GEOLOGY AND MINERAL OCCURRENCES IN NORTH NEWCOMBE LAKE MAP SHEET* (93E/14)

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KEYWORDS: Regional geology, Newcombe Lake, Nechako Plateau, Telkwa Formation, Bulkley intrusions, Kasalka, Nanika intrusions, Cretaceous volcanics, porphyry copper-molybdenum, quartz veins.

INTRODUCTION

The 1988 Whitesail project extends published 1:50 000 regional mapping in the Sibola Range (MacIntyre, 1985) further to the north (Figure 2-21-1). This report describes the dominant features of mappable lithologic units and documents the geological setting of mineral prospects in the map area.

The mapping complements previous work in the Whitesail Reach and Chikamin Mountain map sheets (Diakow and Mihalynuk, 1987; Diakow and Koyanagi, 1988). The aim of the Whitesail project is to update and refine present Mesozoic and Cenozoic stratigraphic nomenclature, and to resolve the genesis and mineralization controls of the principal mineral deposit types. The project area includes the 1:50 000-scale map sheets 93E/6, 10, 11E, 13 and 14 (Figure 1-21-1) and the project will conclude in 1989 with the completion of mapping in the Nanika Lake map area (NTS 93E/13).

STRATIGRAPHY

The Lower Jurassic Telkwa Formation of the Hazelton Group is the oldest volcanic succession exposed in the map area. Younger volcanic rocks, tentatively assigned to the Cretaceous Skeena and Kasalka groups, appear to rest unconformably on the Telkwa Formation. Sedimentary strata of the Middle Jurassic Smithers Formation or Lower Cretaceous Skeena Group are absent from the map area, with the exception of few scattered outcrops between Newcombe and Twinkle lakes. Stocks of diorite, granodiorite and monzonite cut and locally alter the oldest stratified rocks at Tableland Mountain and Smoke Mountain. Hypabyssal dykes and plugs, which have mineralogical and textural similarities to spatially associated Cretaceous volcanic rocks, occur north of Nadina Lake and southwest of Smoke Mountain. The distribution of stratified and intrusive rock units is shown in Figure 1-21-2.

LOWER JURASSIC

HAZELTON GROUP — TELKWA FORMATION

The Telkwa Formation is made up primarily of fragmental deposits and less voluminous lava flows. These rocks form well-layered exposures east of Kidprice Lake, on the plateau of Tableland Mountain, and on the north and west slopes of Smoke Mountain; they also underlie the intervening area. Elsewhere, they outcrop sporadically over the topographically low terrain north and south of Nadina Lake.

Alternating thick beds of dark maroon and green lapilli tuff are characteristic and diagnostic of the Telkwa Formation. The pyroclasts are typically lapilli size; blocks are uncommon with the exception of rare, intercalated lapilli-block tuff layers. The preponderance of dark-hued maroon and green fragments that have aphanitic textures is a widespread and definitive feature in the lapilli tuff beds. In contrast, aphyric and flow-laminated rhyolitic fragments are areally extensive in lapilli tuffs exposed between Tableland Mountain and Newcombe Lake, and in outcrops of the Telkwa Formation north and south of Nadina Lake. Coarse to fine ash tuff and crystal-ash tuff comprise internally laminated beds intercalated and graded with coarser fragmental deposits. Accretionary lapilli occur in ash tuff layers throughout the Telkwa succession. Mafic phenocrysts are not preserved, whereas quartz phenocrysts, about 1 millimetre in diameter, are sparsely distributed in many tuffs.

Dark green and maroon lava flows generally form thin layers within the lapilli tuffs but a composite succession of flows, about 200 metres thick, is exposed on the lower part of the ridge east of Kidprice Lake. Aphyric flows, the most common variety, usually have a transitional contact with amygdaloidal flows. The latter have quartz-calcite-epidote-chlorite amygdules that are randomly distributed or, less frequently, arranged in trains that define igneous layering. Aphyric flows are fine grained and in places contain subvitreous pyroxene phenocrysts. Flow members in a section exposed immediately north of Kidprice Lake weather to a dense rock with subtle protruding laminae several millimetres thick. This feature, and the fresh appearance of these rocks, can be easily confused with the weathered surface of some Upper Cretaceous flows southwest of Smoke Mountain. Epidote accompanies quartz in irregular clots and lines fractures in the aphyric flows.

