Geology and Mineral Occurrences of the Quesnel Terrane, Canim Lake Area (NTS 092P/15), South-Central British Columbia

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INTRODUCTION

The Takomkane Project is a multiyear bedrock mapping program initiated by the BC Geological Survey in 2005. This program will concentrate on Mesozoic arc volcanic and plutonic rocks of the Quesnel Terrane in the vicinity of the Takomkane batholith, which straddles the Bonaparte Lake (92P) and Quesnel Lake (93A) map sheets (Fig. 1). Previous bedrock maps of the area are based on reconnaissance-scale mapping carried out by the Geological Survey of Canada in the 1960s. The purpose of the Takomkane Project is to provide more detailed maps and an improved geological framework for interpreting mineral occurrences and geochemical anomalies, and for predicting favourable settings for future discoveries.

This paper presents preliminary results from the first year of mapping for the Takomkane Project, which was carried out by the authors and two assistants from mid-June to the end of August, 2005. The area mapped covers about 1000 km^2 of generally subdued topography within the Fraser Plateau and adjacent Quesnel Highland of south-central British Columbia, including Canim Lake and the west end of Mahood Lake. Access to Canim Lake is by paved road that branches east from Highway 97 just north of 100 Mile House. Alternate access routes include the Camp 2 logging road, which originates at Clearwater on Highway 5, and the Drewry Lake road, which branches northward from Highway 24 near Sheridan Lake. Networks of secondary logging and Forest Service roads that branch from these main roads provide easy access to most parts of the map area.

The Canim Lake map area is contiguous with, and partially overlaps, an area that was mapped at 1:50 000 scale by the BC Geological Survey as part of the Bonaparte Project in 2000 and 2001 (Schiarizza and Israel, 2001; Schiarizza *et al*., 2002a, b, c). The Takomkane Project will build on the geological interpretations advanced during that work, and on the earlier 1:250 000 scale mapping by Campbell and Tipper (1971) in the Bonaparte Lake map area and the 1:125 000 scale map of Campbell (1978) for the Quesnel Lake map area. The history of geological work in the area also includes a study of Cenozoic volcanic rocks by Hickson and Souther (1984) and Hickson (1986), and numerous descriptions of individual mineral occurrences found in assessment reports on file at offices of the BC Ministry of Energy, Mines and Petroleum Resources in Victoria and Vancouver.

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REGIONAL GEOLOGICAL SETTING

The Takomkane project area is within the Quesnel Terrane, which is characterized by a Late Triassic to Early Jurassic magmatic arc complex that formed along or near the western North American continental margin (Mortimer, 1987; Struik, 1988a, b; Unterschutz *et al*., 2002). To the east, the Quesnel Terrane is faulted against Proterozoic and Paleozoic siliciclastic, carbonate and volcanic rocks of the Kootenay Terrane, and locally an intervening assemblage of Middle to Late Paleozoic oceanic basalt and chert assigned to the Slide Mountain Terrane (Fig. 1). The Kootenay Terrane probably represents an outboard facies of the ancestral North American miogeocline (Schiarizza and Preto, 1987; Colpron and Price, 1995), whereas the Slide Mountain Terrane is interpreted as the imbricated remnants of a Late Paleozoic marginal basin (Schiarizza, 1989; Roback *et al*., 1994). Late Paleozoic through mid-Mesozoic oceanic rocks of the Cache Creek Terrane occur to the west of the Quesnel Terrane, and are interpreted as part of the accretion-subduction complex that was responsible for generating the Quesnel magmatic arc (Travers, 1978; Struik, 1988a). Younger rocks commonly found in the region include Cretaceous granitic stocks and batholiths, Eocene volcanic and sedimentary rocks, and flat-lying basalt of both Neogene and Quaternary age (Fig. 1).

In southern BC, the early Mesozoic arc of the Quesnel Terrane is represented mainly by Middle to Upper Triassic volcanic and sedimentary rocks of the Nicola Group, together with abundant Late Triassic to Early Jurassic calcalkaline to alkaline intrusions (Schau, 1970; Preto, 1977, 1979; Mortimer, 1987; Panteleyev *et al*., 1996; Schiarizza *et al*., 2002a). Much of the Nicola Group comprises volcanic rocks that belong to a high-potassium to shoshonitic rock series, although locally it also includes a western belt of mainly low-potassium calcalkaline volcanic rocks (Preto, 1977; Mortimer, 1987; Monger, 1989; Monger and McMillan, 1989). The younger stratigraphic component of the Quesnel Terrane includes locally exposed successions of Lower to Middle Jurassic sedimentary and less common volcanic rocks that overlie the Nicola Group unconformably (Travers, 1978; Monger and McMillan, 1989; Panteleyev *et al*., 1996; Schiarizza *et al*., 2002a; Logan and Mihalynuk, 2005a). However, the easternmost part of the Quesnel Terrane in southern BC is, in part, represented by an assemblage of Lower Jurassic

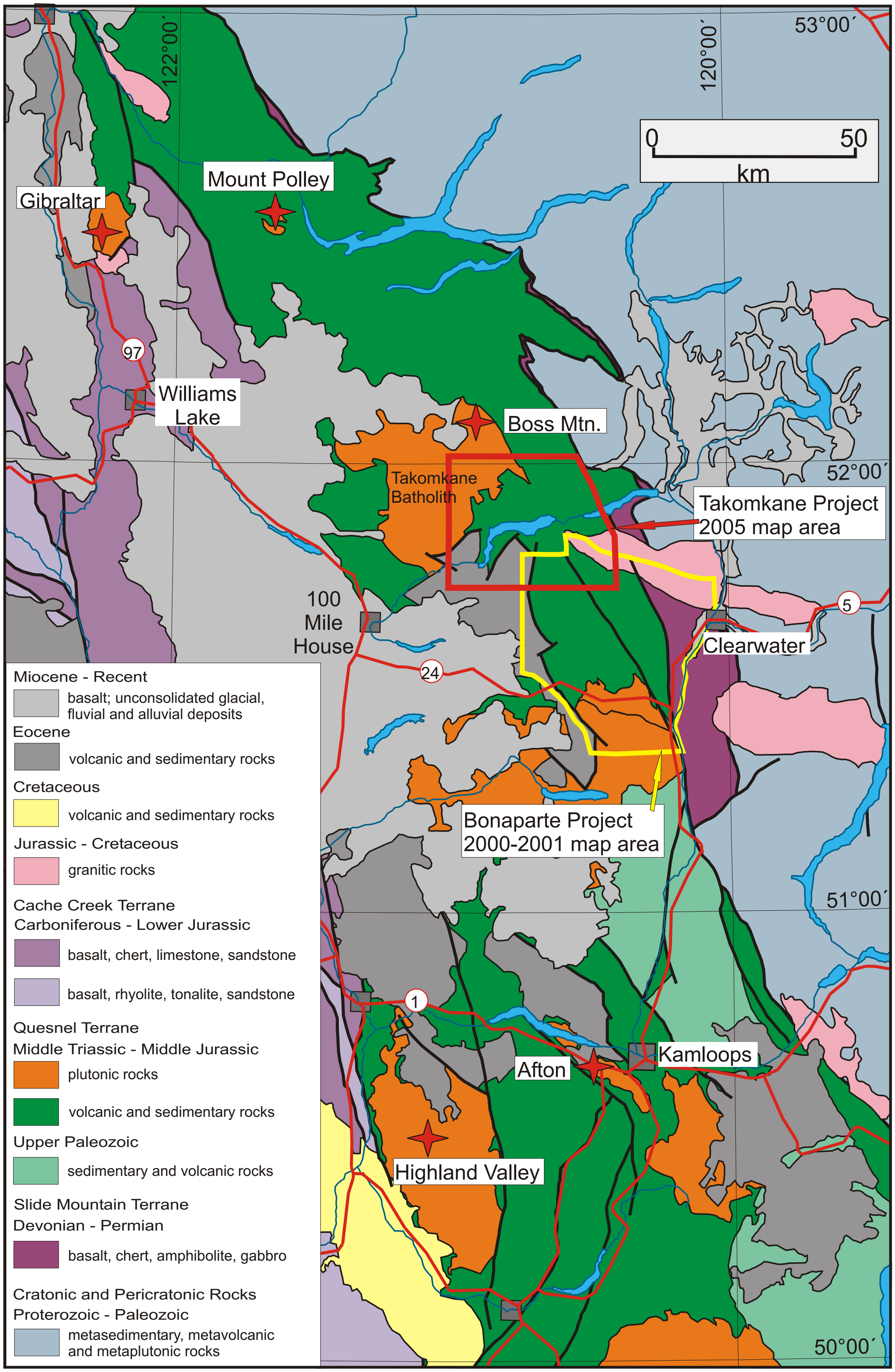


Figure 1. Regional geological setting of the Takomkane Project area, showing the area mapped in 2005, the area mapped in 2000 and 2001 during the Bonaparte Project, and the locations of selected major mineral deposits.

shoshonitic to calcalkaline arc volcanic rocks assigned to the Rossland Group (Höy and Dunne, 1997). These Lower Jurassic volcanic rocks occur well east of the axis of Triassic arc magmatism, but rest above Triassic sedimentary rocks that are correlated with an eastern sedimentary facies of the Nicola Group.

In southern BC, Mesozoic rocks included in the Quesnel Terrane rest stratigraphically above diverse assemblages of Paleozoic rocks, commonly across an angular unconformity (Read and Okulitch, 1977). These Paleozoic successions include arc-derived sedimentary and volcanic rocks of the Harper Ranch Group (Smith, 1979; Danner and Orchard, 2000), Attwood Group (Fyles, 1990; Dostal *et al*., 2001) and Mount Roberts Formation (Little, 1982; Roback and Walker, 1995); metamorphic rocks of the Spa Creek and Bob Creek assemblages (Erdmer *et al*., 2001, 2002); oceanic rocks included in the Slide Mountain Terrane (Campbell, 1971; Klepacki and Wheeler, 1985; Rees, 1987); and assemblages of oceanic rocks farther to the west that include the Knob Hill Group (Fyles, 1990; Dostal *et al*., 2001) and the Old Tom, Independence and Shoemaker formations (Bostock, 1941; Tempelman-Kluit, 1989). There is indirect evidence, mainly from provenance arguments, that some of these underlying Paleozoic successions formed above a basement with North American affinities (Roback and Walker, 1995; Ferri, 1997; Erdmer *et al.*, 2001, 2002). Tectonic models presented by Roback and Walker (1995) and Ferri (1997) suggest that Paleozoic arc rocks of the Quesnel Terrane formed on a fragment of continental crust that rifted away from ancestral North America during back-arc extension that produced the Slide Mountain marginal ocean basin. Subsequent collapse of the Slide Mountain basin in Permian–Triassic time may have brought this fragment back into proximity with the continental margin, and formed a complex, structurally imbricated basement on which the Triassic-Jurassic arc of the Quesnel Terrane formed (*e.*g., Schiarizza, 1989; Ferri, 1997; Dostal *et al*., 2001).

The structural geology of the Quesnel Terrane includes generally poorly understood faults that exerted controls on Late Triassic volcanic-sedimentary facies distributions and the localization of plutons and associated mineralization and alteration systems (Preto, 1977, 1979; Nelson and Bellefontaine, 1996; Logan and Mihalynuk, 2005b). In north-central BC, orogen-parallel sinistral strike-slip faults that may be broadly synchronous with arc magmatism (Schiarizza and Tan, 2005) occur outboard of east-directed thrust faults that formed during the latter stages of magmatism and juxtapose Quesnel Terrane above adjacent miogeoclinal rocks (Nixon *et al*., 1997). These structures may reflect transpressive deformation during construction of the Quesnel magmatic arc, perhaps reflecting oblique sinistral convergence between the arc system and the subducting oceanic tract to the west (Struik, 1993). In southern BC, late Early Jurassic east-directed thrust faults and associated folds are documented within the eastern part of Quesnel Terrane, and along the structural base of the terrane where it is juxtaposed above the Slide Mountain and Kootenay terranes (Struik, 1986, 1988b; Rees, 1987). Younger structures within the southern Quesnel Terrane include west to southwest-verging folds, in part of early Middle Jurassic age, that deform the east-directed thrust faults (Ross *et al*., 1985; Brown *et al*., 1986; Rees, 1987), and prominent systems of Eocene dextral strike-slip and extensional faults (Ewing, 1980; Panteleyev *et al*., 1996; Schiarizza *et al*., 2002a).

