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

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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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ary tectonic event which resulted from the collision of allochthonous terrane with the western plate margin of North America (Monger *et al.*, 1982; Crawford *et al.*, 1987). Late Cretaceous and Early Tertiary post-orogenic plutons cut both the metamorphic rocks and thrust faults.

The Intermontane Belt is represented by a discrete series of volcanic and sedimentary rocks that accumulated in depositional basins which evolved in response to regional tectonic events. Unconformities separate the successive lithostratigraphic successions. The successions pertinent to this study, in order of decreasing age, are: Hazelton Group, Bowser Lake Group, Skeena Group, Kasalka Group, Ootsa Lake Group and Endako Group. The first three groups correspond with lower and middle Jurassic island arc volcanic and sedimentary rocks deposited in the Hazelton trough; middle and upper Jurassic marine and terrestrial sediments accumulated within the Bowser and Nechako successor basins; and mid-Cretaceous transgressive marine sediments deposited on older strata. The Kasalka Group unconformably overlies the Skeena Group. It is an upper Cretaceous volcanic succession erupted in a continental margin arc setting. In turn, Tertiary volcanic rocks of the Ootsa Lake Group and younger Endako Group succeed the Kasalka Group. The Tertiary successions represent widespread effusive flows erupted in a transtensional continental setting.

LOCAL STRATIGRAPHY

The stratigraphy in the study area is dominated by lava flows and pyroclastic rocks; sedimentary beds are not widespread. Plutons cut and in places metamorphose layered strata. These rocks are divided on the basis of general outcrop appearance, lithology and stratigraphic relationships. The age of sedimentary strata is determined by fossil fauna, whereas the age of crystalline rocks will be defined more accurately by isotopic dating techniques. The stratigraphic divisions proposed in this paper build upon the observations of previous workers within and outside the study area. The distribution of stratigraphic units is shown in Figure 1-14-2.

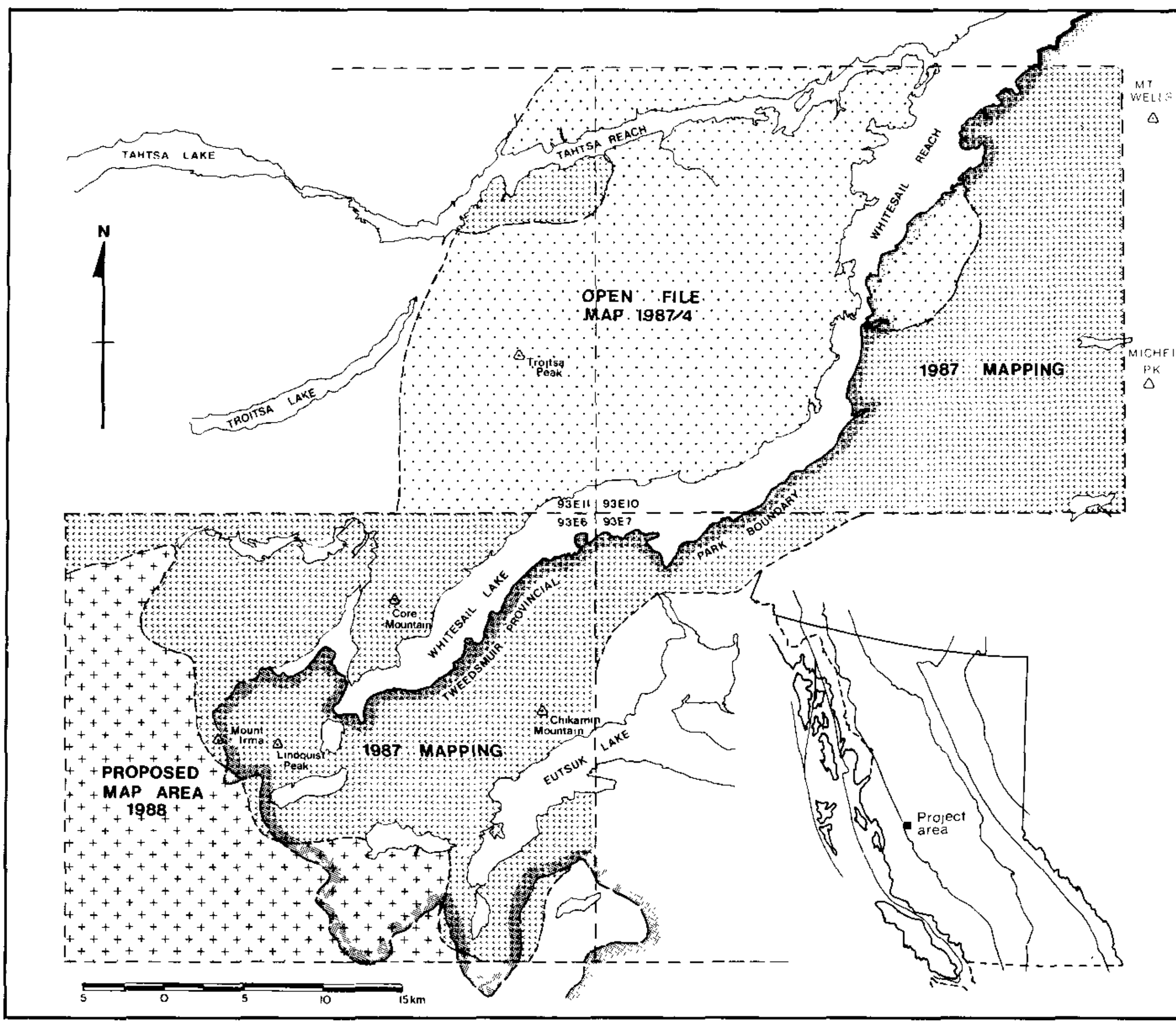

Figure 1-14-1. Location of Whitesail Project area.

PRE-JURASSIC ROCKS–GAMSBY GROUP (MG)

The Gamsby group is an informal name for metavolcanic and metasedimentary rocks exposed near the eastern margin of the Coast plutonic complex in Whitesail Lake map area (Woodsworth, 1978). In the present study area these rocks are confined to a narrow belt south and west of Lindquist Lake, where they structurally overlie the Skeena Group or are intruded by Coast intrusions. They comprise a succession of intermediate and mafic tuffs, flows and schists associated with a dioritic pluton. The diorite is found at the lowest structural level of the succession. It passes topographically upwards into a mixed assemblage of dark green lapilli tuffs, flows and phyllitic tuffs. The strata have been regionally metamorphosed to greenschist grade, a feature indicated by ubiquitous albite, chlorite and epidote. In places epidote lines fractures and is commonly found with quartz in irregular clots and discontinuous veins. The contact between diorite and metavolcanic rocks is not exposed, but is thought to be a fault.

Deformation is defined by a pronounced penetrative foliation with a moderately steep southerly dip in the metavolcanic rocks. The style of deformation varies between beds, from prolate fragments to mylonitic structure. The foliation in dioritic rocks appears to be related to the same deformational event that affected the metavolcanic rocks. It becomes more pronounced, changing the rock into mylonite, at a major thrust fault separating the diorite from younger rocks.

The protolith of the Gamsby group is a tholeiitic and calcalkaline series of volcanic rocks representative of a mature island arc setting (van der Heyden, 1982). The age of these strata is at least upper Triassic, but may be as old as upper Paleozoic (van der Heyden, 1982).

LOWER AND MIDDLE JURASSIC–HAZELTON GROUP

The Hazelton Group (Leach, 1910) is most recently redefined in north-central British Columbia by Tipper and Richards (1976), who propose a threefold division. The strata include, in order of decreasing age: the Telkwa Formation, Nilkitkwa Formation and Smithers Formation. They collectively represent widespread volcanic and sedimentary deposits accumulated within the Hazelton trough from Sinemurian to Early Callovian time. These strata, excluding the Nilkitkwa Formation, are well represented in the study area.

