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GEOLOGY OF THE SITLIKA ASSEMBLAGE IN THE TAKLA LAKE AREA (93N/3, 4, 5, 6, 12), CENTRAL BRITISH COLUMBIA

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(British Columbia Geological Survey Branch contribution to the Nechako NATMAP Project)

KEYWORDS: Sitlika assemblage, Cache Creek Group, Takla Group, Sustut Group, Takla fault, chromite, copper

INTRODUCTION

The Sitlika bedrock mapping program was initiated as part of the Nechako Natmap project in 1996 (Schiarizza and Payie, 1997; Childe and Schiarizza, 1997; Schiarizza *et al.*, 1997). Its purpose is to update the geologic database for the western Manson River map area and, in particular, to determine the stratigraphy and structure of the Sitlika assemblage (Paterson, 1974), the validity of its correlation with the Kutcho assemblage of northern British Columbia (Monger *et al.*, 1978; Gabrielse, 1985), and its potential to host volcanogenic massive sulphide mineralization similar to the Kutcho Creek deposit (Bridge *et al.*, 1986; Childe and Thompson, 1995; Thompson *et al.*, 1995). The 1996 mapping program covered most of the Sitlika assemblage where it was originally defined by Paterson (1974). This resulted in an improved understanding of the composition, distribution and mutual relationships of Paterson's three divisions of the assemblage, and an improved understanding of the structural relationships between the Sitlika assemblage and terranes to the east and west. Furthermore, this mapping and associated radiometric dating and geochemical analyses established that the volcanic rocks of the Sitlika assemblage are readily correlated with metavolcanic rocks of the Kutcho Formation on the basis of lithology (mafic and felsic volcanics with associated intrusions), Permo-Triassic age, and primitive tholeiitic geochemistry (Schiarizza and Payie, 1997; Childe and Schiarizza, 1997).

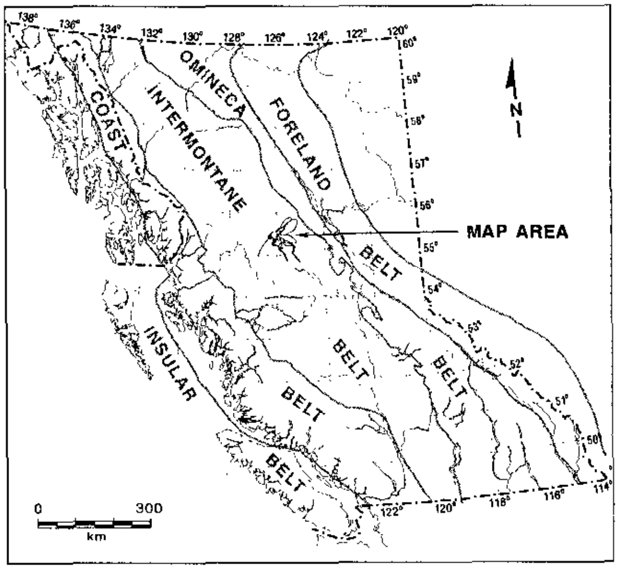

Figure 4-1. Location of the Sitlika Project Area.

This report summarizes the findings from the second year of regional mapping within and adjacent to the Sitlika belt, carried out from late June to the end of August, 1997. This mapping extends the Sitlika assemblage southward from where it was originally defined by Paterson (1974) to the south end of Takla Lake, where rocks now included within the assemblage had been assigned to the Cache Creek and Takla groups by Armstrong (1949). It is planned to continue mapping southward along the Sitlika belt in the 1998 field season, and to establish the relationships between the Sitlika and Cache Creek belts mapped as part of this project with the Cache Creek units studied by the Geological Survey of Canada's Nechako Natmap team to the southeast (*see* MacIntyre and Struik, 1997, 1998).

The 1997 map area is situated mainly within the Hogem Ranges (including the Takla and Mitchell ranges) of the western Omineca Mountains, and encompasses the southern two-thirds of Takla Lake, including most of the northwest arm of the lake (Figure 4-2). The lowlands bordering Takla Lake in the northwestern corner of the area comprise part of the northern end of the Nechako Plateau. The only permanent residences are along Takla Lake, at the village of Takla Landing in the northwest corner of the area, and at Takla Narrows in the south-central part of the area. A network of logging and Forest Service roads that originates at Fort St. James, 125 kilometres southeast of Takla Narrows, provides access to much of the southern, eastern and northern parts of the map area. Boat ramps at Takla Narrows and Takla Landing provide access to excellent bedrock exposures along much of Takla Lake, as does the BC Railroad line along the east shore of the lake. Access to the interior part of the Mitchell and Takla ranges, east and west of the main arm of Takla Lake, respectively, was by helicopter. This was facilitated by a seasonal base established by Pacific Western Helicopters at Rustad Limited's Lovell Cove logging camp, near the north end of Takla Lake.

REGIONAL GEOLOGIC SETTING

The Takla Lake map area is situated within the eastern to central part of the Intermontane Belt, which includes a number of tectonostratigraphic terranes that were amalgamated and tied to the western margin of

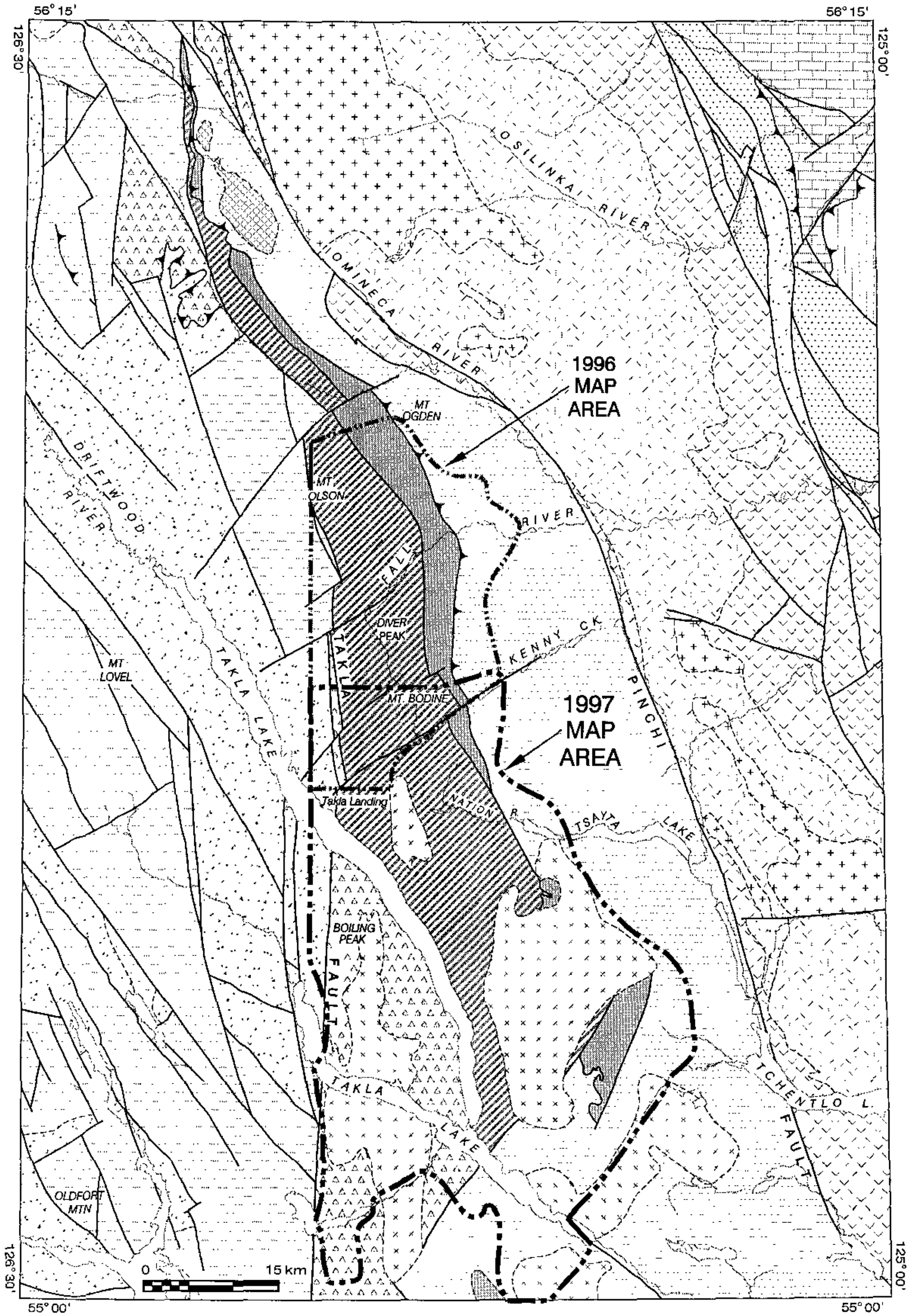

Figure 4-2. Geologic Setting of the Takla Lake map area. Modified from compilations by MacIntyre *et al.* (1994, 1995) and Bellefontaine *et al.* (1995). Note that the geology in and around the 1997 map area has not been modified to reflect this new mapping.

North America by Middle Jurassic time (Monger *et al.*, 1982). At this latitude the eastern Intermontane Belt includes early to mid-Mesozoic arc volcanic and plutonic rocks of the Quesnel Terrane flanked to the west by late Paleozoic and early Mesozoic oceanic rocks of the Cache Creek Terrane (Figure 4-2). The two terranes are in large part separated by the Pinchi fault zone, which also includes slivers of deformed and altered sedimentary rocks of probable Late Cretaceous to Paleocene age. Latest movement is therefore inferred to be Tertiary, and may have been linked to a system of dextral strike-slip faults that was active over much of the length of the Canadian Cordillera during this time period (Gabrielse, 1985; Struik, 1993; Umhoefer and Schiarizza, 1996). Late Triassic blueschist-facies rocks are exposed along the fault zone at Pinchi Lake, suggesting that, at least locally, the Pinchi fault zone coincides with the early Mesozoic plate boundary between the Cache Creek accretionary wedge and the Quesnel Terrane magmatic arc (Paterson, 1977; Ghent *et al.*, 1996).

Cretaceous to Eocene

⁖ Marine to nonmarine conglomerate, sandstone, shale; dacite, rhyolite; includes Skeena, Sustut and Ootsa Lake groups west of Takla fault; Sifton and Uslika formations east of Pinchi fault.

Cretaceous

+ Granite; local quartz syenite and alaskite.

▒ Axelgold intrusions: layered gabbro.

Jurassic to Cretaceous

× Granodiorite, quartz diorite, diorite.