Rocks of dacitic to rhyolitic composition are spatially associated with Telkwa tuffaceous rocks, particularly those west of Newcombe Lake containing rhyolitic fragments. The morphology of exposures varies from lenticular and concordant, with interlayered lapilli tuff, to dome like. The rhyolite flows commonly have laminations and spherulitic textures.

The Telkwa Formation in the Newcombe Lake area resembles well-layered volcanic rocks south of Coles Lake, at Core Mountain and north of Chikamin Mountain in the Chikamin Mountain map area (Diakow and Koyanagi, 1988). The principal difference between these correlative successions is that lava flows of basaltic and rhyolitic composition appear to be more voluminous in the Newcombe Lake area where they

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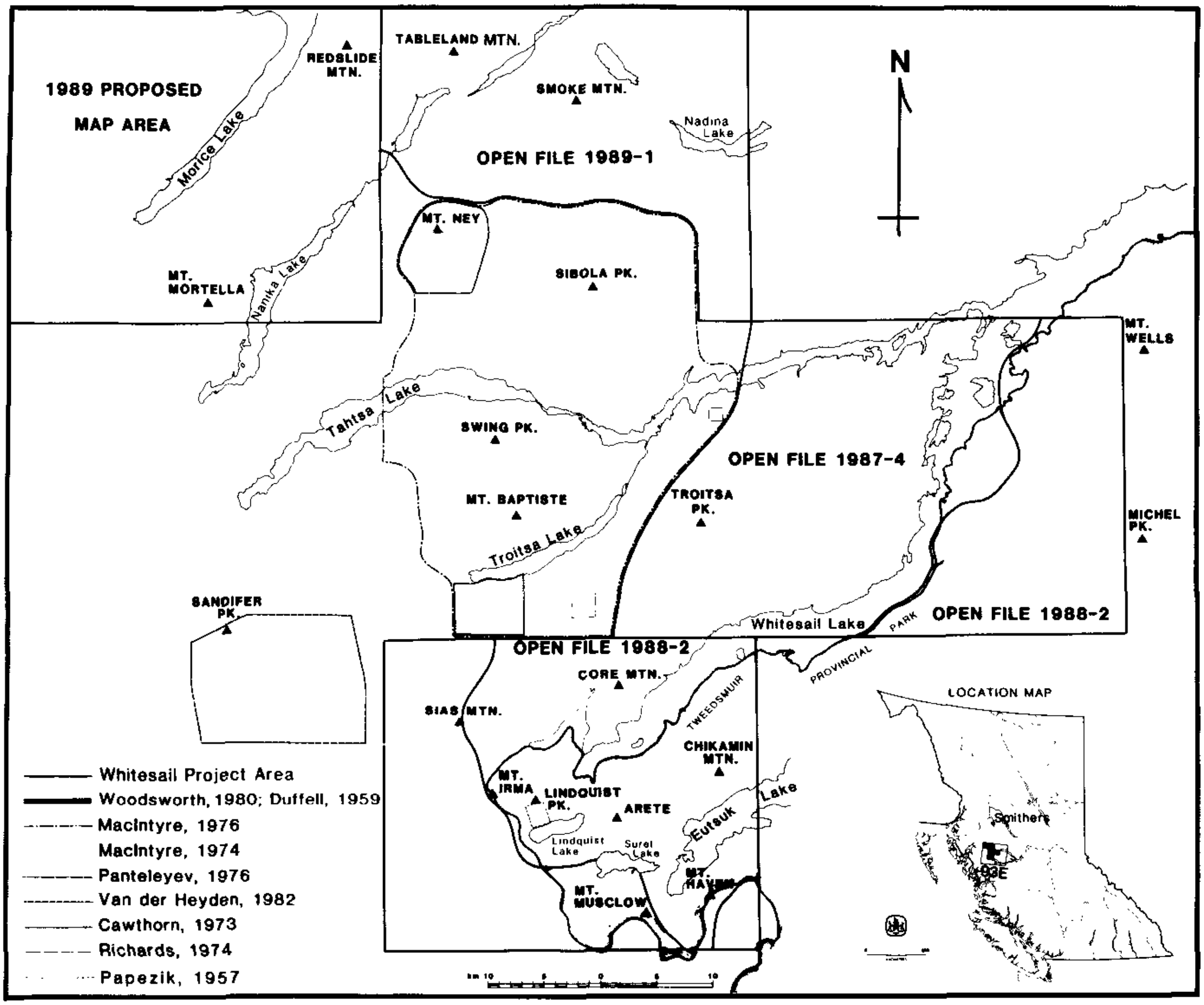


