Geology of Quesnel and Slide Mountain Terranes West of Clearwater, South-Central British Columbia (92P/9, 10, 15, 16)

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KEYWORDS: *Quesnel Terrane, Nicola Group, Harper Ranch Group, Triassic-Jurassic plutons, Thuya Batholith, Slide Mountain Terrane, Fennell Formation, Raft Batholith, copper, molybdenum, dextral strike-slip.*

INTRODUCTION

The Bonaparte project is a multi-year bedrock mapping program initiated by the British Columbia Geological Survey during the 2000 field season. The project is focused on Mesozoic arc volcanic and plutonic rocks of the Quesnel Terrane in the northeastern part of the Bonaparte Lake (92P) map sheet (Figure 1). This area encompasses a northwest-trending belt of high mineral potential that includes a number of interesting mineral occurrences, as well as numerous regional geochemical survey and till geochemical anomalies. The Bonaparte project will improve the quality and detail of bedrock maps for the area, which are based primarily on 1:250 000-scale mapping carried out by the Geological Survey of Canada in the 1960s. The new mapping will provide an improved geologic framework for interpreting the mineral occurrences and geochemical anomalies, and for predicting favourable settings for future discoveries.

The initial mapping for the Bonaparte Project covered about 700 square kilometres within and adjacent to the Nehalliston Plateau, and is summarized by Schiarizza and Israel (2001). Fieldwork in June through August, 2001, extended this mapping northward to the south margin of the Raft Batholith, covering an additional 900 square kilometres (Figure 1). Here, we present preliminary results from this second year of mapping, together with some revisions to the interpretations presented by Schiarizza and Israel (2001) based on new fossil data.

The area described in this report is bounded on the east by the North Thompson River, which is followed by Highway 5 and the main line of the Canadian National Railway. Highway 24 branches westward from Highway 5 at the town of Little Fort and cuts across the southern part of the area to eventually connect with Highway 97 south of 100 Mile House. An east-west transect across the northern part of the area is provided by the Camp 2 logging road between Clearwater and Canim Lake. An extensive network of secondary logging and Forest Service roads that branch from these major roads provides easy access to most parts of the map area.

The geological interpretations presented here build on the 1:250 000-scale mapping of Campbell and Tipper (1971), whose work incorporated earlier studies along the North Thompson River by Uglow (1922) and Walker (1931). Our work also incorporates the work of Preto (1970) who focused on mineral occurrences in the area north of Eakin Creek, and descriptions of geology and mineralization of a more local nature that are found in Assessment Reports and annual reports of the Ministry of Energy and Mines.

REGIONAL GEOLOGIC SETTING

The Bonaparte Project area is situated in the eastern Intermontane Belt, which is underlain mainly by Upper Paleozoic to Lower Mesozoic arc volcanic, plutonic and sedimentary rocks of the Quesnel Terrane. Farther west within the Intermontane Belt are coeval Paleozoic and Mesozoic rocks of the oceanic Cache Creek Terrane. At the latitude of the present study area, the boundary between the Cache Creek and Quesnel terranes is hidden beneath a broad area of Tertiary volcanic rocks and unconsolidated Quaternary sediments (Figure 1). Directly east of the Quesnel Terrane are rocks of the Omineca Belt, represented at this latitude by Upper Paleozoic basalt, chert, gabbro and associated rocks of the Slide Mountain Terrane, and Proterozoic and Paleozoic metasedimentary, metavolcanic and metaplutonic rocks of the pericratonic Kootenay Terrane. The latter succession is generally interpreted as an outboard facies of the North American miogeocline (*eg*. Colpron and Price, 1995), while the former may represent a marginal or back-arc basin that formed directly outboard of the continental margin in Late Paleozoic time (Klepacki and Wheeler, 1985; Schiarizza, 1989; Roback *et al*., 1994; Ferri, 1997). Jura-Cretaceous granitic rocks, including the Raft and Baldy batholiths, crosscut the boundaries between the Kootenay, Slide Mountain and Quesnel terranes. The youngest rocks in the region are valley-filling and plateau-capping flows of mainly Quaternary age that occur in the area of Clearwater and Wells Gray Park (Hickson and Souther, 1984).

