence for this. It appears to be in fault contact with Unit 5 and almost certainly with Units 1 and 2.

A generalized stratigraphic section of the sedimentary and volcanic rocks of the Hydraulic map area is given in Figure 1-13-4.

INTRUSIVE ROCKS

UNIT 7: This unit comprises varying amounts of syenite, monzonite, syenodiorite and monzodiorite and includes the Mount Polley, Bullion Pit, QR and Maud Lake stocks as well as a number of smaller plugs and dykes. Stratigraphic evidence (Bailey, 1978; Bailey and Hodgson, 1979) suggests that the Polley stock was coeval and comagmatic with the products of early Jurassic volcanism. However, radiometric data (Panteleyev, 1987), (Figure 1-13-5) and the observation that hydrothermal alteration associated with the Bullion Pit has affected Pliensbachian rocks indicate that plutonism continued after volcanism had ceased and may have extended into middle Jurassic time.

UNIT 8: Unit 8 consists of a single pluton, the Bootjack stock, which is composed mainly of nepheline syenite. Several textural types occur within this stock but the most distinctive is an orbicular nepheline syenite in which the orbicules are pseudoleucite. A whole-rock potassium-argon date obtained from a chilled margin of the stock is 111±4 Ma suggesting that the stock is Cretaceous in age (Bailey, 1978). However, the material analysed was not very suitable for dating so this age must be treated with caution. Intrusive and stratigraphic relationships of the Bootjack and Polley stocks indicate that the nepheline syenite is younger than late Early Jurassic.

UNIT 9: Unlike all other rock types in the area this unit is characterized by the presence of modal quartz. It consists of quartz monzonite, granodiorite and granite and crops out as a faulted stock in the northwestern part of the map area and as the Gavin stock in the south. Small dykes of leuco-adamellite to leucogranite occur infrequently in the southern part of the map area, notably nepheline syenite of the Bootjack stock.

Unit 9 is probably also Cretaceous. Dykes of Unit 9 are younger than the Bootjack stock but Unit 9 granodiorite in the northwestern part of the area appears to be overlain by Miocene basalt.

Other intrusive rocks occur throughout the map area. Small bosses of hornblende syenite and hornblende monzonite, often surrounded by small alteration envelopes, are interpreted as part of Unit 7. These rocks intrude strata as young as Pliensbachian.

Pyroxene and pyroxene-hornblende-porphyritic mafic dykes, interpreted as feeders for the overlying mafic rocks, intrude Unit 1. Plagioclase-porphyritic mafic or intermediate dykes near the top of Unit 2 have only been seen in the northeastern part of the map area.

The youngest rocks in the map area, unrelated to the Quesnel belt, are plateau basalt flows of Miocene age (Unit 10). A large part of the area is covered by glacial and fluvioglacial deposits of Pleistocene age (Unit 11). Direction of transport of these deposits was toward the northwest (305 degrees).

STRUCTURAL GEOLOGY

The central Quesnel belt has been folded into a broad open syncline of regional extent and cut by at least three generations of faults. In the area described in this report the geology exhibits two contrasting structural styles, one reflecting deformation caused by emplacement of Quesnellia onto the western margin of North America, and the second a later period of extensional tectonism.

The earliest deformation of the rocks is recorded in Unit 1, both to the east and the west of the volcanic belt. In the lower part of the sedimentary sequence, metapelites are deformed into east-verging recumbent folds with a well-developed axial planar fabric (*see also* Bloodgood, 1988). These folds have been refolded, giving rise to northeasterly lineations. No strong penetrative fabric is associated with this second period of folding although a crenulation cleavage is well