STIKINE TERRANE

Lower to Upper Jurassic

⁖ Hazelton and Bowser Lake groups: mafic to felsic flows, tuffs and breccias; sandstone, siltstone, shale, conglomerate.

Permian and Upper Triassic

△ Mainly mafic to intermediate flows, tuffs, breccias & associated sedimentary rocks of the Upper Triassic Takla Group; locally includes basalt, rhyolite, tuff, chert, argillite and limestone of the Lower Permian Asitka Group, or granite of the Topley intrusions.

SITLIKA ASSEMBLAGE

Permian to Jurassic

▨ Basalt, dacite, rhyolite, sandstone, slate, conglomerate; locally includes limestone, diorite, tonalite.

CACHE CREEK TERRANE

Pennsylvanian to Triassic

⁖ Quartz phyllite, chert, argillite, limestone, sandstone, greenstone, gabbro

▒ Variably serpentinized harzburgite, dunite and ultramafic cumulates; serpentinite melange; greenstone, gabbro, amphibolite; local chert and limestone.

QUESNEL TERRANE

Late Triassic to Early Jurassic

⁖ Hogem batholith: monzonite, quartz monzonite, granodiorite, monzodiorite, diorite; locally includes gabbro, pyroxenite, syenite, quartz syenite.

Middle Triassic to Lower Jurassic

∨ Takla Group: mafic volcanic flows, tuffs and breccias; conglomerate, sandstone, siltstone, limestone.

Mississippian to Permian

⁖ Lay Range assemblage: siltstone, argillite, slate, sandstone, chert, conglomerate; basalt, tuff, agglomerate; locally includes gabbro and serpentinite.

SLIDE MOUNTAIN TERRANE

⁞ Nina Creek Group: chert, argillite, basalt, breccia, gabbro.

CASSIAR TERRANE

Hadrynian to Permian

⁖ Sandstone, siltstone, shale, conglomerate, limestone, dolostone; local tuff

Legend to accompany Figure 4-2.

The Cache Creek Terrane is represented mainly by the Late Paleozoic to mid-Mesozoic Cache Creek Group, which includes structurally imbricated carbonate, chert, argillite, basalt, gabbro and alpine ultramafic rocks. Faulted against the Cache Creek Group to the west is a belt of metavolcanic and metasedimentary rocks that are assigned to the Sitlika assemblage (Paterson, 1974). These rocks, which are the focus of the present study, record primitive Permo-Triassic bimodal magmatism and subsequent clastic sedimentation within or adjacent to Cache Creek Terrane (Childe and Schiarizza, 1997; Schiarizza and Payie, 1997). They are apparently part of a much more extensive tract that is also recognized in northern and southern British Columbia (Childe *et al.*, 1996).

The Sitlika assemblage and Cache Creek Group are faulted to the west against the Stikine Terrane, which includes three successive assemblages of arc-derived volcanic, sedimentary and plutonic rocks that are assigned to the Lower Permian Asitka Group, the Upper Triassic Takla Group and the Lower to Middle Jurassic Hazelton Group (Tipper and Richards, 1976; Monger, 1977a; MacIntyre *et al.*, 1996). These arc successions are overlain by predominantly marine clastic sedimentary rocks of the upper Middle Jurassic to Lower Cretaceous Bowser Lake and Skeena groups, which in turn are overlapped by Upper Cretaceous to Eocene nonmarine clastic sedimentary rocks of the Sustut Group or age-equivalent continental arc volcanic rocks of the Kasalka and Ootsa Lake groups. Stikine Terrane and overlying clastic basin and continental arc assemblages cover the western two-thirds of the Intermontane Belt at the latitude of the study area, extending westward to the Coast Mountains.

The earliest deformation documented within Cache Creek Terrane in central British Columbia is related to subduction, probably beneath adjacent magmatic arc rocks of Quesnel Terrane, as indicated by blueschist facies rocks along the Pinchi fault that yield Late Triassic K-Ar and Ar-Ar cooling dates (Paterson and Harakal, 1974; Paterson, 1977; Ghent *et al.*, 1996). Subsequent uplift of Cache Creek Terrane is recorded by chert-rich clastic detritus that was shed westward into the basal part of the Bowser Lake Group in late Middle Jurassic to Late Jurassic time. This uplift may relate to the early stages of a deformational episode that generated greenschist facies metamorphism and penetrative deformation within the Cache Creek Terrane and the Sitlika assemblage, and ultimately resulted in Cache Creek Terrane being thrust westward over Stikine Terrane (Monger *et al.*, 1978). Monger *et al.* suggest that the final stages of this contractional episode occurred in latest Jurassic to earliest Cretaceous time, based on the involvement of Oxfordian strata in west-directed thrusting to the northwest of the present study area, and a 110±4 Ma K-Ar date on synkinematic metamorphic biotite from a sample of the Sitlika assemblage collected in Ominicetla Creek. Younger deformation in the region involved Late Cretaceous(?) to early Tertiary dextral strike-slip and related extension, in part along major structures such as the Pinchi and Takla faults (Monger *et al.*, 1978; Gabrielse, 1985; Struik, 1993; Wetherup and Struik, 1996).

LITHOLOGIC UNITS

Sitlika Assemblage

The Sitlika assemblage was named by Paterson (1974) for greenschist facies metavolcanic and metasedimentary rocks on the east side of Takla Lake that had previously been included in the Cache Creek and Takla groups by Armstrong (1949). Paterson noted that they were structurally and lithologically distinct from the Cache Creek Group, and were separated from the main belt of Cache Creek rocks to the east by a zone of serpentinite melange. He did not establish the age of the assemblage, but suggested that it might correlate with Upper Triassic and Jurassic rocks that were assigned to the Takla Group in the McConnell Creek area to the northwest (Lord, 1948; Monger and Paterson, 1974). The Sitlika assemblage was subsequently traced northwestward as a narrow belt that extends through the northeastern corner of the Hazelton map area (Richards, 1990) and into the southern McConnell Creek map area (Monger, 1977a; Monger *et al.*, 1978), where it was inferred to correlate with a stratigraphic succession that included Lower Permian, Upper Triassic and Lower Jurassic rocks of the Asitka, Takla and Hazelton groups. Monger *et al.* (1978) also recognized a strong lithologic and structural similarity between the Sitlika assemblage and the Kutcho Formation, which occurs in the eastern part of the King Salmon allochthon in northern British Columbia. They suggested that the King Salmon allochthon and structurally overlying Cache Creek Group had been displaced northward from the Sitlika assemblage and adjacent Cache Creek rocks, on Late Cretaceous or early Tertiary dextral strike-slip faults.

Recent studies of the Kutcho Formation, which previously had also been correlated with either the Lower Permian Asitka Group (Panteleyev and Pearson, 1977b; Monger, 1977b) or the Upper Triassic Takla Group (Thorstad and Gabrielse, 1986), have established that the volcanic and intrusive rocks are of Permo-Triassic age and primitive tholeiitic nature (Childe and Thompson, 1995; Thompson *et al.*, 1995). Schiarizza and Payie (1997) confirmed that the Sitlika assemblage resembles the Kutcho Formation and overlying metasedimentary rocks (Sinwa and Inklin formations) in general lithology and stratigraphy, while Childe and Schiarizza (1997) documented that the two assemblages are also similar in age, geochemistry and Nd isotopic signature. Furthermore, Childe *et al.* (1997) and Schiarizza and Payie (1997) suggest that Kutcho-Sitlika-correlatives also occur in at least two places in southern British Columbia. It appears, therefore, that the Sitlika assemblage may be part of an extensive tract within or adjacent to Cache Creek Terrane that occurs over most of the length of the Canadian Cordillera.

Paterson (1974) subdivided the Sitlika assemblage into three divisions. Schiarizza and Payie (1997) adopted this scheme and informally referred to the subdivisions as the volcanic unit (equivalent to Paterson's volcanic division), the eastern clastic unit (equivalent to Paterson's greywacke division) and the western clastic unit (equivalent to Paterson's argillite division). They established that the eastern clastic unit rests depositionally above the Permo-Triassic volcanic unit, but suggested that the western clastic unit, which is structurally beneath the volcanic unit, might be a fault-bounded panel of younger rocks. During the 1997 field season, these same three units of the Sitlika assemblage were traced southward an additional 50 km to the south end of Takla Lake. This work confirms the stratigraphic relationship between the volcanic and eastern clastic units. The age and structural/stratigraphic relationships of the western clastic unit remain uncertain.

Volcanic Unit

The Sitlika volcanic unit was traced continuously from Hogem Pass, at the south end of the belt mapped by Schiarizza and Payie (1997), to the southwest side of Takla Lake (Figure 4-3). The northern part of this belt, represented by excellent exposures along the east shore of Takla Lake, includes rocks that were assigned to the Sitlika volcanic division when it was originally defined by Paterson (1974). Southward from there, the unit crops out along the west side of Takla Lake, from Dominion Point to Takla Narrows, and includes rocks mapped by Armstrong (1949) as Cache Creek volcanics (as were correlative volcanics to the north, prior to their inclusion in the Sitlika assemblage by Paterson). The volcanic unit is not well exposed southward from there, but extends for at least 10 km south of Takla Narrows, where it includes rocks that Armstrong assigned to the Takla and Cache Creek groups on the southwest side of Takla Lake.

The volcanic unit in the Takla Lake area is dominated by a monotonous sequence of actinolite-epidote-chlorite schists and semischists derived from mafic volcanic rocks. Plagioclase, and less common pyroxene, are widespread as relict phenocrysts. Pillow structures, in places outlined by concentric zones of epidote amygdules, are commonly preserved, and locally grade into monolithic mafic fragmental schists that probably represent pillow breccias. Fragmental schists containing feldspar crystals and light grey to pale green felsic volcanic fragments also occur, typically as intervals several metres to tens of metres thick interleaved with mafic volcanics. In the Maclaing Creek area, however, schists containing felsic fragments dominate an interval about 1000 m thick, with a strike length of about 10 km, near the base of the unit. These rocks include sericite-chlorite schists and quartz-chlorite-sericite schists containing variable proportions of feldspar, quartz and pyroxene crystals, together with mafic to felsic volcanic-lithic fragments and, locally, dioritic to tonalitic plutonic fragments. The fragmental schists are generally not conspicuously stratified, but are locally intercalated with narrow intervals, up to 5 m thick, of thin-bedded tuff or volcanic sandstone and siltstone.