The Quesnel Terrane is an important metallogenic province, particularly for porphyry deposits containing Cu, Au and Mo. The world-class Highland Valley Cu-Mo porphyry deposits occur in calcalkaline plutonic rocks of the Late Triassic Guichon Creek Batholith (Casselman *et al*., 1995), which is hosted in the western calcalkaline belt of the Nicola Group (Fig. 1). The Gibraltar Cu-Mo mine, 240 km to the north-northwest, is associated with sodic calcalkaline plutonic rocks of about the same age but occurs in a structurally complex setting along the boundary between Cache Creek and Quesnel terranes (Bysouth *et al*., 1995; Ash and Reveros, 2001). Somewhat younger, latest Triassic alkaline plutons define a wide belt to the east of these calcalkaline deposits, and host important Cu-Au porphyry deposits, including the Afton mine and associated occurrences within the Iron Mask batholith near Kamloops, and the Mount Polley mine west of Quesnel Lake (Mortensen *et al*., 1995; Logan and Mihalynuk, 2005a, b). Cospatial with these latest Triassic alkaline plutons is a belt of large, Early Jurassic calcalkaline plutons that includes the Takomkane and Thuya batholiths in the Bonaparte Lake map sheet. Much younger calcalkaline plutons of mid-Cretaceous age crosscut terrane boundaries and host porphyry Mo deposits, including the past-producing Boss Mountain mine (Macdonald *et al*., 1995).

LITHOLOGICAL UNITS

The distribution of the main lithological units in the Canim Lake area is shown on Figure 2. Figure 3 combines the Canim Lake map area with the area mapped in 2000 and 2001, during the Bonaparte project, to summarize the authors' geological interpretation of the Quesnel belt between the Thuya and Takomkane batholiths. The Canim Lake area is underlain mainly by sedimentary and volcanic rocks assigned to the Middle to Upper Triassic Nicola Group. Lower Jurassic sedimentary rocks are restricted to a small area along the southern boundary of the map area. Intrusive rocks include Late Triassic to Early Jurassic suites that are part of the Quesnel magmatic arc, as well as younger granitic rocks of mainly Cretaceous age. Eocene volcanic and volcaniclastic rocks occupy a large area in the southwestern part of the map area, and outliers of Quaternary basalt, related to the Wells Gray – Clearwater volcanic rocks, occur in the eastern part of the area.

Nicola Group

The Nicola Group, named for exposures on the south side of Nicola Lake (Dawson, 1879), comprises a diverse assemblage of Middle and Upper Triassic volcanic, volcaniclastic and sedimentary rocks that crop out over a broad area in south-central BC. Campbell and Tipper (1971) assigned volcanic and associated sedimentary rocks of known or inferred Late Triassic age in the Bonaparte Lake map sheet to the group, including a belt of rocks on the northern margin of the Thuya batholith, and another, smaller belt, on the southeastern margin of the Takomkane batholith. However, they included most of the Mesozoic sedimentary and volcanic rocks between the Thuya and Takomkane batholiths in two Lower to Middle Jurassic map units, one of mainly sedimentary rocks (their unit 15) and the other dominated by volcanic rocks (unit 16). A fourth Mesozoic unit mapped by Campbell and Tipper in the northeastern Bonaparte Lake map sheet comprises Triassic sedimentary rocks that form a belt on the eastern mar-

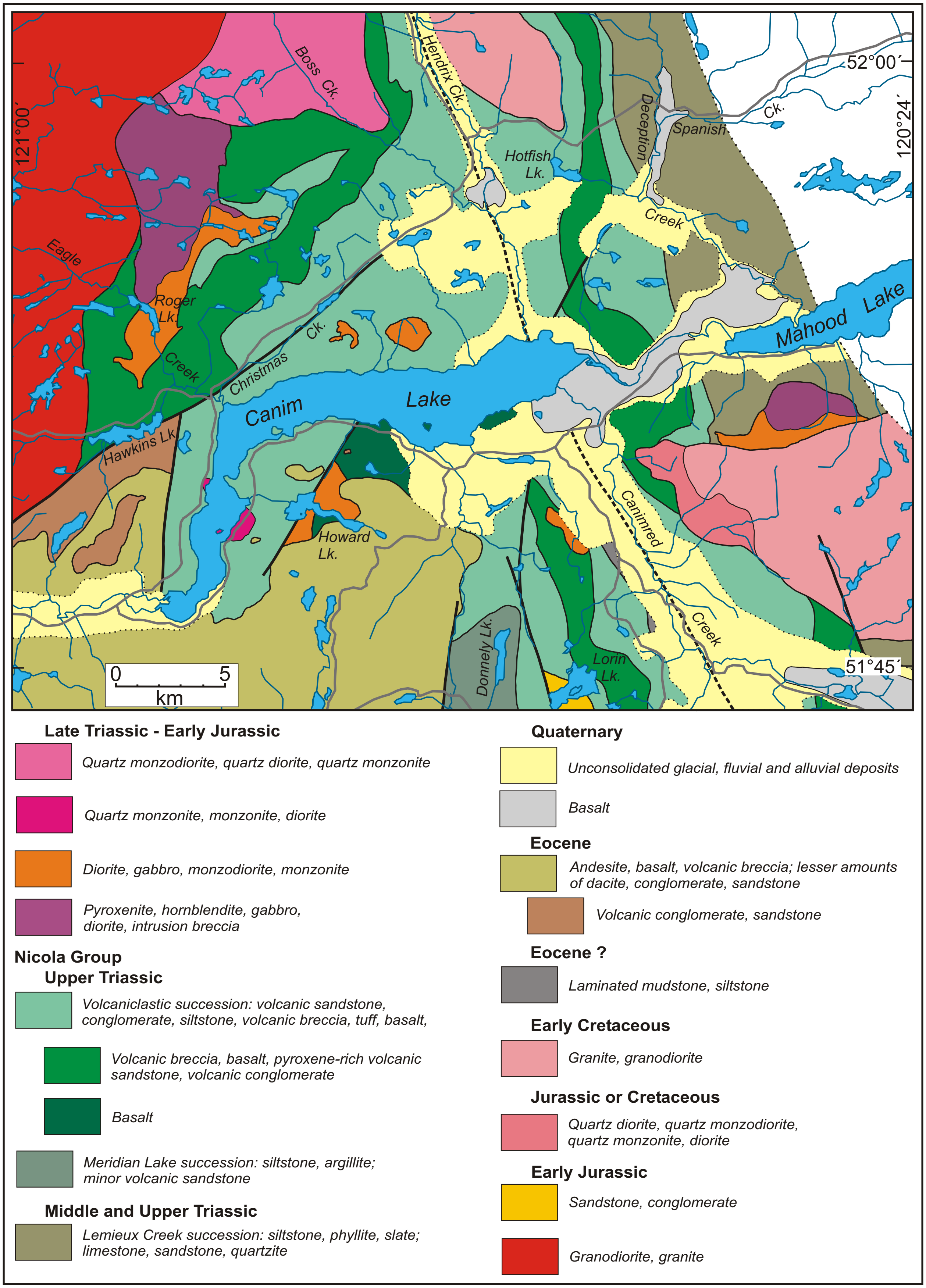
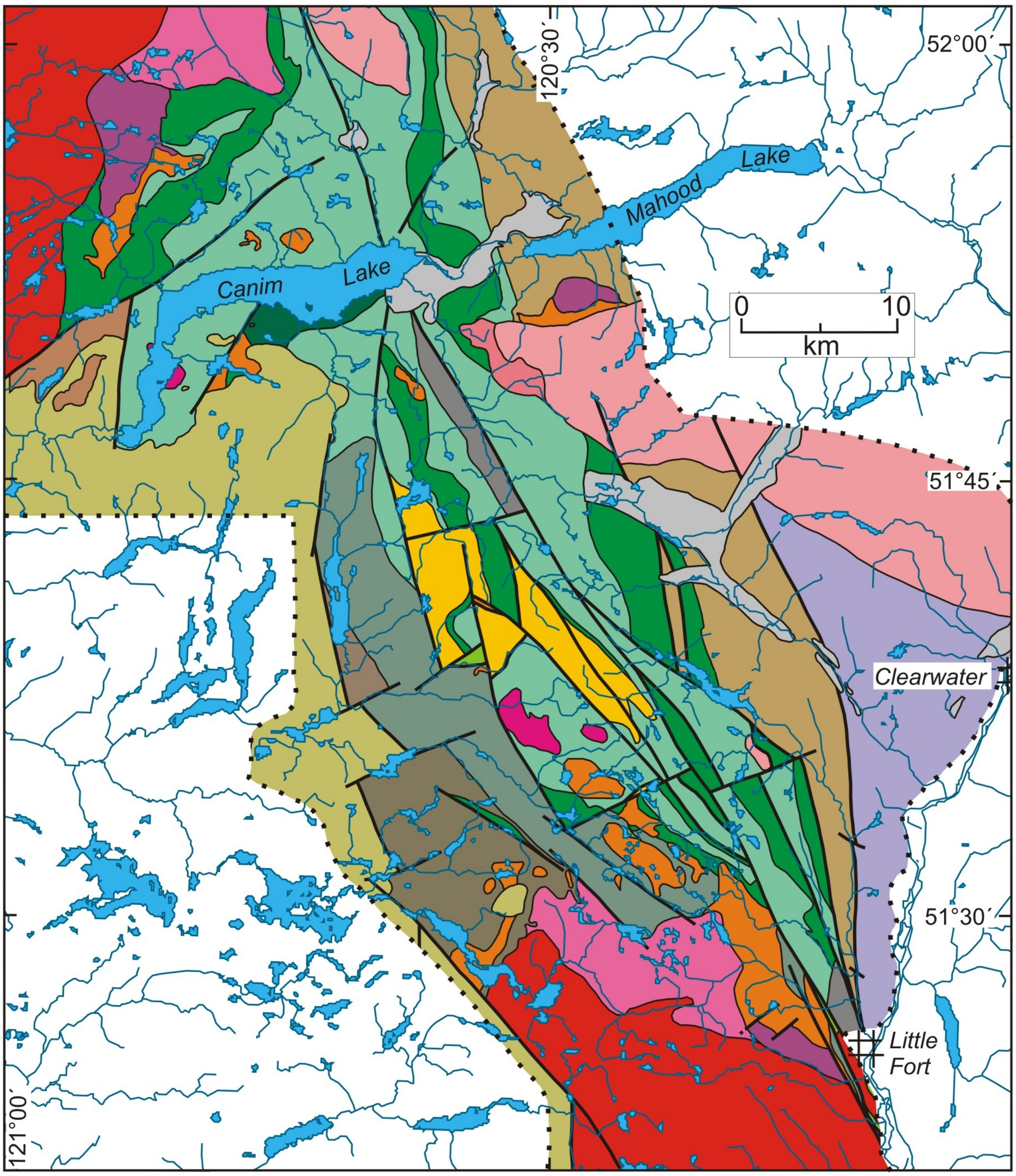


Figure 2. Generalized geology of the Canim Lake map area, based mainly on 2005 fieldwork.