The Quesnel Terrane is characterized by an Upper Triassic to Lower Jurassic magmatic arc complex that formed above an east-dipping subduction zone (Mortimer, 1987).

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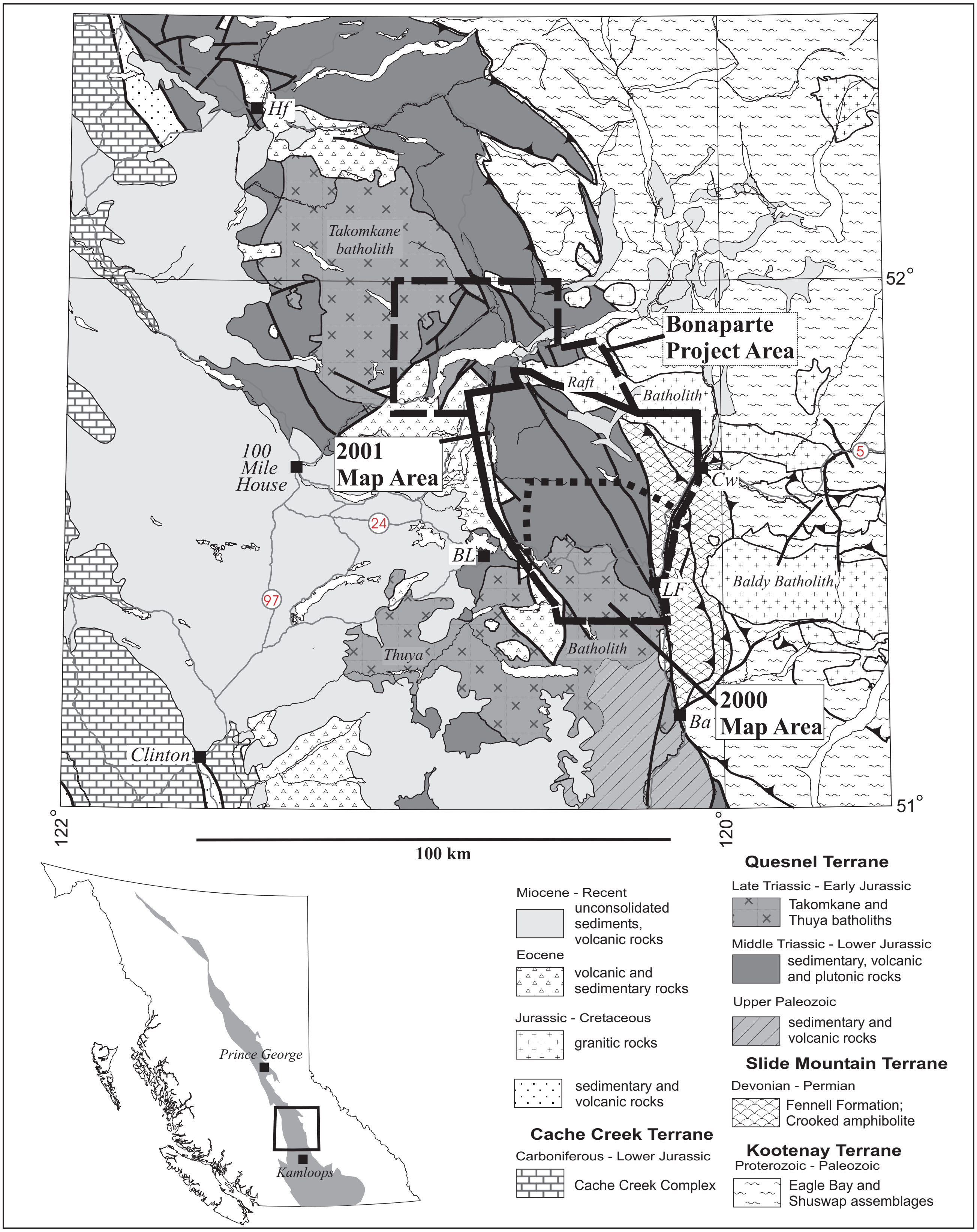

Figure 1. Regional geologic setting of the Bonaparte project area. Abbreviations: Ba, Barriere; BL, Bridge Lake; Cw, Clearwater; Hf, Horsefly; LF, Little Fort. Inset shows location of the map in south-central British Columbia, with distribution of the Quesnel Terrane shown in grey.

