# GEOLOGY OF THE FAWNIE AND NECHAKO RANGES, SOUTHERN NECHAKO PLATEAU, CENTRAL BRITISH COLUMBIA (93F/2, 3, 6, 7)

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*KEYWORDS:* Nechako Plateau, Nechako River, Hazelton Group, Entiako formation, Naglico formation, Nechako volcanics, Capoose batholith, Nechako uplift, Ootsa Lake Group.

## INTRODUCTION

The southern Nechako River map area (93F) was remapped at 1:50 000 scale to update stratigraphic, plutonic and structural relationships, building upon a regional geological base published at 1:250 000 scale (Tipper, 1963). This mapping provides a modern geological framework which better defines Jurassic and Tertiary magmatic events associated with volcanic-hosted gold-bearing epithermal veins and intrusion-related copper-molybdenum mineralization (*see* Lane and Schroeter, 1997, this volume). Advances in the geology of the southern Nechako River map area are discussed in this report and some new informal stratigraphic names introduced for the Jurassic stratigraphy in the area.

Bedrock mapping from 1992 to 1994 covered four 1:50 000 map areas, encompassing approximately 3500 square kilometres of the southern Nechako Plateau (Figure 1). During the first year of the program, mapping was completed in the Natalkuz Lake map area (93F/6; Diakow *et al.*, 1993b; Green and Diakow, 1993). The following year it was expanded southward into the Fawnie Creek area (93F/3), where surficial mapping was conducted in parallel, and the results of each program subsequently published in a combined bedrock-surficial geological map (Diakow and Webster, 1994; Diakow *et al.*, 1994). The program concluded in 1994 with expansion of bedrock and surficial mapping coverage into the Tsacha Lake (93F/2) and Chedakuz Creek (93F/7) areas (Diakow *et al.*, 1995a, b, c).

The Blackwater (West Road) River, a natural physiographic division in the central part of the Interior Plateau, separates the Nechako Plateau to the north from the Fraser Plateau to the south (Holland, 1976). The southern boundary of the study area follows the river; it comprises a series of northeast-oriented interconnected lakes which served as an ancient native trading route between the interior and the coast. G.M. Dawson (1878) followed this route to conduct the first geological reconnaissance of the Interior Plateau region. The present study area is centred on the Fawnie and Nechako ranges and the connected east-west trending ridges of the Entiako Spur and Naglico Hills. The ranges are parallel, trending northwest and rise a maximum of 950 metres above the intervening Chedakuz Creek valley with a base elevation of about 900 metres. The ranges drop abruptly to a surrounding plateau characterized by thickly forested hills. The Nechako Reservoir lies just beyond the northern terminus of the ranges, marking the northern boundary of the study area.

Access to the area from Vanderhoof, the closest major centre, is via the Kluskus-Ootsa forest service road. This all-weather gravel road branches onto secondary logging roads suitable for two-wheel drive vehicles and provides access to logged areas on the upper slopes of the Nechako Range. The Kluskus-Ootsa road transects the central part of the Nechako Range, and continues westward across the Chedakuz Creek valley into the Fawnie Range, to an important junction at the 142-kilometre marker. Here the Kluskus-Malaput forest service road leads to principal areas of bedrock exposure in the Entiako Spur in the north, and the continuation of the Kluskus-Ootsa road southward leads to a network of secondary roads in the Naglico Hills.

## REGIONAL GEOLOGIC SETTING

The Nechako River map area is situated along the eastern margin of the Stikine Terrane, just west of the

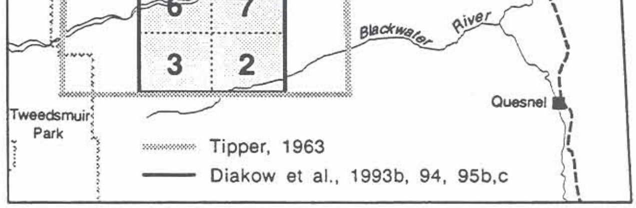


Figure 1. Location of the study area in the southern Nechako Plateau region, central British Columbia.

# TABLE 1
## TABLE OF FORMATIONS AND GENERALIZED LEGEND FOR FIGURE 2

| Period | Epoch | Stage | Stratigraphy | Map Unit | Lithology |
|---|---|---|---|---|---|
| NEOGENE | Pliocene | | Chilcotin Group | MPc | Olivine basalt flows, vesicular texture, columnar jointed |
| | 5 | | | | |
| | Miocene | | | | |
| | 23 | | | | *Unconformity* |
| PALEOGENE | Oligocene | | | | |
| | 35 | | | | |
| | Eocene | | *Endako Group* | EE | Andesite flows, massive and amygdaloidal textures *Disconformity* |
| | | | Ootsa Lake Group | EO | Quartz-phyric rhyolite flows and air-fall tuffs; some bladed feldspar and augite-phyric andesite flows; local basal boulder conglomerate |
| | | | | ECH | CH pluton: Hornblende biotite granodiorite |
| | 57 | | | | *Unconformity; block faulting* |
| | 65 | | | | |
| CRETACEOUS | L | Maastrichtian | *Unnamed volcanics* | uKv | *Hornblende andesite tuff-breccia and flows* |
| | | | | LKf | Biotite-bearing felsite sills |
| | | | | LKd | Quartz diorite stocks and plugs |
| | | Cenomanian | Skeena Group | lKs | Rare black mudstone |
| | 97 | Albian | | | |
| | E | | | | *Unconformity; inception of the Nechako uplift; brittle deformation* |
| | | | | EKc | Capoose batholith: hornblende biotite granodiorite and quartz monzonite |
| | | Berriasian | Unnamed volcanics | lKv | Rare biotite-phyric dacite flows |
| | 146 | | | | |
| JURASSIC | L | Tithonian | | | |
| | | Kimmeridgian | Bowser Lake Group: Nechako volcanics | uJBN | Pyroxene-phyric basalt flows, rhyolitic tuffs |
| | | Oxfordian | | | *Paraconformity/ angular unconformity* |
| | 157 | Callovian | Bowser Lake Group: Ashman Fm. | muJBA | Black mudstone; chert-bearing conglomerate, sandstone and siltstone |
| | M | Bathonian | | | *Major unconformity; erosional interval* |
| | | Bajocian | Hazelton Group: *Naglico fm.* | mJHN | Pyroxene-phyric basalt flows and tuffs; feldspathic sediments |
| | | Aalenian | Hazelton Group: Entiako fm. | lmJHE | Near-shore and distal marine facies: volcanic sandstone and granule-pebble conglomerate; black laminated tuffaceous mudstone |
| | 178 | Toarcian | | | Subaerial facies: quartz-phyric rhyolite tuffs, lesser rhyolite flows; variegated maroon and green air-fall tuffs |
| | E | | | | *Major unconformity* |
| | 208 | | | | |
| TRIASSIC | | Norian | | | |
| | | Carnian | *Unnamed Sediments* | uTRs | Marine black, laminated siltstone |

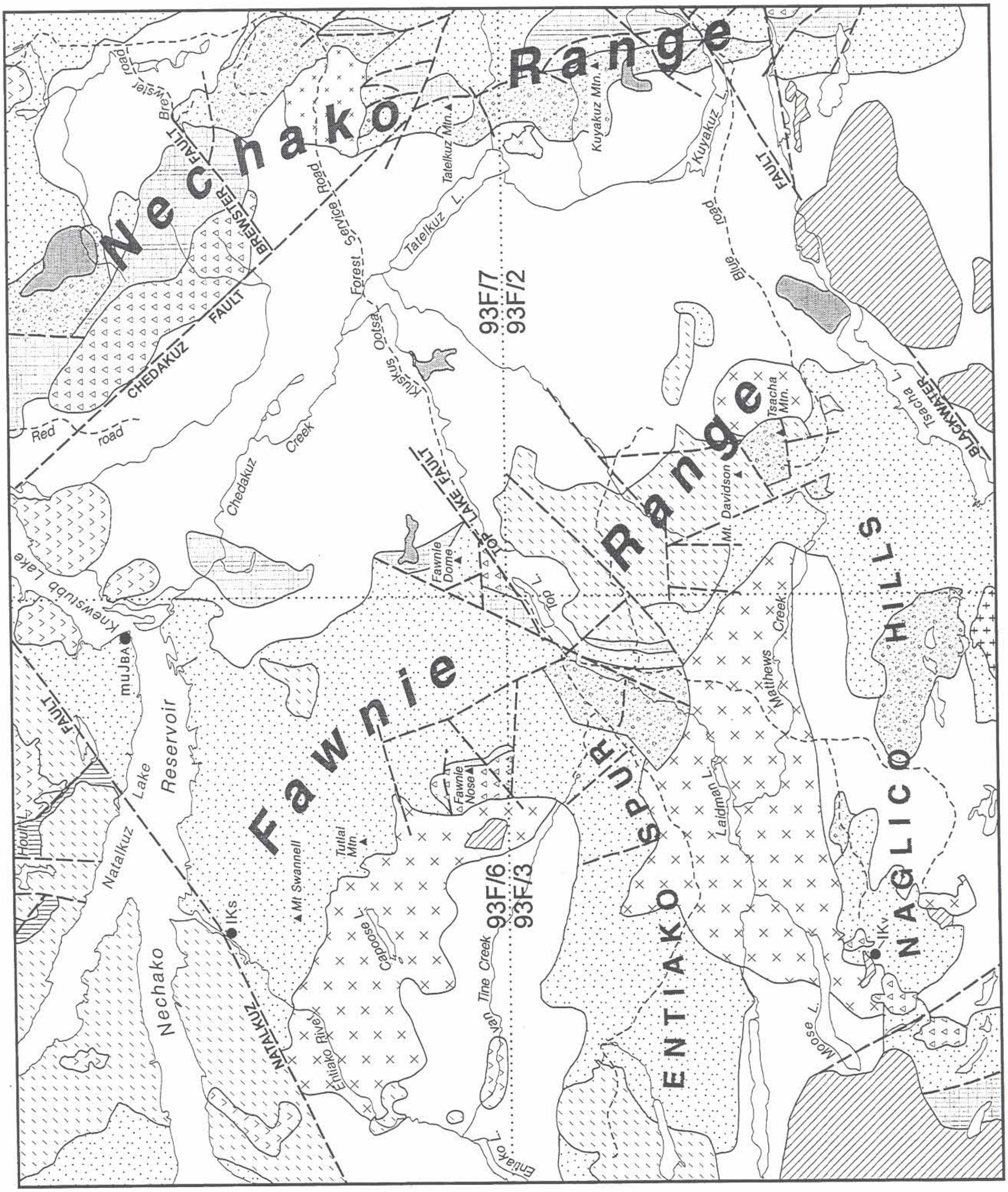


Figure 2. Generalized geology of the Fawnie and Nechako ranges.

presumed structural contact with the Cache Creek Terrane and immediately south of the Skeena Arch. Strata of the Stikine Terrane in central and east-central British Columbia comprise superposed island and continental margin arc assemblages and epicontinental sedimentary sequences.

Island arc volcanism and associated sedimentation in central Stikine Terrane spans Late Triassic to Middle Jurassic time. Elsewhere in Stikinia, remnants of Early Devonian to Permian arc volcanic rocks are known (Monger, 1977). The oldest strata exposed in east-central Stikinia are fossiliferous Upper Triassic sediments, sporadically exposed in the Smithers (Tipper and Richards, 1976b; MacIntyre *et al.*, 1996) and Nechako River (Tipper, 1963) map areas. Rare augite-plagioclase-phyric lavas, yielding a Late Triassic age (D.G. MacIntyre, personal communication, 1996), that closely resemble flows of the Stuhini Group, crop out near fine-grained marine sediments containing the Carnian to early Norian bivalve *Halobia* in the Fulton Lake map area (93L/16; MacIntyre *et al.*, 1996). These rocks are possibly coextensive with fossil-bearing Upper Triassic marine sediments mapped along the western margin of the Stikine Terrane in the Whitesail Lake (van der Heyden, 1982) and Terrace (Mihalynuk, 1987) map areas, where they crop out in close proximity to Lower Permian carbonates (van der Heyden, 1982). Early and Middle Jurassic rocks of the Hazelton Group stratigraphically overlie the Stuhini Group throughout much of Stikinia. The Hazelton Group is a lithologically varied island arc succession composed of subaerial and submarine volcanics locally interlayered with marine sediments (Tipper and Richards, 1976a).

Island arc volcanism commenced in Middle Jurassic time, broadly coincident with a protracted event of terrane accretion and the subsequent overlap of older arc strata by widespread Upper Jurassic and Lower and mid-Cretaceous flysch and molasse deposits. Terrane accretion began possibly as early as Bajocian time, resulting in structural juxtaposition of oceanic Cache Creek Terrane onto Stikinia, and led to early development of the Bowser Basin and shale deposited in a starved marine environment (Ricketts and Evenchick, 1991; Tipper and Richards, 1976a). Overlying coarser clastic rocks, consisting largely of conglomerate shed from the uplifted Cache Creek Terrane, record fluvatile transport and progradation of deltaic deposits along the periphery of the basin. The Skeena Arch became an uplifted area and sediment source for northerly flowing drainages into the southern part of the Bowser Basin from mid-Oxfordian to earliest Early Cretaceous times. During parts of the Early and Late Cretaceous, sediments sourced from the northeast and east record initial deposition of nonmarine and shallow marine sediments of the Sustut and Skeena groups. In south and south-central Stikinia, contemporaneous deposits of sandstone, siltstone and conglomerate are widespread and suggest that a number of smaller sedimentary basins may have been connected (*e.g.*, Nazko Basin; Hunt, 1992).