TELKWA FORMATION

The Telkwa Formation is exclusively comprised of volcanic rocks that can be arbitrarily subdivided into two map units: layered maroon volcanics (lJT_1) and foliated green volcanics (lJT_2).

Layered Maroon Volcanics (lJT_1)

Map unit lJT_1 is best exposed between Little Whitesail and Coles lakes, at Core Mountain and on north and east-facing slopes of Chikamin Mountain. South of Coles Lake an apparently unfaulted north-dipping monocline is at least 3000 metres thick. Neither the top nor bottom contact were found. These rocks are characterized by distinctly bedded maroon, brick red, and lesser green pyroclastic rocks and volumetrically subordinate flows. Intravolcanic epiclastic rocks are negligible or absent.

The pyroclastic rocks include, in order of relative abundance: crystal-lapilli tuff, ash tuff, and uncommon accumulations of lapilli block tuff and lahar. The pyroclasts mainly consist of aphanitic maroon and red subangular fragments that rarely exceed 3 centimetres in diameter. The matrix is dominated by indurated ash which supports plagioclase and sparse quartz phenocrysts. Thick beds exhibit graded pyroclasts, and parallel-laminated ash tuff with and without accretionary lapilli.

Lava flows form resistant layers interspersed within thick pyroclastic successions. The composition of flows ranges from basalt, through andesite to rhyolite, and they have amygdaloidal, porphyritic, aphyric and rarely flow-laminated textures. Most lava flows form uniformly thick beds between 2 and 12 metres thick; exceptions are the felsic flows which have large lateral variation in thickness. This variation probably reflects local eruptions of viscous lava.

The well-layered maroon pyroclastic and flow rocks represent subaerial eruptions probably related to composite volcanic centres. Successive eruptions of tephra and lava constructed a low-gradient plain relatively distant from any major centre.

Foliated Green Volcanic Rocks (lJT_2)

Lava flows and lesser tuff, and tuffaceous sediments, typically dark green with or without a penetrative foliation, characterize map unit lJT_2. They underlie a discontinuous northwest-trending zone straddling the northern half of Little Whitesail Lake and north Coles Lake. Similar rocks also underlie a 12-square-kilometre area west of Michel Lake. Their contacts with lJT_1 are generally presumed to be faulted. In the Michel Lake area, these rocks have an estimated minimum thickness of 2000 metres and a conformable upper contact with Middle Jurassic sedimentary rocks.

No type area exists for map unit lJT_2, instead it comprises variable proportions of flows and pyroclastic rocks. The Michel Lake succession is composed of aphyric and porphyritic basalt and andesite lava flows that are intimately interlayered with lapilli and ash tuff and local sedimentary rocks. The pyroclastic beds are commonly graded, laminated and rarely crosslaminated. Some of these finer grained layers suggest reworking of volcanic detritus within a shallow-marine environment. In places, indeterminate pelecypods have been recovered from volcanic-derived sandstone layers. Marlstone and pebble conglomerate interlayered with tuffs and flows occupy a panel thrust northwesterly over middle Jurassic strata about 3.5 kilometres west of Michel Lake. The marlstone, at least 35 metres thick, is characterized by a differentially weathered surface resembling the appearance of Swiss cheese. These rocks, unlike any observed from the Telkwa Formation elsewhere in the map area, indicate shallow-marine sedimentation prevailed locally during periods of relative volcanic quiescence.

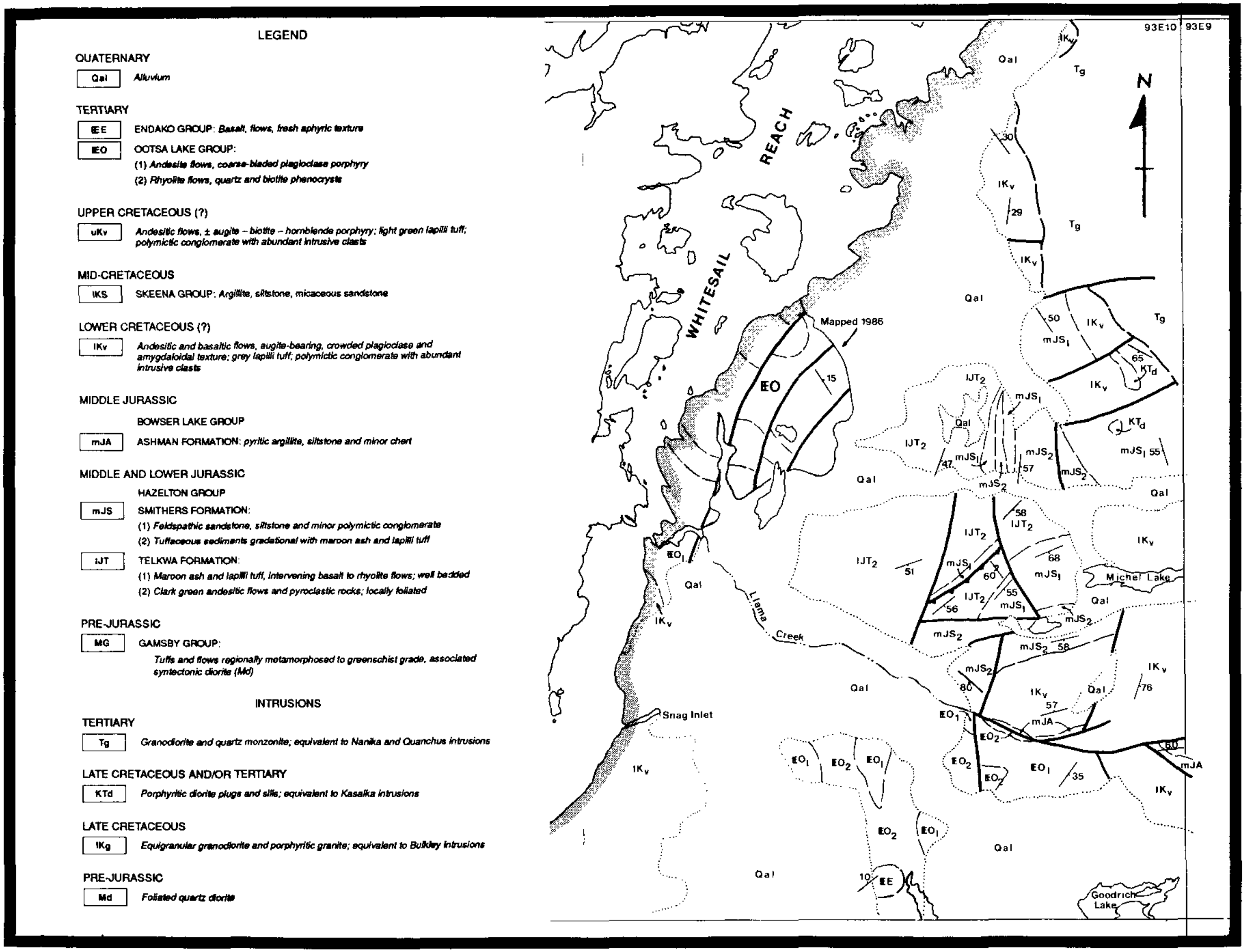

Figure 1-14-2A. Geology of the East Half of Whitesail Reach map sheet. NTS 93E/10.