Metasedimentary rocks are a very minor component of the volcanic unit, but are intercalated with the volcanics at a number of widely scattered localities within the Takla Lake area, and locally form intervals approaching 100 metres in thickness. They are most common in the vicinity of Maclaing Creek, where they occur directly above the felsic fragmental schist unit, and as intercalations within pillowed basalts that overlie the fragmental schists. The metasedimentary rocks are mainly dark grey, rusty weathered, thin-bedded slates and slaty siltstones, with local intercalations of fine to coarse grained sandstone and granule conglomerate containing feldspar, quartz, and flattened volcanic or sedimentary lithic grains. Also present are narrow intervals of black argillite interbedded with pyritic chlorite-sericite phyllite, and thin-bedded, dark grey to pale green chert, cherty argillite and slate.

Volcanic and sedimentary rocks within the Sitlika volcanic unit are intruded by a variety of mafic to felsic sills and dikes that are inferred to be broadly contemporaneous with the volcanics. They include fine to medium-grained feldspar-chlorite schists to semischists, chloritized hornblende-feldspar porphyries, and pyroxene porphyries, of intermediate to mafic composition. Felsic rocks are less abundant, but dikes of variably foliated quartz-feldspar porphyry and tonalite occur locally. These resemble tonalite of the Maclaing Creek pluton (described later), which also includes an older phase of metadiorite that resembles some of the intermediate dikes and sills. The most mafic intrusive rock observed within the unit, possibly derived from a clinopyroxenite or wehrlite, comprises relict clinopyroxene crystals interleaved with foliated phyllosilicate-like material that may include chlorite, serpentine and talc. This rock, together with associated microdiorite, forms a series of sill-like bodies that intrude clastic metasedimentary rocks and pillowed metabasalt 4 km south of the Maclaing Creek pluton.

As reported by Childe and Schiarizza (1997) the age of the Sitlika volcanic unit is in part constrained by a U-Pb date of 258 +10/-1 Ma on zircons from a weakly foliated quartz-plagioclase-phyric rhyolite north of Mount Bodine. This Permian date is corroborated by Permian radiolarians (*Latentibifistula* sp.) extracted from a narrow chert interval intercalated with the volcanic rocks south of Mount Olson (Fabrice Cordey, written communication, 1997). A U-Pb zircon date of 241±1 Ma from a tonalite plug that intrudes the Sitlika volcanic unit east of Diver Lake indicates that magmatism continued into the Triassic (Childe and Schiarizza, 1997). Additional samples were submitted for both microfossil extraction and U-Pb dating following the 1997 field season, in an attempt to further constrain the age of the volcanic unit.

Maclaing Creek Pluton

A composite stock of metadiorite and tonalite intrudes the Sitlika volcanic unit across the middle reaches of Maclaing Creek, about 6 km east of Takla Landing (Figure 4-3). It measures about 12 km long, parallel to the strike of the volcanic unit, and up to 4 km wide. The western and northern parts of the stock consist of moderately to weakly foliated, fine to medium-grained epidote-chlorite-feldspar schist and semischist, locally grading to weakly foliated chloritized hornblende diorite and hornblende-feldspar porphyry. Dikes and sills of similar metadiorite are common within the volcanic rocks peripheral to the stock, and also occur elsewhere within the volcanic unit. The southeastern part of the Maclaing Creek pluton consists of light grey, massive to weakly foliated chlorite-epidote-altered tonalite, characterized by a medium to coarse grained, equigranular to slightly quartz-porphyritic texture. The tonalite intrudes metadiorite to the west and northwest, and apparently cuts the upper part of the volcanic unit to the east, although this contact was not observed. The tonalite was included by Armstrong (1949) in his Late Jurassic to Early Cretaceous Omineca Intrusions, but is here included in the Sitlika assemblage due to its lithologic similarity to the Early Triassic Diver Lake pluton (Childe and Schiarizza, 1997). This correlation is currently being tested by U-Pb dating of zircons extracted from a sample of the Maclaing Creek tonalite.

Eastern Clastic Unit

The Sitlika eastern clastic unit occupies a wide outcrop belt that extends continuously from Kenny Creek to the south end of Takla Lake (Figure 4-3). It rests stratigraphically above the volcanic unit to the west, and is faulted against the Cache Creek ultramafic unit to the east, although the latter contact is in part truncated by the Mitchell batholith. The eastern clastic unit is well exposed on ridges adjacent to the upper Nation River, on the east-west ridge system north of Klowkut Peak, and along the eastern shore of Takla Lake, between 5 and 15 km north of Takla Narrows. Armstrong (1949) included the metasedimentary rocks throughout this belt in his ribbon chert lithologic division of the Cache Creek Group.

Schiarizza and Payie (1997) established that the eastern clastic unit rests stratigraphically above the volcanic unit, based on unfaulted sections southeast of Mount Olson and west of Mount Bodine. There, the contact is marked by a basal conglomerate containing felsic volcanic clasts, together with clasts of limestone, mafic volcanic rocks, felsic plutonic rocks and phyllitic rocks of possible sedimentary origin. The conglomerates pass up-section into green chloritic phyllite containing layers and lenses of buff to rusty dolomitic marble, which in turn pass up-section into grey phyllite containing lenses and layers of grey marble and silty calcarenite. This calcareous interval is several tens of metres thick in the Mount Olson area, where it is overlain by predominantly thin-bedded sandstone and dark-grey slate, typical of rocks found throughout the higher stratigraphic levels of the eastern clastic unit.

In the Takla Lake area, the base of the eastern clastic unit was observed only along the east shore of Takla Lake, about 15 km north of Takla Narrows. There is no basal conglomerate developed, but the lower part of the unit includes abundant carbonate and green chloritic phyllite, which resemble rocks found within the calcareous interval that lies directly above the basal conglomerate seen to the north. The actual contact is marked by about 2 m of pale

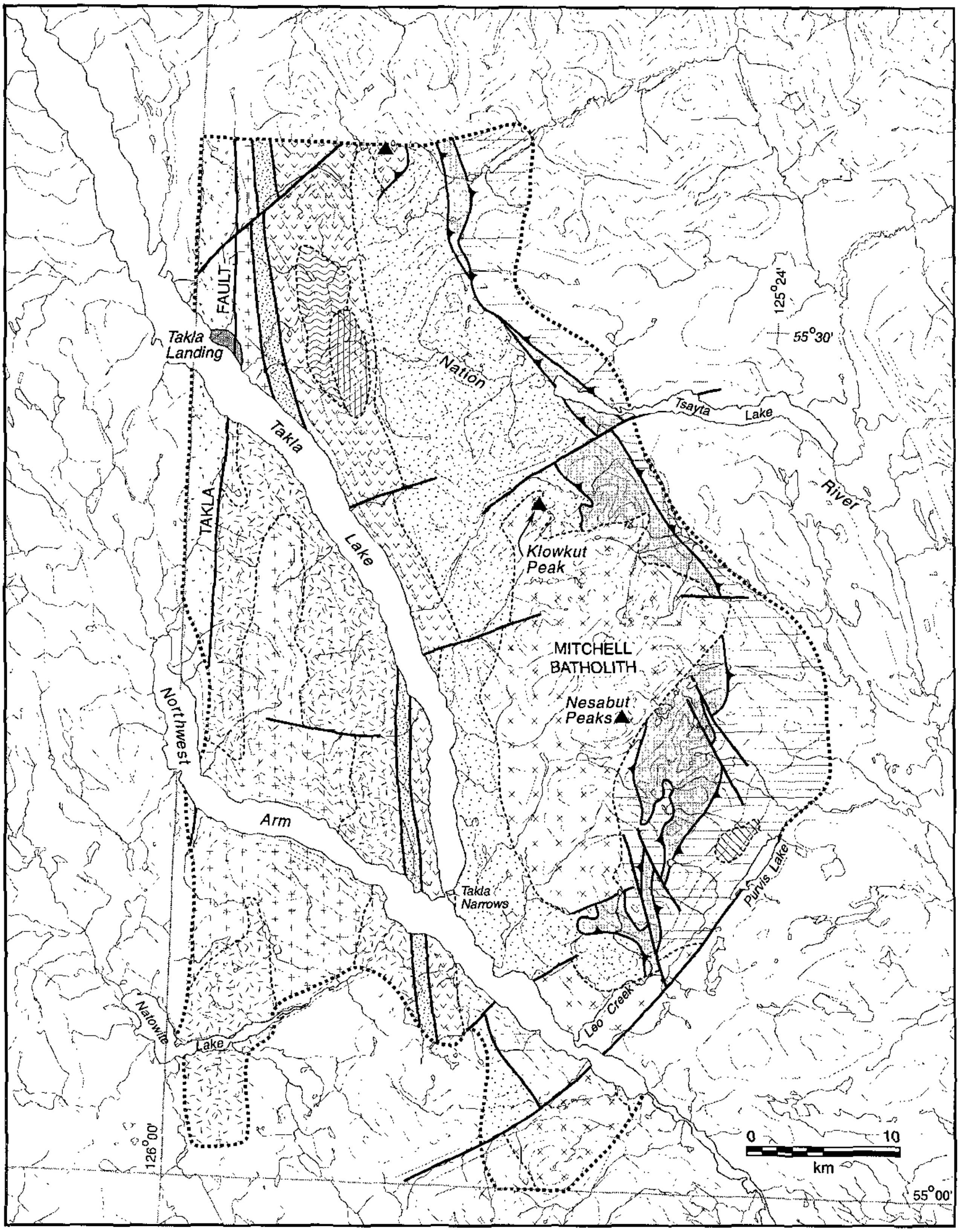

Figure 4-3. Generalized geology of the Takla Lake map area.

silvery-green calcareous sericite-chlorite schist with abundant stringers and lenses of carbonate. These rocks, which are included in the eastern clastic unit, are in abrupt contact with medium green, tuffaceous(?) chlorite schist of the volcanic unit, which passes down section into pillowed metabasalt. The basal 2 m of the sedimentary section is overlain by about 10 m of grey slate containing narrow limestone interbeds, which in turn is overlain by several tens of metres of alternating grey slate and green chloritic phyllite units, each containing lenses of carbonate. Whereas grey slate, commonly containing interbeds of siltstone, sandstone or limestone, continues to be abundant higher in the section, the green chloritic phyllite with carbonate (commonly dolomitic) lenses is characteristic of the basal part of the unit.

Upper Cretaceous

Sustut Group

⁘ Tango Creek Formation: *polymictic conglomerate; sandstone, shale*

Jurassic and/or Cretaceous (?)

× *Medium to coarse grained granite and granodiorite; locally includes diorite and quartz diorite*

Middle Jurassic (?)

▧ *Diorite, quartz diorite, gabbro, clinopyroxenite*

Early to Middle Jurassic (?)