Regional contractional deformation, documented in widely separated areas of the Stikine Terrane in the Taseko-Pemberton (NTS 92N,O; Schiarizza and Garver, 1995), and the Spatsizi (NTS 104H; Evenchick, 1991; Evenchick and McNicoll, 1993) map areas was a middle and Late Cretaceous event. This orogenic event coincides with the transition from sedimentary deposition to continental margin arc volcanism. Definitive evidence of Cretaceous contractional deformation in the intervening region of central Stikinia, particularly in the Nechako River map area (NTS 93F), has not yet been recognized. However, a domain of cleaved rocks with local zones of mylonite in the Nechako Range may be the record of this event.

Continent margin arc volcanism began in south and central Stikine Terrane in Late Cretaceous time and continued episodically into the Eocene with eruption of the Kasalka, Ootsa Lake and Endako groups. The Upper Cretaceous Kasalka Group unconformably overlies the Skeena Group. The Kasalka Group records construction of isolated volcanic centres as the magmatic front apparently migrated from the Coast Belt eastward across the Stikine Terrane over a period of nearly 30 million years, ending in latest Cretaceous time. Robust continental arc magmatism was re-established during Middle and late Eocene time with eruption of the Ootsa Lake and Endako groups. This volcanism appears to be closely linked to regional crustal transtension in central British Columbia, manifest in upwelling of high-grade metamorphic rocks in core complexes (Ewing, 1980) and major strike-slip faults, such as the Tatla Lake Metamorphic Complex adjacent to the Yalakom fault in the Anahim Lake map area (Friedman and Armstrong, 1988).

Miocene and younger volcanism, represented by the Chilcotin Group, is dominated by transitional basalts that formed flat-lying lava fields, mainly in southern Stikinia. The Chilcotin Group is interpreted to have erupted in a back-arc setting, east of the Pemberton-Garibaldi arc (Souther, 1991, Bevier, 1983a,b). Shield volcanoes, comprising the Anahim Belt, are locally perched on the plateau-forming Chilcotin lavas. They consist of distinctive peralkaline volcanoes erupted between 8.7 and 1.1 Ma above a mantle hotspot (Bevier *et al.*, 1979; Souther, 1986; Souther and Souther, 1994).

The study area is underlain by rocks deposited between Late Triassic and Neogene time (Table 1; Figure 2). The Fawnie and Nechako ranges in the southern Nechako River map area are uplifted blocks in which Mesozoic rock units have been widely exposed. These include mainly volcanic and sedimentary strata that broadly correlate in age and lithology with the Stuhini, Hazelton, Bowser Lake, Skeena and Kasalka groups. All sequences are separated by hiatuses inferred from gaps in the stratigraphy. Strata of Cenozoic age include the Ootsa Lake, Endako and Chilcotin groups.

## UPPER TRIASSIC SEDIMENTARY BASEMENT (UNIT $uT_S$)

The oldest rocks are exposed just outside the study area at a single locality along the Red road, which hooks around the northern end of the Nechako Range. The outcrop consists of very thinly bedded black shale and buff-weathered, ripple-laminated siltstone containing the Carnian to early Norian pelecypod *Halobia* (Collection GSC C-203473; H.W. Tipper, personal communication, 1994). Triassic rocks are rare in the Nechako River map area with one other confirmed site of Halobia-bearing siltstone mapped to the northwest of the study area at Verdun Hill (Tipper, 1963). These rocks are representative of a quiescent marine environment that probably existed throughout much of central Stikine Terrane in Late Triassic time.

## JURASSIC ROCKS

Broad areas of volcanic strata underlying much of the study area were previously assigned to Upper Triassic map units (Tipper, 1963). However, through discovery of relatively thin intervals of fossiliferous sedimentary beds interlayered with the volcanic rocks, they are now known to be Jurassic and part of a much thicker, unique Mesozoic stratigraphy. Fossil identifications have played an important role in unraveling the internal stratigraphy of this succession; they indicate a general age range of the rocks that spans early Toarcian to early Bajocian time in an older sequence, which has some lithologic similarity to a younger, unconformable sequence of late Bathonian to early Callovian and possibly early Oxfordian age. Dating the volcanic rocks by isotopic methods has produced indeterminate results in the older sequence, but expands the known range of the younger sequence into the Kimmeridgian. There are many gaps in the biostratigraphy of this area; nevertheless it has been critical to the inference of depositional ages for thick volcanic intervals. These volcano-sedimentary rocks are interpreted to be an island arc deposited above an inferred sub-Toarcian unconformity on Upper Triassic sediments. The older sequence broadly correlates in age and tectonic setting with the Hazelton Group, a lithologically varied subaerial island arc succession which is well exposed in a northerly trending belt that extends for over 450 kilometres from Whitesail Lake map area in the south to the Toodoggone River map area in the north (Tipper and Richards, 1976a; Diakow *et al.*, 1993a; Diakow *et al.*, in preparation). The younger sequence is correlative with the Bowser Lake Group, widespread in the Bowser Basin north of the Skeena Arch (Tipper and Richards, 1976a).

Granodiorite and quartz monzonite of the Early Cretaceous Capoose batholith intrudes the Jurassic succession and may be genetically associated with hydrothermal alteration and a variety of exploration prospects in the study area (Lane and Schroeter, 1996). This magmatic episode may have an extrusive component, manifest in an erosional remnant of volcanic rock that yields a similar K-Ar biotite date as the batholith.

Recent nomenclature for Jurassic volcano-sedimentary strata in the study area originally comprised the Bajocian Naglico formation and an overlying, unnamed Callovian sedimentary sequence (Diakow and Webster, 1994). We now subdivide the Naglico formation into two informal formations, each dominated by lithologically distinct volcanic units and associated volcanic-derived sediments. They are the Entiako formation, in which a western, subaerial felsic volcanic facies grades into an eastern, marine volcaniclastic-epiclastic facies, and stratigraphically overlying augite-phyric mafic flows and volcanogenic sediments of the Naglico formation. The Naglico formation is unconformable with overlying fine-grained and chert-bearing clastic rocks of the late Bathonian to early Oxfordian(?) Ashman Formation. It is locally disconformable with a Kimmeridgian mafic flow member that closely resembles flows characteristic of the older Naglico formation.

### *HAZELTON GROUP*

#### ENTIAKO FORMATION (UNIT $lmJH_E$)

Rocks of the Entiako formation can be grouped in two facies: a marine sedimentary facies characterized by volcanic-derived sediments, and a felsic volcanic facies containing subordinate epiclastic rocks. Ammonites collected from the sediments indicate deposition from early Toarcian to possibly early Bajocian time. Rocks of the sedimentary facies crop out intermittently for nearly 45 kilometres along the flanks of the Nechako Range. In the southern part of the range, near Kuyakuz Lake, the proportion of volcanic rock in the sections increases. The volcanic facies predominates farther west in the Fawnie Range, with the best exposures located in the eastern part of the Entiako Spur.

##### *Marine Volcaniclastic-Epiclastic Facies*

The sedimentary facies is widespread in the Nechako Range and includes varying proportions of mudstone, arkosic sandstone and sharpstone conglomerate. Detritus in these rocks includes abundant angular feldspar, quartz and potassic felsic-volcanic lithics that all appear to be volcanic derived, either laid down contemporaneously during coeval volcanism or as epiclastic debris shed from a nearby volcanic source. Because of poor exposure, lithofacies distributions are not well defined; however, the general trend mapped is towards tuffaceous mudstone-siltstone-dominated sections in the northern half and, locally, east of the central Nechako Range. The proportion of primary volcanic interbeds increases and sedimentary rocks become coarser, dominated by arkosic arenite and granule conglomerate, towards the southern part of the range, particularly in the segment between Tatelkuz Mountain and Kuyakuz Lake. This trend suggests that finer, distalmarine subfacies lay outboard, to the north and east of an intermixed, coeval, coarser grained near-shore marine and subaerial volcanic subfacies.

The distal marine subfacies comprises the oldest Jurassic strata in the study area, dominated by black, laminated argillite and subordinate feldspathic siltstone interbeds containing diagnostic early Toarcian ammonite fauna including *Dactylioceras kanense* (McLearn), *Lioceratoides* (Paciferas) *propinquum* (Whiteaves), *Lioceratoides* (Paciferas) *angionus* and *Tiltoniceras antiquum* (Collection GSC C-177435; H.W. Tipper, Report J7-HWT-1994; Jakobs *et al.*, 1994). These rocks crop out only in a small area immediately to the northeast of the CH pluton. Presumably overlying argillite and lesser feldspathic siltstone containing the small, delicate pelecypod *Bositra* (Collection GSC C-177437; H.W. Tipper, Report J7-HWT-1994) are exposed only 1.5 kilometres northwest of this site. The *Bositra*-bearing beds are exposed sporadically along the eastern lower slope of the northern Nechako Range, and extend just beyond the study area to a quarry along the 2500 road, east of the central Nechako Range. These rocks apparently continue farther east and northwest, beneath low-lying terrain, to *Bositra* sites along the Euchiniko River (Collections GSC C-90798 and GSC 23468; T.P. Poulton, Report J7-TPP-1995; Taiuk Creek (Collection GSC 23469, Tipper, 1963) and one locality now submerged by the Nechako Reservoir at Knewstubb Lake (Collection GSC 2188; Tipper, 1963). Typically, exposures consist of recessively weathered black pyritic mudstone, limy siltstone, and fewer but prominent, thick resistant beds of arkosic sandstone that in places contain angular felsic volcanic-lithic granules, broken shells of more robust fossils and wood fragments. In places the black mudstone is distinctly banded, with parallel laminae a few millimetres to 1 centimetre thick, alternating with cream to pinkish weathered ash-tuff, representing airborne felsic ash ejected from distant, contemporaneous volcanoes and filtered through quiescent marine water. Some of these ash lamellae are potash rich. Grey and brownish weathered limestone layers and concretions were sampled for microfossils but none were found. A similar section of rusty weathered, interlaminated ash and mudstone is exposed to the west in the Fawnie Range in roadcuts between 144.5 and 146.5 kilometres on the Kluskus-Ootsa forest service road. Based on similar lithologies, it is correlated with the *Bositra* beds in the Nechako Range.

These interlaminated tuff and mudstone beds are tentatively correlated with distinctive Toarcian to Bajocian Quock Formation ("pyjama beds") fringing the Bowser Basin (Jeletzky, 1976; Tipper and Richards, 1976a; Thomson *et al.*, 1986; Anderson and Thorkelson, 1990; Evenchick, 1991b; Jakobs, 1993). According to T.P. Poulton "*Bositra* has been identified from Pliensbachian through early Oxfordian collections in western Canada, but predominates in the Toarcian, so that it has come to serve as a guide for that interval. Both its total range, and abundance in the Toarcian, are characteristic of *Bositra* worldwide. Its abundant occurrence in the Toarcian coincides with the high-organic, low-oxygen, pyritic black shale facies that characterizes the Toarcian marine high-stand globally" (Report J9-TPP-1995). Elsewhere in the study area, *Bositra* is reported from a locality immediately north of Kuyakuz Lake (Collection GSC 21889, Tipper, 1963) where it is believed to occur in an interval between fossiliferous middle Toarcian volcaniclastic-epiclastic strata and probable Aalenian(?) feldspathic sediments. Correlative rocks about 200 kilometres to the west, adjacent to Morice Lake in the Whitesail Lake map area, contain *Bositra* in a thinly bedded mudstone-sandstone sequence that occupies an interval between thick basaltic flows of probable late Sinemurian to Pliensbachian age, and unconformably overlying rhyolitic fragmental rocks with a U-Pb zircon date of 184±4 Ma (Sample 83WV-1038; van der Heyden, 1989). This isotopic date is considered provisional as it is based on a single fraction, but nevertheless infers a minimum age for the underlying sediments.

A near-shore subfacies, comprising shallow-marine sediments intermixed with subaerial volcaniclastic beds, underlies a transect along the west-facing slope of the Nechako Range, between Tatelkuz Mountain and Kuyakuz Lake. These rocks, previously subdivided into the Nechako Range and overlying Kuyakuz Mountain volcanic and sedimentary assemblages (Diakow *et al.*, 1995b), form a gently east dipping homoclinal sequence estimated to be more than 600 metres thick on the west side of Kuyakuz Mountain. Neither the lower or upper contacts of the unit have been observed; but it is consistently close to a thick overlying sequence of pyroxene-bearing mafic flows and interspersed maroon tuffs assigned to the Bajocian Naglico formation and is therefore believed to be in stratigraphic contact. The lowest beds, best exposed south of Kuyakuz Lake along the Blue road near the 38 kilometre marker, consist of reworked tuffs. Tuffaceous sandstone, characterized by 15 volume percent broken volcanic quartz grains, marks the bottom of the succession. Uranium-lead dating of this rock gives an erroneous Early Cretaceous date, with a large error, from the lower intercept of a discordia line for three zircon fractions. Sharply overlying these rocks are about 30 metres of feldspathic sandstone and volcanic-lithic granule conglomerate containing *Collina,* a late-middle Toarcian ammonite, extracted from the base of the section (Collection GSC C-143706; H.W.Tipper and G.K.Jacobs, personal communication, 1994). This ammonite establishes a depositional age for the lower part of the near-shore subfacies and a biocorrelation with the distal marine subfacies to the northeast.