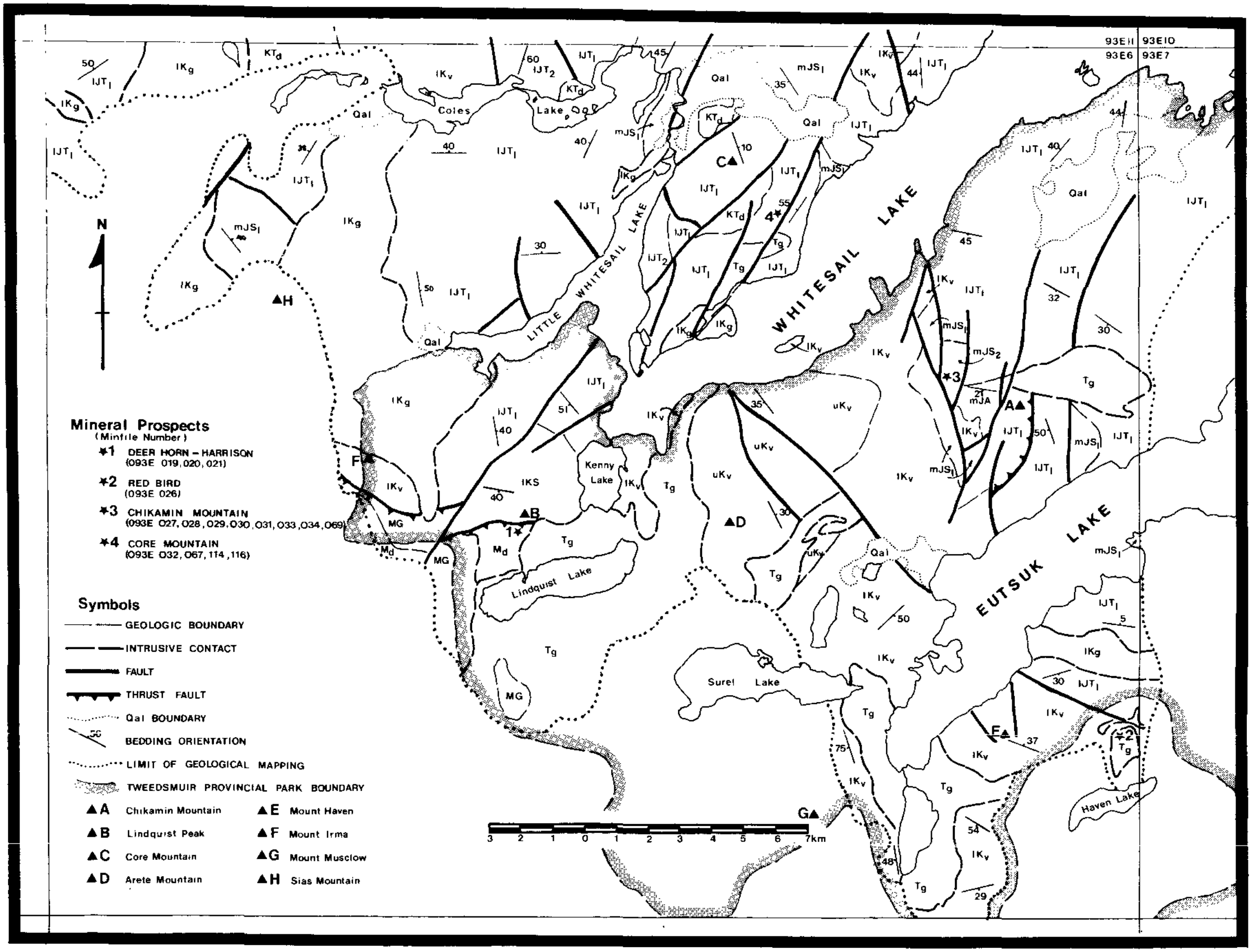

Figure 1-14-2B. Geology of Chikamin Mountain map sheets, NTS 93E/6.

The dark green colour and a locally prominent foliation are characteristic of these rocks. They probably indicate greenschist grade metamorphism, however, this feature is enigmatic in that related rocks of map unit lJT_1 are unaffected. Ubiquitous chlorite and epidote, in addition to irregular quartz veins, are widespread within the mafic flows.

On the basis of lithologic similarity, the maroon volcanic rock (map unit lJT_1) is correlated with the Howson subaerial facies of the Telkwa Formation. The metamorphosed volcanic and lesser sedimentary strata of map unit lJT_2 are most similar in appearance to pre-Jurassic Gamsby group, however, their spatial association within map unit lJT_1 and younger rocks, and their less intense deformation preclude this correlation. Lower Jurassic fossil fauna were recovered from intravolcanic sedimentary rocks in Michel Lake area (H.W. Tipper, personal communication, 1987).

SMITHERS FORMATION (mJS)

The Smithers Formation in the Whitesail Range is subdivided into a lower marine sedimentary division that grades into an upper division of subaerial pyroclastic rocks (Diakow and Mihalynuk, 1987a and b). The sedimentary division is widely exposed in the study area. In its absence, however, the pyroclastic division is indistinguishable from nearby deposits comprising map unit lJT_1 of the Telkwa Formation.

The sedimentary division (mJS_1) underlies mountain ridges and valley bottoms throughout the map area. It mainly comprises grey-green siltstone, sandstone, arkosic wacke and minor granule-pebble conglomerate; limestone and chert beds are uncommon. Most exposures are well bedded with average beds ranging between 10 and 40 centimetres thick. Internally, parallel laminations and grading are widespread within otherwise structureless beds. In several places, calcareous concretions, with recessed elliptical shapes up to 30 centimetres in diameter, are found in the siltstone beds.

The pyroclastic division (mJS_2) comprises tuffs and less common flows that are bound by, and rest upon, marine sedimentary rocks. These rocks are prevalent at Core Mountain, Chikamin Mountain and west of Michel Lake. On the north slope of Core Mountain thickly bedded sedimentary strata pass stratigraphically up-section through alternating immature volcanic sediments and maroon lapilli tuff. On the northwest slope of Chikamin Mountain, a poorly exposed succession at least 150 metres thick comprises accretionary tuff and lapilli tuff beds that are interlayered with fossiliferous clastic rocks. West of Michel Lake, sedimentary strata containing Aalenian ammonite fauna are periodically interrupted by discrete sections, as much as 75 metres thick, comprised of thinly laminated maroon ash tuff and rare accretionary lapilli tuff beds. The sedimentary division strata are eventually overlain by an undetermined thickness of alternating maroon and green ash tuff and lapilli tuff. Thin parallel-laminated and graded tuff is diagnostic of this section; planar crosslaminae are rarely observed. These rocks appear to underlie massive augite-bearing flows thought to be early Cretaceous in age.

The contact between marine sediments and tuffaceous rocks is most often interfingered. This contrasts with a gradational contact in western Whitesail Range. The pyroclastic rocks appear to become finer grained to the east and southeast of the Whitesail Range. These features indicate a local lateral facies gradation from subaerial to shallow-marine deposition of volcanic rocks during middle Jurassic time.

Strata of the Smithers Formation were initially deposited in a shallow-marine environment. The high proportion of angular feldspar in sandstone beds indicates rapid sedimentation and a nearby source. Telkwa Formation tuffaceous rocks are a probable source for the arkosic wacke, however, many of the feldspar-rich beds may be primary waterlain crystal tuff. Volcanic activity occurred contemporaneously with marine sedimentation in the eastern part of the study area. In the Whitesail Range the marine sedimentary division is supplanted by dominantly thickly bedded subaerially erupted pyroclastic rocks.

The age of the marine sedimentary rocks is inferred from abundant fossils, particularly ammonite fauna. Fossils tentatively identified to date by T.P. Poulton, H.W. Tipper and R.L. Hall (personal communications, 1986, 1987) indicate the oldest beds of Aalenian age underlie much of the Whitesail Range and occur west of Michel Lake. Early Bajocian fauna have widespread distribution in Chikamin Range and are found at Tahtsa Reach. At Cumins Creek in the eastern Whitesail Range (93E/10), a fault-bounded sedimentary succession has yielded an Early and Late Bajocian fauna (T.P. Poulton, personal communication, 1987). The irregular regional distribution of similar fauna may reflect local erosional disconformities within the middle Jurassic section.