Upper Triassic

Wavey Lake succession: argillite, chert, siltstone, volcanic sandstone, breccia, conglomerate

Carboniferous - Permian

Harper Ranch Group: siltstone, argillite, limestone, chert

Slide Mountain Terrane; Fennell Formation: basalt, chert, argillite, diabase, gabbro

Legend for other units shown on Figure 2

Figure 3. Generalized geology of the area between the Thuya and Takomkane batholiths, based on fieldwork conducted in 2000, 2001 and 2005.

gin of Quesnel Terrane (their unit 10). This unit was not included in the Nicola Group, in part because it was separated from Nicola exposures to the west by an extensive belt of rocks assigned to their Jurassic map units.

Schiarizza and Israel (2001) and Schiarizza *et al*. (2002a, b, c) reassigned most of Campbell and Tipper's (1971) Jurassic rocks in the Nehalliston Plateau – Bowers Lake area to the Triassic Nicola Group, based on lithological similarity to known Triassic rocks and a single new Late Triassic fossil age. They inferred that Jurassic sedimentary rocks were restricted to a narrow, northwest-trending belt centred on the fossiliferous localities at Windy Mountain (Fig. 3). Schiarizza *et al*. also included the eastern Triassic sedimentary belt (Campbell and Tipper's unit 10) in the Nicola Group, based partly on work to the north, where correlative rocks are interpreted as the stratigraphic base of the Nicola Group (Panteleyev *et al*., 1996), or an eastern sedimentary facies of the group (Struik, 1988b).

The subdivision of Mesozoic volcanic and sedimentary rocks in the Canim Lake map area follows, for the most part, the interpretation of Schiarizza *et al*. (2002a, b). Most rocks are assigned to the Middle to Upper Triassic Nicola Group, which includes two major subdivisions: the Lemieux Creek succession, comprising Middle and Upper Triassic sedimentary rocks in the eastern part of the group; and the volcaniclastic succession, a diverse assemblage of volcaniclastic and volcanic rocks that crop out over a broad area to the west. The Lemieux Creek succession is equivalent to unit 10 of Campbell and Tipper (1971). The volcaniclastic succession includes rocks assigned to the Nicola Group by Campbell and Tipper, but is dominated by rocks that they considered to be Jurassic (their units 15 and 16). The volcaniclastic succession includes two internal subunits, one dominated by coarse pyroxene porphyry breccia (breccia subunit) and one dominated by mafic volcanic flows (basalt subunit). Siltstone and argillite assigned to the Meridian Lake succession constitute an additional subdivision of the Nicola Group, restricted to a small area near the southern boundary of the Canim Lake map area. These rocks seem to underlie and interfinger with those of the volcaniclastic succession and may, in part, be correlative with the Lemieux Creek succession (Schiarizza *et al*., 2002a).

LEMIEUX CREEK SUCCESSION

The Lemieux Creek succession is dominated by dark grey slate, phyllite and siltstone that form the easternmost part of Quesnel Terrane in the Canim Lake map area. It forms a continuous, north-northwest-trending belt extending from the northern margin of the Raft batholith to the northern boundary of the map area. It also crops out on the southern margin of the batholith, and from there has been traced 34 km south to Little Fort, where it apparently pinches out between strands of the Rock Island Lake and Lemieux Creek fault systems (Fig. 3; Schiarizza and Israel, 2001). Rocks correlative with the Lemieux Creek succession extend far to the north of the Canim Lake map area, and include the informally named black phyllite unit of the Quesnel Lake area (unit 1 of Panteleyev *et al*., 1996), and the Slate Creek succession of the Takla Group in north-central BC (Ferri and Melville, 1994; Nelson and Bellefontaine, 1996).

The Lemieux Creek succession is well exposed in a canyon on lower Deception Creek and near the northern boundary of the map area along the east-flowing tributary to Deception Creek that contains the DL gold – quartz vein occurrence. It is also represented by abundant exposures of siltstone near the ridge top south of the west end of Mahood Lake. Elsewhere, it is represented by scattered small exposures, typically along logging roads, and by abundant fine rubble of black slate and phyllite, commonly accompanied by larger blocks of white vein quartz, which is a characteristic feature of the unit.

The Lemieux Creek succession in the Canim Lake map area consists mainly of dark grey to black slate and phyllite, commonly spotted with rusty porphyroblasts of siderite and/or pyrite, and locally containing small dark porphyroblasts of chlorite or chloritoid (Fig. 4). Veins and lenses of quartz or quartz-carbonate are a common feature. These range from a few millimetres to more than 1 m in thickness; most veins are subparallel to the slaty cleavage, but some crosscut cleavage at a high angle. Locally the slaty rocks include laminae and/or thin to medium interbeds of siltstone, slaty siltstone, slaty sandstone, calcareous sandstone and dark grey slaty to sandy limestone. Westernmost exposures of the succession adjacent to the Aqua Creek ultramafic-mafic complex, south of Mahood Lake, are dominated by dark to light grey, thin-bedded to laminated siltstone.

The Lemieux Creek succession is not dated within the Canim Lake map area, but limestone-bearing intervals to the north and south have yielded macrofossils and conodonts of Middle and Late Triassic age (Panteleyev *et al*., 1996; Schiarizza *et al*., 2002a). To the east, beyond the limits of the Canim Lake map area, the Lemieux Creek succession is in fault contact with Paleozoic rocks of the Slide Mountain and Kootenay terranes. To the west, the unit is in contact with the Nicola volcaniclastic succession, across what is interpreted as a west-facing stratigraphic contact.

Figure 4. Grey slate of the Lemieux Creek succession, west side of Deception Creek near northern boundary of the map area.

MERIDIAN LAKE SUCCESSION

Generally fine-grained sedimentary rocks of the Meridian Lake succession form a belt that extends from the northern margin of the Thuya batholith to the south-central part of the Canim Lake map area (Fig. 3). This succession consists mainly of thin-bedded siltstone and argillite, but also includes local beds of fine to coarse-grained volcanic sandstone and conglomerate. Intervals of dark grey limestone occur locally in more southerly exposures of the succession, and have yielded several conodont collections of Late Triassic (Carnian) age (Schiarizza *et al*., 2002a; conodonts identified M.J. Orchard, Geological Survey of Canada). External contacts are in large part faults, but the southern part of the succession is locally overlain to the east by volcanic rocks of the Nicola volcaniclastic succession, and stratigraphically underlain to the west by an assemblage of chert, volcanic sandstone and volcanic breccia assigned to the Wavey Lake succession (Schiarizza *et al*., 2002a).

Figure 5. Thin-bedded sandstone of the Nicola volcaniclastic succession, north of Canim Lake.

In the southern part of the Canim Lake map area, the Meridian Lake succession is represented by sparse exposures of siltstone, argillite and local fine to medium-grained sandstone in the vicinity of Donnely Lake. These fine-grained rocks pass into coarse volcanic sandstone and local breccia of the Nicola volcaniclastic succession to the north and east. The nature of these contacts is not well understood, although it appears that the Meridian Lake succession underlies and/or interfingers with the coarser volcaniclastic rocks.

VOLCANICLASTIC SUCCESSION

The volcaniclastic succession of the Nicola Group is the most widespread map unit in the Canim Lake map area. It forms a wide belt, locally more than 25 km across, bounded by the Lemieux Creek succession to the east and the Takomkane batholith and Eocene Skull Hill Formation to the west. It is the northward extension of rocks mapped mainly as the mixed volcanic-sedimentary unit (uTrNsv) of the Nicola Group by Schiarizza *et al*. (2002a–c). However, it also includes mappable units of volcanic breccia that Schiarizza *et al*. (2002a–c) mapped as two separate units underlying and overlying their mixed volcanic-sedimentary unit (their units uTrNv and lJb, respectively). These volcanic breccia units are here assigned to an internal subunit (breccia subunit) that probably occurs at several different stratigraphic levels within the volcaniclastic succession.

The volcaniclastic succession consists mainly of grey to green, fine to coarse-grained, commonly gritty, volcanogenic sandstone. Mineral grains of pyroxene, feldspar and locally hornblende, together with lithic fragments containing these same minerals, are the dominant constituents. In places, the sandstone forms well-defined thin to thick beds (Fig. 5), but it occurs elsewhere as massive units, up to several tens of metres thick, in which bedding is not apparent. The well-bedded intervals commonly include interbeds of green to grey siltstone or dark grey argillite, and locally display graded bedding, flame structures and rip-up clasts. Locally, siltstone and argillite, with little or no intercalated sandstone, dominate intervals up to several metres thick. Beds of calcareous sandstone to sandy limestone occur within some well-bedded intervals, particularly along the west shore of southern Canim Lake, and rare thin beds of green chert were noted within a section of thin-bedded sandstone and siltstone northwest of Howard Lake.

Coarse-grained intervals, including pebbly sandstone, pebble conglomerate and volcanic breccia, are common within the volcaniclastic succession, and include massive units many tens of metres thick, as well as medium to thick beds intercalated with volcanic sandstone. Conglomerate units contain angular to subrounded clasts of mainly pyroxene-feldspar-phyric mafic volcanic rocks, but also include clasts of siltstone, limestone and diorite. Volcanic breccia comprises angular to subangular fragments of pyroxene-feldspar porphyry within a matrix of mainly pyroxene and feldspar mineral grains. Pyroxene-feldspar porphyry also occurs as massive to rarely pillowed units, apparently derived from flows, sills and dikes, that are widespread but not abundant within the volcaniclastic succession.

The Nicola volcaniclastic succession is not dated within the Canim Lake map area, but similar rocks to the south have yielded Late Triassic macrofossils and conodonts (Campbell and Tipper, 1971; Schiarizza *et al*., 2002a, c). The contact between the volcaniclastic succession and the adjacent Lemieux Creek succession is not exposed, but is thought to be stratigraphic on the basis of concordant bedding orientations and some intercalation of characteristic rock types in adjacent outcrops of the respective units. West-facing stratigraphic tops indicators in easternmost exposures of the volcaniclastic succession indicate that it overlies the Lemieux Creek succession. A gradational stratigraphic contact has also been inferred by some workers to the north (Rees, 1987; Bloodgood, 1990; Panteleyev *et al*., 1996), although Struik (1988b) showed that the western volcanic belt is in part the same age as the eastern sedimentary belt, and suggested that they are separated by a regionally significant thrust fault.

Breccia Subunit

Breccia containing fragments of pyroxene-phyric basalt is fairly common throughout the Nicola volcaniclastic succession and, in three separate areas, forms thick accumulations of mappable thickness and strike-extent that are assigned to the breccia subunit (Fig. 2). These three breccia units occur in different fault panels, so their stratigraphic relationships to one another are unknown. However, the breccia unit in the eastern part of the area is near the base of the volcaniclastic succession, whereas the one west of Canimred Creek is apparently near the top. It is suspected, therefore, that they represent relatively proximal accumulations of coarse volcanic material at two or three spatially and stratigraphically distinct sites within the volcaniclastic succession.

Figure 6. Volcanic breccia containing pyroxene-phyric basalt fragments, breccia subunit, east of Hotfish Lake.

Volcanic breccia of the breccia subunit is medium to dark green or grey-green, and commonly forms relatively resistant, blocky, green-brown to rusty brown weathered exposures. Fragments are typically angular to subangular, and commonly range from a few centimetres to 10 cm in diameter (Fig. 6), although much larger fragments occur locally. In most exposures, the fragments are exclusively or dominantly pyroxene and pyroxene-feldspar-phyric basalt, but show considerable textural variation based on size, abundance and feldspar versus pyroxene proportions in the phenocryst population, as well as degree of vesiculation and presence or absence of amygdules. The matrix is dominated by pyroxene and feldspar grains, and the compositional similarity between clasts and matrix in many exposures obscures the fragmental texture. Locally, the clast population also includes hornblende (±feldspar±pyroxene) porphyry, diorite, aphyric basalt, pyroxenite, hornblendite, laminated siltstone and argillite. In some exposures east of the Boss Creek unit of the Takomkane batholith, the breccia fragments are mainly hornblendite, hornblende pyroxenite, gabbro and diorite, and the matrix is dominated by hornblende crystals. This breccia was derived from erosion of an ultramafic-mafic plutonic complex similar to the Iron Lake complex, which crops out just 8 km to the west.