Figure 1-21-1. Location of Whitesail project.

are associated with fragmental rocks characterized by felsic pryoclasts. These felsic rocks are probably related to small eruptions from domes.

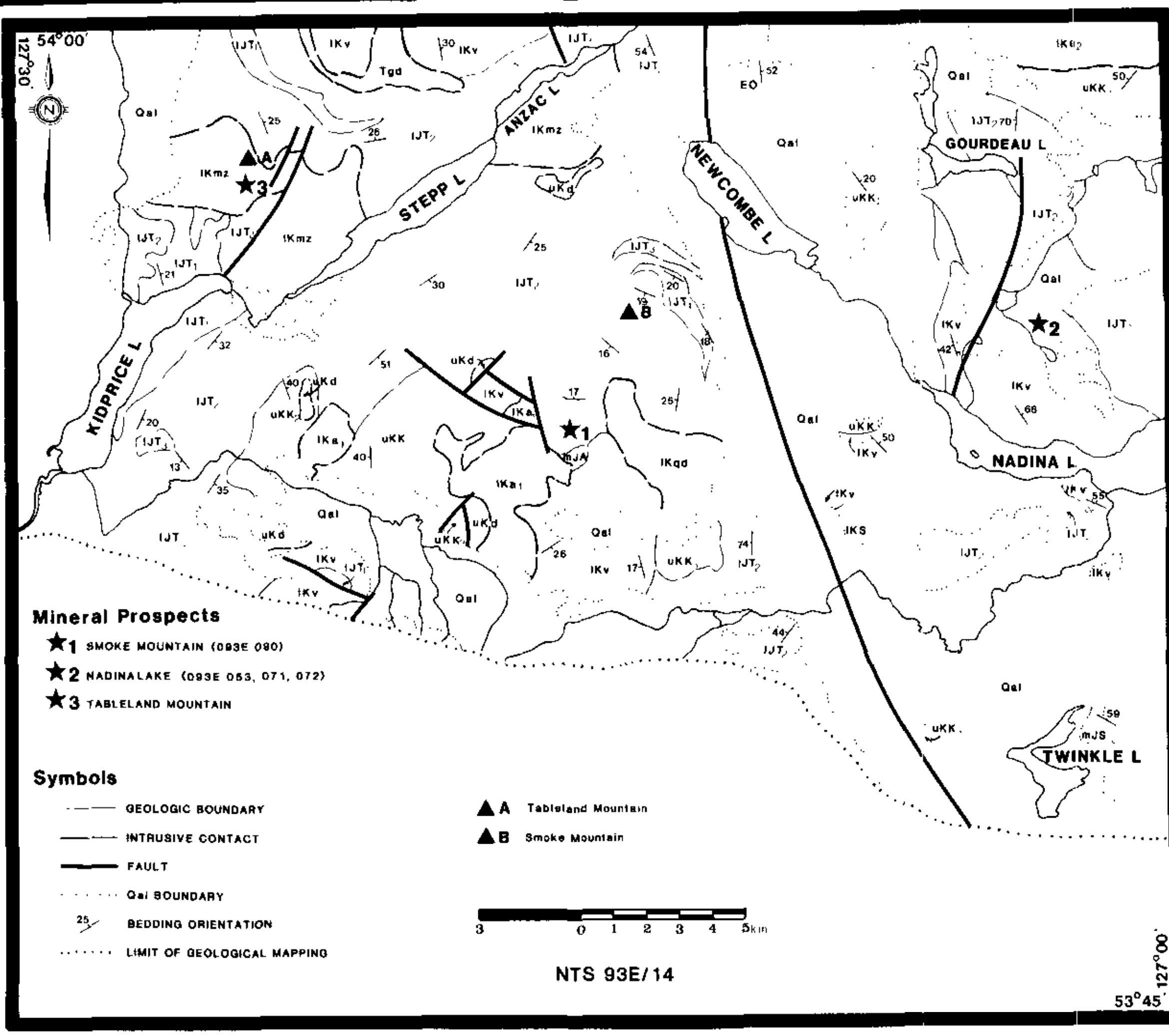
Lower Cretaceous

A succession of lava flows of undetermined thickness crops out on prominent ridges immediately north of Nadina Lake and south of Smoke Mountain. The lower contact is not exposed but is thought to be an unconformity with the Telkwa Formation.

The lava flows range from dark green to maroon in colour and diagnostically contain 30 to 40 per cent slender plagioclase laths between 1 and 3 millimetres long. Pyroxene phenocrysts are ubiquitous as subvitreous crystals that rarely exceed 2 millimetres in diameter. Felty and amygdaloidal textures predominate in these rocks. The spheroidal shape of chlorite and calcite amygdules, between 2 and 5 millimetres in diameter, distinguishes these rocks from Telkwa Formation flows of intermediate composition that typically have an aphyric texture and contain larger, more irregular-shaped amygdules.

Pillow lavas, about 50 metres thick, overlie amygdaloidal and fine-grained porphyritic flows on the first prominent knob southwest of Smoke Mountain. They dominate the upper portion of a stratigraphic succession which changes downward to aphyric lavas resting directly upon about 20 metres of green and black mudstone and siltstone. These sediments are interpreted as a localized sedimentary member within the Upper Jurassic Ashman Formation, however, this correlation cannot be confirmed because fossils have not been found and the lower contact is not exposed.