MIDDLE AND UPPER JURASSIC– BOWSER LAKE GROUP

The Hazelton trough was effectively divided into two successor basins by uplift, defined by a northeast-trending locus of Early Jurassic Topley intrusions along the Skeena arch. The Bowser basin and its southern analogue, the Nechako basin, are sites of early widespread marine sedimentation. These deposits, called the Ashman Formation, constitute the lower division of the Bowser Lake Group. They were deposited between Upper Bajocian and Lower Oxfordian time (Tipper and Richards, 1976).

ASHMAN FORMATION (mJA)

The Ashman Formation is represented by more than 300 metres of interbedded fine-grained clastic and chemical sedimentary rocks capping the prominent peak 2 kilometres west of Chikamin Mountain. The contact with Smithers Formation rocks underlying the lower portion of the mountain is concealed by talus. The upper contact is conformable with Lower Cretaceous (?) lava flows northeast of Goodrich Lake. Bedded sedimentary rocks containing Upper Bathonian and Lower Callovian fauna (H.W. Tipper, personal communication, 1986) appear to conformably overlie similar Smithers sediments in a tributary of Cumins Creek in the eastern Whitesail Range (Diakow and Mihalynuk, 1987b).

The dominant lithologies of the Ashman Formation include black and grey argillite and siltstone. Feldspathic sandstone, arenaceous sandstone, chert and rare coralline limestone lenticles are found locally. Accretionary lapilli tuff is a rare occurrence in argillite at Chikamin Mountain. Rusty orange weathering of argillite is due to local concentrations of oxidized finely disseminated pyrite. Bedding in the Ashman Formation is generally thinner and more uniformly spaced than in Smithers strata and fossil fauna are less prolific.

The Ashman Formation, at least locally, appears to represent a continuation of marine deposits representative of the Smithers Formation. No major hiatus separating these successions is recognized in the study area. The succession exposed near Chikamin Mountain closely resembles regularly layered deep marine deposits.

LOWER CRETACEOUS (?) VOLCANIC ROCKS (lKv)

Map unit lKv is a heterogeneous succession of interlayered lava flows, tuffs and minor sedimentary rocks. The diagnostic presence of subvitreous augite phenocrysts in flows of andesitic to basaltic composition, and their stratigraphic position above middle Jurassic successions, distinguishes these rocks from the Telkwa Formation. The following section briefly describes the lithologic variability of this map unit starting near Michel Lake in the north and working toward Mount Haven in the south.

Southwest of Michel Lake, augite-phyric andesite flows comprise a resistant cap overlying map units mJS_2 and mJA. The flows exhibit "crowded" porphyritic texture imparted by roughly 60 volume per cent plagioclase, averaging 1 to 1.5 millimetres long, and up to 3 volume per cent variably chloritized augite. Similar rocks, noted between Chikamin Bay and Snag Inlet on Whitesail Lake, are associated with flows ranging in composition from basalt to rhyolite. The mafic flows contain platy plagioclase phenocrysts and amygdules, whereas felsic flows display laminations and spherulitic texture. Distinctly laminated pink and green spherulitic rhyolite is interbedded with lapilli-block tuff on the east shoreline of Whitesail Lake. This breccia contains angular fragments of rhyolite and porphyritic andesite as large as 40 centimetres in diameter. Identical rocks were found directly opposite on the west shore of Whitesail Lake.

Volcanic rocks and sporadic exposures of conglomerate extend from Zinc Bay on Whitesail Lake to Maroon Island on Eutsuk Lake. Augite-phyric andesitic flows form a resistant bench apparently overlying Ashman rocks on the south slope of the prominent peak west of Chikamin Mountain. Basaltic flows characterized by platy plagioclase phenocrysts between 4 and 13 millimetres long are prominent. They commonly exhibit amygdaloidal, trachytic and crowded medium-grained plagioclase-porphyritic texture. Rhyolite is uncommon in the pass between the lakes; it forms a dome-like body which contains rock fragments stoped from the Smithers Formation. Conglomerate deposits in excess of 75 metres thick generally consist of rounded cobble and boulder-size clasts with a volcanic provenance; rare argillite clasts also occur.

Mount Haven is underlain by gently inclined, very thick beds comprised of lapilli tuff separated by about 200 metres of augite-phyric andesite flows. The tuff is well exposed within a section in excess of 450 metres thick. It consists dominantly of siliceous lapilli, less than 1 centimetre in diameter, set within a resistant greyish green ash matrix. Lapilli-block tuff associated with parallel-laminated ash tuff were observed in several places. These deposits continue across the south end of Eutsuk Lake; a similar succession is found along the western contact of the Quanchus intrusion in the extreme north part of the mapped area.

East of the confluence of Troitsa Creek with Coles Creek, a conglomerate deposit as thick as 150 metres underlies a 4-square-kilometre area. These rocks appear to overlie the Telkwa Formation, and are in turn overlain locally by tuff interlayered with augite-phyric andesite flows. The conglomerate is characterized by a high proportion of intrusive clasts, upwards of 70 per cent in places. The framework clasts are generally poorly sorted rounded cobbles and boulders up to 30 centimetres in diameter. Sorted cobbles are found locally grading into granule and coarse sand interbeds up to 40 centimetres thick. Andesitic clasts with porphyritic and aphyric texture predominate. The intrusive clasts include quartz monzonite, biotite granite and biotite hornblende diorite. A fluvial origin is interpreted for the conglomerate.

The depositional environment for Lower Cretaceous volcanic rocks in the area is subaerial, indicated by the absence of marine intravolcanic sedimentary deposits. The regional environment was dominated by erupted flows and pyroclastic rocks building stratovolcanos. Periodic cessation of volcanic activity resulted in fluvial deposits in which the clastic detritus were shed from uplifted Jurassic volcanic and comagmatic plutonic rocks.

A porphyritic quartz biotite rhyodacite body is disconformable with volcanic rocks at Mount Haven. A potassium-argon determination on biotite from this rock will infer a minimum age for these volcanics. Tentative Lower Cretaceous rocks in the map area are similar to several lithologies of a succession reported by van der Heyden (1982). The reported succession includes augite-bearing andesite flows and polymictic conglomerate containing intrusive clasts. They form part of a more extensive volcanic-sedimentary succession tentatively assigned a Hauterivian age.

LOWER CRETACEOUS – SKEENA GROUP (lKS)

The Skeena Group (Leach, 1910) is a name applied to interlayered marine and nonmarine sedimentary and volcanic rocks deposited during Hauterivian to Albian time (Tipper and Richards, 1976). The lower contact, which separates it from Jurassic successions, is an unconformity identified by the presence of boulder conglomerate overlying Hazelton Group volcanics in the Tahtsa Lake area (MacIntyre, 1985). The Skeena Group is not present in the Whitesail Range area.

Sedimentary rocks of the Skeena Group are confined to a prominent salient in the northeast margin of Coast intrusive rocks near Lindquist Peak. Neither the top nor the bottom contact are exposed in a 400-metre-thick section.

Skeena strata consist of alternating grey and black sandstone, siltstone and argillite beds. Sandstone beds vary between 1 and 7 metres thick, and are resistant in appearance. Detrital muscovite, a diagnostic constituent, is often concentrated along parting planes within massive structureless beds. In places limy concretions up to 50 centimetres in diameter occur as solitary features aligned along a common plane in sandstone. Flute casts are rarely observed at the sharp base of some sandstone beds. Siltstone-dominated sections commonly display regular parallel laminae that are often internally graded or crosslaminated. Flaser structures and load casts become prevalent in siltstone beds containing a high proportion of mud. Siltstone commonly grades into featureless argillites that may locally contain finely disseminated pyrite. These rocks have features common to proximal turbidites.