Stratigraphically higher sediments of the near-shore subfacies are sporadically exposed along the western slope between Kuyakuz and Tatelkuz mountains, where they are capped by a volcanic marker unit. The lower part of this sequence is dominated by interbedded arenaceous sandstones and siltstones that are rich in angular feldspar detritus, and conglomeratic interbeds dominated by volcanic-lithic and feldspar detritus. The lithics, typically subangular and granule to pebble sized, include aphanitic and fine-grained porphyritic varieties of andesite and rhyolite. Mudstone, which is present but not common, in places occurs with grey or brown weathered impure limestone lenses. Bedding is variable, ranging from laminated in the finer grained beds, to medium and thick layering in coarser grained beds. Fine ripple laminations and internal textural grading suggest facing is towards the northeast. Fossils in the sediments are generally indeterminate, thick-shelled bivalves. Several indistinct ammonite collections, containing either poorly preserved or difficult to identify forms (*i.e. Witchellia*(?); Collection GSC 21886, Frebold *et al.*, 1969, T.P. Poulton, Report J7-1994-TPP; GSC C-143705, T.P. Poulton, Report J6-TPP-1995 and GSC C-203460, H.W. Tipper, personal communication, 1994), indicate a general range of fossil ages from middle Toarcian to early Bajocian. Interestingly, the early Bajocian genus *Witchellia*(?), sonniniid(?) and stephanoceratid(?) ammonites are tentatively identified with *Bositra* from a fossil site on the Euchiniko River (Collection GSC 23468, T.P. Poulton, Report J7-1995-TPP). If this association is valid it implies the age of *Bositra* beds comprising the distal marine subfacies might range from late Toarcian to as young as early Bajocian; evidently not all that unlike the age deduced from fossils of the shoreline subfacies in the Kuyakuz Lake area.

The uppermost section of the near-shore subfacies is marked by an abrupt change from feldspathic sediments into conformably overlying local accumulations of silica-bimodal fragmental volcanic rocks which, in turn, grade into volcaniclastic-epiclastic derivatives of the felsic member. This marker unit is most complete along the ridge through Kuyakuz Mountain where the entire succession may be as much as 250 metres thick. With the exception of a lowermost mafic member, which thickens locally to 60 metres or is missing altogether, the succession trends northerly to the lower west-facing slope of Tatelkuz Mountain and in the opposite direction to the south side of Kuyakuz Lake. In places the base of the section is dominated by superbly layered dark green tuff beds composed of andesitic to basaltic pyroclasts. The pyroclasts are commonly lapilli size or finer with aphanitic and vesicular textures. Successive texturally graded beds, some with shallow planar crossbedding, bomb sags and internal angular unconformities suggest the deposit is a product of multiple air-fall eruptive episodes that probably occurred in relatively rapid succession.

Rhyolitic volcanics and related epiclastic rocks depositionally overlie the mafic tuffs. Locally, several metres of accretionary lapilli tuff underlie the main felsic tuff beds. The tuff is composed of white aphanitic lapilli set in a dense, light green, siliceous ash charged with broken plagioclase and ubiquitous quartz grains. Potash-rich fragments, confirmed by staining, and the presence of quartz fragments in amounts between 1 and 5 volume percent, are the most diagnostic features of these rocks. These tuffs grade imperceptibly, both laterally and up-section, into scantily fossiliferous marine interbeds of reworked volcaniclastic detritus in which much of the ash component is elutriated out, resulting in layers that are exceptionally rich in angular crystals and lithics. Along trend of the Kuyakuz Mountain section, the quartz-bearing unit appears to wedge out, supplanted in the north, near Tatelkuz Mountain, by volcanogenic quartz-bearing arkosic sediments, and south of Kuyakuz Lake by quartz-deficient maroon tuffs with waxy green felsic fragments. Overall, this volcanic section records subaerial and subaqueous deposition of air-fall tephra that mark the top of the Entiako formation and presumably the end of a long period of contemporaneous marine sedimentation. The age of this late volcanic activity in the Entiako formation is unconstrained, but it is believed to be temporally equivalent and coextensive with a belt of subaerial quartz-phryric felsic volcanic rocks that are found to the west in the Fawnie Range.

### *Subaerial Volcanic Facies*

The subaerial volcanic facies of the Entiako formation consists almost exclusively of fragmental rocks of rhyolitic composition. Exposures of these rocks are scattered over a broad area encompassing parts of the Entiako Spur, Naglico Hills and the lower west slope of the Fawnie Range. The contemporaneity of similar rocks on the northwest side of Tsacha Mountain is equivocal and inclusion of these rocks with the volcanic facies of the Entiako formation is provisional.

The reference section for the volcanic facies of the Entiako formation is situated in the eastern Entiako Spur, roughly at the 5-kilometre marker of the Kluskus-Malaput forest service road, where at least 150 metres of rhyolite flows, ash-flow tuff and lapilli tuff form a series of blocky weathered, gently inclined benches that approximate bedding. The base of the section is not exposed and the upper contact is conformable with depositionally overlying flows of the Naglico formation.

Rhyolite of the Entiako formation is typically off-white to salmon coloured and characteristically contains up to 3% rounded and resorbed quartz phenocrysts that average 2 to 3 millimetres in diameter. At the reference section, however, the rocks are grey, hardened and locally laced with epidote-garnet veinlets resulting from thermal overprinting by the Capoose batholith. The lowest exposures in this section are rhyolite flows with light coloured flow laminae in a contrasting dark grey to black aphanitic groundmass. Most of the section, however, is made up of light grey fragmental rocks in typically thick, well-indurated beds devoid of internal structure. The beds are composed of lapilli and fewer block-sized fragments supported by a plagioclase-rich matrix. The lithic fragments are mainly textural variants of plagioclase-porphyritic andesite, and some flow-laminated rhyolite. Several monzonitic accidental fragments were also observed. Scarce, thin, welded zones within the otherwise massive, unwelded tuffs have a compaction fabric defined by compressed lithic fragments. Scant exposures of the Entiako formation in the Naglico Hills consist mainly of compositionally similar rhyolitic lapilli tuff with some strongly welded zones. Some cobble-boulder conglomerate with interlayered siltstone and sandstone containing quartz and rhyolite indicate contemporaneous erosion of the fragmental rocks.

A U-Pb zircon date on rhyolite ash-flow tuff from the reference section is inconclusive, as the most concordant fraction gives a best estimate for the age of crystallization of 170±40 Ma. Despite similar quartz-bearing fragmental rocks in both the subaerial and shoreline facies of the Entiako formation, these facies can only be broadly correlated. It is clear from the high proportion of ash and juvenile felsic volcanic lithic and crystal fragments found throughout the entire stratigraphic range of the marine facies that there was contemporary felsic volcanism. However, the subaerial facies now manifest as a dissected sequence of interleaved fragmental and flow deposits, is merely a snapshot of one, perhaps two, explosive pulses that probably provided direct airborne and epiclastic input from volcanic centres bordering a long-lived marine basin.

Rhyolitic tuffs underlying the northern part of Tsacha Mountain are tentatively included in the volcanic facies of the Entiako formation. They are characterized by a preponderance of flow-laminated pyroclasts, but lack the diagnostic quartz phenocrysts so prevalent elsewhere in the unit. Rare laminated flows are also present. Sedimentary rocks overlying the volcanics consist of hornfelsed black siltstone with minor sandstone and rare quartz-bearing lapilli tuff interbeds. The age of these sediments is not known, but they are believed to be part of the Entiako formation.

The topmost beds of the felsic sequence in the reference section are conformable with lithologically different fragmental rocks. The lowest part of this section is alternating laminated, very thin beds of green ash tuff and crystal tuff. They pass upward into thicker beds containing lapilli to block-sized fragments in which coarse-grained pyroxene is dispersed in both the fragments and matrix. These tuffs record an air-fall event that preceeded comagmatic pyroxene-phyric basaltic flows of the Naglico formation, capping the section. A comparable tuffaceous section, representive of this explosive episode, is also evident immediately to the east of the Kluskus-Ootsa forest service road near the 147 kilometre marker. Here 25 metres of exposed rhyolite flows have a gradational upper contact with about 75 metres of thick, variegated green and maroon ash and crystal tuff beds. Quartz, abundant in the underlying flow and the lowest ash-crystal tuff bed above the contact, is notably absent higher in the tuff section. Near the top, the tuff interval is overlain by fossiliferous synvolcanic sharpstone conglomerate. It is dominated by angular felsic volcanic pebbles and feldspar occupying ball and pillow structures at the interface of sediments and an underlying bed of vitric and ash tuff. Beds of coarse sandstone and fine conglomerate diminish within 25 metres of the contact, passing rapidly up-section into finer grained arkosic sandstone and siltstone and lesser black mudstone. Along strike these same sediments extend northward in a belt for about 3 kilometres, and stratigraphically lower strata exposed along the Kluskus-Ootsa road between 144.5 and 146.5 kilometres consist of distinctly banded white ash and black mudstone beds. The banded beds crop out within 500 metres along strike, and probably wedge out before they reach the previously described volcanic-sediment contact.

Nondiagnostic casts of belemnites and bivalves found at the volcanic-sediment contact provide little information on the depositional age of the sediments. An attempt to obtain a U-Pb zircon date from the quartz-bearing rhyolite flows beneath the sediments was unsuccessful. The banded tuff-mudstone beds which presumably mark the gradational base of the sediments are strikingly similar to the deeper marine Toarcian *Bositra* beds in the northern Nechako Range, and the overlying feldspathic lithologies resemble those of the Toarcian and Aalenian? shoreline facies in the southern Nechako Range. In general, the sediments above the contact weather recessively, resulting in discontinuous exposures traceable up-section for nearly 1200 metres upslope and to the east to an important fossil site at the top of the sediment package that contains definitive early Callovian fauna (Collection GSC C-143396; H.W.Tipper, Report J2-1994-HWT). Because no major lithological differences were noted, the scattered outcrops appear to represent a single continuous section, but in reality a significant hiatus is suspected, spanning late Bajocian(?) and most of Bathonian time. Field evidence for this unconformity is discussed further under Ashman Formation.

## NAGLICO FORMATION (UNIT mJH$_N$)

The Naglico formation is dominated by augite-phyric mafic flows, lesser tuffs and scarce intervolcanic marine sediments, locally, containing early and late(?) Bajocian fossils. It is the most widespread of map units in the study area, underlying much of the Fawnie Range. Extensive exposures throughout the Naglico Hills and Entiako Spur display varying intensity of propylitic alteration which is caused by the Capoose batholith that intrudes the Early and Middle Jurassic strata. In the southern to central Nechako

Range, cleaved mafic and intermediate volcanics of the Naglico formation appear to occupy two parallel belts separated by a medial belt underlain by younger Middle to Upper Jurassic coarse clastic rocks. In the northern part of the range, however, the interpretation of two lithologically identical and temporally equivalent belts of volcanics is refuted by stratigraphic relationships at several localities and a new $Ar^{40}/Ar^{39}$ plateau age which suggests that some of these mafic volcanics are in fact younger (early Kimmeridgian). In the extreme northeast of the study area, the Naglico formation appears to rest on the Entiako formation, but immediately to the west its removal by erosion, or nondeposition of the mafic volcanic sequence, might account for its absence between differing clastic units of the Ashman and Entiako formations. Another possible explanation of the lack of Naglico volcanics is they may be locally replaced by sedimentary rocks. Some support for this possibility is scattered outcrops of compact black shale and lesser feldspathic sandstone along the Brewster road, in close proximity to but not in direct contact with unconformably(?) overlying chert-pebble conglomerates. Poorly preserved ammonite fragments, questionably resembling early Bajocian stephanoceratids(?), are found with belemnites, gastropods and various indeterminate bivalves in the shales (Collections GSC C-177438, 39, 40; J.W. Haggart, Report JWH-1995-04).

The thickness of the Naglico formation is difficult to ascertain because of rather heterogeneous physical attributes of the volcanics and absence of internal stratigraphic markers. Some apparently thicker sections underlie the easternmost Naglico Hills, south to Tsacha Lake, and the region along the eastern slope of the Fawnie Range north of Top Lake. The Capoose batholith is believed to be relatively close to the surface beneath the Entiako Spur so that the Naglico strata are thinner and more altered in this locality than those exposed in the Naglico Hills. Although a direct contact between pyroxene flows of the Naglico formation and underlying rhyolitic rocks of the Entiako formation has not been found, a consistent spatial relationship is observed at a number of localities, suggesting they are in stratigraphic contact. The top of the reference section for the Entiako formation is one of the best places in which to examine the contact zone. At this and another site in the Naglico Hills, a sequence of bedded tuffs, with or without boulder conglomerate that contains clasts derived from the underlying Entiako formation, is exposed at the base of the Naglico formation. Bedding in the tuff section is congruent with that in thin epiclastic layers and compaction foliation in the underlying Entiako formation. This relationship leads to the interpretion that these successions are disconformable, separated by a brief(?) erosional hiatus. In the Nechako Range at Kuyakuz Mountain, the felsic tuff marker at the top of the Entiako formation underlies greenstone of the Naglico formation. In the northeasternmost part of the range, pyroxene-phyric tuffs tentatively included in the Naglico formation because of lithologic similarities, may rest directly upon Toarcian sediments. Farther south along the axis of the Nechako range, a similar lower contact with Lower Jurassic strata is assumed and the upper contact is with a coarse clastic assemblage of probable early Callovian age.