The generally massive breccia of the breccia subunit locally includes intercalations of thin to thick-bedded pyroxene-rich sandstone and pebble to cobble conglomerate. The conglomerate resembles the breccia in composition, but contains a higher proportion of subrounded clasts and tends to be weakly stratified and/or include substantial interbeds of volcanic sandstone. Massive pyroxene-feldspar porphyry, probably derived from sills, dikes and flows, is fairly widespread in the breccia subunit, and pillowed basalt was noted locally within the northwestern and south-central belts (Fig. 7). Limestone occurs within the northwestern belt in a small area north of Hawkins Lake.

Basalt Subunit

A single mappable unit dominated by mafic flow rocks is assigned to the basalt subunit of the Nicola volcaniclastic succession. This unit is represented mainly by scattered small exposures of medium to dark green pyroxene-feldspar-phyric basalt that extend from Howard Lake north-northeastward to Canim Lake. These rocks are intruded by dioritic rocks of the Howard Lake stock, are overlain by Eocene volcanic rocks and are juxtaposed against sandstone typical of the volcaniclastic succession across the Howard Lake fault. The same belt of rocks may be represented by a few isolated exposures of silica-pyrite-altered basalt 5 km to the east, along and near the south shore of Canim Lake.

Figure 7. Pillowed basalt, breccia subunit, northeast of Hawkins Lake.

Lower Jurassic Sedimentary Rocks

A succession of Lower Jurassic sedimentary rocks is well exposed at Windy Mountain, 8 km south of the Canim Lake map area, where it includes a thick section of polymictic conglomerate, and overlying thin-bedded sandstone and siltstone that locally contain Early Jurassic ammonites (Campbell and Tipper, 1971; Schiarizza *et al*., 2002a, b). The most distinctive part of this succession is the conglomerate, which commonly includes clasts of granitic rock. Schiarizza *et al*. (2002a, b) mapped Lower Jurassic sedimentary rocks in several fault panels extending southeast and north-northwest from Windy Mountain, based on lithological correlation with the fossiliferous section (Fig. 3). They projected the westernmost panel of Jurassic rocks northward to within 6 km of Canim Lake, based on reconnaissance-scale mapping. More detailed work during the 2005 field season suggests that the rocks in the northern part of this belt are actually part of the Upper Triassic Nicola Group. The northernmost exposures that are confidently included in the Jurassic succession, based on the occurrence of granitoid-bearing conglomerate, are on the south side of Lorin Lake, near the southern boundary of the Canim Lake map area. These Lower Jurassic rocks are inferred to pinch out to the north, between the underlying Nicola Group to the east and a northerly-striking fault to the west (Fig. 2).

Intrusive Rocks

IRON LAKE ULTRAMAFIC-MAFIC COMPLEX

The Iron Lake complex comprises ultramafic and mafic plutonic rocks that crop out in the northwestern part of the Canim Lake map area. The complex is more than 13 km long and up to 6 km wide. It intrudes the Nicola volcaniclastic succession, mainly the breccia subunit, along its eastern, southern and southwestern margins, but is in contact with the Boss Creek and Schoolhouse Lake units of the Takomkane batholith to the north and northwest. The Iron Lake complex was not mapped by Campbell and Tipper (1971), who included part of it in the Takomkane batholith and part in the Nicola Group. The ultramafic rocks of the complex contain abundant magnetite, and correspond to a very strong positive anomaly on regional aeromagnetic maps.

At the scale of Figure 2, the Iron Lake complex is subdivided into an ultramafic unit and a mafic unit. The ultramafic unit consists mainly of dark green, medium to coarse-grained, commonly biotite or phlogopite-bearing clinopyroxenite and hornblende clinopyroxenite. Olivine clinopyroxenite and wehrlite, locally displaying cumulate textures, occur in the central part of the unit (Buskas, 1989; Morton, 2001). Dark grey to black, coarse-grained hornblendite is the predominant phase in some exposures of the ultramafic unit, and elsewhere occurs as centimetre-scale patches or dikes within pyroxenite. Plagioclase-bearing hornblendite and pyroxenite are also present, and locally grade into melanocratic gabbro. At one locality, near the northwest corner of the ultramafic unit, hornblende pyroxenite, hornblende-feldspar pyroxenite, gabbro and diorite occur as parallel sheets defined partly by modal layering and partly by dikes. Coarse-grained to pegmatitic, leucocratic hornblende-pyroxene gabbro is fairly common as irregular dikes and pods within the ultramafic rocks, and locally forms the matrix to intrusion breccia containing fragments of ultramafic rock and mafic gabbro (Fig. 8). Dikes of medium to fine-grained diorite and monzodiorite are also present but less common.

Mafic intrusive rocks predominate in a mappable unit that bounds the ultramafic unit to the south and southeast (Fig. 2). The mafic unit consists mainly of medium to coarse-grained hornblende-pyroxene gabbro to monzogabbro, and medium to fine-grained hornblende diorite and microdiorite. Dioritic rocks northeast of Roger Lake are commonly cut by a west-northwest-dipping foliation, and locally grade to amphibolite. Monzogabbro in the southern part of the unit locally includes centimetre-scale veins and patches of pegmatitic monzogabbro to monzonite, and locally displays vague concentric zones defined by modal variations in the feldspar versus mafic content. Dikes of hornblende-feldspar porphyry, monzonite and feldspar porphyry occur locally, and one exposure along the southwestern margin of the mafic unit comprises sheeted dikes of diabase, microgabbro and feldspar-hornblende clinopyroxenite.

The Iron Lake complex is not dated, but samples of diorite and hornblende gabbro collected during the 2005 field season have been submitted for U-Pb dating of zircons and Ar/Ar dating of hornblende, respectively.

AQUA CREEK ULTRAMAFIC-MAFIC COMPLEX

The Aqua Creek complex comprises ultramafic and mafic plutonic rocks that crop out on the north side of the Raft batholith, south of the western end of Mahood Lake. These rocks intrude the Lemieux Creek succession of the Nicola Group, and are themselves cut by the main monzogranite to granodiorite phase of the Raft batholith. The Aqua Creek complex was not mapped by Campbell

Figure 8. Intrusion breccia, Iron Lake ultramafic-mafic complex, east of Iron Lake.

and Tipper (1971), who included it in their unit 16, which consists of mafic volcanic and volcaniclastic rocks. They did note, however, that the rocks in this area contain a very high proportion of augite and resemble pyroxenite, and that they might be shallow intrusions. As with the Iron Lake complex, the ultramafic rocks of the Aqua Creek complex are rich in magnetite and generate a very strong positive anomaly on aeromagnetic maps.

The Aqua Creek complex is lithologically very similar to the Iron Lake complex, except that olivine-bearing rocks are not present. Ultramafic rocks dominate an apparently oval-shaped unit that forms the northeastern part of the complex; the northern limit of these rocks is not exposed, but is inferred from the regional aeromagnetic map. This ultramafic unit consists mainly of clinopyroxenite, hornblende clinopyroxenite, hornblendite, mafic gabbro and pegmatitic gabbro (Fig. 9). Most phases contain magnetite and either biotite or phlogopite as important accessory minerals. Mafic plutonic rocks, dominated by medium to coarse-grained hornblende-pyroxene gabbro and medium-grained hornblende diorite, form a mappable unit to the south and southwest of the ultramafic rocks. These rocks are locally converted to amphibolite along their contact with the Raft batholith. The northwestern boundary of the mafic unit is a complex zone of mafic plutonic rocks containing rafts of hornfelsed siltstone, passing northward into siltstone-dominated exposures containing dikes of gabbro and diorite.

Samples of pegmatitic gabbro and diorite from the Aqua Creek complex have been submitted for Ar/Ar dating of hornblende and U-Pb dating of zircons, respectively.

SMALL DIORITIC STOCKS

The Nicola volcaniclastic succession on the north side of Canim Lake is cut by an irregular stock and/or dike swarm of hornblende diorite south-southeast of Christmas Lake (Thompson, 1987), and by a roughly circular stock of similar composition 2 km to the east (Smith, 1976). To the south, at Howard Lake, poorly exposed diorite, monzonite, syenite and associated intrusion breccia form a mineralized intrusive body that cuts the basalt subunit of the Nicola Group. This intrusion is truncated by the Howard Lake fault to the west, and is partially overlapped by Eocene volcanic rocks to the south and southeast. Ten kilometres east of Howard Lake, a northwest-trending stock of hornblende-pyroxene gabbro cuts pyroxene porphyry breccia and conglomerate of the volcanic breccia subunit. All of these stocks, together with numerous smaller intrusive bodies of similar composition, are interpreted as part of the Quesnel magmatic arc and inferred to be Late Triassic and/or Early Jurassic in age.

TAKOMKANE BATHOLITH

The Takomkane batholith is a large, roughly equidimensional body of granitic rock that measures more than 40 km across (Fig. 1). The southeastern part of the batholith crops out within the Canim Lake map area, where it has been subdivided into two units. The most extensive unit consists of granodiorite to monzogranite assigned to the Schoolhouse Lake unit. A lithologically distinct suite dominated by quartz monzodiorite is well exposed on either side of Boss Creek, and is referred to as the Boss Creek unit. Crosscutting relationships were not observed, but the authors suspect that the Boss Creek unit is somewhat older. Both units cut the breccia subunit of the Nicola volcaniclastic succession, as well as the Iron Lake ultramafic-mafic complex. The Schoolhouse Lake unit is faulted against Eocene volcaniclastic rocks of the Skull Hill Formation west of Canim Lake.

The Schoolhouse Lake unit consists mainly of light grey to pinkish grey, coarse to medium-grained hornblende-biotite granodiorite, locally grading to monzogranite in the vicinity of Lang Lake, or to tonalite along the unit's eastern contact near Hawkins Lake. Textures vary from equigranular in granodiorite and tonalite, to K-feldspar porphyritic in monzogranite and some granodiorite. Mafic minerals typically form 10–20% of the rock, with hornblende commonly predominating over biotite. Weak, steeply dipping, margin-parallel foliations were locally observed in tonalite and granodiorite near the eastern contact of the batholith, but most rocks are isotropic. The Schoolhouse Lake unit is assigned an Early Jurassic age on the basis of a 193.5 ±0.6 Ma U-Pb zircon date reported by Whiteaker *et al*. (1998). The zircons were separated from a sample of granodiorite collected at Ruth Lake, just 2 km west of the Canim Lake map area. Similar granodiorite forms a major component of the Thuya batholith to the south, and has yielded an almost identical U-Pb zircon date of 192.7 ±0.9 Ma (Schiarizza *et al*., 2002a, c).

The Boss Creek unit comprises medium to coarse-grained, equigranular, biotite-hornblende quartz monzodiorite, locally grading to quartz diorite, granodiorite, tonalite or diorite. Mafic minerals commonly make up 15–25% of the rock, and biotite is generally more abundant than hornblende. Most rocks are isotropic, but weak south-southeast-dipping foliations were locally observed in the eastern part of the unit, and narrow north-northwest to north-northeast-striking mylonitic shear zones were observed in some exposures directly west of

Figure 9. Pegmatitic hornblende gabbro of the Aqua Creek ultramafic-mafic complex, south of Mahood Lake.

Boss Creek. The Boss Creek unit is undated, but a sample collected during the 2005 field season has been submitted for U-Pb dating of zircons. Similar rocks make up much of the northern part of the Thuya batholith, and have yielded a U-Pb zircon upper intercept date of 201.3 ±2.3 Ma, which is interpreted as a maximum crystallization age (R. Friedman, pers. comm., 2002).