The fine-grained porphyritic and amygdaloidal flows resemble a succession of basaltic flows in the Tahtsa Lake area which MacIntyre (1976) mapped as the lower volcanic division of the Skeena Group. These volcanic rocks are conformably overlain by marine sediments of the Skeena Group, which locally contain Albian fauna (Duffell, 1959). In the present study area, sedimentary rocks correlated with Skeena



Legend

QUATERNARY

Qal Alluvium and glacial till

TERTIARY

EO Ootsa Lake Group
(1) Polymictic conglomerate.
(2) Light pink to grey rhyolite flows.

UPPER CRETACEOUS

uKK Kasalka Group
(1) Intraformational conglomerate; cobbles of lKa1 and granite.
(2) Dark grey basalt flows; flow laminated, locally vitreous.
(3) Grey andesite flows; crowded plagioclase, hornblende.

LOWER CRETACEOUS

lKS Skeena Group
Siltstone, argillite, micaceous sandstone.

lKv Green andesite flows; platy plagioclase, common pyroxene, amygdaloidal.

MIDDLE JURASSIC

mJA Bowser Lake Group
Ashman Formation
Argillite, siltstone, minor sandstone.

MIDDLE AND LOWER JURASSIC

mJS Hazelton Group
Smithers Formation
Siltstone, arkosic sandstone, granule pebble conglomerate; abundant macrofossils.

lJT Telkwa Formation
(1) Dark green andesitic flows, amygdaloidal with plagioclase or flow laminated with sparse pyroxene
(2) Green and maroon lapilli tuff and ash tuff; rhyolitic fragments locally common, minor rhyolite flows.
(3) Grey to mauve rhyolite flows; coarsely spherulitic strongly flow layered.

INTRUSIONS

TERTIARY

Tgd Biotite granodiorite sill; equigranular, columnar jointed.

LATE CRETACEOUS OR TERTIARY

uK Diorite; felty, mottled texture, probable feeders to uKK2.

LATE CRETACEOUS

lKmz Monzonite, quartz monzonite; fresh hornblende

lKqd Quartz diorite, diorite, granodiorite; equigranular, fresh hornblende and biotite.

lKa (1) Porphyritic hornblende-plagioclase andesite stocks and dykes, equivalent to Kasalka intrusions.
(2) Porphyritic hornblende-plagioclase-biotite dykes and plugs; coarse grained, similar to uKK3 flows and lKa1.