+ *Granite, quartz monzonite, monzonite, diorite, monzodiorite, granodiorite and quartz diorite*

STIKINE TERRANE

Upper Triassic

Takla Group

⁘ *Pyroxene-feldspar-phyric basalt and basalt breccia; lesser amounts of siltstone, shale and pebble conglomerate*

SITLIKA ASSEMBLAGE

Age Unknown

▒ Western clastic unit: *dark grey phyllite and slate; foliated chert-pebble conglomerate and chert-grain sandstone; lesser amounts of foliated limestone*

Triassic to Jurassic

⁘ Eastern clastic unit: *varibly foliated siltstone, sandstone and conglomerate containing felsic volcanic and plutonic clasts; medium to dark grey slate and phyllite; foliated limestone, limestone conglomerate and green chloritic phyllite*

Early Triassic(?)

▥ *Light grey, medium to coarse-grained tonalite*

Late Permian or Early Triassic (?)

≈ *Medium grained epidote-chlorite-feldspar schist to semischist; sericite-chlorite-feldspar schist; weakly foliated chloritized hornblende diorite*

Permian to Early Triassic

v Volcanic unit: *medium to dark green chlorite schist, fragmental chlorite schist and pillowed metabasalt; chlorite-sericite schist containing felsic metavolcanic fragments; lesser amounts of grey phyllite, metasandstone and metachert*

CACHE CREEK TERRANE

Pennsylvanian to Jurassic

Cache Creek Group

☐ Sedimentary unit: *light to medium grey quartz phyllite, platy quartzite and metachert; lesser amounts of recrystallized limestone, dark grey phyllite, massive to pillowed greenstone, fragmental greenstone and chlorite schist*

☐ Ultramafic unit: *serpentinite, serpentine-magnesite-talc schist and serpentinite melange; harzburgite, dunite, clinopyroxenite, gabbro, greenstone, diabase, amphibolite, chert and limestone; locally includes mariposite-quartz-magnesite-altered rock and nephrite*

Legend to accompany Figure 4-3.

Above the calcareous chloritic phyllites at the base, most of the eastern clastic unit consists of dark grey slate intercalated with thin beds of siltstone and slaty siltstone. Intercalations of sandstone, calcarenite, limestone and conglomerate are common, but their stratigraphic distribution is not well understood as the unit is not well exposed through much of the area, its top is nowhere exposed, and it is deformed by numerous folds and faults where exposure is good. Fine to coarse-grained sandstone and granule conglomerate occur as thin to thick, massive to graded beds intercalated with thinner interbeds of slate or siltstone. The sandstones range from schistose wackes, containing quartz, feldspar and volcanic(?)-lithic clastic grains, to quartz-rich wackes and arenites. Locally the sandstone-rich intervals include beds of conglomerate or schistose conglomeratic sandstone, ranging from tens of centimetres to several metres thick. The conglomerates contain pebbles and small cobbles of felsic volcanic rock, with or without quartz and feldspar phenocrysts, along with mafic volcanics, phyllite, siltstone and limestone.

Calcareous rocks, including layers and lenses of calcareous sandstone, calcarenite, calcareous phyllite and medium to dark grey marble, are scattered throughout the eastern clastic unit, and locally dominate intervals many tens of metres thick. One such calcareous interval, 4 km northwest of Klowkut Peak, includes two or more units of light-grey weathered marble-matrix conglomerate or breccia, containing flattened pebbles and cobbles of felsic volcanic rock, as well as pebbles, cobbles and angular blocks of grey marble similar to the matrix. One of these conglomeratic marble intervals, which contains blocks of marble up to 1 m across, is about 20 m thick and was traced for more than a kilometre. Similar conglomeratic carbonate intervals are exposed on the ridge 3.5 kilometres northeast of Mount Olson, and are described by Schiarizza and Payie (1997).

The eastern clastic unit is not dated. It appears to be structurally concordant with the underlying volcanic unit, but the contact is abrupt, and the clastic rocks contain volcanic and plutonic detritus that was probably derived from the underlying unit. This suggests that the contact might be a disconformity or an unconformity. In any case, the eastern clastic unit apparently postdates the Permian to Early Triassic magmatism recorded in the underlying volcanic unit, and is therefore Middle Triassic and/or younger. The stratigraphic top of the unit is not exposed, but it is intruded by the Mitchell pluton, of suspected Late Jurassic or Early Cretaceous age. Therefore, the eastern clastic unit was most likely deposited sometime in the Middle Triassic through Middle Jurassic time interval. Limestone and chert samples analysed for microfossils after the 1996 field season were not productive, but additional samples were collected in 1997 and are currently being processed. In addition, a sample of medium to coarse-grained sandstone from the unit was sampled for detrital zircon analysis. This may help constrain the age of the unit and provide additional insight into its provenance.

Western Clastic Unit

The western clastic unit of the Sitlika assemblage consists of dark grey slate, with local intercalations of sandstone, limestone and chert-pebble conglomerate. It apparently forms a narrow continuous belt from Takla Landing to south of Takla Narrows, although it is not exposed for a length of 15 km where it follows the main arm of Takla Lake (Figure 4-3). These rocks were assigned to a sedimentary interval within the Takla Group by Armstrong (1949). Only the northern part of the belt was mapped by Paterson (1974), who assigned it to his argillite division of the Sitlika assemblage. Schiarizza and Payie (1997) traced the unit northward from near Takla Landing to the west flank of Mount Olson. They referred to these rocks as the western clastic unit, and suggested that they might be in fault contact with, and younger than, the structurally overlying volcanic unit.

Within the Takla Lake area the western clastic unit is dominated by dark grey slate and pyritic slaty argillite, with thin beds or laminae of slaty siltstone or fine-grained sandstone. Coarser grained sandstone occurs locally as medium to thick, massive or graded beds that may contain rip-up clasts and flute casts along their bases. Pebble conglomerate dominated by clasts of chert and limestone also occurs, as do rare lenses of dark grey, finely recrystallized limestone and phyllitic limestone.

The age of the western clastic unit is unknown. No macrofossils were found in the unit, and limestone samples submitted for microfossil analysis in 1996 were not productive; additional samples were collected during the 1997 field season and are currently being processed. Because it separates the generally east-facing Permian volcanic unit from Triassic rocks of Stikine Terrane to the west, one or both contacts of the intervening western clastic unit must be faults. The western contact was not observed, but the lithologic similarity between the western clastic unit and Upper Triassic sedimentary rocks within and beneath the Takla Group volcanics suggests a possible correlation. The eastern contact, between the western clastic unit and the Sitlika volcanic unit, is exposed along the railway tracks about 7 km southeast of Takla Landing. There, massive to weakly foliated feldspar-phyric metabasalt of the volcanic unit passes abruptly down-section into several metres of strongly foliated, green chlorite schist (possibly derived from the same basalt protolith) containing abundant veins and pods of quartz. These schistose rocks are in sharp contact with underlying dark grey slates of the western clastic unit. The contact dips steeply east, and is concordant to schistosity in both the western clastic unit and the overlying volcanic unit. The contact between the volcanic and western clastic units has a similar character where seen near Mount Olson, 40 km to the north. There, it was interpreted as a reverse fault by Schiarizza and Payie (1997). It is not clear, however, if it is actually a significant fault (in which case the age of the western clastic unit is unconstrained), or if it is a slightly sheared stratigraphic contact (in which case the western clastic unit is Permian or older).

Correlation of the Sitlika Assemblage

Volcanic Unit

Correlation of the Sitlika volcanic unit with volcanic and plutonic rocks of the Kutcho Formation (Thorstad and Gabrielse, 1986; Childe and Thompson, 1995), as proposed by Monger *et al.* (1978), is strongly supported by the present study. The correlation is based on lithologic and geochemical similarity (bimodal tholeiitic volcanic and plutonic rocks), similar Permo-Triassic age of magmatism, and similar primitive REE and Nd isotopic signatures (Childe and Schiarizza, 1997).

Correlative rocks also occur to the northwest of the Kutcho Formation, in rocks of northern Cache Creek Terrane, where felsic volcanic rocks occur locally within the predominantly mafic volcanic succession assigned to the French Range Formation (Monger, 1969, 1975). Rhyodacite in the French Range is Upper Permian, as it occurs within a stratigraphic succession that includes underlying and overlying fossiliferous strata of Early and Late Guadalupian age, respectively (Monger, 1969; Mihalynuk and Cordey, 1997). It has recently yielded a U-Pb zircon date of 263.1 +1.0/-1.4 Ma (M. Mihalynuk, personal communication, 1997) which is, within error, the same as the U-Pb date of 258 +10/-1 Ma for the Sitlika rhyolite near Mount Bodine.

The volcanic unit of the Sitlika assemblage may also correlate with an assemblage of rocks that lies with thrust contact beneath the Cache Creek Group in the northeastern part of the Taseko Lakes map area, 400 km south of Takla Lake. There, Read (1992, 1993) documented a succession of Upper Permian metadacite flows and tuffs that is overlain by meta-andesite and metabasalt flows and intruded by a Late Permian leucoquartz monzonite pluton. The dacitic volcanics yielded a U-Pb date of 259±2 Ma (Read, 1993), almost identical to the date from the Sitlika rhyolite north of Mount Bodine, and the associated leucoquartz monzonite pluton has been dated at 254±1.2 Ma. Correlation of this succession with the Sitlika volcanic unit is based on similarities in age, general lithologic character (mafic and felsic metavolcanic rocks plus comagmatic intrusions) and structural position along the western margin of the Cache Creek Group.

Childe *et al.* (1996, 1997) suggest that the Kutcho and Sitlika successions may also correlate with one or more fault-bounded panels of felsic and mafic volcanic rocks that are juxtaposed against the Cache Creek Group in the Ashcroft map area, south of the town of Cache Creek. They report that a tonalitic body that intrudes volcanic rocks in one of these panels yielded a preliminary U-Pb zircon age of 242±2 Ma, which correlates with the age of magmatism in the Kutcho Formation, and with the dated tonalite body in the Sitlika assemblage.

Eastern Clastic Unit

The eastern clastic unit is undated, but is known to rest stratigraphically above the Permian to Lower Triassic volcanic unit. It is provisionally correlated with lithologically similar sedimentary rocks that overlie the Kutcho volcanics in northern British Columbia. The latter include undated conglomerates that are included in the upper part of the Kutcho Formation, as well as rocks that have been included in the Upper Triassic Sinwa and Lower Jurassic Inklin formations (Pearson and Panteleyev, 1975; Panteleyev and Pearson, 1977a,b; Thorstad and Gabrielse, 1986). Points of similarity include the presence of a basal conglomerate unit containing clasts derived from the underlying volcanic rocks; an overlying limestone unit gradational with the conglomerates (Sinwa Formation); and an upper interval of slate, siltstone and calcareous greywacke with local conglomerate intervals (Inklin Formation). Correlative sedimentary rocks may also occur in the northeastern Taseko Lakes map area, where they are represented by Lower Jurassic siltstone and sandstone assigned to Unit lJs by Read (1993). These rocks rest depositionally(?) above the Upper Permian volcanic succession that is correlated with the Sitlika volcanics and, like the eastern clastic unit, contain felsic volcanic detritus that is inferred to have been derived from the underlying volcanics.