Because of internal lithologic variability in rocks of the Naglico formation, no single section is representative, however, certain lithological features persist over broad areas. The primary lithologies include dark green and sometimes maroon, massive weathered flows of basalt and andesite. Augite phenocrysts are a diagnostic feature of these flows, commonly comprising 1 to 3 volume percent as vitreous prisms averaging between 1 and 2 millimetres long (in rare instances, 5 to 15 millimetres in length). Despite partial to complete replacement of augite by chlorite, epidote, carbonate and opaque granules, they generally retain their prismatic habit. Plagioclase is the primary constituent in all flows that include a number of textural varieties such as sparsely porphyritic, fine-grained crowded plagioclase porphyry to coarse-grained porphyry. Plagioclase is slender, less than 2 millimetres long, in amounts up to 35 volume percent in the crowded varieties. Elsewhere, it typically occurs as subhedral to idiomorphic equant and tabular phenocrysts between 2 and 4 millimetres in diameter, and rarely as large as 1 centimetre, in volumes between 15 and 20%. Amygdaloidal lavas are comparatively minor and contain rounded to irregular, quartz, epidote and chlorite-filled cavities. They locally grade into hematite-rich breccia in discontinuous layers and lenses less than 1 metre thick. Dense aphanitic basalts are commonly interlayered with the more voluminous porphyritic flow varieties. They are lava flows with a fine granular aphanitic texture that sometimes display millimetre-thick resistant laminae protruding from smooth weathered surfaces. Thin sections of these rocks reveal olivine and augite grains occupying interstices between plagioclase microlites. A representative suite, comprised of both pyroxene-bearing and aphanitic lavas, has a compositional range of basalt to basaltic andesite. Major and trace elements indicate they are subalkaline with a low-potassium tholeiitic to calcalkaline trend of island arc affinity.

Various pyroclastic rocks interlayered with the flows comprise a significant proportion of the Naglico formation, but an estimate of their relative proportion is difficult to determine due to highly variable conditions of preservation and exposure. In general, pyroclastic rocks predominate over flows in the central and eastern Entiako Spur and to the north-northeast across the headwaters of van Tine Creek, in the Fawnie Range. Maroon and green pyroclastic rocks are intercalated with flows in the central part of the Entiako Spur. They are composed predominantly of lapilli tuff in which the lithic fragments and the matrix contain abundant plagioclase and subordinate chloritized mafic minerals. A somewhat different succession of fragmental rocks is found intimately layered with the augite porphyry flows in the central and eastern parts of the spur. They consist of lapilli and lesser block-tuffs dominated by plagioclase-rich pyroclasts with a fine-grained, crowded texture. This distinctive texture is due to minute plagioclase up to 2 millimetres long in amounts up to 35 volume percent. Interbeds of ash-tuff and rare accretionary tuff are also present. Tuffs in shades of red and maroon and containing diagnostic quartz phenocrysts are widespread, with scattered exposures along the shoreline of Natalkuz Lake, and in parts of the western Entiako Spur, central and southern Fawnie Range and southern Nechako Range. Although these tuffs cover a wide area and look similiar, they are unlikely to be products of a single eruptive event, as they recur at different stratigraphic levels, typically in layers several metres to tens of metres thick, between aphanitic and pyroxene-phyric flows. Dark red, aphanitic lapilli rarely exceed 1.5 centimetres in diameter and occur in a matrix of plagioclase and ash. In many beds where the ash and crystals dominate over lithic fragments, layering is thinner and small-scale textural grading is noted. Quartz fragments are generally present, but because of their small size, typically about 1 to 2 millimetres in diameter, and low abundance (less than 2% and rarely to 5%) they are easily overlooked. The red coloration is due to finely comminuted hematite dispersed throughout the fragments and matrix. Oxidation of these rocks probably reflects their subaerial environment of deposition.

Fossiliferous sediments are only rarely in direct contact with volcanic rocks of the Naglico formation. Generally, these sedimentary rocks tend to comprise thin recessive beds that rarely crop out and are commonly found as angular sedimentary debris churned up in roadcuts and logging cutblocks, near more diagnostic lithologies of the Naglico formation. The main feature of these intervolcanic sediments is their immaturity, characterized by the high proportion of angular plagioclase and volcanic-lithic detritus. The dominant lithologies include feldspathic sandstone and siltstone, tuffaceous argillite, locally prominent volcanic conglomerate and scarce limestone. Fossils are nearly always present, varying in abundance from a few indeterminate belemnites and bivalves to zones containing a rich and varied fauna. A solitary sonninid ammonite extracted from limestone suggests a probable early Bajocian age for the Naglico formation underlying much of the Entiako Spur (Collection GSC C-143394; H.W. Tipper, Report J2-1994-HWT).

Presumably higher stratigraphy of the Naglico formation is exposed along the banks of the Blackwater River, beneath the waterfall located about 4.5 kilometres due west of the inflow to Tsacha Lake. Here medium and thick-bedded siltstone and arkosic sandstone predominate, with lenses of pebble conglomerate and minor limy interbeds. Fossils are abundant, including mainly thick-shelled bivalves and a few ammonites that suggest the section was deposited in a relatively high-energy marine environment, probably during latest early Bajocian or early late Bajocian time (Collection GSC C-203458; T.P. Poulton, Report J6-TPP-1995). Exposures above the waterfall pass into overlying younger rocks assumed to be Callovian; however, they unfortunately were not examined. Similar rocks about 1 kilometre to the northwest of the waterfall are poorly exposed in a section 20 metres thick at the base of a prominent east-trending ridge. The lowest beds consist of siltstone and fine-grained feldspathic sandstone, transitional into about 5 metres of fine volcanic conglomerate and coarse sandstone in the uppermost exposures. The lithic component is typically angular and of volcanic origin. Farther west, along strike, these rock pass into about 40 metres of lapilli and block-lapilli tuffs that alternate with thinner interbeds containing ash, crystals and fine lithic fragments.

The Naglico formation represents early constructional events of low-potassium tholeiitic and calcalkaline volcanics in an island arc setting. It is difficult to decipher from the volcanic units whether some represent submarine deposits. With the exception of one locality where hyaloclastite breccia was observed, scattered accretionary lapilli tuff layers, oxidized tuff beds and the paucity of pillow lavas in apparently thick massive lava sections, points to subaerial deposition. Scarce marine sediments comprised of a large proportion of angular feldspar and some volcanic-lithic fragments probably represent comparatively short-lived marine incursions onto the volcanic pile. However, there is no obvious explanation for the absence of pyroxene grains, if these sediments have an intrabasinal provenance.

## *AUGITE PORPHYRY PLUGS (UNIT mJap)*

Augite porphyry plugs, typically less than 1.5 square kilometres in area, are exposed in the eastern part of Entiako Spur and south of Tommy Lakes. These plutons apparently intrude and bleach rocks of the Entiako formation. Their main feature is subhedral augite phenocrysts, which comprise as much as 25% of the rock, and plagioclase microphenocrysts arranged in a felty texture. The similar texture, mineralogy and spatial relationship of these plutons to volcanic rocks of the Naglico formation, lead to the conclusion that they may be cogenetic and possible feeder intrusions. Lithologically similar augite-phyric dikes and sills intrude sediments of the Entiako formation east of Fawnie Creek. However, without field evidence of an intrusive relationship, it would be impossible to distinguish these hypabyssal rocks from mafic extrusive flows of the Naglico formation or younger Nechako volcanics.

## *BOWSER LAKE GROUP*

### ASHMAN FORMATION (UNIT muJBA)

The Ashman Formation in the study area consists of possibly late Bathonian, early Callovian and possibly early Oxfordian clastic rocks that succeed the Naglico formation. It is subdivided into two interfingering clastic successions that represent contrasting depositional environments. The earliest deposits comprise a deeper water succession composed mainly of mudstone and siltstone with limy lenses and layers that are generally transitional, up-section and laterally, into an eastward thickened wedge of conglomerate interlayered with sandstone and siltstone. The coarser facies crops out mainly in the Nechako Range, occupying a belt that widens significantly to the north. It is thickest (possibly as much as 1500 m) along the axis of the northern Nechako Range and thins rapidly to the west where, across the Chedakuz Creek valley and farther west into the Fawnie Range, conglomerate diminishes to only a few rare lenses and beds within a predominantly finer siltstone and shale facies. The fine-grained facies is best exposed in the Fawnie Range where sections estimated at more than 150 metres thick occur intermittantly in a belt that extends along the lower east slope for about 9 kilometres, truncated in the south by an east-trending fault.

The Ashman Formation contrasts markedly in lithology and depositional environment with that of the underlying Naglico formation, suggesting the two units may be separated by a major unconformity. This contention is further supported by the lack of definitive upper Bajocian and Bathonian strata throughout the study area in the interval between a lower Callovian and possibly upper Bathonian fine-grained marine facies that comprises the base of the Ashman Formation, and the older, early Bajocian Naglico formation. Locally in the Fawnie Range there is a sharp conformable contact with overlying volcanic rocks that are tentatively considered to be Late Jurassic (*see* Nechako volcanics). The contact relationship in not as obvious in the Nechako Range where the upper contact is obscured by vegetation, but there is a similar general relationship of sediments succeeded by volcanics. The actual contact with underlying rocks has not been observed, although in the southern part of the Nechako Range volcanic rocks of the Naglico formation are always nearby, apparently beneath the sediments.

The finer clastic facies is mainly a sequence of black mudstone and some feldspathic sandstone beds. They weather recessively, resulting in poor exposures, most of which are found at widely spaced localities west of the Chedakuz Creek valley. The facies in the Fawnie Range is particularly well exposed in one bedded section exposed about 1 kilometre at 110° azimuth from Fawnie Nose. Here a section 75 metres thick consists mainly of rusty weathered, black siliceous mudstone with limy lenses and a few more resistant thick beds that include a lens of chert-pebble conglomerate, 2 to 5 metre-thick, and grey, fine-grained sandstone. The upper contact, which is exposed at several localities, is an abrupt change into stratigraphically overlying rhyolitic dust and welded ash-flow tuffs that, in turn, are overlain by dark green, andesitic crowded feldspar porphyry flows. Light coloured ash-tuff laminae in some of the uppermost mudstone beds may represent the initial pulse of explosive felsic volcanism near the end of mudstone deposition. Relatively sparse fossils are scattered throughout the mudstone, although the friable nature of these rocks makes collecting difficult. Fossils collected from along the belt of sediments in the Fawnie Range include the early Callovian ammonite, *Kepplerites* (Collection GSC 91762, H.W. Tipper), and perhaps *Iniskinites*(?) (Collection GSC C-143383; T.P. Poulton, Report J7-1992-TPP), which would indicate the presence of upper Bathonian strata. Mudstone several metres below the volcanic contact contains the bivalve *Anditrigonia* sp. aff. *plumasensis* (Hyatt) which probably indicates a range of Callovian or early Oxfordian (Collection GSC C-143726, T.P. Poulton, Report J9-TPP-1995).

Farther to the east, broadly coeval strata crop out discontinuously from the Kluskus-Ootsa road in the south, northward along the western side of the Chedakuz Creek valley bottom to a prominent point that marks the narrows between Knewstubb and Natalkuz lakes. The shoreline exposure at this locality consists of a section of lower sandstone with scarce chert pebbles, overlain by black mudstone containing large, differentially weathered calcareous concretions, which in turn is overlain by feldspathic sandstone. Above the sediments is an abrupt stratigraphic contact with basaltic flows and some tuffs characterized by coarse, vitreous pyroxene phenocrysts. The contact lacks evidence of erosion and is thought to be depositional, similar to that observed with volcanic rocks in the Fawnie Range. Corresponding sedimentary strata were previously mapped along the Nechako River to the north, but are now submerged beneath Knewstubb Lake. Mudstone exposed at this site is reported to contain abundant calcareous concretions, each containing an ammonite identified as the early Callovian species *Lilloettia tipperi* (Collection GSC 21885; H.W. Tipper, 1963). Coextensive lithologic units continue south of the Nechako Reservoir, indicated by the presence and probable identification of the ammonite *Lilloettia* (Collection GSC C-143712, H.W. Tipper, personal communication, 1994). These sediments display some fundamental differences from those exposed to the north, including general coarsening, evidenced by an increased proportion of coarse feldspathic sandstone and the rare occurrence of chert granule and pebble interbeds; mudstone is a comparatively lesser component generally occurring as only minor thin interbeds. Abundant fossils, including thick-shelled bivalves, belemnites, gastropods, worm burrows and wood debris suggest a shallow-marine, high-energy environment (Collection GSC C-143712, T.P.

Poulton, Report J6-TPP-1995). The sandstones are typically dark green and contain angular grains of pyroxene, some delicate resorbed volcanic quartz, plagioclase and lithic clasts of very fine feldspar porphyries. The provenance is suspected to be local, perhaps from the underlying Naglico and Entiako formations. Grains of potassic detritus, confirmed by staining, are also present in the matrix of chert-pebble conglomerate and it may reveal local downcutting through the Naglico formation and erosion of felsic rocks from the older Entiako formation. Excluding the chert beds, these strata extend westward to a small creek north of Top Lake where friable black mudstone with limy concretions and some resistant feldspathic sandstone layers up to 2 metres thick are exposed. Diverse fauna at this site include at least four species of early Callovian ammonites and numerous other less diagnostic fossils (Collection GSC C-143395; H. W. Tipper, Report J2-1994-HWT and T.P. Poulton, Report J7-1995-TPP).