Figure 1-21-2. Geology of North Newcombe Lake map sheet (NTS 93E/14).

Group consist of micaceous sandstone rubble exposed at a single locality southwest of Nadina Lake.

Upper Cretaceous

The Upper Cretaceous section consists almost exclusively of greenish-grey-weathering lava flows, although conglomerate beds are present locally. These rocks are best exposed north of Nadina Lake and underlie much of the low area southwest of Smoke Mountain. Isolated exposures also occur southeast of Newcombe Lake. The basal contact of this unit has not been observed, although the widespread spatial association with nearby Telkwa volcanic rocks suggests it is an unconformity.

The lava flows, particularly north of Nadina Lake, are distinguished from Early Cretaceous volcanic rocks by mineralogical and textural differences. Tabular plagioclase phenocrysts comprise as much as 45 per cent of the rock; the resulting crowded texture is very apparent on weathered surfaces. Plagioclase phenocrysts range from 0.5 to 5 millimetres in length, but average less than 2 millimetres. Pyroxene, generally less than 3 per cent, is the most common mafic mineral. Hornblende is usually present, but less abundant than pyroxene, and biotite is rarely preserved and is restricted to poorly exposed flows southeast of Newcombe Lake.

The lava flows southwest of Smoke Mountain differ mainly in their aphyric texture and weathering characteristics. Weathered surfaces locally have features which include subtly protruding laminae a few millimetres thick, and interlocking, slightly rounded to polygonal shapes that resemble the scaly appearance of alligator hide. Vitreous pyroxene occurs as phenocrysts rarely larger than 1.5 millimetres in diameter, in amounts not exceeding 1 per cent. The freshest rocks appear black and glassy; shades of green with a mauve to purple tint are more widespread and indicative of variable weathering and oxidation in the flows.

A polymictic conglomerate, about 20 metres thick and 75 metres wide, overlies a succession of aphyric flows exposed in the major valley southwest of Smoke Mountain. The framework clasts are typically well-rounded cobbles and boulders as large as 1 metre in diameter. The dominant clast composition is porphyritic andesite with crowded plagioclase phenocrysts, which resemble the Upper Cretaceous flows north of Nadina Lake. Also present are clasts of aphyric andesite and granodiorite. Several widely separated exposures of pebble conglomerate west of Smoke Mountain appear to occur at a similar stratigraphic level. Collectively, these conglomerates probably reflect a period of local uplift and fluvial transport of detritus eroded mainly from Upper Cretaceous rocks.

The aphyric and crowded porphyritic andesite flows diagnostic of this map unit are correlated with a succession of latite-andesite flows near the base of the Kasalka Group at Swing Peak (MacIntyre, 1976). A very fresh specimen of aphyric rock was collected southwest of Smoke Mountain for potassium-argon dating.

INTRUSIVE ROCKS

Jurassic and Cretaceous volcanic rocks are intruded by small irregular stocks, sills and numerous dykes. Intrusions have been subdivided into three groups of probable Late Cretaceous and Early Tertiary age, based on their texture, freshness and field relationships. They are the Nanika and Bulkley intrusions of Carter (1981) and the Kasalka intrusions of MacIntyre (1976).

LATE CRETACEOUS — BULKLEY INTRUSIONS

On Tableland Mountain and on the hills east of Stepp and Anzac lakes, a texturally varied monzonite pluton is exposed that is probably correlative with the Bulkley intrusions. The contact with altered Telkwa volcanic rocks is sharp. This intrusive is typically pink, medium to coarse grained and equigranular. Locally, it may be fine grained with about 15 per cent hornblende laths up to 7 millimetres in length. Northeast of Stepp Lake, this intrusion contains unmineralized quartz veins up to 5 metres long and 50 centimetres wide.

A pluton of quartz diorite to granodiorite composition intrudes Telkwa tuffs and flows on the southeast slope of Smoke Mountain. It is typically medium to coarse grained with an equigranular texture composed dominantly of plagioclase. Hornblende and lesser biotite are fresh to weakly chloritized and together total 5 to 20 per cent of the rock volume. The mineralogy may change over several metres with the addition of 10 to 15 per cent potassium feldspar and 5 to 10 per cent quartz. Minor disseminated pyrite is widespread.