Western Clastic Unit

The age of the western clastic unit is unknown. As discussed previously, if its contact with the structurally overlying volcanic unit is a slightly sheared stratigraphic contact then the western clastic unit is Late Permian and/or older. Although this interpretation cannot be entirely dismissed, it is not presently favoured, in part because there are no sills or dikes of the overlying volcanic unit present in the metasedimentary rocks, despite the fact that mafic to felsic intrusive phases are common throughout the volcanic unit itself. Furthermore, Schiarizza and Payie (1997) suggest that there is a gradual truncation of the volcanic unit along its contact with the western clastic unit in the central part of the Kenny Creek - Mount Olson area. The contact between the western clastic unit and the volcanic unit may therefore be a significant fault, in which case the age of the western clastic unit is unconstrained, and the most likely correlation is with Upper Triassic sedimentary rocks of the Takla Group, as suggested by Armstrong (1949). Alternatively, the western clastic unit may be a fault-bounded panel of younger rocks, perhaps correlative with the Middle to Upper Jurassic Ashman Formation of the Bowser Lake Group (Schiarizza and Payie, 1997).

Cache Creek Group

The Cache Creek Group within and adjacent to the Takla Lake map area was referred to as the Stuart Lake Belt by Armstrong (1949) in order to distinguish it from a separate belt of rocks that he also included in the Cache Creek Group farther to the east. The latter, which he referred to as the Manson Creek belt, includes rocks that are presently assigned to the Cassiar, Slide Mountain and Quesnel terranes (Ferri and Melville, 1994). The Stuart Lake belt can be traced southward for 400 kilometres into the type area of the Cache Creek Group in southern British Columbia (Wheeler and McFeely, 1991). It is truncated by the Takla-Ingenika fault system about 60 km north of Takla Lake, along which it is separated by about 300 km from a belt of Cache Creek rocks exposed in northern British Columbia (Gabrielse, 1985).

The Cache Creek Group includes polydeformed chert, siliceous argillite, limestone, phyllite, slate, siltstone, sandstone, and mafic metavolcanic and meta-intrusive rocks. Thick limestone units contain fusulinids, corals, brachiopods, bryozoans, gastropods and conodonts that are Pennsylvanian and Permian in age (Armstrong, 1949; Thompson, 1965; Orchard and Struik, 1996); radiolarian chert and cherty mudstone range from Early Permian to earliest Jurassic age (Cordey and Struik, 1996a,b). Ultramafic rocks within the Stuart Lake belt were referred to as the Trembleur intrusions by Armstrong, who interpreted them to be intrusive bodies cutting the Cache Creek sedimentary and volcanic rocks. These rocks are now included within the Cache Creek Group, and interpreted to be tectonically emplaced upper mantle and lower crustal portions of dismembered ophiolite sequences (Paterson, 1977; Ross, 1977; Whittaker, 1983; Ash and Macdonald, 1993; Struik *et al.*, 1996).

In the Takla Lake map area the Cache Creek Group is subdivided into an ultramafic unit and a sedimentary unit. These units are continuous with the same subdivisions of Schiarizza and Payie (1997) to the north.

Ultramafic Unit

Paterson (1974) identified a belt of ultramafic rocks and serpentinite melange that separates metasedimentary and metavolcanic rocks of the Cache Creek Group from the Sitlika assemblage to the west. This belt was mapped in more detail by Schiarizza *et al.* (1997) who assigned it to the ultramafic unit of the Cache Creek Group. During the 1997 field season this unit was traced as a more or less continuous belt to the southern end of the Takla Lake map area. It is separated from the underlying Sitlika assemblage and the overlying Cache Creek sedimentary unit by systems of easterly-dipping thrust faults. This belt includes rocks that were mapped as Trembleur intrusions by Armstrong (1949), and later studied in more detail by Elliot (1975) and Whittaker (1983), who interpreted them to be structurally emplaced alpine-type peridotites.

The ultramafic unit comprises a relatively narrow, possibly discontinuous belt in the northern part of the map area, between Kenny Creek and Tsayta Lake. There, it consists of serpentinite, talc-magnesite schist, and serpentinite melange, as described by Schiarizza and Payie (1997) for the area along strike to the north. Knockers and lenses in the serpentinite melange include serpentinized ultramafite of uncertain protolith, greenstone, amphibolite, gabbro and a variety of metasedimentary rocks. Silicified argillite, slate, metachert and marble are the dominant metasedimentary lithologies encountered. A sedimentary lens exposed on the south shore of Tsayta Lake, however, includes foliated pebble conglomerate, bioclastic limestone and fossiliferous quartzose sandstone. A previous fossil collection from this lens included *Pustula* sp. and a large striated brachiopod suggestive of *Meekella kueichowensis* Huang, indicating a probable Permian age (A.E. Wilson *in* Armstrong, 1949, page 46). These rocks were resampled for both macrofossils and microfossils during the present study.

The ultramafic unit is considerably wider in the eastern Mitchell Range, although it is in part truncated by the Mitchell batholith (Figure 4-3). This part of the belt includes foliated serpentinite and serpentinite melange, similar to that in the northern part of the belt, but also includes large areas of more coherent ultramafic and mafic rock, which probably represent a sampling of both mantle and crustal elements of a dismembered ophiolite suite. The dominant ultramafic rock is variably serpentinized harzburgite, which commonly contains irregular pods and lenses of dunite. Locally the harzburgite displays a penetrative foliation that may represent a mantle tectonite fabric (Whittaker, 1983). Clinopyroxenite was observed in several areas east of Klowkut Peak, where it is separated from harzburgite by narrow faults or wider zones of serpentinite melange. Relatively large blocks of layered to isotropic gabbros are likewise separated from harzburgite by faults. Gabbro and microgabbro also occur as boudinaged dike-like bodies, partially altered to rodingite, within harzburgite, clinopyroxenite and layered gabbro.

Sedimentary Unit

The sedimentary unit of the Cache Creek Group is dominated by grey platy quartz phyllites, but also includes metachert, cherty argillite, slate, limestone, greenstone and chlorite schist. It crops out mainly along the eastern edge of the Takla Lake map area, and similar rocks apparently dominate the Cache Creek Group eastward all the way to the Pinchi fault (Armstrong, 1949). These rocks are juxtaposed against the ultramafic unit to the west. The contact is not well exposed anywhere in the Takla Lake area, but is inferred to be a system of predominantly east-dipping faults based on relationships seen to the north (Schiarizza and Payie, 1997). A panel of similar metasedimentary rocks that is enclosed by ultramafic rocks south of Nesabut Peaks is interpreted as a structural repeat of the sedimentary unit, exposed in the core of a synform along the southeastern margin of the Mitchell batholith. The sedimentary unit is also represented by exposures on the southwest side of southern Takla Lake. There it is faulted against the Sitlika eastern clastic unit to the west, and intruded(?) by the Purvis Lake stock and Pyramid Peak pluton to the east (Figure 4-3).

The sedimentary unit consists mainly of light to dark grey platy quartz phyllites, comprising plates and lenses of fine-grained recrystallized granular quartz, typically a centimetre or less thick, separated by phyllitic mica-rich partings. Locally these platy rocks grade into less siliceous and more homogeneous medium to dark grey phyllites. Less commonly they include intervals of light to medium grey or green chert that occurs as beds and lenses, from 1 to 5 centimetres thick, separated by phyllitic partings.

Light to dark grey recrystallized limestone is locally intercalated with the siliceous metasedimentary rocks, and occurs as units ranging from a few metres to more than 100 metres thick. It is most common in the synformal lens on the southeast flank of the Mitchell batholith, and in a potentially correlative interval west of Purvis Lake. Armstrong (1949) included these rocks in a limestone unit that extends southeastward to Mount Copley, north of Trembleur Lake, where it contains Middle Permian fusulinids. None of the limestones encountered in the Takla Lake map area contain well-preserved macrofossils, but samples were collected and are currently being processed for microfossils.

Mafic metavolcanic rocks, including chlorite schist, pillowed greenstone and fragmental greenstone, occur as intervals ranging from a few metres to several tens of metres thick within the sedimentary unit. These are widespread, but are not volumetrically a major component of the unit. The mafic metavolcanic rocks typically form lenses parallel to the synmetamorphic foliation and transposed compositional layering in surrounding metasedimentary intervals. Locally they are associated with weakly foliated, fine-grained chlorite-feldspar semischists that were probably derived from mafic dikes or sills.

Stikine Terrane

Takla Group

Armstrong (1949) used the name Takla Group for occurrences of Upper Triassic and Jurassic volcanic and sedimentary rocks exposed west and southwest of the main arm of Takla Lake. In addition to the exposures around Takla Lake, he also included in the Group a more extensive belt to the east of the Pinchi fault, which extended from Pinchi Lake north-northwestward to beyond Germansen Lake. Subsequent revisions to the nomenclature of the western belt, based largely on excellent exposures in the McConnell Creek map area to the northwest, restricted the name Takla Group to Triassic rocks, and included the overlying Lower to Middle Jurassic volcanic-sedimentary succession in the Hazelton Group (Tipper and Richards, 1976; Monger, 1977a; Monger and Church, 1977). Likewise in the eastern belt, Nelson and Bellefontaine (1996) restrict the name Takla Group to Triassic rocks and assign the disconformably overlying Lower Jurassic volcanic and sedimentary rocks to several informal successions. As noted by Nelson *et al.* (1991) the two belts of Takla rocks are lithologically and stratigraphically similar, although the eastern belt is part of Quesnel Terrane and the western belt is part of Stikine Terrane.

The Takla Group is exposed on the southwest side of Takla Lake, from the shoreline south of Takla Landing to the southern boundary of the map area. This belt is bounded by the western clastic unit of the Sitlika assemblage to the east and, at least in part, by the Takla fault to the west. Within this belt, the volcanic and sedimentary rocks of the Takla Group are intruded by Jurassic? diorite, granodiorite and quartz monzonite of the large, composite Northwest Arm pluton, and also by the smaller Takla Landing pluton.