SOUTH CANIM STOCK

The South Canim stock cuts volcanic sandstone and related rocks of the Nicola volcaniclastic succession along the southern part of Canim Lake. It consists mainly of light greenish grey to pinkish grey, medium to coarse-grained, hornblende-biotite monzonite, locally grading to quartz monzonite, monzodiorite and diorite. Textures are typically isotropic and equigranular, although K-feldspar crystals locally tend to be slightly larger than other mineral grains. The stock is best exposed as a series of bluffs on the east side of Canim Lake, but is also represented by exposures of monzonite to diorite on two islands in the eastern part of the lake. A single exposure along the Canim-Hendrix road, comprising a complex mixture of syenite to monzonite, diorite and microdiorite, with local hornblendite xenoliths and leucodiorite dikes, indicates that the northwestern tip of the stock extends to the west side of the lake.

The South Canim stock was mapped as Cretaceous by Campbell and Tipper (1971). However, its relatively alkalic composition suggests that it is more likely part of the Quesnel Terrane magmatic suite, and Late Triassic or Early Jurassic in age. A sample of quartz monzonite that was collected during the 2005 field season has been submitted for U-Pb dating of zircons.

RAFT BATHOLITH

The Raft batholith is an elongate granitic pluton that extends for about 70 km in a west-northwest direction, and cuts across the boundaries between the Kootenay, Slide Mountain and Quesnel terranes (Fig. 1). The Canim Lake map area includes the western end of the batholith, which crosscuts several mappable units of the Nicola Group and also truncates the Aqua Creek ultramafic-mafic complex. The batholith consists mainly of granite and granodiorite of mid-Cretaceous age, but a separate unit of mainly quartz monzodiorite makes up its western end.

Most of the Raft batholith within the Canim Lake map area consists of light grey, medium to coarse-grained biotite-hornblende granodiorite to monzogranite. Textures vary from equigranular to porphyritic, the latter characterized by pink orthoclase crystals up to 1.5 cm in size. Mafic minerals typically make up 10–20% of the rock, with biotite predominating over hornblende. At one locality near the northern margin of the batholith, however, modal layering on a scale of 10–30 cm is defined mainly by variations in the mafic mineral content, which ranges from 5–40%.

The lithologically distinct, western end of the Raft batholith consists mainly of medium to fine-grained, equigranular hornblende-biotite quartz monzodiorite, locally grading to quartz diorite, diorite or granodiorite. Crosscutting relationships between these rocks and the main granodiorite to monzogranite unit to the east were not observed. Both mappable units are cut by uncommon aplite dikes.

Previous mapping to the east-southeast indicates that biotite-hornblende granodiorite to monzogranite, as found in the Canim Lake map area, is the predominant rock type within the southern part of the Raft batholith as far east as the Clearwater River (Schiarizza *et al*., 2002a). A sample collected about 10 km east of the Canim Lake area in 2001 was submitted to Richard Friedman at the University of British Columbia for U-Pb dating of zircons, and yielded a concordia date of 105.5 ±0.5 Ma (Schiarizza *et al*., 2002b). This late Early Cretaceous date is interpreted as the crystallization age of the main part of the Raft batholith. However, Calderwood *et al*. (1990) obtained an upper intercept U-Pb zircon date of 168 +14/–12 Ma from a granodiorite sample collected from the west side of the Clearwater River, about 8 km north of Clearwater. They interpreted this Middle Jurassic date as a magmatic age, although the same sample yielded a biotite K-Ar date of 138 ±6 Ma and a Rb-Sr whole-rock mineral separates isochron date of 104.3 ±3.3 Ma (Jung, 1986).

The relationship between the granodiorite sample dated by Calderwood *et al*. (1990) and the granitic rocks here assigned a mid-Cretaceous age is not known. Although there is large analytical uncertainty in the Jurassic date, similar ages have been obtained from several Jurassic plutons associated with the arcuate belt of mid-Cretaceous granite that extends from the Raft batholith southeastward to the International Boundary (Logan, 2002). The closest such occurrence is about 50 km southeast of Clearwater, where quartz monzodiorite of the Honeymoon stock, on the southern margin of the mid-Cretaceous Baldy batholith, has yielded a Middle Jurassic U-Pb titanite date of 161 ±7.8 Ma (Logan, 2001). Therefore, it is possible that the predominantly mid-Cretaceous Raft batholith encompasses some older, Middle Jurassic phases. In light of this possible heterogeneity, a sample of quartz monzodiorite from the western unit of the Raft batholith was collected during the 2005 field season and submitted for U-Pb dating of zircons.

HENDRIX STOCK

A granitic pluton that intrudes the Nicola volcaniclastic succession at the north end of the map area, east of Hendrix Creek, is informally referred to as the Hendrix stock. The stock has an elliptical shape in plan view, with a northwest-trending major axis about 9 km long, although the northernmost portion lies beyond the limit of the present mapping. The western margin of the stock is obscured by Quaternary drift along Hendrix Creek; consequently, its relationship to the fault that is inferred to follow the creek is unknown.

The Hendrix stock consists mainly of light grey, medium to coarse-grained, equigranular biotite-hornblende monzogranite to granodiorite. Mafic minerals typically make up 10–20% of the rock, with biotite generally predominating over hornblende. Tonalite that was observed along the southern margin of the stock, however, has hornblende as the dominant mafic phase. The stock was assigned a Cretaceous age by Campbell and Tipper (1971). This interpretation is reasonable, as it is lithologically similar to Cretaceous rocks of the Raft batholith, but will be tested by U-Pb dating of zircons from a sample collected during the 2005 field season. The northern margin of the stock, which the authors anticipate mapping in 2006, is spatially associated with a zone of skarn-like mineral showings in the adjacent country rock (Dave Ridley, pers. comm., 2005).

Eocene (?) Sedimentary Rocks West of Canimred Creek

Thin-bedded sedimentary rocks, represented by sparse exposures west of Canimred Creek in the southeastern part of the map area, were first recognized by Schiarizza *et al.* (2002a), and tentatively correlated with an assemblage of Eocene lacustrine sedimentary rocks that crops out in the valley of the Horsefly River, about 60 km to the north-northwest (Wilson, 1977; unit 10 of Panteleyev *et al.*, 1996). The rocks west of Canimred Creek comprise laminated to thin-bedded siltstone and mudstone, in pale shades of purple, grey and green. They dip eastward at moderate angles and are inferred to unconformably overlie Triassic volcaniclastic rocks of the Nicola Group, which crop out to the west. Relationships to the east are masked by a wide belt of unconsolidated Quaternary deposits, but it is suspected that the thin-bedded sedimentary rocks dip into, and are bounded by, a north-northwest-striking fault (Rock Island Lake fault) that follows the valley of Canimred Creek (Schiarizza *et al.*, 2002a).

Eocene Volcanic and Volcaniclastic Rocks (Skull Hill Formation)

Campbell and Tipper (1971) assigned Eocene volcanic rocks in the Bonaparte Lake map sheet to the Skull Hill Formation of the Kamloops Group. The Skull Hill Formation is well represented in the southwestern part of the Canim Lake map area, where it forms a horseshoe-shaped belt, more than 20 km wide, that wraps around the south end of Canim Lake. These rocks form the north end of a continuous belt of Eocene exposures that extends 70 km south to Bonaparte Lake (Fig. 1). The Eocene rocks in the Canim Lake area typically flat lying and markedly less altered and deformed than the Mesozoic rocks. They rest unconformably above the Nicola Group and related intrusions, but are locally separated from the older rocks by north or north-northeast-striking faults. Two outliers of the Skull Hill Formation rest above the Nicola volcaniclastic succession on hilltops east of southern Canim Lake (Fig. 2).

The Skull Hill Formation in the Canim Lake map area consists mainly of grey to brown, red to brown-weathered, pyroxene-feldspar-phyric basalt or andesite, and related flow breccia. Hornblende-feldspar-phyric andesite occurs locally, and pink dacite containing angular fragments of sedimentary and volcanic rock was observed at one locality in the northeast corner of the main exposure belt. The mafic volcanic rocks are commonly vesicular, and vesicles are partially filled with chalcedony, calcite or zeolite minerals.

Sedimentary intervals, dominated by polymictic pebble to cobble conglomerate, occur as local interbeds within the volcanic rocks, and form two mappable subdivisions south of Hawkins Lake. The conglomerate typically consists of angular to subrounded clasts within a somewhat friable, yellow-brown sandy matrix. It is massive to weakly stratified, but locally displays well-defined medium to thick beds with interbeds of lithic wacke. Clast populations are dominated by basaltic to andesitic volcanic fragments derived from the Skull Hill Formation, but also include felsic volcanic rocks that are also suspected to be Eocene. Green chlorite-epidote-altered clasts of volcanic and volcaniclastic rock, probably derived from the Nicola Group, were observed in only one exposure, 1 km south of the east end of Hawkins Lake.

Quaternary Volcanic Rocks

Flat-lying basalt flows crop out in several valleys in the eastern part of the Canim Lake map area (Fig. 2). Campbell and Tipper (1971) assigned these rocks to the Miocene–Pliocene Chilcotin basalt, which covers much of the Interior Plateau to the west (Mathews, 1989). However, more detailed study by Hickson and Souther (1984) and Hickson (1986) indicated that they are outliers of the younger Clearwater – Wells Gray volcanic field, which is a prominent feature of Wells Gray Park to the east. The Clearwater – Wells Gray volcanic rocks are, like the Chilcotin basalt, mainly alkali olivine basalt, but are almost entirely Pleistocene and Holocene in age.

Actual exposures of Quaternary volcanic rocks are restricted to stream cuts along the Canim River and Hendrix and Deception creeks. Their distribution on Figure 2 is based on extrapolating these exposures to adjacent areas of flat, plateau-like topography, where the basalt is inferred to underlie a thin veneer of alluvium and/or glacial deposits; locally their extent can also be inferred from positive anomalies on regional aeromagnetic maps. The most extensive exposures are along the Canim River below the outlet of Canim Lake, including Canim and Mahood falls. These flows are inferred to extend eastward to Deception Creek, where small exposures occur on the west side of Deception Falls. An isolated outlier farther upstream, below the confluence of Spanish Creek, is represented by one small exposure in the creek bed, but its extent is shown by a well-defined aeromagnetic anomaly. This outlier may have once been continuous with the extensive flows exposed along Spanish Creek, 7 km to the east. Good exposures also occur along Hendrix Creek at and downstream from Hendrix Falls, where about 20 m of basalt represents an outlier of restricted aerial extent. Quaternary basalt inferred to underlie the southeast corner of the map area forms the west end of a broad volcanic plateau that extends westward from Mann Creek (Schiarizza *et al.*, 2002a, b).

The Quaternary volcanic rocks exposed in the Canim Lake area consist mainly of dark grey vesicular basalt that commonly contains small olivine phenocrysts. The basalt occurs as multiple, thin, columnar-jointed subaerial flows, with an aggregate thickness of several tens of metres in the thickest sections exposed along the Canim River. The basal contact was observed at one locality, on the east side of Deception Falls, where the basalt is separated from the underlying Lemieux Creek succession by a thin veneer of unconsolidated till, confirming its Pleistocene or younger age.

STRUCTURE

Mesoscopic Structure

Mesoscopic structures observed in the Lemieux Creek succession include a well-developed slaty to phyllitic cleavage that is axial planar to folds of bedding, and a crenulation cleavage, with associated crenulation lineation and mesoscopic folds, that deforms the slaty cleavage. The crenulation cleavage strikes north-northwest to north, and dips steeply to the east or west. Associated folds and crenulations plunge at moderate angles to the north or northwest. Slaty cleavage and bedding are more variable in orientation, but commonly dip at moderate angles to the southwest or northeast. Folds associated with formation of the slaty cleavage were observed only rarely, northeast of lower Deception Creek, where they plunge steeply to the south-southwest.