The youngest intrusive rocks around Smoke Mountain are fine to medium-grained diorites with a distinctive mottled appearance. They occur as plugs and dykes outcropping in the lowlands around the southwestern flanks of Smoke Mountain. The intrusions form knobs and ridges at the height of land between Smoke Mountain and Anzac Lake, and are in sharp contact with Upper Cretaceous and Telkwa rocks. The diorites contain 20 to 30 per cent pyroxene as anhedral grains interstitial to crowded subhedral plagioclase laths. Pyroxene phenocrysts averaging 2 to 4 millimetres in length may also be present and comprise 5 to 20 per cent of the rock volume. The lath-shaped, subhedral plagioclase imparts a diagnostic felty texture and a mottled light grey and dark green colour to the rock. These intrusions are possible feeders to aphyric andesite flows that are widespread nearby.

LATE CRETACEOUS — KASALKA INTRUSIONS

Kasalka intrusions, as defined by MacIntyre (1976) in the Tahtsa Lake area, have porphyritic textures and compositions similar to the volcanic rocks of the Kasalka Group. In the Newcombe Lake area several small stocks and dykes are exposed north of Nadina Lake and south of Smoke Mountain, where upper Cretaceous volcanic rocks are best preserved. The intrusive contacts are generally sharp, but in places the intrusions grade imperceptibly into lava flows.

These plutons contain a diagnostic phenocryst assemblage of plagioclase, hornblende and, in places, biotite, set in a greyish green aphanitic matrix. A typical pluton, north of Nadina Lake, consists of 30 to 40 per cent plagioclase phenocrysts between 4 and 10 millimetres in diameter. These rocks differ in texture from the small stock south of Smoke Mountain, where plagioclase rarely exceeds 4 millimetres in diameter and comprises as much as 45 per cent of the rock volume, resulting in a diagnostic crowded porphyritic texture. Hornblende prisms, commonly 3 to 5 millimetres long, are ubiquitous, locally comprising as much as 7 per cent of the rock volume, but averaging less than 3 per cent. Biotite is found as subvitreous and partially chloritized grains, generally in amounts of 1 to 2 volume per cent and mainly in dykes spatially associated with the small stocks near Nadina Lake.

The Kasalka intrusions have textural features that suggest crystallization of andesitic magma at a high crustal level. The similar mineralogy and texture of nearby Upper Cretaceous flows suggest a genetic relationship. The age of these intrusive rocks is inferred from a potassium-argon date of 85 Ma (Diakow, unpublished data, 1987) from a biotite-hornblende-plagioclase porphyritic andesite stock in the western part of the Whitesail Reach map area (NTS 93E/10). *En echelon*, northwest-trending dykes identical to this rock occur on west Tahtsa Reach and probably correlate with those outcropping near Nadina Lake.

EARLY TERTIARY — NANIKA INTRUSIONS

A columnar-jointed sill of biotite-phyric coarse-grained granodiorite outcrops on a dip slope on the northeast flank of Tableland Mountain. Vitreous biotite books up to 3 millimetres across comprise as much as 20 per cent of the rock. This sill was intruded along the contact between Telkwa lapilli tuffs and Lower Cretaceous andesite flows, and is probably Tertiary in age.

STRUCTURE

Steeply inclined faults which trend northwest and northeast are the principal structural elements in the Newcombe Lake area. The absence of stratigraphic markers inhibits mapping the trace of significant through-going faults, particularly in large areas underlain by a single rock unit. This results in a map pattern of unconnected fault segments.

Fault displacements are clearly recognized where bedded Lower Cretaceous rocks are in contact with the Telkwa Formation on the southwest side of Smoke Mountain and in offsets of the intrusive contact on Tableland Mountain. Elsewhere, inferred faults, mainly within the Telkwa Formation volcanic rocks near Kidprice Lake, are thought to be minor structures.

The absence of Middle Jurassic Smithers Formation and Lower Cretaceous Skeena Group sedimentary successions above Telkwa volcanic rocks throughout most of the map area is difficult to explain, as thick accumulations of these sediments are widely exposed immediately to the south in the Sibola Range. The restriction of sedimentary rocks to the low terrain between Twinkle and Newcombe lakes may be related to block faulting, however, no major faults have been mapped.