The Cache Creek Terrane to the west is inferred to include the remnants of the associated accretion-subduction complex (Travers, 1978). In southern and central British Columbia the early Mesozoic arc of the Quesnel Terrane is represented mainly by Upper Triassic volcanic and associated sedimentary rocks of the Nicola Group, together with abundant Late Triassic to Early Jurassic calc-alkaline to alkaline intrusions (Schau, 1970; Lefebure, 1976; Preto, 1977, 1979). Lower Jurassic volcanic rocks rest stratigraphically above Triassic arc volcanic rocks to the north of the Bonaparte project area, (Panteleyev *et al*., 1996; Nelson and Bellefontaine, 1996), but are apparently missing to the south, where this stratigraphic position is occupied by sedimentary rocks of the Lower to Middle Jurassic Ashcroft Formation (Travers, 1978; Monger and McMillan, 1989). However, Lower Jurassic arc volcanic rocks do occur in the easternmost part of the Quesnel Terrane in southern British Columbia, where they are represented by the Rossland Group (Höy and Dunne, 1997). In contrast to the Lower Jurassic volcanic rocks to the north of the Bonaparte area, these volcanic rocks rest above Triassic sedimentary rocks that were apparently deposited well east of the axis of Triassic arc magmatism.

In southern British Columbia, Mesozoic rocks of the Quesnel Terrane rest stratigraphically above a diverse assemblage of Paleozoic rocks, commonly across an angular unconformity (Read and Okulitch, 1977). Within and directly south of the Bonaparte project area, the Paleozoic part of the Quesnel Terrane comprises the Harper Ranch Group, which is interpreted as part of a late Paleozoic arc complex (Monger, 1977; Smith, 1979; Danner and Orchard, 2000). Elsewhere in southern British Columbia, Mesozoic rocks of the Quesnel Terrane rest stratigraphically above Paleozoic rocks of more oceanic aspect. These include rocks assigned to the Okanagan subterrane by Monger *et al*. (1991), and, along the eastern edge of the Quesnel Terrane, rocks included in the Slide Mountain Terrane (Campbell, 1971; Klepacki and Wheeler, 1985; Rees, 1987). In both southern and central British Columbia there is indirect evidence suggesting that Late Paleozoic arc rocks correlated with the Harper Ranch Group may have formed above a basement with North American affinities (Roback and Walker, 1995; Ferri, 1997). Furthermore, recent mapping directly south of the Bonaparte Lake map sheet, in the Vernon and Ashcroft map areas, suggests that pericratonic rocks correlative with those in the Kootenay Terrane extend farther west than previously thought, and underlie Permian and Triassic rocks of the Quesnel Terrane across an unconformable stratigraphic contact (Erdmer *et al*., 1999).

Deformation in the region included several pulses of Late Paleozoic to mid-Mesozoic contraction, as well as an important episode of dextral strike-slip and block faulting during Eocene time. Studies to the north of the Bonaparte project area document east-directed thrusting of Quesnel and Slide Mountain terranes over the Kootenay Terrane in late Early Jurassic time, followed by west-vergent folding and thrust faulting in the Middle Jurassic (Brown *et al*., 1986; Rees, 1987). A similar scenario, involving post-early Late Permian imbrication and emplacement above the Kootenay Terrane, followed by west-directed folding and thrust faulting, is documented for the Slide Mountain Terrane directly east of the project area (Schiarizza, 1983). There, the structural imbrication and emplacement of the Slide Mountain Terrane is interpreted as a Permo-Triassic event correlated with the Sonoma orogeny (Schiarizza, 1989).