The Takla Group is dominated by basaltic flows and associated breccias that occur in dark shades of green, grey and maroon. The volcanics typically contain phenocrysts of plagioclase and pyroxene, but may be aphyric. They lack the penetrative foliation that characterizes the volcanic rocks within the adjacent Sitlika assemblage, but commonly display varying degrees of chlorite-epidote alteration. Sedimentary rocks occur locally within the volcanics, as intervals ranging from a few metres to more than 100 metres thick. These intervals are dominated by thin-bedded siltstone, slate and cherty argillite, but also include pebble to cobble conglomerates containing clasts of chert and limestone. In contrast to the massive volcanic rocks, the sedimentary rocks are typically foliated, and are lithologically similar to rocks within the adjacent western clastic unit of the Sitlika assemblage.

The Takla rocks exposed in the Takla Lake area are correlated with the upper Carnian to lower Norian Savage Mountain Formation of Monger and Church (1977). As discussed previously, the western clastic unit of the Sitlika assemblage may be a fault-bounded(?) panel of the Dewar Formation, which underlies and interfingers with the Savage Mountain Formation in the McConnell Creek map area.

Sustut Group

The Sustut Group (Lord, 1948; Eisbacher, 1974) consists of Upper Cretaceous to Eocene nonmarine clastic sedimentary rocks and intercalated tuffs that were deposited above Stikine Terrane and overlying Bowser Lake Group in central and northern British Columbia. The group is represented by exposures along the western boundary of the Takla Lake map area, west of the Takla fault. These rocks extend westward into the Hazelton map area (Richards, 1990; MacIntyre, 1998), at the south end of a belt that extends northwestward to the type area of the group along the Sustut River in the McConnell Creek map area (Lord, 1948).

The Sustut Group in the Takla Lake map area is entirely sedimentary, and has yielded collections of Cenomanian plant fossils (Armstrong, 1949). These rocks are therefore assigned to the basal unit of the group, the Tango Creek Formation, as defined by Eisbacher (1974). Most exposures are dominated by light brownish-weathering, well-indurated conglomerate containing clasts of chert, vein quartz, quartz tectonite, mafic to felsic volcanic rock, and a wide variety of plutonic clasts, including granite, granodiorite and monzonite. The conglomerates are generally poorly to moderately sorted, with rounded to subrounded cobbles and pebbles in a gritty sandstone matrix of similar composition. They occur as medium to very thick beds, locally intercalated with thinner beds of medium to coarse-grained sandstone and gritty sandstone. In some intervals conglomerate is absent and coarse sandstone occurs as thick to thin, planar to lenticular beds that commonly contain abundant woody material. Both conglomerate and coarse sandstone-dominated intervals are interspersed with finer-grained rocks, at least in part as distinct fining-upwards sequences. The fine-grained rocks comprise thin beds of grey to green concretionary mudstone, siltstone and fine-grained sandstone, commonly containing fossil plant remains.

Jurassic and Cretaceous Plutonic Rocks

Northwest Arm Pluton

The Northwest Arm pluton is a large, composite intrusion that cuts the Takla Group in the western part of the map area. It is well exposed along both shorelines of the Northwest Arm of Takla Lake, and also in the Takla Range to the north. Less extensive exposures are scattered through the area of more subdued topography south of the arm, north of Natowite Lake and the Sakeniche River.

The northern and western portions of the Northwest Arm pluton consist mainly of pink to red weathering, medium to coarse-grained quartz monzonite and monzogranite. These rocks typically comprise equigranular intergrowths of pink K-feldspar and lesser amounts of grey-green saussuritic plagioclase, together with 10 to 20 per cent quartz and 5 to 10 percent chloritized mafic grains. Grey, medium-grained hornblende diorite constitutes an older phase that occurs as screens within the quartz monzonite and locally forms an eastern border phase in the central part of the pluton. Similar diorite, together with monzodiorite and monzonite, forms much of the southeastern part of the pluton, in the area north of the Sakeniche River. Grey biotite ±hornblende granodiorite is a third important phase that outcrops in the central part of the pluton on both shores of the Northwest Arm. It is in contact with quartz monzonite to the west, north and northeast, and with diorite and monzodiorite to the southeast, but its chronological relationship to these phases was not established.

Westernmost exposures of plutonic rock on the south shore of the Northwest Arm comprise diorite and microdiorite that are in contact with quartz monzonite to the east. These dioritic rocks are in part heavily fractured and pervaded by quartz stockwork veins. They may be a western border phase of the Northwest Arm pluton, or might be part of a different plutonic body that is juxtaposed against the Northwest Arm pluton across the southern continuation of the Takla fault (Figure 4-3).

The age of the Northwest Arm pluton is presently unknown, but U-Pb isotopic dating of samples collected during the 1997 field season is in progress. It is suspected that these plutonic rocks correlate with either the Late Triassic-Early Jurassic Topley intrusive suite, or the Middle Jurassic Tachek suite described by MacIntyre *et al.* (1998).

Takla Landing Pluton

Sparse exposures of pink-weathering monzogranite and quartz-feldspar porphyry directly east of Takla Landing comprise part of a narrow wedge that has been traced for almost 20 km to the north (Schiarizza and Payie, 1997; Figure 4-3). The plutonic rocks within this wedge are juxtaposed against the Sustut Group to the west, across the Takla fault, and are in contact with the Sitlika western clastic unit to the east. Pink-weathering monzogranite that outcrops on the south side of Takla Lake, directly south of Takla Landing, is presumed to be part of the same plutonic body (Figure 4-3). These rocks are also truncated by the Takla fault to the west, but are in presumed intrusive contact with Takla Group volcanics to the east. They are lithologically very similar to the northern and western portions of the Northwest Arm pluton, and contain xenoliths of diorite and monzonite that likewise resemble older phases of the larger pluton to the south. A sample of monzogranite from the Takla Landing pluton, collected about 11 km north of Takla Landing in 1996, has yielded a U-Pb zircon date of 169.1 +1.0/-4.8 Ma (R. Friedman, written communication, 1997). This late Middle Jurassic date is somewhat younger than U-Pb and Ar-Ar ages reported for the lithologically similar Tachek intrusions, which cut the Takla Group to the south in the vicinity of Babine and Tochcha lakes (MacIntyre *et al.*, 1998).

Purvis Lake Stock

A small intermediate to mafic stock, measuring about 3.5 km by 1.5 km, intrudes the Cache Creek metasedimentary unit a short distance northwest of Purvis Lake. It consists mainly of medium-grained, equigranular hornblende diorite to quartz diorite. Older phases include clinopyroxenite and gabbro, which are locally common as xenoliths and screens within the diorite. Younger phases are represented mainly by dikes, and include microdiorite, monzonite and tonalite. The Purvis Lake stock is undated, but is suspected to be Middle Jurassic based on tentative correlation with the Stag Lake - Twentysix Mile Lake plutonic suite described from the Fort Fraser and Hallet Lake map areas to the south (Whalen and Struik, 1997; Anderson *et al.* 1997).

Mitchell Batholith

Granitic rocks of the Mitchell batholith underlie the core of the Mitchell Range, and intrude both the Cache Creek Group and the Sitlika assemblage. The batholith is about 25 km long, north to south, and up to 15 km wide. The northern part is dominated by light grey, massive, coarse-grained, ±hornblende-biotite monzogranite, commonly with potassium feldspar phenocrysts up to 1.5 cm in size. An earlier phase, consisting of fine to medium grained, mafic-rich biotite-hornblende quartz diorite to diorite, is common along the east-central and northwestern margins of the pluton. The southern part of the batholith, south of Nesabut Peaks, consists mainly of massive, equigranular, medium to coarse-grained biotite granodiorite, locally with conspicuous muscovite flakes. This phase, which is thought to be younger than the K-feldspar megacrystic monzogranite that dominates the northern part of the pluton, is locally intruded by thick dikes of quartz-feldspar porphyry.

The western part of the Mitchell batholith intrudes the eastern clastic unit of the Sitlika assemblage, while to the east it intrudes both the ultramafic and sedimentary units of the Cache Creek Group. The thrust contact between the Cache Creek ultramafic unit and structurally underlying Sitlika metasedimentary rocks is truncated by the batholith 3 km southeast of Klowkut Peak. This same contact abuts the southern end of the pluton 10 km east of Takla Narrows, but there the contact is defined by a relatively young northeast-striking fault. Contact metamorphic effects of the batholith were studied in the Cache Creek ultramafic unit east of Nesabut Peaks by Elliot (1975). He found that serpentinite changed to talc-olivine rock within 2.5 to 3 km of the batholith contact, which in turn progressed to an olivine-enstatite-anthophyllite zone about 1.5 km from the contact. Contact metamorphic effects on the Sitlika eastern clastic unit are generally conspicuous for about a kilometre from the batholith contact, where semi-pelitic rocks become biotite-quartz hornfels and calcareous intervals are characterized by calc-silicate hornfels and marble, locally with small garnets.

The Mitchell batholith is not yet dated, but is suspected to be Late Jurassic or Early Cretaceous based on its lithological similarity to the Francois Lake plutonic suite which outcrops extensively near Fraser Lake, 130 km to the south-southeast (Whalen and Struik, 1997; Anderson *et al.*, 1997). A sample of K-feldspar megacrystic monzogranite, collected from the northeastern part of the pluton, has been submitted for U-Pb dating of zircons. This will establish the age of the main phase of the Mitchell batholith, and will provide a minimum date for west-directed thrusting of the Cache Creek ultramafic unit above the Sitlika eastern clastic unit.

Leo Creek Stock

The Leo Creek stock consists of medium to coarse-grained ±muscovite-biotite granodiorite that is exposed along the lower reaches of Leo Creek, on the northeast side of southern Takla Lake (Figure 4-3). It resembles granodiorite that comprises the southern part of the Mitchell batholith, just 3 km to the north, and is presumed to be the same age. The Leo Creek stock intrudes the Sitlika eastern clastic unit to the north. It is apparently in contact with the Cache Creek sedimentary unit to the southwest, but the nature of this contact is obscured by Takla Lake.

Pyramid Peak Pluton

Biotite granodiorite exposed on the southwest side of southern Takla Lake is part of a large pluton that extends southward into the Tochcha Lake map area, where it is referred to as the Pyramid Peak pluton by MacIntyre *et al.* (1998). The granodiorite intrudes hornfelsed argillite just west of the southern tip of Takla Lake, and locally contains screens and pendants of similar hornfelsed argillite, together with calc-silicate rock and marble. These rocks are tentatively assigned to the eastern clastic unit of the Sitlika assemblage. To the west, however, the pluton is in contact with the sedimentary unit of the Cache Creek Group. This contact is not exposed in the Takla Lake area, but is locally well-defined in the Tochcha Lake area, where it is interpreted as an intrusive contact (MacIntyre *et al.*, 1998).