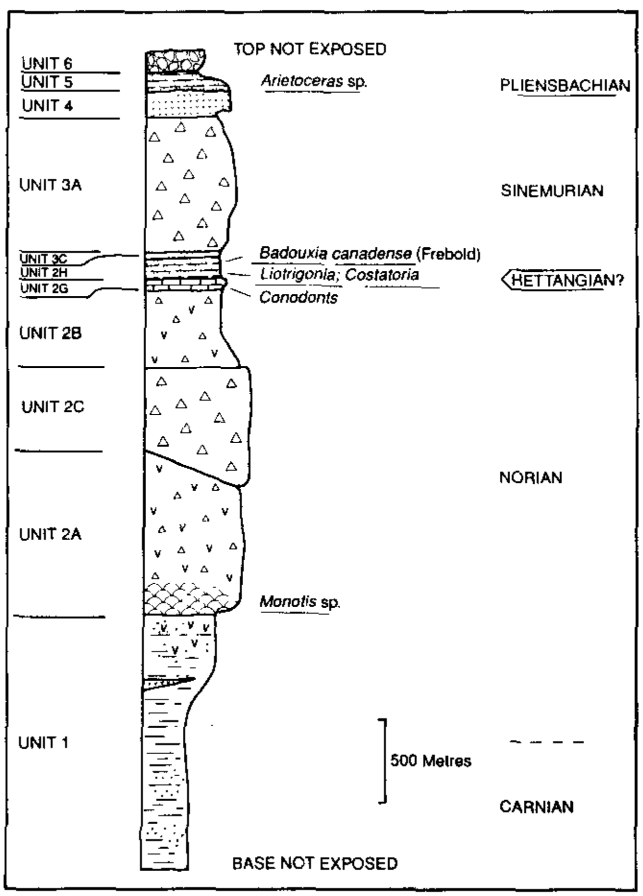


Figure 1-13-4. Generalized stratigraphic section, Hydraulic map area.

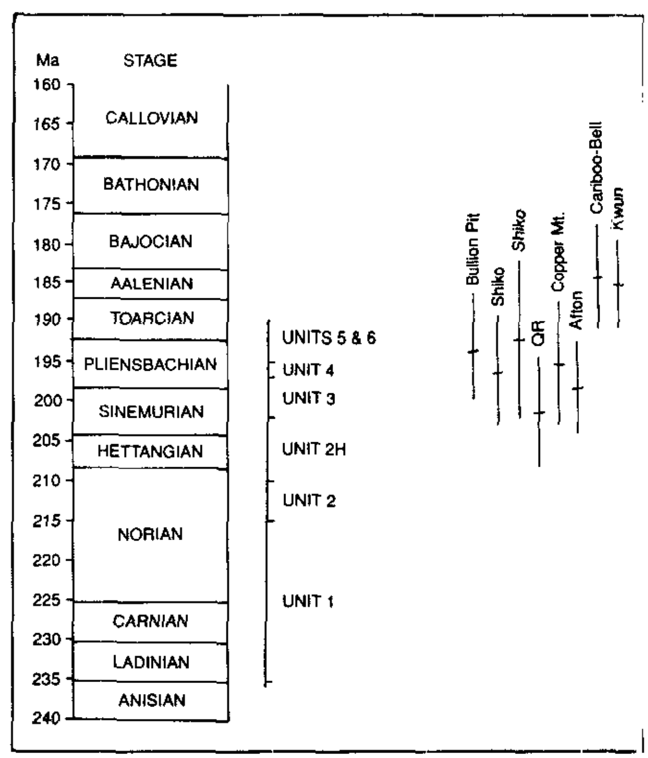


Figure 1-13-5. K/Ar radiometric ages of alkalic stocks of the Quesnel belt and their relationships to the stratigraphy of the central Quesnel belt.

developed in places. Higher in the Unit 1 stratigraphy deformation becomes less intense and, in the west, the coarser grained sedimentary rocks at the top of Unit 1 have not been penetratively deformed at all. Similarly, the coarse clastic and volcanic rocks of Units 2, 3 and 4 have behaved as a competent block and, although tilted and warped into a broad synform, are not penetratively deformed.

At least two periods of faulting have occurred within the map area. Early faults strike northwest. They appear to have been low-angle reverse faults which were subsequently steepened by tilting during later faulting. These reverse faults are seen only in the eastern part of the map area and are probably related to collision of Quesnellia with the Omineca terrane. Later faults strike dominantly to the northeast and the distribution of rock units suggests mainly sinistral displacement. A third fault set, mainly north striking, is probably related to the Pinchi fault system; these faults cut northeasterly striking faults. A north-striking dextral fault, informally named the Chiaz Creek fault, has displaced the central Quesnel belt and a pluton of probable Cretaceous age by a distance of about 7 kilometres.

The time of deformation of the central Quesnel belt was no earlier than late Early Jurassic, as Phase 1 thrust faults developed along incompetent siltstone beds within the conglomerate unit of probable Pliensbachian age. During this phase of deformation, which was probably the time of the first phase of folding in the lower sedimentary rocks, Norian volcanic rocks were apparently thrust eastwards over the Pliensbachian strata that are now exposed along the Quesnel River north of Likely.