LITHOLOGIC UNITS

The distribution of the main lithologic units within the southern and central parts of the Bonaparte project area, mapped during the 2000 and 2001 field seasons, is shown on Figure 2. Figure 3 provides a more detailed view of part of this area, including two-fold subdivisions of both the Nicola volcanic unit and the overlying Jurassic rocks. The cross sections of Figure 4 include the detailed subdivisions of Figure 3, and the lines of section are shown on both maps (although only partially represented on Figure 3). Most of the map units shown on Figures 2 and 3 are discussed in the following sections. However, some minor units in the southern part of the area, such as the Tintlhohtan Lake stock, are not mentioned because there is no new information to add to the descriptions provided by Schiarizza and Israel (2001).

FENNELL FORMATION

The Fennell Formation was defined by Uglow (1922) to include greenstone, gabbro and chert that he mapped along the east side of the North Thompson River valley between the Barriere River and Joseph Creek. It was traced northward by Walker (1931), who considered it to be mainly an intrusive body (the Fennell batholith), and then by Campbell and Tipper (1971) who, like Uglow, recognized that it included submarine volcanic and sedimentary rocks and local gabbroic intrusions. Campbell and Tipper correlated it with the Antler Formation of the Slide Mountain Group, which crops out 150 kilometres to the north in the Cariboo River area. The Fennell and Antler formations, together with similar rocks to the north and south, were subsequently assigned to the Slide Mountain Terrane, the most inboard tract of oceanic rocks within the Canadian Cordillera (Monger *et al*., 1982).

Detailed mapping of the Fennell Formation between the Barriere River and Clearwater by Schiarizza (1983, 1989) established that the formation could be separated into two major divisions. The structurally lower division is a heterogeneous assemblage of bedded chert, gabbro, diabase and pillowed basalt, with lesser amounts of sandstone, quartz-feldspar-porphyry rhyolite and intraformational conglomerate. Conodonts extracted from bedded chert range from Early Mississippian to early Late Permian in age (M.J. Orchard *in* Schiarizza and Preto, 1987), and their distribution demonstrates that the lower division comprises several imbricate thrust slices. The upper division consists almost entirely of pillowed and massive basalt, together with minor amounts of bedded chert and gabbro. Conodonts from chert intercalated with basalt at two localities are Pennsylvanian and Permian, respectively, indicating that the upper division spans at least part of the same age range as the lower division. Schiarizza (1983, 1989) therefore in-