A penetrative foliation is pronounced in argillaceous beds. Bedding and cleavage relationships indicate local overturned bedding defining limbs of tightly appressed folds. Further work is required to determine the significance of deformed rocks. The contact of Skeena strata west of Lindquist Peak is a steep, north-trending fault. The fault trace is delineated by rusty weathering polymictic conglomerate. The conglomerate marks the top of an unfoliated well-layered succession of tuff and lahar from map unit lJT_1, juxtaposed with foliated argillite. Quartz veinlets cutting the conglomerate contain sparse copper minerals. Southern and southeastern exposures of sedimentary rocks are truncated by a southerly inclined thrust fault. The hangingwall above the décollement is metamorphosed plutonic and volcanic rocks of the Gamsby group. The northeastern contact is concealed, however argillite contains andalusite crystals suggesting these rocks are likely in contact with an intrusion which is widely exposed in Lindquist Lake area.

UPPER CRETACEOUS– KASALKA GROUP (uK_v)

The Kasalka Group is an informal name proposed by MacIntyre (1976) for an Upper Cretaceous volcanic succession that unconformably overlies the Skeena Group in the Tahtsa Lake area. This succession varies from early silicic to late mafic eruptions that collectively represent a cauldron-forming eruptive cycle. The Kasalka group signifies a tectonically active episode in a continental margin arc setting during late Cretaceous time in west-central British Columbia.

Upper Cretaceous strata attain an estimated minimum thickness of 600 metres within a 26-square-kilometre area centred on Arete Mountain. Neither the top nor bottom contacts of the succession are exposed. It comprises a central tuff and epiclastic division which separates mainly flows comprising the lower and upper divisions. Contacts between divisions are transitional, marked by interfingered tuff and flow rocks. All strata are inclined gently westward, although beds deviate from this trend across steep faults.

The lower division is characterized by lava flows and relatively few tuff and epiclastic interbeds. The flows weather to cliffs that display local columnar joints at Arete Mountain. Green-grey and brown flow rocks typically contain vitreous phenocrysts of plagioclase averaging 3 or 4 millimetres, several per cent biotite and hornblende and trace augite. Plagioclase laths, up to 1.5 centimetres long, were observed in flows at Arete Mountain. Sparse intravolcanic rudite beds, generally less than 2 metres thick, are dominated by plutonic clasts. Lapilli tuff and thin parallel-laminated ash tuff comprise local thin units interspersed between flows.

The middle division is a poorly stratified and diverse assemblage composed of tuff and epiclastic rocks about 200 metres thick. Tuff beds dominate the lower and upper parts of the section. They are made up of subrounded green and maroon lapilli and few blocks, some as large as 1 metre in diameter. The fragments include, in order of abundance, aphyric and porphyritic andesite, flow-laminated dacite, plutonic rocks, laminated ash tuff, white rhyodacite and coarse platy plagioclase basalt. The matrix is composed of broken lithic fragments and crystals supported by light green and cream-coloured ash.

Conglomerate characterized by plutonic clasts is diagnostic of the crudely layered middle division. The plutonic clasts occur with heterolithic volcanic debris in tuffite beds or comprise discrete polymictic orthoconglomerate beds separated by lapilli tuff. Framework clasts in conglomerate are subrounded and rounded poorly sorted cobbles, ranging to boulders as large as 1 metre diameter. The composition of plutonic clasts includes coarse-grained biotite hornblende granodiorite, quartz monzonite and foliated quartz diorite. Coarse conglomerate and lapilli-block tuff rest directly on lower division flows on the 2000-metre summit along the west spur of Arete Mountain. The contact is sharp, and chilling of the upper flow contact indicates a brief time interval separates these deposits. A 25-metre section of dark grey siltstone and sandstone containing argillaceous partings, located at about 1650 metres elevation 4.0 kilometres northwest of Arete Mountain, apparently rests on lapilli tuff. Parallel laminations and flaser bedding are common in the finer grained beds.

Partially welded pyroclastic flows characterize the upper division. The lower contact is recognized by increasing induration and a corresponding decrease in the size and abundance of lithic fragments as middle division lapilli tuff grades upwards into flows. These flows are distinguished from the lower division by their brown to lavender colour, ubiquitous fragments and fluidal flow laminae. The pyroclasts include roughly 15 per cent phenocrysts and less than 10 per cent accidental fragments. Plagioclase, the most abundant phenocryst, is accompanied by 1 per cent variably chloritized biotite. The fragments, generally of lapilli-size, are typically subangular and have aphanitic texture. Exceptional plutonic and coarse platy plagioclase basalt fragments are also present.

The layered succession in the Arete Mountain area is interpreted as deposits built up on the flank of a composite volcano. The divisions suggest an eruptive history that began with passive effusion of flows, succeeded and partly synchronous with deposition of conglomerates and subaerial pyroclastic rocks, and culminating in pyroclastic flow eruptions. A general trend of increasing tectonic activity and increasing magnitude of eruptions is reflected by the lithologies of succeeding divisions. The conglomeratic deposits attest to rapid uplift and unroofing of a nearby intrusion. The Coast intrusions, southwest of Arete Mountain, may be comagmatic with volcanic rocks of this succession.

A Late Cretaceous age is tentatively inferred for volcanic and sedimentary rocks near Arete Mountain. This age is implied by the overall fresh appearance of rocks, vitreous mafic minerals, and widely dispersed plutonic fragments which resemble nearby Coast intrusions. Lower division flows were sampled at two localities for potassium-argon dates. The lower and middle divisions have lithologic and stratigraphic similarities with MacIntyre's (1985) porphyritic andesite unit and lahar unit, respectively. The upper division has no direct analog in Tahtsa Lake area.

TERTIARY VOLCANIC ROCKS–OOTSA LAKE GROUP (EO)

The Ootsa Lake Group (Duffell, 1959) is a succession of continental calcalkaline volcanic rocks and less abundant sedimentary rocks. They unconformably overlie Jurassic strata in the Whitesail Range and Whitesail Reach areas, where six lithologic divisions are recognized (Diakow and Mihalynuk, 1987a and b). The volcanic rocks are mainly lava flows ranging in composition from basalt to rhyodacite. The age of this volcanic succession is established by four new potassium-argon dates.

Tertiary strata are confined to the Whitesail Reach map sheet (93E/10). In this report they constitute basaltic and rhyolitic flows that underlie a plateau in the Goodrich Lake area. The plateau extends northward to a pronounced escarpment above Llama Creek.

Basalt comprises flat-lying flows with massive appearance and uncommon columnar joints. Deeply weathered exposures produce popcorn-size rubble and brownish orange soil. Relatively fresh lava flows are typified by evenly distributed platy plagioclase phenocrysts, between 4 and 12 millimetres long, set in a matrix that is dark green, reddish maroon and aphanitic. Amygdules infilled by opalescent silica are present, but uncommon. Celadonite, an earthy green mineral, is widespread in these rocks and can be easily confused with secondary copper. Rhyolitic rocks constitute a series of isolated knolls rising in excess of 40 metres above the basalt. They also underlie areas faulted against basalt. The rhyolite has a porphyritic texture imparted by 2 to 5 per cent plagioclase, several per cent vitreous biotite and 1 per cent or less quartz. These minerals rarely exceed 3 millimetres in diameter within a pink, grey or cream-coloured matrix that may be thinly laminated and have a spherulitic texture.

The lower contact is not exposed near Goodrich Lake. Lower Cretaceous (?) volcanic rocks exposed to the west presumably extend eastward, directly underlying the basaltic flows. Near Llama Creek, the basalt and rhyolite appear to abut Middle Jurassic sedimentary rocks. The contact, defined roughly by the creek, may be a steep fault or a buttress unconformity.