The polyphase mesoscopic structures within the Lemieux Creek succession are similar to structures documented within correlative rocks to the north (Bloodgood, 1990; Rees, 1987). This deformation is attributed to east-directed thrusting of the Quesnel and Slide Mountain terranes over the Kootenay terrane in late Early Jurassic time, and subsequent early Middle Jurassic folding of these thrust faults by west-verging folds (Ross *et al*., 1985; Brown *et al*., 1986).

Fabrics comparable to those of the Lemieux Creek succession are generally not apparent in the Nicola volcaniclastic succession, although slaty cleavage was observed within fine-grained intervals intercalated with coarse volcaniclastic rocks in a few areas just west of the contact between the two units. Elsewhere, outcrop-scale structures within the volcaniclastic succession consist mainly of brittle faults and fractures. Mesoscopic folds of bedding were noted only rarely, and penetrative foliations are, for the most part, restricted to local high-strain zones associated with faults and pluton margins. Foliated rocks are most common within the breccia subunit where it borders the Schoolhouse Lake unit of the Takomkane batholith, particularly in the north-tapering wedge between the batholith and the Iron Lake complex (Fig. 2).

Map-Scale Structure

The macroscopic structure of the Canim Lake map area is not well understood, in part due to poor exposure and in part because of the lack of reliable marker beds within either the Lemieux Creek succession or the Nicola volcaniclastic succession. Mapped structures consist of north-northwest to northeast-trending faults that cut the Nicola volcaniclastic succession. Eocene volcanic rocks of the Skull Hill Formation are cut by some of these faults but are generally flat lying and show little internal deformation. Eocene (?) sedimentary rocks west of Canimred Creek, however, dip at moderate angles to the east, presumably due to rotation along the adjacent Rock Island Lake fault. In contrast to the Eocene rocks, strata of the Nicola volcaniclastic succession show highly variable orientations, with common steep to overturned dips, indicating significant pre-Eocene deformation. It is suspected that much of this deformation was Early to Middle Jurassic and related to the regional events that generated the mesoscopic structural fabrics that are common in the Lemieux Creek succession.

Despite the lack of a detailed understanding, some general features of the structure of the Nicola rocks can be noted. East of the Rock Island Lake fault, the contact between the Lemieux Creek and volcaniclastic successions, together with a mappable breccia subunit within the volcaniclastic succession, strike northward, without major disruption, from the Raft batholith to the northern limit of the map area, suggesting that the Nicola rocks in the eastern part of the area form a coherent, west-facing panel. Bedding dips mainly at moderate to steep angles toward the west, but east-dipping overturned beds are common in the lower part of the volcaniclastic succession. In the southern part of the map area, the volcaniclastic succession east of the Rock Island Lake fault forms a predominantly west-facing and west-dipping panel that is overlain, to the west, by Early Jurassic rocks. East-facing beds were noted at one place in the northern part of this belt, however, suggesting that the internal structure may be complicated. Furthermore, the Nicola rocks are unconformably overlain by east-dipping Eocene (?) sedimentary rocks directly west of Canimred Creek, suggesting that this panel has undergone some rotation adjacent to the Rock Island Lake fault. The Nicola volcaniclastic succession south of the Hawkins Creek fault appears to form a northwest-facing homoclinal panel, with southeast-dipping overturned beds predominating in the section between Canim Lake and the Howard Lake fault. The panel of rocks north of the Hawkins Creek fault also faces to the northwest and, for the most part, dips at moderate angles in that direction. However, bedding swings to a north-striking, west-dipping orientation in the northern part of this domain, in the area between the Takomkane batholith and the Rock Island Lake fault.

ROCK ISLAND LAKE FAULT

The Rock Island Lake fault is the main component of a system of steep brittle faults that Schiarizza and Israel (2001) traced from Little Fort northwestward to Canimred Creek. These faults are best exposed near Little Fort, where they cut rocks as young as the Eocene Chu Chua Formation and display kinematic indicators suggesting mainly dextral strike-slip movement. It is suspected that the Rock Island Lake fault continues to the northern boundary of the Canim Lake map area along a system of topographic linears, locally coincident with truncations of aeromagnetic patterns, defined by the drift-covered valleys of Canimred Creek, lower Boss Creek and Hendrix Creek (Fig. 2, 3). The segment inferred along Canimred Creek may truncate the poorly exposed panel of east-dipping Eocene (?) siltstone and mudstone mapped west of the creek. The inferred trace in the northern part of the area separates a belt of northerly-striking stratigraphic units to the east from a belt with mainly northeast strikes to the west.

NORTHEAST-TRENDING FAULTS

The Hawkins Lake fault extends northeastward from the western boundary of the map area through a series of topographic lineaments that include Hawkins Lake, Christmas Creek and Christmas Lake. The southwestern segment of the fault separates the Takomkane batholith and adjacent Nicola rocks of the breccia subunit from Eocene conglomerate to the south. The northeastern segment is mainly within undivided rocks of the Nicola volcaniclastic succession, but is marked by an apparently broad area of poorly exposed quartz-pyrite and carbonate-altered rocks. An exposure of heavily fractured, faulted and chlorite-epidote-calcite-altered pillowed basalt on the north side of Canim-Hendrix road, east of Eagle Creek, is near the inferred trace of the fault. The most prominent faults cutting this exposure strike north-northeast to northeast, dip steeply and contain gently plunging calcite fibres with accretion steps indicating dextral strike-slip movement.

The north-northeast-striking Howard Lake fault extends through the west end of Howard Lake to Canim Lake. It separates volcanic sandstone of the Nicola volcaniclastic succession on its west side from the basalt subunit and Howard Lake stock to the east. The fault follows a prominent topographic lineament over much of its length north of Howard Lake. Rare isolated exposures observed near this trace are so highly fractured, calcite altered and weathered that their protolith could not be established with certainty. It is suspected, but not proven, that the fault is Eocene or younger, because Eocene volcanic rocks are much more extensive on its east side and may be truncated by it south of Howard Lake. These relationships suggest that the fault has a component of east-side-down displacement.

A north-northeast-striking fault is inferred within the Nicola volcaniclastic succession north of the east end of Canim Lake, based on the apparent offset of the breccia subunit. The fault trace follows a prominent topographic depression, in part, and corresponds to an apparent dextral offset of the breccia subunit (Fig. 2).

NORTH-TRENDING FAULTS

A north-trending fault in the south-central part of the Canim Lake map area is part of a system of north to northwest-striking faults that define the eastern limit of Eocene volcanic rocks north of the Thuya batholith (Fig. 3). Displacement along this fault appears to die out northward within the current map area. However, 13 km to the west, a parallel fault is inferred to define the eastern limit of Eocene rocks on the west side of Canim Lake. Here, the contact between Eocene and Nicola rocks is fairly well defined but not exposed. Evidence for a fault is the apparent truncation of the contact between the conglomerate and volcanic units of the Eocene assemblage, and the abrupt development of a strong, steeply dipping, north-striking foliation in Nicola rocks near the Eocene contact. This north-striking fault is apparently truncated to the north by the northeast-trending Hawkins Lake fault.

MINERAL OCCURRENCES

The known mineral occurrences in the Canim Lake map area are shown on Figure 10. Many are Cu and/or Au showings, locally enriched in Pt-Pd, associated with ultramafic, dioritic and monzonitic plutonic rocks of the Quesnel Terrane. Others include vein and shear zone–hosted occurrences that are being explored for precious metals. Porphyry Mo occurrences are associated with mid-Cretaceous granitic rocks of the Raft batholith. The MINFILE (2005) number is included after the name of each occurrence for ease of reference.

Occurrences Associated with the Iron Lake Complex

IRON LAKE (092P 132)

The Iron Lake occurrence comprises Cu-Au-Pt-Pd-Co mineralization within ultramafic rocks of the Iron Lake complex. The area was staked as the Sheri claims by Pickands Mather and Company in 1972. Low-grade Cu mineralization was discovered during a 1972–1974 exploration program that included geological mapping, a soil geochemical survey, magnetometer and IP geophysical surveys, and 694 m of diamond drilling in eight holes. The Sheri claims were allowed to lapse, but the area was subsequently covered by the Ironhorse claims from 1983 to 1987, and the Horse and Canim claims from 1987 to 1992. Exploration work was carried out by a number of individuals and companies during this time period, and the focus shifted from Cu to precious metals when anomalous Au and Pt values were returned from multielement analyses of selected core samples from the 1974 Pickands Mather drill program. The Canim and Horse claims were allowed to lapse in the early 1990s, and the Iron Lake property was restaked by Eastfield Resources Limited in 2000. The property was subsequently optioned to Argent Resources Limited, who completed a helicopter-borne electromagnetic and magnetic survey in 2004, and a four-hole, 502.7 m diamond-drill program in the winter of 2005.

Visible low-grade Cu mineralization occurs sporadically within a west-northwest-trending belt 3 km long on the Iron Lake property, but is concentrated mainly in the eastern part of this belt, near Island Lake (Buskas, 1989). Mineralization includes pyrite and chalcopyrite as blebs and disseminations in clinopyroxenite, hornblendite and gabbro, and pyrite with traces of chalcopyrite in quartz-carbonate-altered shear zones. The quartz-carbonate-altered zones also contain Au, Pt, Pd and Co (Morton, 1984; Buskas, 1989). A different style of mineralization is represented by several large, angular pieces of mineralized rubble that were discovered southeast of Island Lake in 2000. The rubble consists of olivine pyroxenite containing disseminated bornite, chalcopyrite and magnetite. Analyzed samples of this material consistently graded about 0.60% Cu, 0.55 ppm Au, 0.20 ppm Pd and 0.10 ppm Pt (Morton, 2001).

Two of the four diamond-drill holes completed on the Iron Lake property by Argent Resources early in 2005 intersected massive sulphide mineralization (Eastfield Resources Limited, news release, March 15, 2005). In one hole, a section of hornblendite contained a 1.4 m intercept of mainly pyrrhotite with lesser chalcopyrite, and graded 0.66% Cu, 299 ppm Ni and 1349 ppm Co. In the other hole, a 17 m sulphide-rich intersection in peridotite contained 0.34% Cu and 359 ppm Ni, and included 1.4 m of massive sulphide that graded 0.95% Cu, 927 ppm Ni and 836 ppm Co. None of these sulphide intervals yielded significant platinum group element or Au values.

JULY (092P 112) AND BEER (092P 125)

The July and Beer occurrences comprise low-grade Cu mineralization within and adjacent to the Iron Lake ultramafic-mafic complex northeast of Roger Lake. The Beer showing is on ground that was covered by the Beer claims, which were staked in 1970 and explored by Aragon Resources Ltd. in 1971 and 1972 (Cukor, 1973). The July claims, which covered both the July and Beer showings, were staked and explored by Utah Mines Ltd. in 1972 (Gatchalian, 1972). Work performed by these two companies included geological mapping, soil geochemical surveys, magnetometer surveys, an IP survey and bulldozer trenching. Both claim groups were allowed to lapse in the early 1970s. The two occurrences were subsequently covered by the Straw claim group, which was staked in 1993 and explored with a small program that included prospecting and a soil geochemical survey (Ridley and Dunn, 1994a).