MINERAL OCCURRENCES

Porphyry copper-molybdenum mineralization associated with granitic intrusions is the principal type of mineral occurrence found in the map area. Quartz veins and veinlets, sparsely mineralized with pyrite, locally cut Lower Jurassic volcanic rocks.

PORPHYRY COPPER-MOLYBDENUM

Porphyry-style mineral occurrences in the study area form part of a north-trending belt of porphyry deposits associated with Late Cretaceous Bulkley intrusions and Eocene Nanika intrusions in west-central British Columbia (Carter, 1981). The geological setting of deposits in the vicinity of Tahtsa Lake and the Sibola Range has been described by MacIntyre (1985).

Porphyry copper mineralization is associated with intrusions north of Nadina Lake and at Smoke Mountain. Both areas were extensively explored between 1968 and 1974.

NADINA LAKE AREA

Several small granitic stocks intrude and alter Lower Jurassic Telkwa and Cretaceous volcanic rocks in the hilly region north of Nadina Lake. The intrusions and surrounding tuffs and andesites are well mineralized with disseminated pyrite, typically comprising 1 to 3 per cent of the rock volume, but ranging up to 5 per cent. Chalcopyrite and molybdenite, in amounts usually less than 1 per cent, are assocated with the pyritic rocks. The sulphides also fill narrow fractures and line sporadic quartz gash veins which are less than 2 metres long and 20 centimetres wide. Pyritic alteration zones centred over the intrusions result in strong induced polarization and magnetic anomalies which have been used to guide exploration.

SMOKE MOUNTAIN AREA

A Late Cretaceous quartz diorite intrusion that outcrops on the southern flank of Smoke Mountain contains 1 to 3 per cent pyrite, 0.5 to 1 per cent chalcopyrite, and traces of molybdenite and bornite mineralization as disseminations and fracture coatings. Sulphide mineralization is spotty, with highly fractured, calcite-rich exposures showing the most sulphides. Elsewhere, the rock is fresh with only a trace of disseminated pyrite that extends into nearby altered Telkwa volcanic rocks.

A well-mineralized zone is exposed by a creek draining the southern flank of Smoke Mountain. It has eroded highly fractured and gossanous shaly sediments with sparse intercalated sandstone beds. The shales contain 5 to 10 per cent disseminated pyrite and veins of massive pyrite 3 metres long and up to 20 centimetres wide. Traces of chalcopyrite, bornite and malachite are associated with calcite veining and fracture coatings. This mineralized zone can be traced for about 200 metres along the creek and 30 metres up slope. The sediments are tentatively correlated with the Ashman Formation.

QUARTZ VEINS

Quartz veinlets and short, narrow veins cut Lower Jurassic rhyolitic flows and pyroclastic rocks immediately north of Anzac Lake. The veins trend easterly and dip steeply. Veins typically consist of white drusy quartz, rarely exceed a few centimetres in width, and are traceable along strike for less than 10 metres. They occur mainly as discrete *en echelon* veinlets with variable spacing but, in places, form zones of anastomosing veins over widths of up to a metre. The veins are generally barren of sulphides and the lack of wallrock alteration suggests they have little economic potential.

Several quartz veins are exposed on a series of knobs and ridges northeast of Stepp Lake. One group of veins cuts fine-grained andesite, another is within a quartz monzonite intrusive. The fine-grained flow-laminated andesite hosts four or more quartz veins that average 10 to 30 centimetres wide and 1 to 3 metres long. The quartz is coarsely crystalline and comb textured with much open space. Hematite imparts a gossanous look to the veins, but no sulphides are visible. West of this occurrence, five or more subparallel quartz veins, again averaging 10 to 30 centimetres wide and 1 to 3 metres long, cut coarse-grained unaltered monzonite outcropping on a west-facing dip slope. The quartz is milky and massive, or clear, coarsely crystalline and comb textured. Hematite is common and gives the veins a rusty colour. Many smaller, barren quartz veins are evenly distributed across the outcrop.