AGES OF OOTSA LAKE GROUP STRATA

Four new numeric ages constrain the timing of volcanic eruptions represented by the Ootsa Lake Group in Whitesail Range and Whitesail Reach areas.

The first three ages reported are from a well-layered succession of differentiated lava flows about 400 metres thick exposed approximately 7.0 kilometres northeast of Troitsa Peak. The fourth is for the uppermost volcanic member of the Ootsa Lake Group which is confined to an area adjacent to central Whitesail Reach. The results of potassium-argon age determinations are presented in Table 1-14-1.

Biotite-bearing dacitic lava, presumed to occur near the bottom of the Ootsa Lake Group in the Whitesail Range, yielded an age of 49.9 Ma. A synchronous age of 49.9 Ma for the overlying conformable section of platy plagioclase basaltic flows is inferred from a crystal ash tuff interbed low in the section. Rhyodacite lava flows generally rest conformably on platy basalt, although in places they are separated by a succession of vitrophyre interlayered with laharic deposits. Rhyodacite lava yields an age of 49.1 Ma close to its lower contact with platy basalt. To the east, at Whitesail Reach, an identical succession of basalt and rhyodacite is in turn overlain by vitrophyric andesite lava flows. An age of 50.0 Ma is determined for these vitrophyric flows. The age of the stratigraphically lowest and highest members increases. This variability is not, however, sufficient to preclude more or less continuous volcanic activity over a period of about 1 million years during Eocene time. Conglomerate, containing clasts derived from underlying rhyodacite and vitrophyric flows, marks the top of the Ootsa Lake succession at Whitesail Reach. Polynomorphs, extracted from amber, indicate a tentative Eocene or younger age for this deposit (J.M. White, personal communication, 1986).

Undivided volcanic rocks, thought to be part of the Ootsa Lake Group, underlie the area between Ootsa and Francois lakes. A date of 55.6 ± 2.5 Ma from dacite immediately north of Ootsa Lake is reported (Woodsworth, 1982). North of Francois Lake, the Goosly Lake and Buck Creek volcanic rocks are dated at 48.0 ± 1.8 Ma and 47.3 ± 1.6 Ma respectively (Church, 1972). These rocks correlate on the basis of

TABLE 1-14-1
POTASSIUM-ARGON DETERMINATIONS OF ENDAKO GROUP AND OOTSA LAKE GROUP VOLCANIC ROCKS, WHITESAIL REACH AND TROITSA LAKE MAP AREAS

Sample No.	UTM Location Zone 09 Easting	Northing	Mineral	K_2O %	^{40}Ar 10^{-10} mole/gm	$^{40}Ar^*$ %	Apparent Age (Ma)	Formation (Group)	Map Unit 1987-4 (Diakow)	Map Unit This Report
86-LD-19-1	644071	5955865	Whole rock	1.64 ± 0.01	0.899	27.6	31.3 ± 1.2	Endako	7c	EE
86-LD-32-4	630884	5942976	Whole rock	0.938 ± 0.017	0.686	86.9	41.7 ± 1.5	Endako	7c	
86-LD-5-0	647000	5947250	Biotite	6.87 ± 0.07	6.044	84.7	50.0 ± 1.7	Ootsa Lake	10	
86-LD-33-1	630807	5942805	Biotite	6.33 ± 0.02	5.467	87.7	49.1 ± 1.7	Ootsa Lake	9	EO_2
86-LD-22-3	639720	5945923	Biotite	6.65 ± 0.07	5.820	89.1	49.8 ± 1.7	Ootsa Lake	7b	EO_1
86-LD-31-1	632390	5943584	Biotite	6.13 ± 0.07	5.367	86.3	49.8 ± 1.7	Ootsa Lake	6a	

* radiogenic Ar.
Constants: $\lambda^{40}K_e = 0.581 \times 10^{-10}$ yr^{-1}; $\lambda^{40}K_b = 4.96 \times 10^{-10}$ yr^{-1}; $^{40}K/K = 1.167 \times 10^{-4}$.
%K determined by the Analytical Laboratory, British Columbia Ministry of Energy, Mines and Petroleum Resources, Victoria.
Ar determination and age calculation by J.E. Harakal, The University of British Columbia.

age with Eocene strata in the study area; the volcanic rocks dated at Ootsa Lake are slightly older.

ENDAKO GROUP

The Endako Group (Armstrong, 1949) is comprised of fresh basaltic flows in the map area. These rocks were previously included by the writer as a member of the Ootsa Lake Group. In this report they have been separated in light of two new potassium-argon dates.

The Endako Group underlies Mosquito Hills at Tahtsa Reach. These rocks also form isolated remnants overlying platy plagioclase basaltic flows of the Ootsa Lake Group in the Whitesail Range and northwest of Goodrich Lake. The dominant lithology is basalt which weathers to massive exposures that locally display columnar joints. The flows are characteristically black and aphyric, but the texture may vary from sparsely porphyritic to crowded platy plagioclase porphyry. The latter is indistinguishable from platy plagioclase andesitic rocks prevalent in the Ootsa Lake Group. The aphyric flows may exhibit thin parallel laminae which result from pilotaxitic texture of microscopic plagioclase. Interflow breccia and crudely stratified lahar are locally associated with the flows at Tahtsa Reach.

The results of two potassium-argon determinations on whole rock samples of Endako Group flows are presented in Table 1-14-1. The older date of 41 Ma is for a remnant of columar jointed aphyric lava in the Whitesail Range. These rocks overlie platy plagioclase basalt and crystal ash tuff dated at 49 Ma. Aphyric lava flows at Tahtsa Reach have an age of 31 Ma. This date is discordant with a 38.7 ± 3.1 Ma date derived from nearby flows (Woodsworth, 1982), and the 41 Ma date from the Whitesail Range, however, the latter two dates correlate.

INTRUSIVE ROCKS

Intrusions in west-central British Columbia are divided into discrete belts based on their composition and texture, isotopic age and associated metallic deposits (Carter, 1981). Two intrusive divisions applicable to this study include Eocene Nanika intrusions (Tg) and Late Cretaceous Bulkley intrusions (lKg). Late Cretaceous–Tertiary fine-grained porphyritic diorite (KTd) and pre-Lower Jurassic foliated quartz diorite (Md) also occur. The two former divisions are regionally distributed, whereas the latter have only local prominence. These intrusive rocks are manifested as plugs and stocks that display considerable variability in composition and texture. The following section describes intrusions in order of decreasing age.

Foliated quartz diorite (Md) is found exclusively in the Lindquist Lake area, where it is spatially associated with pre-Jurassic metamorphic rocks. This rock is typically medium grained, and contains as much as 35 per cent chlorite. The sole of a major north-directed thrust fault detaches the diorite and places it atop Skeena Group rocks near Lindquist Peak. The diorite hosts mineralized quartz veins in several localities at or near the décollement. At the Deerhorn mine, mineralized veins are found in sericite-altered diorite. A bulk sample of sericitized diorite has been collected for a potassium-argon age determination. This diorite body is centrally positioned relative to sedimentary rocks to the west and fresh granodiorite to the southeast. Dykes related to granodiorite cut the foliated diorite.

The Bulkley intrusions (lKg) include porphyritic granodiorite and quartz monzonite stocks dated at 70 to 84 Ma (Carter, 1981). A large body underlying the area between Coles Lake and Mount Irma is an example of such intrusions. It consists of unfoliated, equigranular medium and coarse-grained granodiorite and quartz monzonite. Biotite and hornblende, variably pseudomorphed by chlorite and epidote, are present in amounts ranging between 5 and 10 per cent of the rock. Between Coles Lake and Sias Mountain the inclination of lower Jurassic strata steepens approaching the intrusive contact, suggesting forceful intrusion.