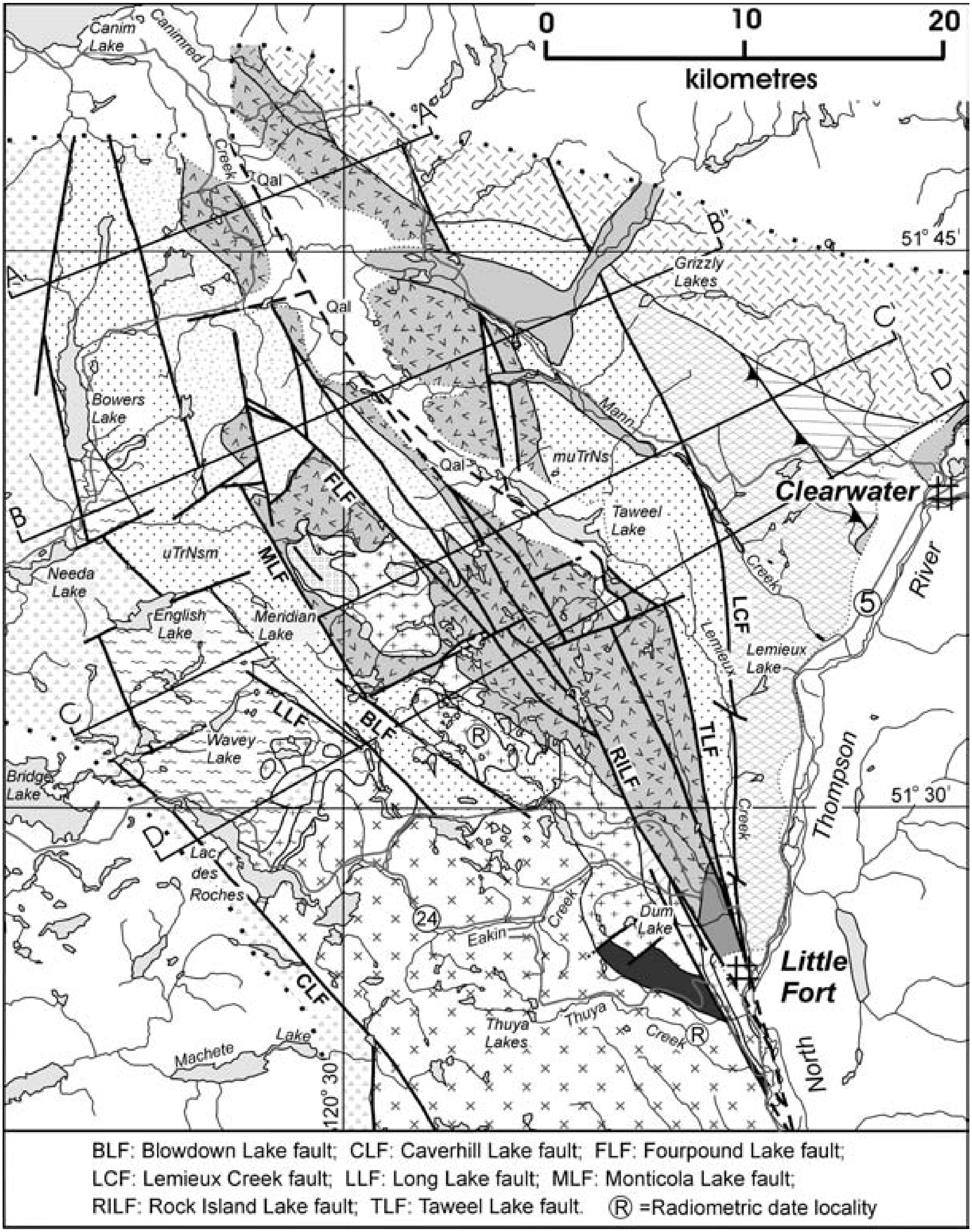

Figure 2a. Generalized geology of the southern and central parts of the Bonaparte project area.