The age of the Pyramid Peak pluton is presently unknown, but samples have been submitted for U-Pb and Ar-Ar radiometric dating. It is lithologically similar to the Leo Creek stock, and is likewise thought to be Late Jurassic or Early Cretaceous. Furthermore, like the Leo Creek stock it intrudes the Sitlika eastern clastic unit to the east, and is in contact with the Cache Creek sedimentary unit to the west. The two intrusive bodies are therefore suspected to be offset portions of a single pluton, presently separated from one another by about 8 km of apparent dextral displacement along the northeast-striking Purvis Lake fault.

STRUCTURE

Mesoscopic Fabrics

All three units of the Sitlika assemblage are characterized by a single penetrative cleavage or schistosity defined by the preferred orientation of greenschist facies metamorphic minerals and variably flattened clastic grains or volcanic fragments. The cleavage dips steeply to the east or east-northeast through most of the Sitlika belt, although steep westerly dips prevail locally. It is axial planar to upright folds of bedding, most commonly observed in the well-bedded eastern clastic unit, with axes that plunge north-northwest or south-southeast. Younger folds and crenulations with similarly oriented axes deform the cleavage locally, as do rare east or west plunging kink folds and crenulations.

Volcanic flows and breccias of the Takla Group do not generally display a tectonic foliation. Associated fine-grained sedimentary rocks, however, commonly contain a moderately to strongly developed slaty cleavage, and intercalated conglomerates contain clasts that are variably flattened in the plane of this cleavage. Although their metamorphic mineralogy has not been studied, these clastic sedimentary rocks do not appear to differ significantly from metasedimentary rocks within the western clastic unit of the Sitlika assemblage.

The Cache Creek Group comprises greenschist facies rocks that are of comparable metamorphic grade to the Sitlika assemblage, but contrast markedly in structural style (Paterson, 1974; Schiarizza and Payie, 1997; Wright, 1997). Mesoscopic structures are best displayed in the sedimentary unit, where compositional layering has been transposed into parallelism with a prominent metamorphic foliation. In the main belt of Cache Creek rocks, along the eastern margin of the map area, this schistosity most commonly dips at moderate angles to the east or northeast, and may be related to east-dipping thrust(?) faults that separate the Cache Creek ultramafic unit from the overlying sedimentary unit and the underlying Sitlika eastern clastic unit (*see* later section). In detail, however, the schistosity and compositional layering are variable in orientation, largely due to reorientation by later structures. These younger structures are represented mainly by a set of east-verging folds with moderately west-dipping axial surfaces, generally marked by a crenulation or fracture cleavage. The axes of these folds, along with associated crenulation lineations, plunge gently north to north-northwest through most of the area, but display southerly plunges in the south. Metamorphic minerals that define the first generation schistosity are, at least in part, bent and kinked by these younger structures, indicating that these folds postdated most of the metamorphism.

Macroscopic Structure of the Sitlika Assemblage

The volcanic and eastern clastic units of the Sitlika assemblage are folded through a southerly-plunging anticline/syncline pair in the vicinity of Mount Bodine (Schiarizza and Payie, 1997; Figure 4-3). The volcanic unit on the western limb of the syncline extends southward for more than 50 km through the Takla Lake area as a simple homocline. Schistosity dips steeply east to northeast through most of the belt, but locally fans through the vertical to attain steep westerly dips in the eastern part of the unit. Bedding was observed only locally within the belt; it dips at moderate to steep angles eastward, typically with shallower dips than the associated schistosity.

The eastern clastic unit forms a relatively wide outcrop belt to the east of the volcanic unit. Where observed, west of Mount Bodine and on the shore of Takla Lake, the base of the unit is an east-dipping stratigraphic contact with the underlying volcanic unit. The eastern contact of the unit is an east-dipping thrust fault at the base of the Cache Creek ultramafic unit. Internally, the eastern clastic unit is folded through numerous north-northwest to south-southeast plunging synmetamorphic folds, although none of these structures has been mapped out in detail.

The western clastic unit forms a continuous narrow belt west of the volcanic unit. It is characterized by steeply east-dipping schistosity and subparallel to more gently east-dipping bedding. Where observed, on the railway tracks southeast of Takla Landing, the eastern contact dips steeply east, and is concordant to schistosity in both the western clastic unit and the overlying volcanic unit. As discussed previously, there is some evidence for shearing along this contact, but it is not clear whether or not it is a major fault. To the west, the western clastic unit is in contact with Takla Group volcanics southeast of Takla Lake, and with plutonic rocks of the Takla Landing pluton to the north. These contacts were not observed, but are suspected to be faults.

East-dipping Thrust Faults along the Sitlika - Cache Creek Contact

Monger *et al.* (1978) referred to the contact between the Cache Creek Group and Sitlika assemblage as the Vital fault, which they described as "a zone of imbricated alpine-type peridotite and basalt up to 3 kilometres wide with fault planes dipping easterly at about 50 degrees". This fault zone corresponds to the Cache Creek ultramafic unit of this report. Observations made during the 1996 and 1997 field seasons confirm that the Cache Creek ultramafic unit is, at least in part, bounded by east-dipping faults. Locally however, such as along the northerly-trending fault segment east of Diver Peak (Figure 4-2), the Sitlika - Cache Creek contact is marked by a system of dextral strike-slip faults (Schiarizza and Payie, 1997). These dextral faults are inferred to be relatively young structures, perhaps contemporaneous with the Tertiary Takla and Pinchi fault systems, which postdate the east to northeast-dipping fault that marks the contact elsewhere.

Structural relationships between the mappable units of the Cache Creek Group are best exposed in the Kenny Creek - Mount Olson area, where east-dipping faults, parallel to the penetrative east-dipping foliation, were observed at the contact between the ultramafic unit and overlying sedimentary and volcanic rocks in several places (Schiarizza and Payie, 1997). Kinematic indicators were observed at only one locality, east of Mount Bodine, where asymmetric fabrics within east-dipping shear zones indicate west-directed thrust movement along the fault that separates the sedimentary unit from the underlying ultramafic unit. This same fault contact has been traced southward for more than 50 km through the eastern part of the Takla Lake map area (Figure 4-3). The actual contact was not observed along this segment, but the predominantly easterly-dipping foliation is consistent with the interpretation that the sedimentary unit is structurally above the ultramafic unit throughout most of the belt. A narrow panel of metasedimentary rocks that outcrops to the west of the ultramafic unit, south of Nesabut Peaks, is interpreted as an outlier of the sedimentary unit, repeated by a synformal structure along the southeast margin of the Mitchell batholith.

The contact between the ultramafic unit and the Sitlika eastern clastic unit is fairly well constrained in the northern part of the Takla Lake map area, between Kenny Creek and the Mitchell Range, but was actually seen only to the east of Klowkut Peak (Figure 4-3). There, the ultramafic unit rests above the eastern clastic unit across a gently to moderately-dipping fault that is folded through an antiform/synform pair just north of its truncation by the Mitchell batholith. No kinematic indicators were observed along this segment of the fault. Just to the north however, south of Tsayta Lake, easternmost exposures of the eastern clastic unit contain east-northeast dipping thrust faults that are sub-parallel to foliation. These mesoscopic faults are inferred to be parallel, and related to, the contact with the immediately adjacent ultramafic rocks. The Cache Creek - Sitlika contact is obscured by the Mitchell batholith in most of the Mitchell Range, but was also mapped over a limited area south of the pluton. The contact was not observed in this area, but is mapped as a northeast-dipping thrust fault based on relationships to the north.

The northeast-dipping faults discussed above are apparently part of an extensive west-directed thrust system that places the Cache Creek Group above the Sitlika assemblage and its correlatives. This thrust system has been mapped in the western Axelgold Range at the north end of the Stuart Lake belt (Monger, 1977a; Monger *et al.*, 1978); in northern British Columbia where it separates the Cache Creek Group from the Sitlika-correlative King Salmon allochthon (Nahlin fault: Monger *et al.*, 1978; Thorstad and Gabrielse, 1986); and in southern British Columbia where it separates the Cache Creek Group from Sitlika-correlative rocks in the northeastern Taseko Lakes map area (Read, 1992, 1993). The timing of thrusting is not well constrained in central British Columbia, but may be Late Jurassic or younger based on the involvement of Oxfordian strata in west-directed thrusting northwest of the present study area (Monger *et al.*, 1978). The pending U-Pb date from the Mitchell batholith may further constrain the timing of this deformation, as the batholith truncates the east-dipping fault that juxtaposes the Cache Creek ultramafic unit above the Sitlika eastern clastic unit.

Contact Between the Sitlika Assemblage and the Takla Group

The contact between the Sitlika assemblage and the Takla Group is interpreted as a fault because the Permian volcanic unit faces east, but is juxtaposed against the younger Takla Group to the west. The western clastic unit is the general locus of this fault but, as discussed previously, it is not clear if the main fault is located at the eastern, western or both contacts. The presently preferred interpretation is that the western clastic unit correlates with Triassic sedimentary rocks of the Takla Group, and the main fault separates these rocks from the structurally overlying Sitlika volcanic unit. The 80-kilometre-long strike-length of the narrow western clastic unit suggests that these relatively weak sedimentary rocks might correspond to a flat within a westerly-directed thrust system, possibly related to the system that imbricates the Cache Creek Group and juxtaposes it above the Sitlika eastern clastic unit at higher structural levels to the east. This is consistent with relationships farther to the north, where westerly-directed thrust faults imbricate Stikine Terrane and Bowser basin strata, as well as structurally overlying Sitlika and Cache Creek rocks (Monger *et al.*, 1978). The steep dip of this fault system in the Takla Lake area may relate to rotation during translation and gradual northward truncation of the footwall along the younger Takla fault system (Figure 4-3).

Takla Fault

The Takla fault (Armstrong, 1949) is interpreted as one component of a Late Cretaceous to early Tertiary dextral strike-slip fault system that may have a cumulative displacement of about 300 kilometres (Monger *et al.*, 1978; Gabrielse, 1985). It is not exposed, but its north-striking trace is fairly well defined near the western edge of the Takla Lake map area, where it separates the Upper Cretaceous Sustut Group from the Takla Group and associated plutonic rocks of the Northwest Arm and Takla Landing plutons. South of Takla Landing, monzogranite of the Takla Landing pluton adjacent to the inferred trace of the fault is cut by numerous northerly-striking faults containing gently-plunging slickensides and mineral fibres, some with accretion steps indicating dextral movement.