Ashman strata that comprise meagre exposures along the lower eastern slope of the northern Fawnie Range, described above, are possibly between 900 and 1500 metres thick in the northern Nechako Range, only 15 kilometres to the east across the Chedakuz Creek valley. For this reason the Ashman Formation is thought to perhaps underlie the entire Chedakuz Creek valley, although this is difficult to prove because a thick mantle of till obscures bedrock beneath the valley. In the Nechako Range, the northwest-trending belt of Ashman strata is segmented by faults trending both parallel and transverse to the belt. The thickest continuous exposures underlie the northernmost segment which is bounded on the south by the Brewster fault. The nature of the contacts is conjectural because of poor exposure, however, here the Ashman Formation is thought to be unconformable on sediments of the Entiako formation and possibly the Naglico formation, and it is overlain by the Nechako volcanics.

Chert-bearing conglomerates are very abundant in the Nechako Range, locally accounting for as much as 40% of the Ashman Formation. Siltstone, sandstone and mudstone predominate, generally forming the better layered intervals between more massive, thick conglomerate interbeds and lenses. The conglomerates are typically a clast-supported aggregate of well rounded spherical pebbles and small cobbles that commonly fine upwards into tops with isolated clasts supported in sandstone and siltstone. The matrix is composed of a finer mixture of granules and coarse sandstone compositionally consanguineous with the framework clasts. The framework clasts are characterized by chert which is found in translucent shades of grey, green, off-white and black. Black, oblate mudstone clasts are also common. The proportion of siltstone, sandstone and mudstone varies from place to place, but the latter is least abundant, generally evident as thin beds with shaly partings. The sandstones are characteristically light grey, with a salt and pepper appearance imparted by tightly packed subangular grains typically between 0.5 and 1 millimetre in diameter. In thin section the grains appear to be chert(?) and mudstone varieties with some apparently containing microfossils. Siltstone may weather light green, contrasting with the general grey coloration of the sandstone and conglomeratic beds. Locally the siltstone may have a distinctive differentially weathered surface characterized by randomly distributed voids and indentations. Bedding is typically planar, the contacts are sharp and lack evidence of scours or channels and internal traction bedforms are rarely seen; where present they constitute shallow planar crosslaminations in some of the sandstone and finer layers. Thin coal beds are found in the chert unit exposed along the Red road (Kennecott Canada Inc., personal communication, 1995); these deposits are just outside the study area.

Rare, indeterminate shelly fauna and a single ammonite impression (Collection GSC C-56989; H.W. Tipper, Report J7-1994-HWT) provide little information on the age of the clastic assemblage in the Nechako Range. However, because of the similarity to fossiliferous strata farther west, they are believed to be at least of Early Callovian age, and pre-Kimmeridgian based on the isotopic age from the immediately overlying Nechako volcanics. The coarse clastic deposits in the Nechako Range are interpreted to represent deposition in a moderately deep marine-delta slope environment.

Unlike the strata along the western side of the Chedakuz Creek valley, systematic staining of a large suite of conglomerates and sandstones from the Nechako Range did not reveal the presence of any potassic detritus. This suggests that the Nechako Range area received a high influx of compositionally uniform chert detritus from an extrabasinal source throughout its history. In the vicinity of the Fawnie Range some of this chert detritus was at times carried farther west into deeper water, forming sparse, discrete layers in mudstone. In the intervening area of the Chedakuz valley, shoaling resulted in periodic mixing of sorted chert with immature detritus shed from a local volcanic source. Paleocurrent directions could not be determined from outcrops in the study area, hampering attempts to infer transport direction. The most probable source of the chert is the Cache Creek Terrane, now exposed only 70 kilometres to the northeast. However, because of the absence of mafic volcanic or carbonate clasts in deposits in the study area, a short, direct drainage corridor connecting the source region with a basin, situated in part over the study area, is questionable. Chert clasts are characteristically well sorted and spherical implying considerable transport or perhaps extensive and prolonged reworking.

Basalt dikes and a few sills(?), characterized by fresh pyroxene phenocrysts, cut and alter sediments of the Ashman Formation at several localities in the northern Nechako Range. These rocks are intrepreted as feeder dikes for lavas of the stratigraphically overlying Nechako volcanics.

## NECHAKO VOLCANICS (UNIT uJBN)

The informally named Nechako volcanics are a sequence of silica bimodal flows and pyroclastic deposits that abruptly overlie sedimentary rocks of the Ashman Formation. The lower contact of the Nechako volcanics rests directly on the Ashman Formation in the Fawnie Range. At the reference section in the northern Nechako Range, the Nechako volcanics are separated from the Ashman Formation to the east by an apparent angular unconformity. Bedding in the lowest exposed volcanic members dips steeply at about 70° to the west, whereas the topographically lower sediments face west, dipping at about 40°. Because the overlying volcanic package has many lithologic features in common with rocks of the Naglico formation, it was originally assigned to it and the contact interpreted as a thrust fault that appeared to place a panel dominated by mafic volcanic rocks structurally above the younger Ashman Formation (Diakow *et al.*, 1995c). A new Late Jurassic $^{40}Ar/^{39}Ar$ plateau age on very coarse hornblende from a flow at the base of the volcanic succession is 152±2 Ma (Kimmeridgian), indicating general stratigraphic continuity with the underlying Ashman Formation, which may be as young as early Oxfordian(?). In addition to the localities mentioned above, other exposures considered to represent the Nechako volcanics include roadcuts along the Kluskus-Ootsa forest service road immediately north of Top Lake and, several remote areas of outcrop in the western Naglico Hills and southern Nechako Range, south of Kuyakuz Lake.

The reference section for the Nechako volcanics is a thick succession of mafic flows and tuffs exposed along the west-facing slope of the northern Nechako Range. The hallmark of the mafic package is the presence of commonly coarse (5 to 7 mm) vitreous pyroxene in flows that are more voluminous than associated ash and lapilli tuffs. A hornblende-bearing flow at the base of the section is the only occurrence known anywhere in the study area. Glassy black hornblende and pyroxene commonly range from 0.3 to 1 centimetre long, with some as long as 2.5 centimetres. This flow is interlayered with block tuff containing pyroxene-phyric pyroclasts. Furthest west and presumably up section, the mafic unit passes into rhyolitic lapilli tuff and some flows. Although a contact was nowhere observed, brittle shearing and mylonitized felsic tuffs in several outcrops indicate the units may be juxtaposed against the mafic package across the Chedakuz fault which follows the base of the range. The felsic unit contains bone white, flow-laminated and aphanitic rhyolite pyroclasts in a matrix with 1 to 2% volcanic quartz and potassium feldspar phenocrysts.

Rocks tentatively assigned to the Nechako volcanics succeed the belt of Ashman sediments in the Fawnie Range. At the top of the Ashman Formation east of Fawnie Nose, the bottom of the volcanic sequence is locally marked either by off-white rhyolite ash-flow tuff and ash tuff or andesite porphyry flow members in depositional contact with underlying late Bathonian or early Callovian black mudstone. Above this contact exposure is discontinuous and largely unmapped, passing farther west and up-section into cliffs, bounding the ridge on the east, that exhibit a continuous, crudely bedded west-southwest-inclined volcanic sequence that persists to the ridge axis. This sequence, which is more than 350 metres thick, consists of mafic flows, some containing vitreous pyroxene, interlayered with dacitic to rhyolitic volcanics and thin intervals of variegated maroon and green ash-tuffs. Somewhat different rhyolite is exposed along the ridge axis, capping the previously described volcanic section. It is considered to be an erosional remnant of an Upper Cretaceous volcanic member that is stratigraphically above probable Nechako volcanics (*see* Unnamed Volcanic Rocks at Hoult Lake and in the Northern Fawnie Range).

The most southerly extent of the Nechako volcanics is in the Naglico Hills where they overlie rocks of the Naglico formation. The main lithologies are felsic tuffs composed of aphanitic off-white lapilli in a light green matrix. The fragmental rocks are interlayered with augite-bearing basalt flows and locally with welded dacite. In the central part of the study area, immediately north of Top Lake, the Naglico formation is confined to a fault block lodged against Eocene strata to the south across the Top Lake fault. Early Callovian fossiliferous sediments crop out about 2 kilometres southwest of an area underlain by volcanic rocks, believed to be up-section and representative of the Nechako volcanics. These rocks are mainly basaltic flows with coarse, fresh pyroxene, some up to 1.5 centimetres long. A bedded section along the main access road at Top Lake consists of interlayered volcanic conglomerate and some epiclastic sandstone interbeds with pyroxene detritus, pyroxene-bearing mafic flows and lesser ash-tuff with accretionary lapilli horizons. Locally, interbeds of pyroxene-rich sandstone contain abundant bivalves.

It is difficult to distinguish between mafic volcanic units of the Naglico formation and those of the Nechako volcanics. The problem is critical, particularly in the Nechako Range where two belts with similar lithologic characteristics and alteration are exposed. In the absence of a distinctive recognizable lithologic datum below the units, such as the Ashman Formation, they are inseparable. Outcrop at several of the localities described above is discontinuous and Ashman sediments are absent or some distance away from the first exposures of mafic rocks. At these sites the presence of rhyolitic volcanics, either tuffs or flows, with the ubiquitous pyroxene-phyric mafic volcanics serves to distinguish the Nechako volcanics. Geochemistry might prove useful discriminating these units, but this possibility was not systematically tested.

## CRETACEOUS ROCKS

### UNNAMED VOLCANIC ROCKS IN THE WESTERN NAGLICO HILLS (UNIT $lK_v$)

Map unit $lK_v$ comprises rare biotite-phyric dacitic lava flows exposed at two sites 700 metres apart in the western Naglico Hills. The contacts with bounding strata are covered, however, dacitic flows about 30 metres thick presumably cap mafic volcanics assigned to the Naglico formation on a prominent knoll and, at another nearby locality, they also crop out between tuffs of the Nechako volcanics, and immediately down slope from overlying basaltic flows of the Chilcotin Group. The rocks contain biotite (1-2%) and plagioclase (25%) phenocrysts arranged in trachytic texture in black, variably devitrified fluidal-banded glass. A K-Ar date on biotite from the dacite is 144±4 Ma.

### CAPOOSE BATHOLITH (UNIT EKc)

The Capoose batholith underlies a broad region in the southwestern half of the study area. At its northwestern extremity, it is juxtaposed against Paleogene volcanic rocks across the Natalkuz fault. The main mass of the batholith lies to the southeast, outcropping extensively between the Entiako River and van Tine Creek. It continues at depth to the south, beneath a thin roof of altered volcanic rocks that comprise the backbone of the Entiako Spur, cropping out again along the south-facing slope down to Laidman and Moose lakes, and beyond to its southern contact in the Naglico Hills. Thick glacial drift mantles the batholith in the valley between the Entiako Spur and the Naglico Hills, however, farther east exposure improves locally with increasing elevation up the west-facing slope of the Fawnie Range. The Capoose batholith has a strong magnetic response identified in a recent regional aeromagnetic survey covering part of the study area (GSC Open File 2785). Beyond the main exposures of the batholith, strong magnetic anomalies extend to the south beyond the study area, and also to the east where they coincide with widespread propylitically altered country rocks and rare exposure of granitic rocks in the region east of Tsacha Mountain and the eastern Naglico Hills. These features undoubtedly indicate the presence of larger, near-surface plutons that may be extensions of the Capoose batholith. A time-domain electromagnetic survey has proved useful for mapping the margin of the batholith in areas of thick drift cover (Best *et al.*, 1996).

The main phase of the batholith is homogeneous medium to coarse-grained equigranular quartz monzonite. The rock is typically light pink and has a hypiodomorphic-granular texture imparted by 35% quartz, roughly equal proportions of alkali feldspar and plagioclase, about 10 to 15% combined fresh hornblende and biotite, and trace amounts of microscopic idiomorphic titanite. Xenoliths are abundant in the pluton and composed of fine-grained porphyry with randomly oriented plagioclase laths less than 1 millimetre long and an interstitial anhedral mafic mineral, possibly hornblende. Quartz monzonite is gradational into a porphyritic monzonite phase that is most common south of Moose Lake. Plagioclase phenocrysts in this rock are subhedral and approximately 5 millimetres long, forming an interlocking aggregate with anhedral potassium feldspar, approximately 10% quartz and 5% hornblende and biotite. A small isolated stock, south of the main body in the Naglico Hills, may represent yet another phase of the batholith. It consists for the most part of white, equigranular granodiorite with up to 15% chloritized mafic minerals. Coarse potassium feldspar phenocrysts, and chloritized plagioclase and biotite, occur locally along the northern margin this satellite pluton.

The contact zone of the Capoose batholith is locally marked by thermally altered rocks. Between Mount Swannell and Fawnie Nose the contact between the batholith and country rocks appears to be a relatively planar surface gently inclined toward the east beneath the Fawnie Range. Alteration associated with the intrusion varies from intense silicification immediately adjacent to the contact, outward to a zone of hornfels alteration up to 1 kilometre wide, that is characterized by destruction of primary volcanic textures and the local development of patchy secondary biotite. Intensely altered rocks, localized below Tutiai Mountain and nearest the intrusion, are characterized by pervasive replacement of the primary minerals in mafic to intermediate volcanic rocks by fine-grained silica. These rocks commonly grade imperceptibly, over just a few metres, into an assemblage of silica and pyrite, with or without clay minerals. Disseminated pyrite is particularly abundant (up to 15% by volume) in rocks around Green Lake where it is oxidized and forms an extensive gossan. Minor sericite accompanies the quartz-pyrite assemblage in this area. On the southwest side of Tutiai Mountain the silicified zone is at least 100 metres wide and probably wider, as exposure continues down slope where it is obscured by cover. This silicified zone passes abruptly outward into a broad zone of dense, baked country rocks that are typically dark grey-green and recrystallized. Alteration is also extensive throughout the Entiako Spur where volcanic strata of the Naglico and Entiako formations comprise a relatively thin cover above the batholith. The altered rocks consist of an epidote-quartz-calcite±garnet assemblage. These minerals are most evident lining fractures, as veins and incipient replacement of groundmass and primary minerals.