Northeasterly striking faults appear to cut and, therefore, postdate low-angle reverse faults. Northeasterly faults are interpreted to cut the Polley stock, dated at about 185 Ma, but do not cut the Bootjack stock dated 111 Ma. Therefore, northeasterly faulting had ceased by Albian times (assuming the age of the Bootjack stock is correct).

North-striking faults which are related to the Pinchi fault system form the western boundary of the central Quesnel belt and may have been active into Tertiary time.

METAMORPHISM

With the exception of the lower sedimentary unit, the rocks of the central Quesnel belt are not significantly metamorphosed. Primary textures and fabrics are preserved except where the rocks have been affected by faulting or hydrothermal alteration. Most of the volcanic rocks record effects of zeolite facies regional metamorphism, due to burial.

In the underlying sedimentary rocks metamorphic grade is higher than zeolite facies but probably still subgreenschist.

MINERALIZATION

Alkalic stocks of the central Quesnel belt, such as the Polley stock, commonly host porphyry copper deposits which have a strong copper-gold association. Extensive propylitic alteration zones around these deposits are characterized by chlorite, epidote, calcite, pyrite and zeolites. Cariboo-Bell is the largest of the known alkalic porphyry deposits in the map area; reserves are about 116 million tonnes, grading 0.41 per cent copper and 0.025 gram per tonne gold.

The QR deposit to the north of the Quesnel River, with reserves of about 1.1 tonnes grading 7.2 grams per tonne gold, is also associated with an alkalic stock. Mineralization occurs within a zone of intense propylitization to the north and west of the stock but not within the intrusive body. Copper is closely associated with gold in the QR deposit which, although lower in the stratigraphy than the Cariboo-Bell porphyry deposit, probably formed at a much higher structural level.

Most of the syenite-monzonite stocks of similar age within the map area (for example, Morehead Creek, Morehead Lake, Bullion Pit) have propylitic alteration haloes. East of the Bullion Pit stock, alteration has affected rocks as young as Pliensbachian, which is in accord with the radiometric age of 193 ± 7 Ma determined for the Bullion Pit stock (Panteleyev, 1987).

A number of monzonite-syenite stocks (for example, Maud Lake, QR, Bullion Pit and several smaller stocks) are distributed along or near the base of Subunit 2a in the easternpart of the map area. This distribution along a major facies boundary, at the base of the volcanic sequence and immediately above the lower sedimentary sequence, may reflect an early northwest-striking fault or fault zone which controlled the locii of mafic volcanism and stock emplacement. Similarly, the alignment of the Polley, Shiko, Lemon Lake and several other stocks suggests the presence of another linear structural feature controlling stock emplacement in the central part of the belt.

Hydrothermal calcite veins are associated with a hornblende monzonite intrusion to the east of the QR stock on the north bank of the Quesnel River. The veins occupy small extension fractures or faults within pyritic and chloritic basalt of Unit 2a which has been intruded by the monzonite.

The Gavin Lake stock hosts mineralization unrelated to Triassic-Jurassic volcanism and plutonism. The Gavin Lake stock consists of quartz monzonite and granodiorite which have intruded sedimentary rocks of Unit 1. These sedimentary rocks have been variably hornfelsed and metasomatized adjacent to intrusive contacts. Chlorite-pyrite alteration is prominent in places. Chalcopyrite-molybdenite mineralization is associated with quartz monzonite of the complex, mainly in the northern part. Exploration carried out in the 1970s failed to define economic mineralization and since that time no further exploration has been carried out in this area.

A granodiorite to quartz monzonite stock in the northwestern part of the map area, and which is presumed to belong to the same suite of intrusions as the Gavin Lake stock, has been variably propylitized around its margins and contains minor copper-molybdenum mineralization. The stock and its environs are at present being re-examined for possible gold mineralization.

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STRATIGRAPHY AND MINERAL OCCURRENCES OF CHIKAMIN MOUNTAIN AND WHITESAIL REACH MAP AREAS* (93E/06, 10)

By L. J. Diakow and V. Koyanagi

KEYWORDS: Regional geology, Chikamin Mountain, Whitesail Reach, Coast Complex, Intermontane Belt, Hazelton, Bowser Lake, Skeena, Kasalka, Ootsa Lake, Endako, quartz vein mineralization, porphyry copper-molybdenum, gold, silver-lead-zinc.