Granitic contacts are varied in appearance and often characterized by increased concentration of mafic minerals, including actinolite adjacent to hornfelsed middle Jurassic sedimentary rocks. Chlorite enrichment marginal to the contact is observed at one locality where intermediate volcanic rocks have been assimilated. Andesitic dykes with a northwest trend and steep dips are found west of Sias Mountain. Similar intrusions also parallel and crosscut the contact in the same area. Elsewhere granitic dykes project outwards from the main intrusive body into the country rocks. A wedge-shaped pendant of Skeena Group argillite, enclosed by granodiorite, suggests a post-mid-Cretaceous emplacement for this intrusion.

The Nanika intrusions (Tg), described by Carter (1981), were originally named for quartz monzonite and granite plutons near Nanika Lake. They range in age from 47 to 56 Ma. In the map area these intrusions occur as stocks and batholiths in the vicinity of Lindquist, Surel and Musclow lakes, at Red Bird Mountain and in the Quanchus Range. The intrusion near Lindquist Lake is a coarse-grained granodiorite containing as much as 10 per cent vitreous biotite. Dioritic phases containing roughly 25 per cent combined hornblende and biotite are associated with granodiorite immediately west of Musclow Lake. The texture of these rocks varies from equigranular to porphyritic. The plutons intrude and metamorphose pelitic rocks to andalusite slate near Lindquist Peak and also hornfels upper Cretaceous volcanics near Arete Mountain. Dykes related to the main granodiorite body, southeast of Lindquist Lake, cut pre-Jurassic foliated quartz diorite and metavolcanic rocks. In this general area the granodiorite is dated at 58.8 ± 1.8 Ma (Woodsworth, 1979). Two additional age determinations from granodiorite near the northwest end of Lindquist Lake and at the head of Eutsuk Lake will be undertaken during this study.

The Quanchus batholith, named by Marshall (1925), occupies the core of the Quanchus Range which extends from Ootsa Lake to Eutsuk Lake. This intrusion occupies much of the eastern boundary of the study area on Whitesail Reach map sheet. The composition is mainly granite and quartz monzonite with equigranular and porphyritic texture. The batholith is characterized by a broad flat top and gently sloping flanks. Metamorphosed screens of country rock found near the margin, and small satellite plutons peripheral to the main intrusive body, suggest that the Quanchus batholith was emplaced at a high level in the crust and is barely exhumed. The intrusion is dated at 51.4 ± 2.2 Ma from porphyritic granite near Grizzly Hill (Woodsworth, 1982).

The Red Bird intrusion, located north of Haven Lake on Red Bird Mountain, is a quartz monzonite porphyry with phenocrysts of euhedral quartz, zoned plagioclase, orthoclase and biotite. This pluton is host to concentrically zoned molybdenum mineralization and is dated at 49.5 ± 3 and 49.0 ± 2 Ma (Carter, 1981).

Fine-grained porphyritic diorite (KTd) plugs and sills cap topographically high areas on Core Mountain. Elsewhere small isolated bodies occur west of Little Whitesail Lake and at Coles Lake. Dykes of the same lithology crosscut Late Cretaceous porphyritic granite on the southeast side of Core Mountain. These hypabyssal intrusions contain diagnostic chloritized pyroxene phenocrysts rarely exceeding 3 millimetres in diameter and felty textured plagioclase. The matrix is typically dark green and a high proportion of epidote is not uncommon. In the Tahtsa Lake area, MacIntyre (1985) describes these intrusive rocks as microdiorites that intrude Upper Cretaceous Kasalka Group strata.

STRUCTURE

Structural features in stratified rocks divide the study area into two domains. The western domain consists of penetratively deformed metavolcanic and metaplutonic rocks of the Gamsby group that are disrupted by thrust faults. The eastern domain is characterized by relatively undeformed but extensively block-faulted Mesozoic and Cenozoic strata. Foliated volcanic rocks have local prominence in the eastern domain. The boundary separating the domains is a northwest-trending thrust fault west of Lindquist Lake.

The Gamsby group underlies a thrust panel that structurally overlies strata of the Skeena Group. This décollement is traceable from the southwest ridge of Lindquist Peak, for about 2 kilometres to the west across Lindquist Pass to Mount Irma. The fault trace, concealed by talus on the southwest-facing slope of Lindquist Peak, is projected obliquely downslope, passing through the workings at the Deerhorn mine. The detachment plane dips at 20 degrees south, subparallel to bedding, increasing to about 50 degrees south at the Deerhorn mine. Several excellent exposures of the décollement are characterized by mylonitic structure which grades symmetrically over several metres into undeformed bedded sedimentary rocks in the footwall and variably foliated quartz diorite in the hangingwall.

Similar structural features are documented in Gamsby group strata, immediately west of this study area by van der Heyden (1982). There the rocks have been subject to multiple phases of ductile deformation and are imbricated by northeast-directed compression. The most easterly of these thrust faults roughly coincides with the boundary separating the Coast Complex from the Intermontane Belt. Conceivably the same boundary relationship is indicated by the stratigraphic setting of the thrust fault near Lindquist Peak. The timing of thrust-related compression in the Lindquist area postdates Lower Cretaceous Skeena Group sedimentary rocks. Cessation of movement is constrained by a mariolitic monzonite stock, dated at 48.9 ± 2.3 Ma (Woodsworth, 1979), which intrudes and truncates a thrust straddling the Gamsby River valley. A large body of granodiorite at Lindquist Lake appears to truncate hangingwall rocks and the thrust fault at the most easterly locality. A potassium-argon age determination for this body is in progress. The same pluton, 4 kilometres southwest of the west end of Lindquist Lake, is dated at 58.8 ± 1.8 Ma (Woodsworth, 1979).

High-angle gravity faults are the principal structures in the eastern domain. These structures are inferred by abrupt changes in lithology and variations in bedding attitudes. Some faults correspond with topographic depressions evident as prominent airphoto linears. In many areas, absence of stratigraphic markers makes it difficult to recognize faults in monotonous volcanic successions.

Core Mountain is transected by an array of northeast and a few northwest-trending faults. Displacement along individual structures is presumed small, inferred from brittle shear entirely within Jurassic strata. Slickensides on fault planes commonly have steep rake, indicating that many of the faults are extensional features with oblique slip movement. A pronounced north-trending fault controls the northwest shoreline of Whitesail Lake at Core Mountain. This structure is delineated for at least 5 kilometres by an incised drainage and offset plutons. A steep northwest-trending biotite-phyric dyke, offset by the fault, indicates sinistral movement of about 750 metres. The faults at Core Mountain are difficult to trace with certainty into bordering areas, but nevertheless comply with the dominant trend of faults mapped regionally in Whitesail Range and Whitesail Reach areas where northeast-trending faults juxtapose Eocene against lower Jurassic strata. Steep faults with variable orientation disrupt stratified rocks on the margin of intrusions occupying the core of Quanchus Range, Chikamin Range and on the ridge east of Eutsuk Lake. These faults place locally hornfelsed and altered rocks against unaltered, inclined sedimentary and volcanic strata.

Several northwest-directed thrust faults are documented at Chikamin Mountain in Open File Map 708 (Woodsworth, 1980). No compelling evidence was found to confirm these structures, instead gentle warping of strata in this area may be related to a northeast-directed thrust fault. About 1 kilometre west of Chikamin Mountain summit, a steeply dipping northerly trending fault separates gently inclined Ashman strata to the west from open-folded Telkwa maroon tuff. Smithers strata are tilted to a near-vertical position adjacent to this fault.