The age of the Capoose batholith is equivocal as available K-Ar dates derived during this study are contradictory, and another date from a previous study (Andrew, 1988) indicate the presence of a much younger, Late Cretaceous pluton. Uranium-lead geochronology of the batholith is in progress at the University of British Columbia, but age determinations were not yet available at the time of writing. Coexisting biotite and hornblende from quartz monzonite exposed along the southern slope of the Entiako Spur give

K-Ar ages of 141±4 Ma and 201±6 Ma, respectively. The biotite date is interpreted as a cooling age and, the considerably older date derived from hornblende is attributed to excess radiogenic argon. Nearby, similar quartz monzonite dikes intrude diorite that yields a congruent K-Ar biotite date of 142±4 Ma and an erroneous K-Ar hornblende date of 105±4 Ma. The older diorite possibly records resetting of biotite during cooling of crosscutting quartz monzonite, and simultaneous argon diffusion from coexisting hornblende to account for the substantially younger date. Field relationships indicate the batholith is younger than fossiliferous early Bajocian strata that it thermally alters near where the intrusion is dated. If the Early Cretaceous age (*ca.* 141 Ma) for the Capoose batholith is correct, it indicates a temporal equivalence with rare exposures of possibly cogenetic dacite flows described above (*i.e.,* $lK_V$).

## *SEDIMENTARY ROCKS ALONG THE ENTIAKO RIVER (UNIT $lK_S$)*

Lower Cretaceous sediments crop out at a single site adjacent to the Natalkuz fault where it cuts across the mouth of the Entiako River. This small exposure consists of about 6 metres of interlayered black mudstone and dark green siltstone. The sediments are faulted against probable Eocene volcanic rocks. Palynomorphs recovered from a thin layer of carbonaceous plant debris are tentatively identified as late Albian to early Cenomanian species (Collection GSC 143390; G. Rouse, 1993, internal report). Near Hoult Lake, a small, isolated exposure of grey siltstone, and 20 metres of bedded chert sandstone to coaly mudstone in another nearby outcrop may represent Lower Cretaceous strata north of the Natalkuz fault. A sample was barren of palynomorphs, making a definitive stratigraphic determination of these rocks difficult. The lithology and inferred age of these sediments implies they are correlative with the Skeena Group which is widespread throughout much of the northern Interior Plateau (Hunt, 1992).

## *UNNAMED VOLCANICS AT HOULT LAKE AND IN THE NORTHERN FAWNIE RANGE (UNIT $uK_V$)*

Upper Cretaceous volcanic rocks of differing lithology and composition are exposed in two widely separated areas, at substantially different elevations, on opposite sides of the Natalkuz fault. North of the Nechako Reservoir, scattered exposures of Upper Cretaceous rocks occupy a belt trending towards Hoult Lake. They may unconformably overlie recessive grey and black siltstone resembling strata of the Skeena Group, but because exposure is poor and the contact zone is covered, this relationship cannot be proven. Eocene volcanic rocks of the Ootsa Lake Group, exposed nearby, presumably are unconformable on the Upper Cretaceous volcanics. These Cretaceous volcanics are generally everywhere the same, composed of block-lapilli tuff and volcanic breccia in which the pyroclasts are characteristically monolithic, grey-green or purple hornblende-phyric andesite that are up to 15 centimetres in diameter. Plagioclase crystals between 1 and 3 millimetres long comprise up to 35% of the rock, accompanied by 5% hornblende as long as 4 millimetres. Pristine vitreous common hornblende, dated by the K-Ar method, indicate they crystallized around 64.5±1.8 Ma. This latest Cretaceous volcanic episode is represented elsewhere in the Nechako River map area by compositionally similar hornblende-phyric andesite flows, near Holy Cross Mountain, that yield a preliminary K-Ar date of 70.3±3 Ma (R.M. Friedman, personal communication, 1996).

In the northern Fawnie Range probable Upper Cretaceous rhyolitic rocks form a series of isolated exposures that cap the ridge crest above 1700 metres elevation. They are apparently conformable with underlying rocks of either the Nechako volcanics or the Ashman Formation. The rhyolitic rocks consist of lava flows, welded ash-flow tuff and some interbedded ash and crystal tuffs. Subtle flow laminae are locally evident, but most flows are massive and typically grey or off-white, dense siliceous rocks. These flows may be coeval and perhaps genetically related to a variety of garnet-bearing rhyolitic hypabyssal rocks that have demonstrable intrusive relationships with volcanics stratigraphically down-section from the capping rhyolites.

Maastrichtian rhyolitic and andestic volcanics in the study area correlate with nearly identical strata mapped locally in the Whitesail Range and at Mount Ney (NTS 93E/14 and 11), respectively; at the latter locality Maastrichtian rhyolite conformably overlies hornblende-phyric andesitic rocks more typical of the Kasalka Group (Diakow, unpublished data). If Maastrichtian rocks in the study area are in fact part of the Kasalka Group, they represent a discrete felsic event that terminates a protracted interval of episodic continental arc magmatism spanning roughly 30 million years, which, in its youngest eruptive phase, extended across the breadth of Stikinia.

## *RHYOLITIC SILLS AND DIKES (UNITS LKr AND LKf)*

On the Capoose property in the the northern Fawnie Range, Andrew (1988) distinguished several varieties of dikes and sills which commonly vary from 2 to 20 metres thick, generally trending northwest and moderately inclined (<30°) southwest. Features common to most of these intrusions include their rhyolitic composition, the ubiquitous presence of garnets as aggregates of small brown crystals, and resorbed quartz phenocrysts (unit LKr). Some intrusions actually resemble flows with finely laminated and spherulitic textures. Within some very thick rhyolitic sills(?) round spherulite-like balls, between 2 and 25 centimetres in diameter, occupy crude layers within otherwise massive, aphanitic rocks.

Potassium-argon age determinations on whole rocks from the sills range from 68.4 to 70.3 Ma, with the youngest sill dated at 64.3 Ma (Andrew, 1988). Uranium-lead zircon geochronometry on identical garnetiferous rhyolite sills in the Fawnie Range suggests two distinct magmatic episodes (R.M. Friedman, personal communication, 1996). A younger Maastrichtian (*ca.* 70 Ma) U-Pb date was obtained from massive aphanitic rhyolite that underlies the upper part of a prominent rusty knoll on the Capoose property. These data corroborate K-Ar geochronometry on the same rock reported by Andrew (1988). Andrew also obtained a K-Ar biotite date of 67.1±2.3 Ma on quartz monzonite near Capoose Lake, which she interpreted to be comagmatic with coeval garnet-bearing sills on the nearby Capoose property. An older U-Pb zircon date (*ca.* 140 Ma.) obtained from a sill that intrudes early Callovian fossiliferous sediments, lower on the east side of the knoll, is coeval with Early Cretaceous K-Ar dates obtained from the Capoose batholith in the Entiako Spur area. Although our mapping failed to discriminate the separate plutons, together these age determinations suggest the possibility of two similar quartz monzonite bodies, each associated with age-equivalent subvolcanic felsic sills.

Greyish green fine-grained crystalline felsite sills (unit LKf), that characteristically contain up to 5% minute biotite grains, are confined to the area around Tommy Lake in the southeast corner of map sheet 93F/3. These rocks crop out sporadically over a broad area, and are locally concordant with gently south dipping sediments and volcanics of the Naglico formation. One isolated remnant rests directly on a probable Middle Jurassic augite porphyry plug (unit MJap). These sills also cut across mineralized quartz veins at the Tsacha prospect, where a U-Pb zircon date indicates latest Cretaceous emplacement (R.M. Friedman, personal communication, 1996). The sills weather to porcellaneous, conchoidally fractured fragments. Sparse plagioclase phenocrysts, up to 4 millimetres long, are observed on the fine-granular weathered surface.

### *LATE CRETACEOUS (?) DIORITIC PLUTONS (UNIT LKd)*

Unit LKd includes widely distributed dioritic stocks in the central and southern Chedakuz Creek valley and throughout the Nechako Range. Dioritic rocks in the Nechako Range consist of numerous small dikes and clusters of small, poor exposures that have been portrayed on the map as larger cohesive stocks. They consist of dull mottled dark greenish white fine to medium-grained pyroxene and plagioclase with a hypidiomorphic-granular texture. These plutons are undeformed but intrude the penetratively cleaved Upper Jurassic and older strata underlying the range. The age of these plutons is unknown; an attempt to date rocks from the largest body in the northern Nechako Range by U-Pb zircon geochonometry was thwarted by the absence of zircon.

The plutons exposed in the Chedakuz valley are grouped with those in the Nechako Range only on the basis of similar bulk composition. They are exposed through thick till and Neogene lavas that occupy the valley. The plutons in the central part of the valley appear to cut pyritized rocks of the Middle Jurassic Ashman Formation and are composed, for the most part, of fresh medium-grained equigranular diorite, and a local coarse-grained pyroxene-rich phase. The main dioritic phase of these plutons is very similar to the stock just north of Tsacha Lake.

## PALEOGENE ROCKS

Paleogene rocks in the study area include the mid-Eocene Ootsa Lake Group and younger Endako Group. The Ootsa Lake Group forms a semicontinuous volcanic field in the central Nechako River (Tipper, 1963) and eastern Anahim Lake areas (Tipper, 1969, Metcalfe *et al.*, 1996). Their continuity is interrupted in the study area by a medial zone of widely exposed Jurassic rocks that delineate the Nechako uplift. Rocks of the Ootsa Lake Group thin dramatically over the uplifted region, forming scattered remnants that unconformably overlie Mesozoic rocks. The Nechako uplift evidently restricted the distribution of the Endako Group largely to the topographically subdued region to the north, where gently inclined flows are unconformable on the Ootsa Lake Group and, farther south, onlap Mesozoic rocks.

### *OOTSA LAKE GROUP (UNIT EO)*

The type area for the Ootsa Lake Group is in the Whitesail Lake map area (Duffell, 1959). Here detailed studies on the Whitesail Volcanic Complex and other outliers indicate a brief eruptive history of continental volcanism, inferred from eleven K-Ar dates between 47 and 53 Ma, producing high-potassium calcalkaline rhyolite and lesser andesite flows and associated fragmental rocks (Drobe, 1991; Diakow *et al.*, in preparation). Remarkably similar mid-Eocene volcanic strata extend to the east into the study area, where they are most widespread immediately north of the Natalkuz fault. The fault roughly demarcates the southern margin of the extensive Ootsa volcanic field in central Nechako River map area against older basement of the Nechako uplift. South of the fault, Ootsa Lake volcanic strata form outliers that cap high-standing Jurassic rocks along the Fawnie Range and Entiako Spur. Except for a small area of rhyolites exposed low down along the eastern slope of the southern Nechako Range the Ootsa Lake Group was not found elsewhere in the uplifted region east of the Fawnie Range.

North of the Natalkuz fault, crudely layered Ootsa Lake strata unconformably overlie Upper Cretaceous volcanics and have an estimated minimum composite thickness of 450 metres. The lowermost unit consists of dark grey, massive and amygdaloidal andesite flows with amygdules infilled by silica, calcite and epidote. These flows are minor members within a gradationally overlying bladed-feldspar porphyritic andesite section that is locally up to 100 metres thick. Typically these rocks are dark grey-green and contain diagnostic plagioclase laths between 5 and 15 millimetres long (20-40% by volume) and pyroxene (5-10% by volume). These units generally appear beneath an upper, conformable section of felsic rocks made up of volumetrically minor dacite flows and more prevalent rhyolite flows and tuffs. The dacitic rocks, which commonly weather to flaggy porcellaneous fragments, are light green or grey and contain tabular feldspar phenocrysts 2 to 3 millimetres long (5-10% by volume) and slender hornblende phenocrysts 1 to 3 millimetres long. Rhyolitic rocks occupy the stratigraphic top of the Eocene sequence north of the Natalkuz fault. They consist primarily of flows, and occasionally recessive air-fall tuffs are preserved. The flows are typically chalky white and pink coloured and display a variety of textures that includes porphyritic and thinly laminated flows, massive flows and flow breccias, and rare interlayered pitchstones. Spherulites are common in rocks that have undergone varying degrees of devitrification. Phenocrysts up to 3 millimetres in diameter comprise up to 20% of the rhyolite flows and include, in order of abundance, plagioclase, potassium feldspar, quartz (<3%) and biotite (1-2%). Air-fall tuffs, sometimes interlayered with the rhyolite flows, consist of white and light green, massive to well bedded ash, crystal, crystal-lapilli and lapilli-block tuffs. A section of graded crystal-lapilli tuffs more than 200 metres thick crops out along the north side of Natalkuz Lake, almost directly north of Jim Smith Point. The tuffs contain a phenocryst assemblage of feldspar, quartz and biotite. Lithic fragments are fine grained, subangular to angular and predominantly felsic volcanic rocks. Carbonized wood fragments and rare upright tree trunks observed in the rhyolitic tuff unit attest to subaerial deposition. A massive aphanitic rhyolite, with conspicuous parallel joints, is exposed in the canyon walls along the Entiako River near its confluence with the Nechako Reservoir. This rhyolite is interpreted as a possible subvolcanic dome that has intruded along the Natalkuz fault and warped the peripheral Eocene flows, tuffs and Cretaceous sediments into a broad antiformal structure.