On Tableland Mountain, near the eastern margin of the plateau, an outcrop of strongly fractured purple lapilli tuffs is cut by quartz veins with a northerly trend, parallel to the fractures. The veins are gossanous due to hematite but contain only thin selvages weakly mineralized with pyrite and very minor malachite. The host rock is gossanous within about a metre of the veins.

CONCLUSIONS

Regional mapping in Newcombe Lake map area reveals the following:

1. The Lower Telkwa Formation, representing the lowest stratigraphic level exposed, consists mainly of well-bedded pyroclastic rocks interlayered locally with thick flows of basaltic to rhyolitic composition. These rocks are generally unconformably overlain by two similar successions of porphyritic andesite flows of probable Early and Late Cretaceous age. In adjacent areas, the interval represented by this non-erosional unconformity is normally occupied by marine sedimentary rocks of the Middle Jurassic Smithers Formation.

   The distribution of stratified Cretaceous rocks suggests deposition on an uplifted and irregular paleosurface underlain by Telkwa volcanic rocks. Uplift is assumed to be the result of block faulting, although major through-going faults have not been recognized.
2. Porphyry copper-molybdenum mineralization is associated with plutons tentatively correlated with the Late Cretaceous Bulkley intrusions and Eocene Nanika intrusions.

   Quartz veins occurring in narrow, discontinuous zones, with no associated wallrock alteration, contain sporadic pyrite and lesser chalcopyrite.

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REFERENCES

Carter, N.C. (1981): Porphyry Copper and Molybdenum Deposits, West-central British Columbia, *B.C. Ministry of Energy, Mines, and Petroleum Resources*, Bulletin 64, 150 pages.

Cawthorn, N.G. (1973): Geology and Petrology of the Troitsa Property, Whitesail Lake Map-area, British Columbia, Unpublished M.Sc. Thesis, *The University of British Columbia*.

Diakow, L.J. and Koyanagi, V. (1988): Stratigraphy and Mineral Occurrences of Chikamin Mountain and Whitesail Reach Map Areas, *B.C. Ministry of Energy, Mines, and Petroleum Resources*, Geological Fieldwork, 1987, Paper 1988-1, pages 155-168.

Diakow, L.J. and Mihalynuk, M. (1987): Geology of the Whitesail Reach and Troitsa Lake Map Areas, *B.C. Ministry of Energy, Mines, and Petroleum Resources*, Geological Fieldwork, 1986, Paper 1987-1, pages 171-179.

Duffell, S. (1959): Whitesail Lake Map-area, British Columbia, *Geological Survey of Canada*, Memoir 299, 119 pages.

MacIntyre, D.G. (1974): Zonation of Alteration and Metallic Mineral Assemblages, Coles Creek Copper Prospect, West-central British Columbia, Unpublished M.Sc. Thesis, *University of Western Ontario*.

——— (1976): Evolution of Upper Cretaceous Volcanic and Plutonic Centres and Associated Porphyry Copper Occurrences, Tahtsa Lake Area, British Columbia, Unpublished Ph.D. Thesis, *University of Western Ontario*, 149 pages.

——— (1985): Geology and Mineral Deposits of the Tahtsa Lake District, West-central British Columbia, *B.C. Ministry of Energy, Mines, and Petroleum Resources*, Bulletin 75, 82 pages.

Panteleyev, A. (1976): Berg Porphyry Copper-molybdenum Deposit, Unpublished Ph.D. Thesis, *The University of British Columbia*, 235 pages.

Papezik, V.S. (1957): Geology of the Deer Horn Prospect, Omineca Mining Division, British Columbia, Unpublished M.Sc. Thesis, *The University of British Columbia*.

Richards, G.G. (1974): Geology of the Ox Lake Cu-Mo Porphyry Deposit, Unpublished M.Sc. Thesis, *The University of British Columbia*.

van der Heyden, P. (1982): Tectonic and Stratigraphic Relations between the Coast Plutonic Complex and Intermontane Belt, West-central Whitesail Lake Map Area, British Columbia, Unpublished M.Sc. Thesis, *The University of British Columbia*, 172 pages.

Woodsworth, G.J. (1980): Geology of Whitesail Lake (93E) Map-area, *Geological Survey of Canada*, Open File Map 708.