A penetrative foliation is locally developed in volcanic rocks of map unit lJT_2 of the Telkwa Formation. These rocks occur intermittently between Little Whitesail and Coles lakes, and they underlie a large area west of Michel Lake. At the former area, a steeply dipping foliation is evident within zones, tens of metres wide, that grade into unfoliated rock. This fabric is explained in terms of fault movement. In contrast, the latter area is characterized by a pervasive foliation akin to regional deformation. The widespread occurrence of greenschist facies minerals, and local folds indicated by bedding and cleavage relationships, support the idea of regional deformation. The proximity of foliated strata close to the Quanchus intrusion suggests this deformation is related to emplacement of plutons.

MINERAL PROSPECTS

Mineral showings and developed prospects are concentrated at Lindquist Peak, Chikamin Mountain, Core Mountain and Red Bird Mountain. They can be categorized as follows:

(1) Gold-bearing quartz veins associated with thrust faults.
(2) Silver-lead-zinc quartz veins in extensional fractures.
(3) Porphyry copper-molybdenum deposits associated with quartz monzonite intrusions.

LINDQUIST PEAK AREA–GOLD-BEARING QUARTZ VEINS

The original Harrison claim group (Holland, 1945, 1946) were staked in 1943, following the discovery of scheelite in talus about 1 kilometre southeast of Lindquist Peak. Subsequent interest in the property focused on gold and silver-bearing quartz veins. Pioneer Gold Mines Ltd. conducted surface trenching and diamond drilling on quartz veins in 1944 and continued exploration work until 1946 when its option lapsed. In 1950, title of the original claims was acquired by Deer Horn Mines Ltd. which actively developed the property in 1954 and 1955. Development included construction of a road connecting the property with Whitesail Lake, and extensive underground and surface work (Bacon, 1956). No further work was recorded after 1967, when Granby Mining Company Ltd. undertook a program of bulldozer trenching and geological mapping.

The Harrison quartz veins occur mainly within foliated diorite and associated metavolcanic rocks assigned to the pre-Lower Jurassic Gamsby group. These rocks are in sharp contact with a succession of black argillite, flaser siltstone and sandstone that underlies Lindquist Peak. The sedimentary rocks are representative of the Lower Cretaceous Skeena Group. The contact between diorite and sedimentary rocks strikes westerly and dips south. Increased shearing in diorite resting structurally above younger sediments indicates the contact is a thrust fault. A large granodiorite stock and dykes of Nanika intrusions cut the diorite and locally metamorphose pelitic rocks to andalusite slate.

The quartz vein system consists of two mineralized zones that coalesce downdip on the main vein. The zones include a main vein striking west and dipping south that is traceable for 370 metres, and a subsurface zone of quartz stringers in quartz-sericite-altered diorite adjacent to the contact with sedimentary rocks. Gold is found in native form and with silver in tellurides within the quartz vein system. Minor quantities of arsenopyrite, galena, sphalerite, chalcopyrite and scheelite have also been identified (Papezik, 1957). Underground work has defined a 330-metre section of the main vein averaging 7.7 grams per tonne gold and 216 grams per tonne silver over a vein width of 2.9 metres. A section of the contact zone 221 metres long averages 13.9 grams gold and 420 grams silver per tonne over 2.7 metres (Buckles, 1954).

CORE MOUNTAIN AREA

Activity in the Core Mountain area began in 1944 with staking of the Core and Shirley groups of claims to cover numerous vein-type mineral occurrences along strong northeast-trending fault structures. Telkwa Formation volcanics and Smithers Formation sediments dominate the geology of Core Mountain; younger diorite and granite bodies, possibly related to the Coast and Bulkley intrusions, intrude the older rocks. Limited soil, rock and stream geochemical surveys, as well as a magnetometer survey, were conducted from 1980 to 1983, revealing mineralization in quartz-filled fracture zones and shear zones carrying erratic geochemically anomalous gold and silver values. Disseminated pyrite and chalcopyrite constitute sporadic mineral prospects adjacent to the major fault structure bounding the northwest shore of Whitesail Lake.

CHIKAMIN MOUNTAIN AREA–SILVER-LEAD-ZINC VEINS

Claims in Chikamin Mountain area were initially staked in 1916 on silver-lead occurrences at Zinc Bay on Whitesail Lake. Subsequent work until 1924 outlined a number of similar vein occurrences traversing the northwest slope of Chikamin Mountain. Trenches and several adits outlined these mineralized zones, and in the 1940s some diamond drilling was done.

The mineralized area is underlain by tuffaceous sedimentary rocks of the Smithers and Ashman formations. Mineralization consists of sulphides in quartz-calcite veins that infill extensional fractures, joints and shear fractures. The veins host typically massive pyrite, galena, chalcopyrite, sphalerite and sporadic arsenopyrite and tetrahedrite. Gold is, for the most part, negligible although spotty anomalous assays are reported from grab samples. The structures hosting the veins appear to be related to a poorly defined system of extensional faults that delimit Middle Jurassic sedimentary rocks at Chikamin Mountain. They consistently trend in a southeasterly direction and veining is generally steeply dipping.

RED BIRD MOUNTAIN–PORPHYRY COPPER-MOLYBDENUM

The Red Bird group of claims, located on the northeastern side of Red Bird Mountain, was staked in 1929 and restaked as the Old Glory group in 1944. From 1960 to 1967, Phelps Dodge Corporation of Canada conducted surface trenching, geophysical surveys and diamond drilling totalling over 20 000 metres. In 1966, a 762-metre airstrip was built near the outlet of Bone Creek on Eutsuk Lake. It is connected to the property by a 17.6-kilometre road. During 1979 and 1980, Craigmont Mines Limited completed close to 20 000 metres of diamond drilling.

The area is mainly underlain by bedded pyroclastic rocks of the Telkwa Formation. A quartz monzonite porphyry intrudes the volcanics and hosts molybdenum mineralization. The mineralization is found within a concentrically zoned pluton but extends into hornfelsed wallrock. Quartz stockwork veins are found near the contact and occur for over 300 metres into the country rock, but decrease sharply beyond the pluton. Disseminated pyrite and chalcopyrite are common within the quartz veins. A gossanous zone outlines pyrite-rich rocks extending for up to 1.5 kilometres beyond the pluton and is reported to contain pyrite, galena, sphalerite and molybdenite mineralization.

CONCLUSIONS

This study establishes a stratigraphy and describes the setting of several mineral occurrence types in the map area. The conclusions of this work are:

(1) *The stratigraphic succession is principally comprised* of volcanic and lesser sedimentary strata. The volcanics include Lower Jurassic, Cretaceous and Tertiary lava flows and pyroclastic rocks. Middle Jurassic and mid-Cretaceous marine deposits dominate the sedimentary successions. The Middle Jurassic sedimentary section separates visually similar maroon pyroclastic rocks. These pyroclastic successions are difficult to distinguish in the absence of the sedimentary marker.

(2) Pre-Jurassic metavolcanic and metaplutonic rocks constitute the oldest strata. They form a thrust panel structurally overlying mid-Cretaceous sedimentary rocks at Lindquist Peak.

(3) Easterly directed thrust movement is a post mid-Cretaceous and pre-Eocene tectonic event, which presumably resulted from collision of allochthonous Wrangellia with the previously accreted Stikine terrane. Auriferous quartz veins at Deerhorn mine occur in thrust-faulted metamorphic rocks west of Lindquist Lake. *Similar vein occurrences, localized in meta*plutonic rocks intermittently along the thrust fault west of the minesite, suggest that these strata and structures have regional exploration significance.

(4) Northeast and northwest-trending high-angle gravity faults disrupt Mesozoic and Cenozoic strata. These structures displace volcanic rocks dated at 50 Ma in Whitesail Range. At Chikamin Mountain, narrow quartz veins contain silver-lead-zinc minerals in steep northwest-trending fractures. Sparse pyrite and copper minerals occur adjacent to northeast faults at Core Mountain.

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