South of the Natalkuz fault rocks of the Ootsa Lake Group form three widely separated outliers.The largest covers more than 100 square kilometres between the Top Lake valley and a narrower valley separating Mount Davidson and Tsacha Mountain. Northeast-trending, steeply dipping normal faults trace through these valleys, placing Eocene rocks against fault blocks underlain by Jurassic formations. Other northerly and northeasterly trending faults locally disrupt the Eocene strata. Movement on some of these structures is synchronous with and postdates deposition of the Eocene rocks.

Stratigraphy in the Mount Davidson outlier consists of two lithologically distinct rhyolite flow and pyroclastic members that bound an intervening andesite flow member. The lower rhyolite bears a close lithologic resemblance to rocks forming the top of the Eocene sequence north of the Natalkuz fault. It consists of off-white, mauve and pale green flows, interflow breccia, and scarce lapilli tuff. Typically these rhyolitic rocks have thinly laminated and aphyric textures, however, some are sparsely porphyritic and contain plagioclase, quartz and biotite phenocrysts. Fine laminae in the flows are commonly overgrown in part by spherulites, which coalesce and form discontinuous layers that obscure the primary textures. Scarce lithophysae are also present. The middle andesite member is mainly composed of massive flows, with lesser flow breccia and some laharic deposits that conformably overlie rhyolitic rocks. The flows contain slender plagioclase phenocrysts up to 6 millimetres long and sometimes rounded amygdules, filled with chlorite and opalescent and crystalline silica, set in a dark green groundmass. The lithologic similarity of these rocks to those of the Naglico formation and Nechako volcanics makes separating the successions difficult. In general, Eocene andesites in the area are relatively unaltered and vitreous pyroxene, although present, is more abundant in the Jurassic rocks. Nevertheless these andesite flows are very difficult to distinguish from the older andesites unless found in close proximity to each other. The upper rhyolite member consists of pyroclastic flows and related tuffs that thicken locally to 250 metres within a small volcanic subsidence structure centred on Mount Davidson. The rocks thin outward from the main area of subsidence, with the farthest outcrops north of Top Lake and south of Tsacha Mountain forming isolated exposures that rest directly on Jurassic rocks. The main lithology is massive, blocky weathered, uniformly welded ash-flow tuff that forms resistant benches, some dominated by cooling features resembling columnal joints. The ash-flows typically contain up to 35% broken crystals, usually less than 3 millimetres in diameter, and lithic fragments within a grey indurated matrix. Quartz is very diagnostic (3-10%), commonly occurring as clear euhedra between 1 and 4 millimetres in diameter. The lithic fragments are mainly porphyritic lapilli and fewer blocks of andesitic composition. Thin discontinuous volcaniclastic-epiclastic deposits locally cap the upper rhyolitic member along the Mount Davidson ridge. These deposits are only a few to 10 metres thick and consist of poorly sorted blocks and lapilli beds, and less common mudstone and siltstone interbeds. The fragments are subangular to subrounded and consist of coarse-grained plagioclase and pyroxene that resemble andesitic flows characteristic of the Naglico formation. Quartz and some biotite grains are found with plagioclase in the matrix of the coarse deposit and some of the finer grained beds. These remnants are interpreted as post-subsidence fill, derived in part from high-standing Jurassic rocks and deposited with thin lacustrine mudstone and siltstone over locally subsided ash-flow tuff.

A variety of small hypabyssal intrusions are found in the Davidson outlier, but none are particularily prominent. Rhyolite, thought to represent a high-level intrusive dome, is exposed immediately southwest of Top Lake. It is similar to the dome that intrudes the Natalkuz fault at the mouth of the Entiako River. It consists exclusively of monolithic, aphanitic rhyolite breccia fragments loosely packed in a finer grained rhyolitic matrix. This deposit may represent the breccia carapace of a near-surface pluton or talus breccia of a small plug dome. Biotite-plagioclase porphyry sills and dikes of dacitic composition intrude the upper rhyolite member. Typically they weather to a light green or grey rock containing up to 10% chloritized euhedral biotite between 1 and 3 millimetres in diameter, up to 20% subhedral plagioclase up to 5 millimetres in diameter and, in places, trace quartz phenocrysts.

Eocene outliers elsewhere in the uplifted region are mainly dominated by quartz-bearing rhyolitic flows and associated fragmental rocks. A cluster of exposures sporadically caps Jurassic rocks along the northeast side of the northern Fawnie Range. Eocene rocks north of Entiako Lake are dominated by thinly laminated andesite and quartz-phyric rhyolite flows that nonconfomably overlie the Capoose batholith. Farther south, near Cow Lake, discontinuous Eocene rocks cover about 20 square kilometres with the best exposures occurring on three isolated hills north of the lake. The sequence is relatively thin, about 150 to 175 metres thick, dipping gently westward above an unconformable contact with underlying Jurassic sedimentary and volcanic rocks. The base is locally marked by an oligomictic orthoconglomerate about 20 metres thick composed of well rounded hornblende-biotite quartz monzonite and aplite clasts up to 1.3 metres in diameter. The texture and mineralogic features of the clasts suggest local derivation from the Capoose batholith. Quartz-phyric rhyolite flows are the predominant lithology and are interlayered with some welded tuffs and unwelded ash and lithic-rich beds. Tuffaceous siltstone and sandstone of probable lacustrine origin locally comprise a bedded section 3 metres thick beneath conformably overlying rhyolite. A sill-like body and rhyolitic dikes, interpreted as synvolcanic hypabyssal rocks, intrude the lavas. They have a medium to coarse-grained porphyritic texture imparted by plagioclase, potassium feldspar megacrysts and quartz.

The ages of the volcanic rocks assigned to the Ootsa Lake Group in the study area are established by K-Ar radiometric dates. North of the Natalkuz fault, on an island approximately 1 kilometre east of Jim Smith Point, a rhyodacite flow member contains vitreous biotite dated at 49.2±1 Ma. It is one of the fresher members of a laterally extensive, incipiently altered rhyolitic member that comprises the top of the Ootsa Lake Group north of the fault. Nearby, leaves and palynomorphs identified as mid-Eocene forms (Collection C-143387; G. Rouse, internal report, 1993) were recovered from an interval of laminated tuffaceous siltstone and lithic wacke that locally overlies rhyolite breccia, and is sharply overlain by lavas of the Endako Group. At the Cow Lake outlier, rhyolitic volcanic rocks and the subvolcanic intrusion into the upper part of the flow succession yield three whole-rock K-Ar dates varying from 47.6±1.7 to 49.9±1.7 Ma (Andrew, 1988).

### *EOCENE INTRUSIVE ROCKS (UNITS ECH AND Eqfp)*

The CH stock (unit ECH) is the largest dated Eocene intrusion in the study area. It is a circular body that intrudes and thermally alters strongly sheared Middle Jurassic sedimentary and volcanic rocks in the central Nechako Range. The pluton itself is undeformed, composed of equigranular to slightly porphyritic biotite-hornblende granodiorite in which the mafic minerals are fresh and locally comprise 15% of the rock. The stock has returned K-Ar dates of 51.8±1.8 Ma and 48.8±1.3 Ma on coexisting hornblende and biotite, respectively. These dates are similar to an unpublished crystallization age determined from the pluton by U-Pb zircon geochronology (R.M. Friedman, personal communication, 1996). Pervasively altered rocks, locally forming a narrow envelope along the northeast margin of the intrusion, are bleached and rusty, containing an assemblage of pyrite, clay minerals, quartz and sericite, with or without garnet and secondary biotite. The sharp eastern contact of the CH pluton appears to dip steeply under altered country rocks. Molybdenum mineralization on the CH property to the east is associated with granitic rocks, but their relationship with the dated intrusion remains conjectural.

Elsewhere in the Nechako Range, granodiorite similar to the CH stock contains quartz-molybdenite veins and disseminated chalcopyrite. Scattered outcrops of coarse equigranular granite are mapped on the heavily forested western slope of Nechako Range, south of Tatelkuz Lake. A strong aeromagnetic signature, corresponding with this intrusion, is comparable to another magnetic anomaly farther south (GSC Open File 2785). Sparse basalt outcroppings of the Chilcotin Group in this area evidently do not account for this anomalous magnetism.

Small stocks and dikes composed of quartz feldspar porphyry (unit Eqfp) crop out intermittantly east of the Capoose batholith between Mount Swannell and Matthews Creek, and also north of the Natalkuz fault. Locally they cut Middle Jurassic rocks. They commonly occur in close proximity to Eocene rocks. Because of this spatial association and their similar bulk composition, particularly with rhyolitic strata that predominate in the Ootsa Lake Group within the study area, they are thought to represent subvolcanic roots of the Eocene felsic extrusives. These plutons vary in size and shape, ranging from oval, 1 by 2-kilometre plugs to elongate bodies hundreds of metres wide to narrow dikes a few metres thick. Diagnostic features include medium to coarse-grained quartz phenocrysts (1-5%; rarely to

10%), subhedral plagioclase up to 5 millimetres in diameter (<20%), biotite (1-2%) and, on occasion, hornblende phenocrysts. The matrix is typically pink or light grey and aphanitic. Rare mariolitic cavities locally suggest high-level emplacement.

### *ENDAKO GROUP (UNIT EE)*

The Endako Group, as originally defined by Armstrong (1949), included Oligocene or younger flat-lying lava flows up to 600 metres thick that underlie the Endako River drainage basin between Babine and Francois lakes. These rocks extend beyond the type area, westward into the Whitesail Lake and southward into the Nechako River map areas, where they comprise scattered erosional remnants unconformably resting on volcanic rocks of the Ootsa Lake Group. In the Nechako River area, Endako volcanics mapped along the northern part of the study area apparently mark the southern edge of this extensive belt of lavas, onlapping Jurassic rocks along the north side of the Nechako uplift. The sharp disconformable contact between massive and columnar jointed lavas of the Endako Group and underlying subaerial air-fall rhyolite tuff of the Ootsa Lake Group is exposed locally along the shoreline of Knewstubb Lake. In the study area exposures of these lavas are less than 100 metres thick. They form a series of isolated knolls and fill channels and undulations on the upper surface of the Ootsa Lake Group.

The Endako Group is dominated by gently inclined lava flows which typically display massive, crudely layered, thick beds and uncommon columnar jointing. Individual flows are rarely discernible in the low-relief exposures; however, in a superb section exposed in a quarry on the southside of the Kenney Dam, they vary from several metres to over 15 metres thick. Hematized breccia is locally present between individual flows. They weather tan or grey and produce brown soil. The lava flows are characteristically dense, black and aphanitic to sparsely porphyritic, but commonly include vesicular or amygdaloidal varieties. Amygdules are commonly filled with creamy opalescent silica and calcite. Despite the appearance of basalts, chemical data indicate the majority are andesite and lesser basaltic andesite with high-potassium calcalkaline compositions. In thin section they contain plagioclase microlites, augite, and rarer hypersthene and olivine grains. Clay minerals and chlorite occur as alteration products of both phenocrysts and groundmass phases.

The Endako Group has not been dated in the study area. However, whole-rock K-Ar dates from identical aphanitic basaltic andesite flows about 120 kilometres to the west in the Whitesail Lake map area range from 31 to 42 Ma (Diakow and Koyanagi, 1988). Similar rocks described in the southeast quadrant of the Smithers map area are assigned to the Swan Lake member of the Buck Creek formation (Church and Barakso, 1990). The lowest member of the Buck Creek formation yielded a whole-rock K-Ar date of 48.2±1.6 Ma, which indicates a maximum age for conformably overlying rocks of the Swan Lake member.

## NEOGENE ROCKS

### *CHILCOTIN GROUP (UNIT MpC)*

Basalt lava flows of the Chilcotin Group are the youngest rocks mapped in the study area. Chilcotin lavas exposed in the southern Nechako River map area mark the northern margin of the extensive Neogene volcanic field that underlies much of the southern Interior Plateau (Mathews, 1989). The Blackwater River coincides with a profound physiographic change from a highland underlain by Mesozoic rocks of the Nechako uplift in the north, to a plateau comprised of thick, flat-lying basaltic lavas of the Chilcotin Group to the south (Bevier, 1983a, Mathews, 1989), on which late-Miocene and younger shield volcanoes of the Anahim volcanic belt (Souther and Souther, 1994) are perched. South of Tsacha Lake and the Blackwater River, the plateau is rimmed by an escarpment that exposes more than 150 metres of basaltic flows. North of the Blackwater River, the Chilcotin Group crops out between 1000 and 1400 metres elevation. However Chilcotin basalts also generally underlie low-lying areas, below 1150 metres elevation, where exposure is commonly obscured by glacial deposits, but there presence is inferred from abundant large boulders and diagnostic brown soil. Isolated lava exposures, typically no more than 50 metres thick and rarely covering more than 2 square kilometres, rest unconformably on Jurassic and Upper Cretaceous volcanic rocks and, in a few outcrops, nonconformably on the Capoose batholith and probable Eocene granite. Lavas of the Chilcotin and Endako groups overlap geographically in only one locality around van Tine Creek, but nowhere is the contact observed. Lavas of these groups also crop out at the opposite ends of the broad Chedakuz Creek valley. Although the Chilcotin lavas are exposed south of Tatelkuz Lake at 1350 metres elevation, well above the valley bottom, they are not recognized farther north within the valley, where they may be covered by till or are mistakenly mapped as part of the Endako Group.