INTRODUCTION

The Whitesail project is a 3-year regional 1:50 000-scale mapping program that was begun in 1986. The project area, centred on Whitesail Lake, encompasses map sheets 93E/06, 10 and 11E.

The area is underlain by Mesozoic and Cenozoic volcanic and plutonic rocks that host epithermal and mesothermal vein deposits. The project objectives are twofold:

- Refine mapping of Mesozoic and Cenozoic stratigraphy and structures.
- Determine the geologic setting of known mineral occurrences.

During 1986, fieldwork was restricted to the Whitesail Range and Whitesail Reach areas. The results of this work are published as Open File 1987-4 and supplemented by a report in Geological Fieldwork, 1986 (Diakow and Mihalynuk, 1987b). In 1987, map coverage was expanded to the east and southwest to cover an additional 900 square kilometres (Figure 1-14-1). This report describes the lithostratigraphic divisions and structure of the area and the geological setting of several notable mineralized areas. The Whitesail project is funded under the Canada/British Columbia Mineral Development Agreement.

PREVIOUS WORK

The earliest reports of geological work in the study area cite results of reconnaissance shoreline mapping and document the development of mineral prospects in the Chikamin Range (Galloway, 1917, 1920; Brock, 1920; Marshall, 1924, 1925). Duffell (1959) published the first regional synthesis of geology in the Whitesail Lake map area. The same area was later remapped and the results published in a preliminary map (Woodsworth, 1980). This map, in addition to mapping immediately west of the project area by MacIntyre (1976, 1985) and van der Heyden (1982), are sources frequently referred to in the present study.

PHYSIOGRAPHY

The study area encompasses portions of the Coast Mountains and the Nechako Plateau. The Coast Mountains are a northwest-trending series of ranges made up of granitic and metamorphic rocks. The mountains commonly rise above 1800 metres elevation and typically have steep dissected slopes. The Nechako Plateau, which extends easterly from the Coast Mountains, is underlain by volcanic and sedimentary rocks. The transition between physiographic divisions is marked by Chikamin Range and Whitesail Range, which project northeastward from the Coast Mountains. These ranges have peaks in excess of 2200 metres elevation; relief gradually diminishes northeastwards to hilly topography, above 900 metres elevation, characteristic of the Nechako Plateau. The Quanchus intrusion forms the core of the Quanchus Range, an uplifted area rising more than 1100 metres above the valley bottom along the eastern margin of the study area.

The drainage in the area is split at a divide roughly coincident with the east boundary of the Coast Mountains. A northeastly drainage originates through a system of creeks and small lakes connected with Whitesail and Eutsuk lakes. This system provides access to lower slopes of the Whitesail and Chikamin ranges. A southwesterly drainage comprises a dendritic pattern of smaller tributaries connecting with larger streams flowing to the Pacific at Gardner Canal.

The effects of a major glacial epoch are evident throughout the map area. Striations on bedrock indicate a general northeasterly ice flow, roughly following the axis of Whitesail Lake. Ice-flow direction deviates easterly in northern Whitesail Range and north-central Chikamin Range, possibly indicating lobes deflected around areas of high relief. In the valleys, low amplitude glacial ridges and rounded topography, in places mantled with glacial deposits as thick as 75 metres, attest to widespread glaciation. Icefields and cirque glaciers are restricted to alpine areas above 1500 metres elevation in the mountain ranges.

GENERAL GEOLOGY

The study area, for the most part, is within the Intermontane Belt although the Coast plutonic complex underlies the southwestern sector. The boundary between these tectonic divisions is characterized by northeast-directed thrust faults, overprinted in places by younger high-angle faults (Woodsworth, 1978; van der Heyden, 1982).

The Coast Complex comprises polydeformed amphibolite and greenschist facies metamorphic rocks and synkinematic plutons that form a series of northeast-directed thrust sheets in the western Whitesail Lake map area. The protolith is interpreted as pre-Lower Jurassic volcanic and sedimentary rocks mostly of island arc affinity (van der Heyden, 1982). The deformed rocks reflect a Late Cretaceous to Early Terti-

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British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1987, Paper 1988-1.