The July showings occur in an area that is underlain mainly by pyroxenite, hornblende pyroxenite and mafic gabbro, cut by numerous dikes of diorite, monzodiorite and monzonite. Local areas of intense diking grade into intrusion breccia, comprising fragments of ultramafic rock, mafic gabbro and diorite within a matrix of leucocratic monzodiorite to diorite. Chlorite-epidote alteration is ubiquitous, and calcite, magnetite and K-feldspar are also common in late-stage veinlets and alteration patches. Mineralization is widespread, but not common and of low grade. It comprises scattered grains and small blebs of chalcopyrite, bornite and malachite, commonly associated with magne-

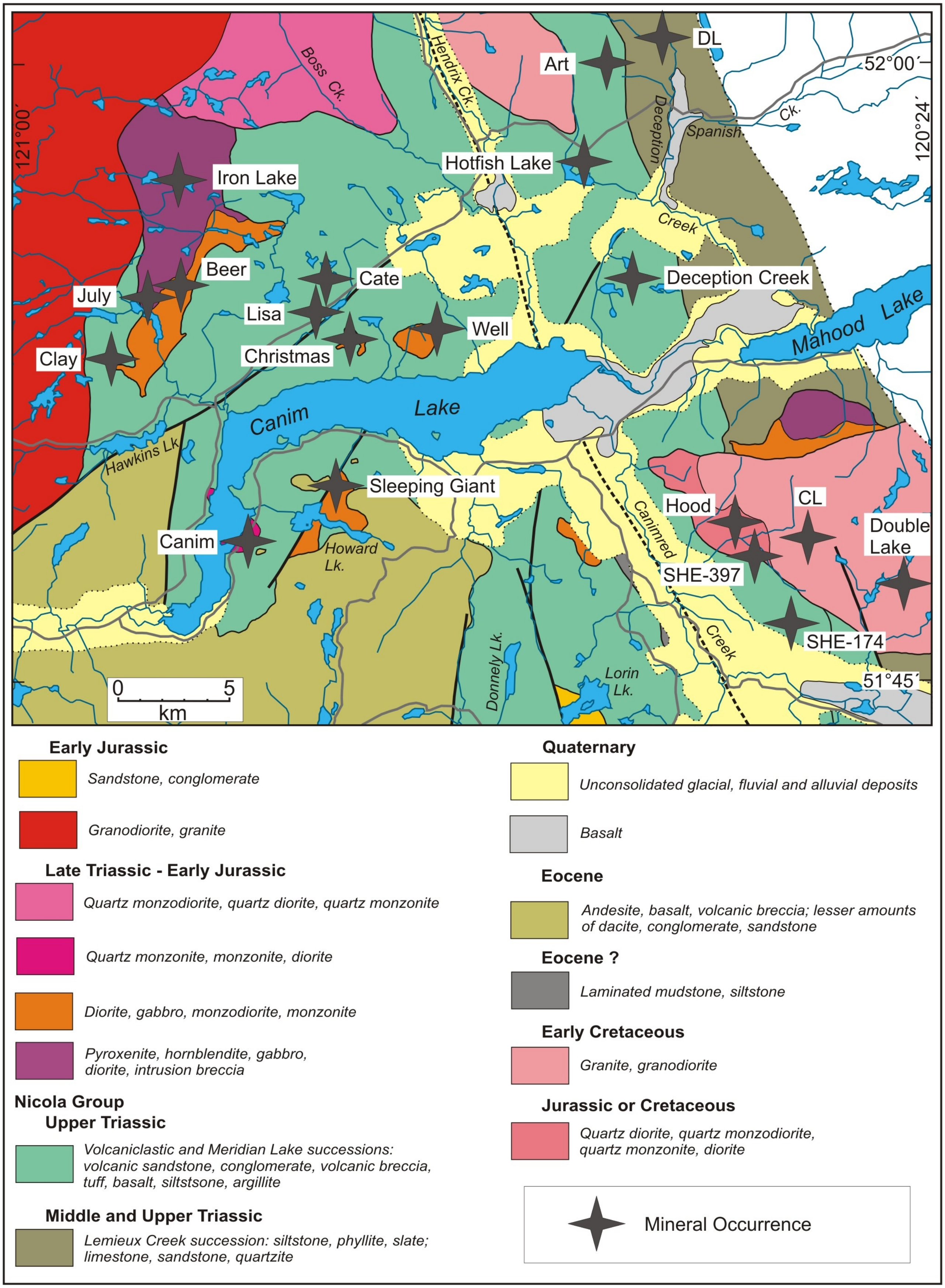


Figure 10. Mineral occurrences in the Canim Lake map area.

tite and/or disseminated pyrite (Gatchalian, 1972; this study). Host rocks are most commonly dioritic to monzonitic dikes or intrusion breccia matrix, but also include pyroxenite, gabbro and foliated volcanic breccia along the western contact of the intrusive complex.

The Beer showing comprises scattered occurrences of disseminated chalcopyrite and malachite that were identified on the Beer grid by Cukor (1973). The hostrocks were interpreted as mainly volcanic by Cukor (1973), but are herein interpreted as mainly variably altered medium to fine-grained diorite, monzodiorite and monzonite of the Iron Lake complex. However, some fine-grained, heavily chlorite-epidote-calcite-magnetite-altered rocks might be screens of volcanic country rock. The mineralization and alteration at the Beer showing is much the same as, and essentially a continuation of, the widespread but sparse and low-grade mineralization of the July showing.

CLAY (092P 155)

The Clay occurrence consists of Cu-Au mineralization within volcanic breccia of the Nicola volcaniclastic succession, adjacent to diorite and monzodiorite of the Iron Lake complex. The mineralization was discovered in 1978, and the property was explored by several different companies from then until 1994. Exploration work included geological mapping, soil geochemical surveys, magnetometer and IP surveys and trenching. It also included an 11 hole, 424 m diamond-drilling program carried out by Alcare Resources Inc. in 1982 (Werner, 1982) and a four hole, 397 m diamond-drilling program carried out by Noranda in 1985 (Baerg, 1985).

Mineralization at the Clay showing comprises disseminations, blebs and fracture coatings of bornite, malachite and, locally, chalcopyrite, commonly associated with pink calcite veins (Baerg, 1985). The hostrocks are chlorite-epidote-altered volcanic breccia, intercalated with a lens of skarny limestone and cut by diorite to monzonite dikes that are probably related to the adjacent Iron Lake complex. Mineralization is concentrated in a north-trending zone, 20–30 m wide, that has been traced discontinuously on surface and in drill holes for about 200 m (Baerg, 1985). The highest grades recorded in drillcore from the northern part of this zone came from a 61 cm intersection that yielded 2.17% Cu, 28 ppm Ag and 6.13 ppm Au (Werner, 1982). A 19.66 m intercept at the south end of the zone returned an average of 1190 ppm Cu, 1.92 ppm Ag and 233 ppb Au (Baerg, 1985).

Occurrences in the Christmas Lake Area

CHRISTMAS (092P 110) AND LISA

The Christmas occurrence, comprising gold mineralization within sulphide-rich hornfels adjacent to dioritic intrusions, is located about halfway between Christmas Lake and the north shore of Canim Lake. This area was covered by the RK claims and explored for porphyry Cu mineralization in the early 1970s. It was restaked as the Christmas claims by E&B Explorations Inc. in 1983, and from 1983 to 1987 explored with geological mapping, rock and soil geochemical surveys, and magnetometer, VLF-EM and IP geophysical surveys (Thompson, 1987). The property was optioned by Nustar Resources Inc. in 2002. Nustar explored the area of the main showing in 2002 and 2003 with trenching, rock sampling and 305 m of diamond drilling in two holes (McLeod, 2003). In 2004, they conducted soil geochemical and self-potential surveys over the Lisa showing, almost 2 km northwest of the main showing, where rubble of Au-arsenopyrite-mineralized quartz-ankerite vein material had been discovered in 1987 (Thompson, 1987; McLeod, 2004).

The area of the main Christmas showing is underlain by volcanic sandstone, siltstone, breccia and mafic flows of the Nicola volcaniclastic succession. These rocks are variably silicified and hornfelsed adjacent to a complex stock and/or dike swarm consisting mainly of hornblende diorite. The hornfelsed rocks commonly contain 1–2% disseminated pyrite. Gold mineralization is mainly associated with zones of higher sulphide content, which include pyrite, pyrrhotite and, locally, chalcopyrite and arsenopyrite. The highest assay value reported from the main zone is 5.910 ppm Au from a grab sample containing 30% pyrrhotite (Thompson, 1987).

The Lisa showing comprises rubble of arsenopyrite-mineralized quartz-ankerite vein material that was discovered during follow-up examination of a 4.027 ppm gold in soils anomaly. Two rock samples of the arsenopyrite-mineralized float returned assay values of 2.537 and 3.510 ppm Au, respectively (Thompson, 1987).

WELL (092P 144)

The Well occurrence is located on the north side of Canim Lake, 4.5 km west of Boss Creek. It consists of disseminated pyrite, with rare traces of chalcopyrite, within volcanic sandstone and breccia of the Nicola volcaniclastic succession, on the northeast margin of a diorite stock. It forms part of a prominent aeromagnetic high that was staked as the Well claim, and explored with geological mapping and a soil geochemical survey, by Du Pont of Canada Exploration Limited in 1975 (Smith, 1976). This exploration program failed to detect any significant mineralization and no subsequent work has been recorded in this area.

CATE (092P 182)

The Cate showing comprises a narrow, Au-bearing sulphide vein that is hosted in a shear zone exposed along a logging road about 1.5 km north of Christmas Lake. It is one of about a dozen vein and/or shear-related Cu±Au occurrences that have been identified on the Papoose claims, staked by Dave Ridley in 1993 and 1994. These claims cover an area that had previously been staked by Imperial Metals in 1983 (Senicar claims), and explored in 1984 through 1988 with geological mapping, soil and silt geochemical surveys, trenching and an IP survey.

The Papoose claims are underlain mainly by volcanic sandstone, breccia, siltstone and argillite assigned to the Nicola volcaniclastic succession, locally cut by dikes of diorite, gabbro and feldspar porphyry. Mineralization consists of local shear zones, quartz-carbonate veins and stockworks mineralized with variable amounts and combinations of pyrite, pyrrhotite, arsenopyrite and chalcopyrite (Ridley, and Dunn, 1993b; Ridley, 1995, 1997). These occurrences have been documented in a northwest-trending belt almost 1.5 km long. The Cate showing, discovered in 1993, comprises a steep, north-northeast-striking shear zone that includes a massive, 2 cm wide sulphide vein, consisting of pyrrhotite, arsenopyrite, pyrite and chalcopyrite. The shear zone separates diorite to the west from feldspar porphyry to the east, and is located at the southeast end of the belt of known mineralization. A 60 cm chip sample across the shear zone returned 1.32 ppm Au, 8985 ppm As and 210 ppm Cu, whereas a grab sample of the massive sulphide vein contained 74.9 ppm Au, 20.6 ppm Ag, 1835 ppm Cu and greater than 1% As (Ridley and Dunn, 1993b). Ridley (1997) pointed out that mineralization at the Cate showing resembles, and is more or less along strike from, that at the Liza showing, 1.3 km to the south-southwest.

Occurrences in the Howard Lake Area

SLEEPING GIANT (092P 128)

The Sleeping Giant occurrence comprises disseminated and fracture-controlled Cu mineralization within the Howard Lake stock. The showings were covered by the RM claim group in 1972 and, over the next two years, explored with a program that included geological mapping; soil, silt and rock geochemical sampling; ground magnetometer and IP surveys; and bulldozer trenching (Fox, 1973). An 18 hole percussion-drill program, totalling 1222 m, was carried out in 1974, but the results were disappointing and the RM claims were allowed to lapse (Rebagliati, 1974). The area was covered by the Sleeping Giant claim group in 1989, and explored by rock and soil geochemical sampling in 1990 (Ridley, 1990). These claims were also allowed to lapse, but the showings were staked as the S.G. 1 claim in 1993, and a small area of previously untested ground was tested with 63 m of diamond drilling, which did not intersect any mineralization (Ridley and Dunn, 1994b).