Basalt of the Chilcotin Group is massive and commonly columnar jointed. Individual flows commonly grade through massive into vesicular and oxidized scoriacous and brecciated flow tops. They weather light brown and fresh surfaces are black with a dense aphanitic texture. Unaltered olivine phenocrysts are conspicuous in a dark black aphanitic groundmass; plagioclase laths between 1 and 1.5 centimetres long are present, only rarely. Chilcotin basalts were not dated in the study area, but numerous dates on the Chilcotin Group to the south indicate a broad Miocene-Pliocene range (Mathews, 1989).

## STRUCTURE OF THE NECHAKO UPLIFT

The Nechako uplift is specifically applied to the broad region of uplifted Mesozoic rocks that underlie the Fawnie and Nechako ranges. Several northeast-trending faults bound the uplifted region, they include the Natakuz fault in the north and the Blackwater fault in the south. These structures are not well understood because they are largely concealed by thick till and Tertiary volcanic rocks. The faults approximate terminal points of the ranges, where they pass into lower terrain. Internally the Nechako uplift comprises two distinct domains, separated by a probable northwest structure(s) beneath the Chedakuz Creek valley. The western domain comprises a coherent block in the Fawnie Range and connected ridges in the west, broken by a rectilinear pattern of faults. The eastern domain encompasses the Nechako Range where a regional penetrative foliation is locally transitional into steep zones of mylonite striking northwest.

Uplift has been relatively uniform across the Fawnie Range and connected ridges as inferred from the widespread distribution of a relatively narrow stratigraphic interval of Middle Jurassic rocks, comprised mainly of the Naglico formation. Commonly these strata underlie broad areas and display relatively consistent bedding which deviates across high-angle faults that trend either northwest or northeast. Movement on these faults is difficult to document, but it is considered minor as many appear to displace only one stratigraphic unit. In some cases the cumulative displacement along poorly defined networks of steep faults may be significant, as in the case of early Callovian sediments in the northern Fawnie Range that are dropped more than 500 metres, almost to the level of the valley occupied by Top Lake.

The Top Lake fault, which strikes northeast along this valley, juxtaposes early Callovian sediments and overlying Kimmeridgian(?) volcanics exposed locally north of the fault against a thick sequence of Eocene volcanic rocks south of the fault. The latest movement on the Top Lake fault is mid-Eocene, evidently closely timed with explosive ash-flow tuff eruptions and synvolcanic subsidence that mark the last event of Ootsa Lake volcanism in the study area. The main area of subsidence near Mount Davidson is controlled by a system of steep northeast and northerly striking faults that delimit blocks underlain by thick quartz-phyric ash-flow tuff, placing them against older Jurassic units. To the west, the Top Lake fault intersects a structure that trends southwest along a straight valley occupied by Fawnie Creek and to the northeast appears colinear with a topographic break. Strata of the Entiako formation dip in opposite directions across the southern part of this fault, suggesting they may be broadly warped or occupy rotated blocks.

High-level emplacement of the Early Cretaceous Capoose batholith into Middle Jurassic rocks beneath the Entiako Spur generated numerous small-scale faults and fractures. Fracturing, accompanied by widespread propylitic alteration, is most intense in the central part of the spur where the batholith is closest to the surface. Adjacent to the batholith, particularly in the Naglico Hills, country rocks appear to be gently bowed radially outwards from the intrusion, inferring relatively passive emplacement.

At the Eocene outlier near Cow Lake, granite boulder conglomerate found locally at the base of the sequence is dominated by clasts resembling the Capoose batholith. This suggests that the batholith was unroofed prior to deposition of dated mid-Eocene rhyolites that overlie the conglomerate. Faults postdating rhyolite deposition are indicated by the incremental displacement of the basal unconformity separating Eocene rhyolite from underlying Middle Jurassic rocks. This contact is disrupted by several steeply dipping north-trending structures that coincide with two valleys that separate three prominent knolls capped by rhyolite. The apparent movement is extensional; the unconformable surface steps down progressively toward the west, resulting in thicker Eocene strata towards the west.

Stuctural geology of the Nechako Range is characterized by a weak to intense penetrative foliation and zones of mylonite. The deformed rocks are confined to belt over 50 kilometres long that tapers from 8 kilometres wide in the north to about 1.5 kilometres wide in the south. The intensity of foliation development varies along the length of the belt, independent of lithological contrasts and unaffected by a system of steep northerly and northeast-striking faults. The attitude of the foliation generally maintains a consistent northwest strike and moderate southwest to locally vertical dip.

Early and Middle Jurassic volcanic and sedimentary rocks underlying the Nechako Range are separated into three structural blocks by the northeast-striking Brewster and Blackwater faults which trace along prominent valleys traversing the range. The block north of the Brewster fault is mostly underlain by the youngest Jurassic units, the Ashman Formation and Nechako volcanics, which are also significantly thicker here than elsewhere in the study area. The extent of deformed rocks is also greatest within this block, about 8 kilometres wide. Strain is most prevalent in some of the finer grained clastic units in which phyllitic cleavage is locally prominent. Conglomerate beds commonly exhibit stretched and flattened clasts. An incipient foliation is developed in the overlying mafic volcanics that rapidly grades into localized zones of strongly cleaved greenschist. The Chedakuz fault, at the western edge of the block, traces along the eastern edge of the Chedakuz Creek valley and is marked by mylonite exposed locally through thick till. The fault dips steeply west, and trends southwest where it apparently converges or is represented by a broad zone of vertically dipping mylonitized sediments and volcanic rocks, extensively exposed along the southern perimeter of the CH pluton in the middle structural block.

The middle block, between the Brewster and Blackwater faults, is dominated by the oldest Jurassic strata of the Entiako formation. Overlying mafic flows of the Naglico formation are divided into two parallel belts by a series of disconnected fault segments that are interpreted as the probable southward continuation of the Chedakuz fault. These faults trend northerly, roughly parallel to the axis of the range. In the south they are cut by the northeast-trending Blackwater fault that passes through the valley occupied by Kuyakuz Lake. Across this structure the southern extension of the Chedakuz fault system is manifest again in mylonitized volcanic rocks exposed in a roadside outcrop south of the east end of Kuyakuz Lake. This structure extends to the south, mainly juxtaposing different units of the Entiako formation, where it is truncated by a splay off the Blackwater fault that follows the east-trending valley occupied by the Euchiniko Lakes.

In the middle block between Tatelkuz Mountain and Euchiniko Lakes, the broad region west of the Chedakuz fault system has undergone varying amounts of uplift relative to the eastern region. Block rotation is inferred from opposing bedding attitudes across the fault. East of the fault younger sediments of the Ashman Formation apparently face and dip west, overlying a thick sequence of mafic flows assigned to the Naglico formation. On the uplifted side, volcaniclastic sediments of the Entiako formation are widely exposed in bedded sections dipping east. Overlying, or possibly in sharp fault contact, are mafic rocks of the Naglico formation. They appear as a thick, locally foliated greenstone unit underlying Tatelkuz Mountain, but farther south, between Kuyakuz Mountain and Kuyakuz Lake the section is considerably thinner and rotated to a vertical, moderately to strongly foliated greenstone-greenschist section along the Chedakuz fault. Clastic rocks of the Ashman Formation are absent above the Naglico formation west of the fault. North of Tatelkuz Mountain, the Chedakuz fault intersects another steep fault trending southeast. North of this structure the relatively straightforward stratigraphic relationships observed to the south are complicated by a number of smaller northerly trending faults in a broad zone marked by moderately foliated to locally mylonitized rocks of Lower to Upper Jurassic units that are truncated by undeformed granodiorite of the CH pluton.

Rocks of the Naglico formation predominate in the southern structural block. They dip to the east and are locally overlain by sediments of the Ashman Formation and possibly the Nechako volcanics. Foliation, confined to the Naglico formation, is present but less pronounced and more randomly oriented than elsewhere in the range.

The timing and nature of movement on these major structures are difficult to determine because of poor exposure. The presence of thin Eocene strata above uplifted Mesozoic rocks between the Natalkuz and Blackwater faults may suggest the region was already partly elevated in Eocene time and perhaps formed a low buttress that impeded broader distribution of the Oosta Lake Group. However, small volcanic centres in the Mount Davidson area and Eocene plutons in the Nechako Range also suggest the uplifted region was the locus for some Eocene magmatism. In the Nechako Range, the CH pluton truncates the regional penetrative foliation and three age determinations on the granodiorite of *circa* 51 Ma establish a minimum age for deformation. A possible lower bracketing age is provided by sericite from mylonitic rocks along the Chedakuz fault zone south of Kuyakuz Lake, which yields a "tentative" mid-Cretaceous $^{40}Ar/^{39}Ar$ plateau date. The extent of deformed rocks beyond the study area to the north is not known. Structures in the northern Nechako Range may extend through low terrain towards the northern end of Knewstubb Lake and terminate against the northeast-trending Natalkuz fault.

## SUMMARY AND CONCLUSIONS

Extensive Tertiary volcanic deposits and Quaternary glacial debris cover much of the Interior Plateau region. They are interrupted in the southern Nechako River map area by the Nechako uplift, a structurally uplifted region centred on the Fawnie and Nechako ranges. Regional mapping, supported by paleontologic and geochronologic work by outside agencies has provided new insights into stratigraphic, magmatic and structural development of the Nechako uplift. It provides a window through comparatively young cover into an underlying Mesozoic substrate that is lithologically distinct and perhaps indicative of the broader makeup of the central Stikine Terrane near its eastern contact with the Cache Creek Terrane at 53°N latitude.

Prior to this study, broad tracts of pre-Tertiary rocks in the southern Nechako River map area were assigned to the Upper Triassic Takla Group. Triassic rocks are in fact, represented by a single exposure of Carnian to early Norian siltstone. Lower and Middle Jurassic volcanic and sedimentary rocks predominate in the Nechako uplift where they are subdivided into two informal formations correlative with the Hazelton Group. The Entiako formation is an early Toarcian and possibly Aalenian sequence comprised of a subaerial rhyolitic volcanic facies that is replaced to the east by near-shore and deeper marine facies dominated by volcanogenic-epiclastic rocks. The conformably overlying Naglico formation is a sequence of subaerial pyroxene-phyric basaltic flows and tuffs containing interbeds of early Bajocian shallow-marine volcanic-derived sediments. Together these strata record island arc volcanism and associated intra-arc clastic sedimentation. Lower Callovian marine siltstone and shale are sporadically exposed, but widespread in the study area. They feature chert-bearing conglomerate interbeds that become thicker eastward from the Fawnie Range towards the Nechako Range. These deposits, correlative with the Bowser Lake Group, are interpreted to record intial transport of chert-rich detritus shed into the Nechako basin from a probable source region underlain by high-standing rocks of Cache Creek Terrane.

Extrusive products of Late Jurassic and earliest Cretaceous magmatism are rare in the Stikine Terrane; however, based on several new age determinations a few are preserved in the Nechako River map area. An assemblage of pyroxene-phyric flows, indistinguishable in the field from those of the Naglico formation, occurs with rhyolitic fragmental rocks in both the Nechako and Fawnie ranges above a sharp conformable contact with clastic rocks of the Ashman Formation. This volcanic succession, called the Nechako volcanics, yields an $^{40}Ar/^{39}Ar$ date of 152 Ma. Even more areally restricted are dacitic volcanic rocks of Jura-Cretaceous age (*ca.* 144 Ma). These rare volcanics are coeval with the Capoose batholith (*ca.* 142 Ma) and together they may represent the southern extension of Jura-Cretaceous magmatism related to the Francois Lake intrusive suite. Late Cretaceous (*ca.* 65-70 Ma) hornblende andesite and rhyolitic extrusives and subvolcanic dikes and sills, and contemporaneous quartz monzonite sporadically exposed in the area, may represent the easternmost and youngest continental arc magmatic event corresponding with the Kasalka Group in central Stikinia.

Uplift of the Fawnie and Nechako ranges in the southern Nechako River area is related to several inferred northeast-striking faults that truncate the ranges to the north and south. They intersect a major structural zone trending northeast beneath the Nechako Range, evidenced by the development of a persistent foliation and zones of mylonite. Deformation in the Nechako Range is thought to have coincided with regional uplift. The timing of this event is bracketed by a provisional mid-Cretaceous $^{40}Ar/^{39}Ar$ date on sericite from mylonite and the undeformed Eocene CH stock which locally trucates the penetrative fabric.

Uplift of the ranges preceeded widespread Paleogene and Neogene volcanism, influencing the distribution of Tertiary volcanic rocks repetitions. Subaerial high-potassium calcalkaline volcanic rocks of the Ootsa Lake Group cap a small area in the uplifted region, resting unconformably on Mesozoic rocks, but are widespread in topographically lower regions to the north and south. The Endako Group is a sequence of andesitic flows that have compositional continuity with volcanic rocks of the Ootsa Lake Group. Their source is believed to be volcanic centres to the north of the uplifted region as they thin dramatically southward, overlying progressively older rocks along the northern flank of the ranges. The youngest magmatic event in the study area is represented by Neogene plateau-forming alkali olivine basalts that flooded the region from sources south of the Nechako uplift. The uplift apparently served as a partial barrier to northward advance of these flows as they have not been observed overlapping older Endako lavas along the northern slope of the uplifted region.

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