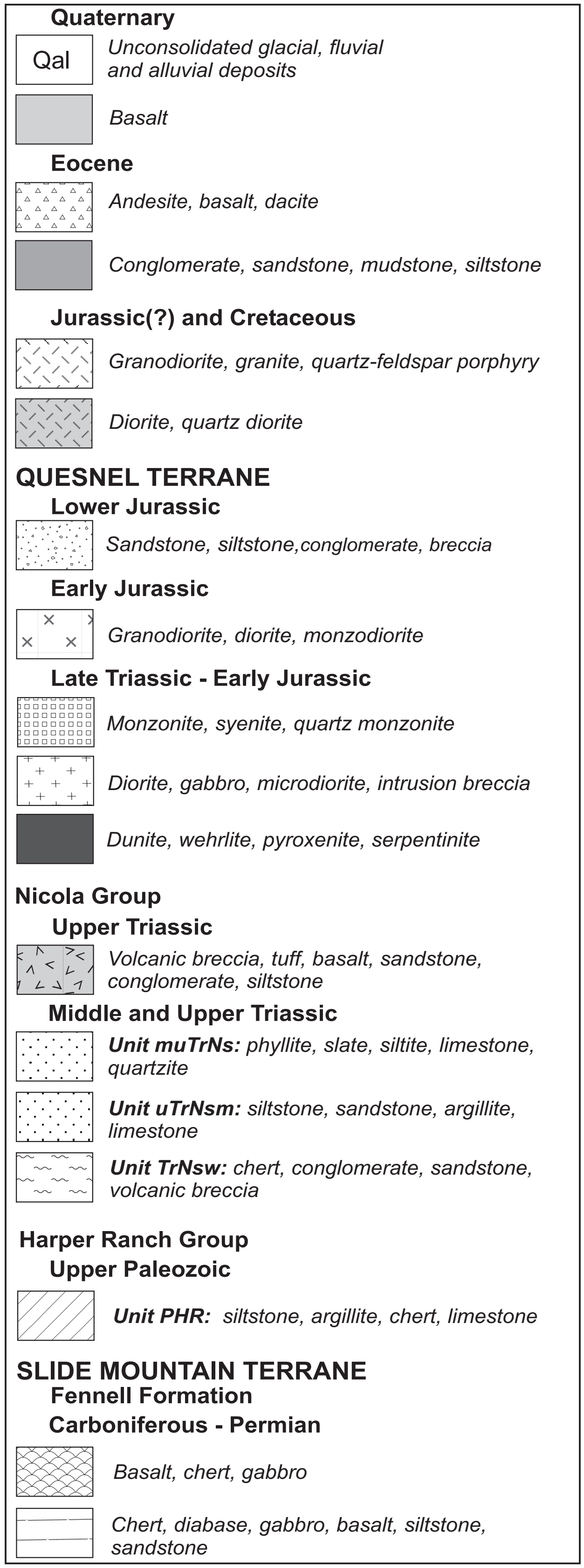

Figure 2b. Legend to accompany Figure 2a.

ferred that the two divisions are separated by a thrust fault similar to those that imbricate the lower division.

Within the present map area, the Fennell Formation forms a continuous belt that extends from Little Fort to the Raft Batholith. The western boundary of this belt is the Lemieux Creek fault, which separates the Fennell belt from Middle and Upper Triassic sedimentary rocks of the Lemieux Creek succession, the easternmost representative of Quesnel Terrane at this latitude. The Fennell belt is bounded by the North Thompson River valley to the east, which separates it from the more extensive exposures of the formation that were studied in detail by Schiarizza (1983, 1989).

Most of the Fennell Formation within the present map area comprises pillowed to massive basalt assigned to the upper division (Photo 1). The basalts form resistant brown-weathered exposures that form many of the more prominent mountains and ridges in the map area, including Mount Olie, Mount Loveway and Skwilatin Mountain in the south, and Clearwater, Grizzly and Grizzly Cub mountains in the north. The basalts include rare interbeds of bedded chert, and are locally intruded by dikes and sills of diabase and gabbro.

The lower structural division of the Fennell Formation crops out in a relatively small area west of Clearwater (Figure 2). It is not nearly as well exposed as the upper division, but is represented by scattered exposures of mainly chert, diabase, gabbro and basalt. The cherts occur in light to dark shades of grey to green, and commonly include interbeds of argillite, phyllite and siltstone. Bedding dips at moderate to steep angles to the southwest. The contact with structurally overlying basalts of the upper division is not well exposed, but is constrained to have a northwesterly strike. One isolated exposure along or near the contact, 3.5 kilometres northwest of the North Thompson River valley, shows basalt structurally above chert across a warped but mainly southwest-dipping fault contact. This observation is consistent with the interpretation that the two structural divisions are separated by a thrust fault.

HARPER RANCH GROUP

The Harper Ranch Group (Smith, 1979) consists of Upper Paleozoic sedimentary and volcanic rocks that rest stratigraphically beneath lower Mesozoic rocks of the Quesnel Terrane across an angular unconformity. The type area is on and near the Harper family ranch, located east of Kamloops on the north side of the South Thompson River, where the group comprises a Devonian to Upper Permian assemblage of carbonates, siltstones, mudstones, volcaniclastic sandstones and local andesitic volcanic rocks (Danner and Orchard, 2000). This belt of Paleozoic rocks extends northward to the south margin of the Thuya Batholith (Figure 1), and is also represented by several isolated fault and/or unconformity-bounded inliers farther north, within the Bonaparte Project area (Figures 2 and 3). These Paleozoic rocks were included in the Badger Creek Formation of Uglow (1922) and were assigned to the eastern Cache Creek Group by Campbell and Tipper (1971).

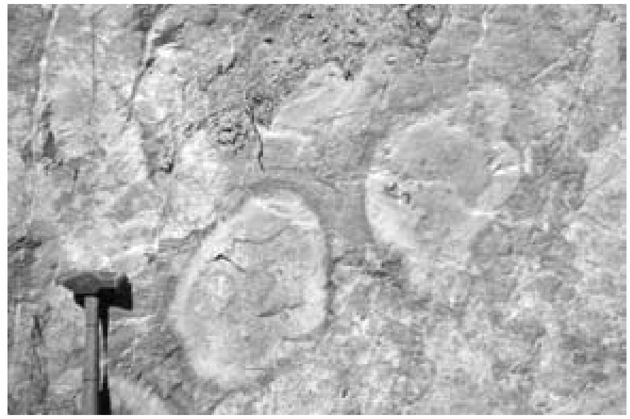

Photo 1. Pillowed basalt from the upper structural division of the Fennell Formation, 9 kilometres west of Clearwater.