The main Sleeping Giant showings are hosted in fractured dioritic intrusion breccia about 1 km north of Howard Lake. Mineralization occurs over an area 300–400 m in diameter, and consists of thin fracture fillings and disseminated grains of pyrite, chalcopyrite and local bornite (Fox, 1973; Ridley, 1990). The mineralization occurs in breccia fragments and matrix, and is accompanied by chlorite, epidote, K-feldspar and magnetite alteration. Pyrite and chalcopyrite also occur as disseminations and fracture fillings in syenitic rocks several hundred metres north of the breccia showings (Pat Lake showing; Ridley, 1990). Although the mineralization is quite widespread, geochemical analyses of percussion-drill cuttings from the main Sleeping Giant showings returned only low Cu values and no significant Au values (Rebagliati, 1974).

CANIM (092P 158)

The Canim showing consists of fracture-controlled Cu-Au-Ag mineralization within the South Canim stock. It was first described by Ridley (1986) following a prospecting survey of the Canim 1 mineral claim, although the south Canim stock is part of a broader area, stretching northeastward to Howard Lake, that underwent several phases of porphyry Cu exploration, beginning in the late 1960s.

Ridley (1986) described three separate mineralized zones within the South Canim stock. The main zone covers an area measuring about 120 m (north-south) by 50 m. Mineralization consists mainly of pyrite-chalcopyrite-magnetite-quartz within narrow (1–3 cm) fractures that dip at moderate angles to the northeast. Wallrocks are commonly altered to chlorite-epidote, and may be cut by sulphide-bearing veinlets oriented at high angles to the main mineralized fractures. A 1 m chip sample along one of the main mineralized fractures returned 19 556 ppm Cu and 16.6 ppm Ag (Ridley, 1986, sample 85-8). The highest precious metal values, 1420 ppb Au and 28.1 ppm Ag, came from a weathered fracture filling consisting of limonite with traces of pyrite, chalcopyrite and malachite (Ridley, 1986, sample 85-14). Stockwork-style veins mineralized with pyrite-chalcopyrite-magnetite-quartz were also located at the north showing, 200 m north of the main zone, and at the northernmost showing, 350 m north of the main zone (Ridley, 1986).

Occurrences in the Northwestern Part of the Map Area

DECEPTION CREEK (092P 130)

The Deception Creek occurrence comprises minor Cu and Zn mineralization within volcanic breccia, tuff, sandstone and argillite of the Nicola volcaniclastic succession near Christopher Lake, 3–4 km north-northeast of the east end of Canim Lake. The Chris claims were staked over the area by Pickands Mather and Company in the fall of 1972, and minor disseminated chalcopyrite was discovered during an exploration program in 1973, which included geological mapping and soil sampling (Pollmer and Dodd, 1973). More extensive exploration was carried out in the early to mid-1980s, after the area was restaked as the W claims by Archean Engineering Limited. This work included geological mapping; silt, soil and heavy mineral geochemical surveys; and VLF-EM surveys. It culminated in a four-hole diamond-drilling program in 1986, which tested two elongate VLF-EM conductors and coincident Zn soil anomalies for possible Cu-Zn massive sulphide mineralization. The holes encountered very minor mineralization, comprising pyrite, pyrrhotite and rare traces of chalcopyrite and sphalerite within quartz-calcite stringers. It was concluded that unmineralized graphitic argillite produced both the VLF-EM conductors and the Zn soil anomalies, and it was recommended that no further work be conducted on the property (Holmgren and Kowalchuk, 1986).

HOTFISH LAKE (092P 184)

The Hotfish Lake showing comprises mineralized quartz-carbonate veins located along and near the logging road northeast of Hotfish Lake. The veins were discovered during a 1994 exploration program on the Fish mineral claims that included line cutting; soil, silt and rock geochemical sampling; and a small amount of hand stripping (Wahl, 1994). There has been no subsequent work recorded on the claims.

The Hotfish Lake showing includes three separate quartz-carbonate veins, individually located in small isolated exposures that form a belt about 400 m long in a north-northwesterly direction (Wahl, 1994). The hostrocks observed during the present study are thin-bedded siltstone, calcareous siltstone and local volcanic sandstone of the Nicola volcaniclastic succession, although Wahl (1994) interpreted the vein hosts as mainly felsic volcanic rocks. The sedimentary rocks are complexly folded, mainly along westerly-plunging axes, and are faulted and fractured in multiple orientations. They are brecciated in fold hinges and along faults, and these breccias are typically altered to an assemblage that includes calcite, quartz, chlorite and pyrite. The three steeply dipping quartz-carbonate veins described by Wahl (1994) are 10 cm, 10–20 cm and 50–60 cm thick, respectively, and strike 170°, 235° and 198°. All are mineralized with pyrite and chalcopyrite, and one also contains sphalerite. An assay sample from the sphalerite-bearing vein, which is 10 cm wide, yielded 2175 ppm Cu, 1343 ppm Zn, 9.9 ppm Ag and 140 ppb Au (Wahl, 1994, sample SHF-3R).

ART (093A 200)

The Art showing is located near the northern boundary of the map area, about 1.5 km east of the Hendrix stock. The showing was discovered and staked by Dave Ridley in 1997, along the newly constructed Art Creek logging road. Subsequent work has included geological mapping, rock and soil geochemical surveys, a combined magnetometer and VLF-EM geophysical survey, and limited diamond drilling (Adamec, 1999; Ridley, 2001; Blann and Ridley, 2005).

Exposures in the general area of the Art showing are mainly volcanic breccia, with local pyroxene-phyric basalt, volcanic sandstone and siltstone, assigned to the breccia subunit of the Nicola volcaniclastic succession. The showing itself is within a light grey, tan-weathered, fine-grained felsite that forms a 30 m stretch of outcrop in the east bank of the Art Creek logging road. The felsite, together with diorite exposed 50 m to the south, appears to intrude the Nicola succession. The discovery showing, as presently exposed, comprises a 60 cm by 120 cm exposure in the ditch between the main felsite outcrop and the road. It consists of rusty, silicified, highly fractured felsite that contains clots, up to several centimetres across, of fine to coarsely crystalline pyrite-arsenopyrite. The predominant fracture orientation, parallel to the long axis of the showing outcrop, suggests that it is part of a north-northeast-striking fault zone within the felsite. A grab sample of mineralized material collected during the 2005 field season contained 50 ppb Au, 1914.6 ppm As and 7.02 ppm Sb; the moderate Au enrichment and high As values are consistent with values obtained from two separate 1 m chip samples reported by Adamec (1999). A shallow drillhole, collared on the road in 2001, was oriented to the south so did not crosscut the strongly mineralized zone, although the upper part of the hole cut moderately fractured felsite with calcite veinlets and local areas of disseminated sulphide minerals that include pyrite, arsenopyrite and traces of chalcopyrite. Samples from this interval returned an average of 167 ppb Au and 3500 ppm As over 12 m of core length (Ridley, 2001). Angular float of heavily pyrite-altered dioritic rock from near the diorite outcrop south of the felsite returned 1474 ppb Au (Blann and Ridley, 2005).

DL (093A 089)

The DL occurrence, in the northwest corner of the map area, comprises Au-bearing quartz veins hosted in phyllite of the Lemieux Creek succession. The showings are located about 400 m west of Deception Creek, along an east-flowing tributary stream. Gold mineralization from this general area is briefly mentioned in the BC Minister of Mines Annual Report for 1886 (Soues, 1887), and an old adit and trenches on the property may date from that time period (Ridley, 1992). These workings were staked as the REC claim in 1987, and evaluated with a limited program of mapping and rock sampling (Durfeld, 1988). The REC claim was allowed to lapse, and the showings were subsequently covered by the DL claim group, staked by their current owner, Dave Ridley, in 1991. Exploration since that time has included geological mapping, soil and rock geochemical sampling, magnetometer and VLF-EM geophysical surveys, and limited diamond drilling (Ridley and Dunn, 1993a; Christopher, 1999; Blann and Ridley, 2005).

The area of the DL showing is underlain by dark grey phyllite, commonly with small rusted porphyroblasts of Fe-carbonate. Cleavage is warped and variable in orientation, but it typically dips at moderate angles to the north or northeast. The phyllite is cut by tan-weathered feldspar±quartz porphyry dikes, and by lenses and veins of quartz which range from less than 1 cm to 2 m in width. Most dikes and veins are oriented approximately parallel to cleavage, but some narrow planar quartz veins are discordant. Many veins include knots of rusty carbonate, and some thicker veins contain fragments of wallrock. Most quartz veins do not contain sulphide minerals, but the Au-bearing veins in the area of the old workings locally contain pyrite, galena, tetrahedrite and chalcopyrite (Durfeld, 1988). Exploration to date has documented significant Au mineralization only in the immediate vicinity of these old workings, which include an adit oriented at about 015° in the north bank of the creek. There, the main mineralized zone is about 2 m wide and comprises several quartz veins, from 5 cm to 1 m thick, separated by thin lenses of phyllite (Ridley and Dunn, 1993a). A 1 m chip sample that included the main adit vein returned 42.9 ppm Au and 34.7 ppm Ag. (Ridley, 1992). A sample of pyrite-galena-mineralized vein material from an old trench about 20 m east of the adit yielded 1.22 ppm Au, 620 ppm Ag and 51 592 ppm Pb (Durfeld, 1988).

Occurrences Associated with the Raft Batholith

Mineral occurrences in the southeastern part of the Canim Lake map area are within and peripheral to the Raft batholith. These include porphyry Mo showings within the main monzogranite phase of the batholith. (CL and Double Lake occurrences), disseminated chalcopyrite ±molybdenite occurrences within the western quartz monzodiorite to diorite phase of the batholith (Hood and SHE-397 showings), and a base metal–bearing fault zone within the Nicola Group, near the south margin of the batholith (SHE-174 occurrence). All of these showings are described by Schiarizza *et al*. (2002a), so are not discussed here.

SUMMARY OF MAIN CONCLUSIONS

- The Canim Lake map area is underlain mainly by sedimentary and volcanic rocks of the Middle to Upper Triassic Nicola Group, together with Late Triassic to Early Jurassic ultramafic to granitic plutonic rocks. These rocks are all part of the Quesnel magmatic arc. Younger rocks in the map area include mid-Cretaceous granite and granodiorite of the Raft batholith and Hendrix stock, Eocene volcanic and sedimentary rocks, and Quaternary basalt.
- The Nicola Group in the Canim Lake map area includes two major subdivisions. The Lemieux Creek succession forms the eastern part of the belt and consists mainly of slate, phyllite and siltstone. It is assigned a Middle to Upper Triassic age based on correlation with rocks south of the Raft batholith. The volcaniclastic succession forms a wide outcrop belt to the west, and is inferred to stratigraphically overlie the Lemieux Creek succession. It consists of massive to well-bedded volcanic sandstone intercalated with pyroxene-rich volcanic breccia and mafic flows. It is not dated within the map area, but is as-

signed a Late Triassic age based on correlation with rocks to the south.

- Intrusive rocks assigned to the Quesnel magmatic arc include the Iron Lake and Aqua Creek ultramafic-mafic plutonic complexes, several small stocks of diorite to monzonite composition, and the Takomkane batholith, which is subdivided into a granodiorite phase (Schoolhouse Lake unit) and a quartz monzodiorite phase (Boss Creek unit). Only the Schoolhouse Lake unit of the Takomkane batholith is currently dated; it has yielded an Early Jurassic U-Pb zircon age of 193.5 ±0.6 Ma (Whiteaker *et al*., 1998). Dating of other plutonic units is in progress.
- Widespread, low-grade Cu mineralization, locally accompanied by Au, Pt and Pd, is found within and adjacent to the Iron Lake ultramafic-mafic complex. Disseminated and fracture-controlled Cu±Au mineralization also occurs within the Howard Lake and South Canim dioritic to monzonitic stocks. Other mineral occurrences in the Canim Lake map area include Au-bearing quartz±carbonate veins, mineralized shears, and porphyry Mo showings within mid-Cretaceous granite of the Raft batholith.

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