Northeast-trending folds mapped within the Sustut Group directly west of the fault (Schiarizza *et al.*, 1997) and in the Takla Group directly east of the fault (Armstrong, 1949) are of an appropriate orientation to be related to dextral movement on the Takla fault (Wilcox *et al.*, 1973).

Northeast Striking Faults

Northeast striking faults, commonly along prominent topographic lineaments, correspond to apparent dextral displacements of the northwest trending stratigraphic and structural contacts at several places within the Takla Lake map area (Figure 4-3). These include a four-kilometre-offset of the thrust contact between the Cache Creek Group and Sitlika assemblage east of Tsayta Lake, and an eight-kilometre-offset of plutonic rocks and adjacent Cache Creek and Sitlika rocks along the Purvis Lake - Bivouac Creek - Gloyazikut Creek lineament near the southern boundary of the map area. These northeast striking faults are relatively young features, as they offset the Takla fault and related structures (Schiarizza *et al.*, 1997) which are probably of Tertiary age. They might be broadly related to strike-slip faulting on the Takla system, or might reflect a discrete younger event.

MINERAL OCCURRENCES

Chromite Occurrences within the Cache Creek Ultramafic Unit

Cache Creek ultramafic rocks in the Stuart Lake belt host a number of chromite occurrences, many of which were discovered in the early 1940s during regional mapping of the Fort St. James map area by the Geological Survey of Canada (Armstrong, 1949). A large proportion of these occurrences are in the present map area, mainly in the wide belt of ultramafic rocks that borders the eastern margin of the Mitchell batholith, east of Nesabut Peaks (Figure 4-4). These occurrences were studied in detail by Whittaker (1982, 1983; Whittaker and Watkinson, 1984), who identified 17 separate chromite concentrations. Some of these have been combined for the purposes of MINFILE, which lists 8 chromite occurrences in this area (093N 033, 034, 035, 036, 037, 038, 039, 129). Other chromite occurrences in the map area, identified by Armstrong but not included in Whittaker's study, are the Leo Creek showing (093N 040) directly south of the Mitchell batholith, and the Cyprus showing (093N 016), about 3.5 km east-southeast of Klowkut Peak, directly north of the batholith.

The Simpson prospect (093N 033), southeast of Nesabut Peaks, was staked by Hunter Simpson and Associates in 1941, but no work was recorded and the claims were allowed to lapse (Armstrong, 1949). The area of the Cyprus occurrence (093N 016), which had previously been staked by the Magnum Corporation, was restaked by Imperial Metals Corporation in 1986 and evaluated by a program of soil sampling, geological mapping and lithogeochemical analyses (Taylor, 1987). However, no anomalous metal targets thought to be worthy of follow-up were defined, and the claims were allowed to lapse. No other exploration work has been recorded on the ultramafic rocks in the Mitchell Range (Hancock, 1991).

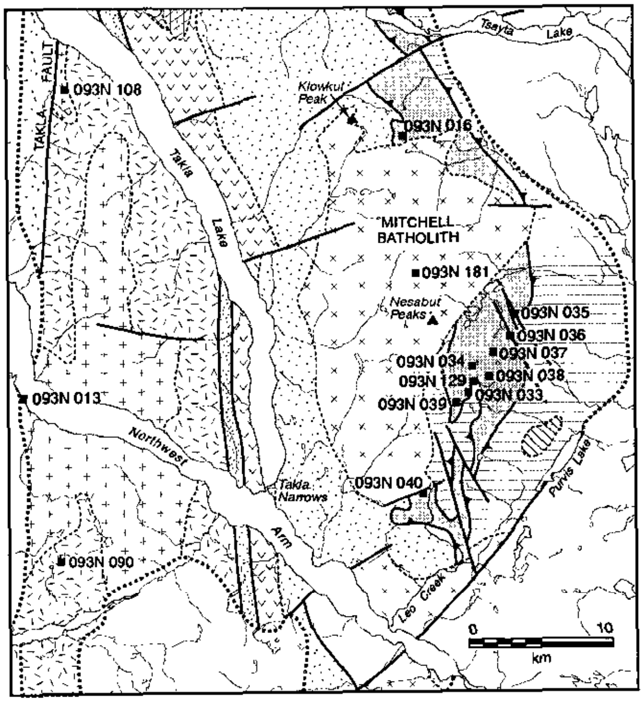

Figure 4-4. Locations of MINFILE occurrences in the Takla Lake map area. For legend see Figure 4-3.

The chromite occurrences in the Mitchell Range comprise discontinuous layers and pods of massive (more than 95%) to heavily disseminated (more than 75%) chromite (Whittaker, 1983; Whittaker and Watkinson, 1984). The host rocks are mainly tectonized harzburgite, although one layer of heavily disseminated chromite at the Bob prospect (MINFILE 093N 034) is hosted by dunite. Some chromite layers and pods are in sharp contact with harzburgite, while others are separated from the harzburgite by a thin dunitic selvage. Individual layers and pods range from a few centimetres to a few metres in longest dimension, are typically aligned with the harzburgite foliation, and display a range of deformational features, including schlieren structure, pinch-and-swell, boundinage and folding. Whittaker and Watkinson (1984) suggest that the Mitchell Range occurrences were derived from a chromitiferous zone in refractory harzburgite of upper mantle origin, which became extended and deformed during upper mantle tectonism and also during later obduction of the ultramafic rocks.

Ultramafic rocks in the vicinity of the Cyprus occurrence (093N 016), southeast of Klowkut Peak, locally display discontinuous zones of listwanite or quartz-carbonate alteration. Taylor (1987) reports that a sample taken from a copper-stained quartz-carbonate fracture-filling, 150 m east of the fault contact with the Sitlika eastern clastic unit, yielded 345 ppb Au. Veins and listwanite-altered zones containing anomalous gold concentrations are also known from the Cache Creek ultramafic unit east and northeast of Mount Bodine, 25 to

30 km north-northeast of the Cyprus occurrence (Schiarizza and Payie, 1997).

Copper Occurrences within Stikine Terrane

Chalcopyrite mineralization has been reported from three separate areas within Stikine Terrane near the western edge of the Takla Lake map area (Figure 4-4). The northernmost is the Bol occurrence (MINFILE 093N 108), located on the southwest side of Takla Lake about 8 km south of Takla Landing. This area was explored by Helicon Explorations Limited and Magnum Consolidated Mining Co. Ltd. in 1966 and 1967 (Annual Report of the Minister of Mines for 1966, page 119; Annual Report of the Minister of Mines for 1967, page 119). The mineralization apparently comprises chalcopyrite within intrusive rocks along the eastern margin of the Takla Landing pluton. However, no detailed descriptions of the mineralization or exploration work are available.

The Adda occurrence (MINFILE 093N 013) is near the south shore of the Northwest Arm of Takla Lake, 18 km west-northwest of Takla Narrows, where several narrow veins of chalcopyrite were reported to occur within andestitic volcanics (Annual Report of the Minister of Mines for 1930, page A149). There has been no recent work on this showing, and it was not located during the present study. Outcrops along the shoreline near the poorly constrained MINFILE location are of fractured diorite containing quartz stockwork and quartz-calcite-chlorite veins. These rocks may be a western border phase of the Northwest Arm pluton, or may represent a separate unit, juxtaposed against the Northwest Arm pluton across an important splay of the Takla fault.

The Lucy occurrence (MINFILE 093N 090) is 4 km north of Natowite Lake and 15 km west-southwest of Takla Narrows. It is hosted by volcanic rocks of the Takla Group which are partially enclosed by two different phases of the Northwest Arm pluton; granite on the northwest and diorite to monzonite on the east. The showing was first described in 1968, as minor pyrite and chalcopyrite in small quartz veins and shears cutting intermediate volcanic rock, following a program of geological mapping and soil sampling conducted over the Lucy claims by Texas Gulf Sulphur Company (Annual Report of the Minister of Mines and Petroleum Resources for 1968, page 148). However, no assessment report was filed and the claims were allowed to lapse. The area was restaked as the Nato claims by Rio Algom Exploration Inc. in 1991, after anomalous copper values were discovered during a regional lake sediment survey. A program of reconnaissance soil sampling, rock sampling, geological mapping and prospecting was conducted over these claims in 1992, and rocks in the vicinity of the showing were described as andesites showing moderate chloritization, silicification and epidote-calcite veining, with up to 5% pyrite and traces of chalcopyrite and magnetite (Casselman and Campbell, 1992). There has been no subsequent work reported, and the Nato claims lapsed in 1993.

Don Molybdenum Occurrence

The Don occurrence (MINFILE 093N 181) is within the east-central part of the Mitchell batholith, about 4 km north of Nesabut Peaks (Figure 4-4). Quartz-molybdenite veinlets, 1 mm to 2 cm thick, form a stockwork across several widely spaced, weakly kaolinized zones within a medium-grained, equigranular, biotite quartz monzonite stock that intrudes coarse-grained porphyritic monzogranite that forms the dominant phase of the pluton (Kimura, 1978). The Endako Mines Division of Placer Development Limited explored the area with soil geochemical surveys in 1978 and two short drill holes in 1980. One of the drill holes intersected a quartz vein containing a small clot of molybdenite, chalcopyrite and pyrite (Buckley, 1980), but the results did not encourage further work and the claims were allowed to lapse.

Gold Nation Occurrence

The Gold Nation occurrence consists of gold-bearing quartz veins within syenite dikes that cut the Sitlika eastern clastic unit, 4.5 km due west of the west end of Tsayta Lake. The main showing is accessed by a short spur road that branches westward from the Driftwood Forest Service road near the 54 kilometre marker. The mineralization was discovered by prospector Efrem Specogna in July 1992, and staked as the Julio 1-16 mineral claims. Huntington Resources Inc. expanded the property with the addition of the Gold Nation 1-5 claims in the fall of 1983, and carried out a geological, geochemical and geophysical exploration program in the summer of 1994 (Gruenwald and Montgomery, 1994). No further assessment work was recorded, however, and the claims have lapsed.

The Gold Nation property is underlain mainly by medium to dark grey phyllite, recrystallized limestone and sandstone of the Sitlika eastern clastic unit. The metasedimentary rocks are cut by a system of fine-grained syenitic dikes, ranging from 0.5 m to almost 3 m in width. Dike rocks commonly contain finely disseminated pyrite, and locally are heavily veined with milky quartz containing pyrite and traces of chalcopyrite and altaite (PbTe). Gold values reportedly range up to .280 oz/ton at the Main showing, and .667 oz/ton at the Creek showing, 1 km to the south (Gruenwald and Montgomery, 1994). A sample of vein material collected from the main showing during this year's mapping program contained 434 ppb Au.

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