Within the Bonaparte project area, the most extensive belt of rocks assigned to the Harper Ranch Group extends discontinuously from Highway 24 to Highway 5, along the west side of the Rock Island Lake fault (Figure 2). This assemblage, described by Schiarizza and Israel (2001), is dominated by siltstone and limestone, with local intercalations of chert and siliceous argillite. It is tentatively included in the Harper Ranch Group following Campbell and Tipper (1971), but is undated and may include Triassic rocks of Unit uTrNsm, which crop out along strike to the northwest (Figure 2).

Campbell and Tipper (1971) documented an occurrence of fossiliferous Permian limestone 3 kilometres northwest of Deer Lake. They did not map it as a separate unit, but included it in a belt of volcanic and sedimentary rocks assigned primarily to the Upper Triassic Nicola Group (their Unit 11). The fossiliferous limestone was located and resampled by Schiarizza and Israel (2001). They tentatively correlated it with more extensive, but undated exposures of limestone and mineralized skarn at Deer Lake, implying that the Harper Ranch Group underlies a large area north of the Thuya batholith. Subsequent fossil identifications (including Permian macrofossils by E.W. Bamber, Geological Survey of Canada, Calgary; and Permian and Triassic conodonts by M.J Orchard, Geological Survey of Canada, Vancouver) have confirmed the Permian age of the limestone 3 kilometres northwest of Deer Lake, but have shown that the limestone right at Deer Lake is Upper (to Middle?) Triassic. Therefore, most of the Deer Lake belt assigned to the Harper Ranch Group by Schiarizza and Israel is now included in Unit uTrNsm of the Nicola Group (described later in this report). The Permian rocks northwest of Deer Lake, comprising dark grey fossiliferous limestone with thin interbeds of dark grey argillite and chert, are apparently a small inlier of the underlying Harper Ranch Group. The Permian succession is only a few tens of metres thick and is truncated by a diorite pluton to the southwest. Its contact with sedimentary rocks of the Nicola Group to the northeast is not exposed, but is suspected to be an unconformity.

Permian rocks of the Harper Ranch Group also occur in a small, isolated fault block on the west slopes of Windy Mountain (Figure 3). The succession there is dominated by light to dark grey, locally green, laminated to massive chert and chert-rich sedimentary breccia. It also includes minor amounts of argillite and siltstone, as well as a lens of fossiliferous limestone. The limestone lens is up to 10 metres thick, at least 30 metres long, and is enclosed in a sedimentary breccia that contains millimetre to metre-scale clasts within a fine-grained clastic to cherty matrix. The clasts are dominated by chert and limestone, but also include aphyric and feldspar-phyric volcanic rocks, microdiorite, argillite and siltstone. A fossil collection from this limestone lens, which included brachiopods, corals and bryozoans, was assigned a Permian age by E.W. Bamber of the Geological Survey of Canada (Campbell and Tipper, 1971, page 22).

NICOLA GROUP

Campbell and Tipper (1971) assigned most Triassic volcanic and sedimentary rocks in the central and eastern Bonaparte Lake map sheet to the Nicola Group, but excluded the Triassic sedimentary succession along Lemieux Creek (their Unit 10; Lemieux Creek succession of this report). Schiarizza and Israel (2000) included the Lemieux Creek succession in the group, and also felt that substantial sections of rock mapped as Jurassic by Campbell and Tipper (their Unit 16, and parts of Unit 15) were more likely Triassic, so also included them in the Nicola Group. The reinterpretation of Campbell and Tipper's Unit 16 has been substantiated by a single microfossil call and continues to be applied here. Likewise, their Unit 15 continues to be regarded as partly Triassic (included in units uTrNsm and uTrNsv of this report) and partly Jurassic.

Schiarizza and Israel (2001) discussed the Nicola Group in terms of three fault-bounded belts of uncertain stratigraphic relationship. These included an eastern sedimentary belt, a central volcanic belt and a western belt of sedimentary rocks with local intercalations of volcanic rock. Our 2001 mapping program, together with some new microfossil dates, suggests that the eastern and western sedimentary belts are at least in part the same age, and that they both underlie the volcanic rocks of the central belt stratigraphically. This suggests that the pattern of volcanic versus sedimentary rocks may be primarily the result of preservation of the younger, volcanic part of the succession in the core of large synclinal structure. Local occurrences of volcanic breccia within the western sedimentary belt suggest, however, that there were also pulses of volcanism prior to deposition of the main volcanic units presently preserved in the core of the Nicola belt.

In the descriptions that follow, the Nicola Group is subdivided into 5 informal units. The Lemieux Creek succession comprises the easternmost element of the group and contains sedimentary rocks of Middle and Upper Triassic age. The Meridian Lake succession crops out on west side of the main belt of volcanic rocks within the group, but includes rocks that are lithologically similar and of the same age as the Lemieux Creek succession, so is thought to be largely its western equivalent. The Wavey Lake succession is an undated chert-rich unit that, at least in part, structurally underlies the Meridian Lake succession and forms the westernmost element of the Nicola Group in the map area. The main concentration of volcanic rocks form a belt that separates the Lemieux Creek and Meridian Lake successions. The rocks of this belt are undivided on Figure 2, but separated into a lower volcanic unit and an upper unit of mixed volcanic, volcaniclastic and sedimentary rocks on Figure 3. The upper mixed unit forms the top of the Nicola Group and is stratigraphically overlain by Jurassic rocks.

Lemieux Creek Succession (Unit muTrNs)

Triassic sedimentary rocks of the Lemieux Creek succession crop out within a single north-northwest-trending belt that extends from Little Fort to the Raft Batholith (Figure 2). This belt forms the easternmost element of the Quesnel Terrane and is juxtaposed with the Fennell Formation of the Slide Mountain Terrane across the Eocene(?) Lemieux Creek fault. The western contact of the Lemieux Creek succession is also marked by a young fault in the southern part of the belt, but north of Taweel Lake it is interpreted as a stratigraphic contact with overlying volcanic rocks of Unit uTrNv.

The Lemieux Creek succession consists mainly of medium to dark grey phyllites, slates and slaty siltstones that commonly contain thin beds and lenses of laminated siltstone or quartzose siltite. The succession also includes thin to thick beds of fine-grained quartzite and calcareous quartzite, and beds of medium to coarse-grained feldspathic to quartzose sandstone. Thin-section analysis of a sample of fine-grained quartzose sandstone collected a few kilometres southeast of Taweel Lake during the 2000 field season (Schiarizza and Israel, 2001) confirms that it contains a significant amount of detrital muscovite and biotite.

Limestone is common within eastern exposures of the Lemieux Creek succession between Highway 24 and Lemieux Lake. Much of it forms fractured and brecciated exposures within the Lemieux Creek fault zone, but it also occurs in well preserved intervals, up to 100 metres thick, comprising thin to thick limestone beds intercalated with siltstone and slate (Photo 2). Only a few scattered beds of limestone were noted in the northern part of the belt, although much of the siltstone, sandstone and quartzite is distinctly calcareous.

Campbell and Tipper (1971) report that collections of poorly preserved macrofossils from limestone exposures within Unit muTrNs north of Highway 24 suggest a Late Triassic age. Three samples collected from this same belt during the 2000 field season yielded conodonts of Early Carnian or Ladinian-Carnian age (northern two sample locations shown on Figure 3), whereas collections made from this belt by M.J. Orchard in 1985 yielded conodonts of Anisian, Ladinian and Early Carnian age (M.J. Orchard, written communication, May and June 2001). These fossil collections support correlation of the Lemieux Creek succession with lithologically similar Middle to Upper Triassic rocks that form the base of the Nicola Group in the Quesnel River - Horsefly map area (Unit 1 of Panteleyev *et al*., 1996).

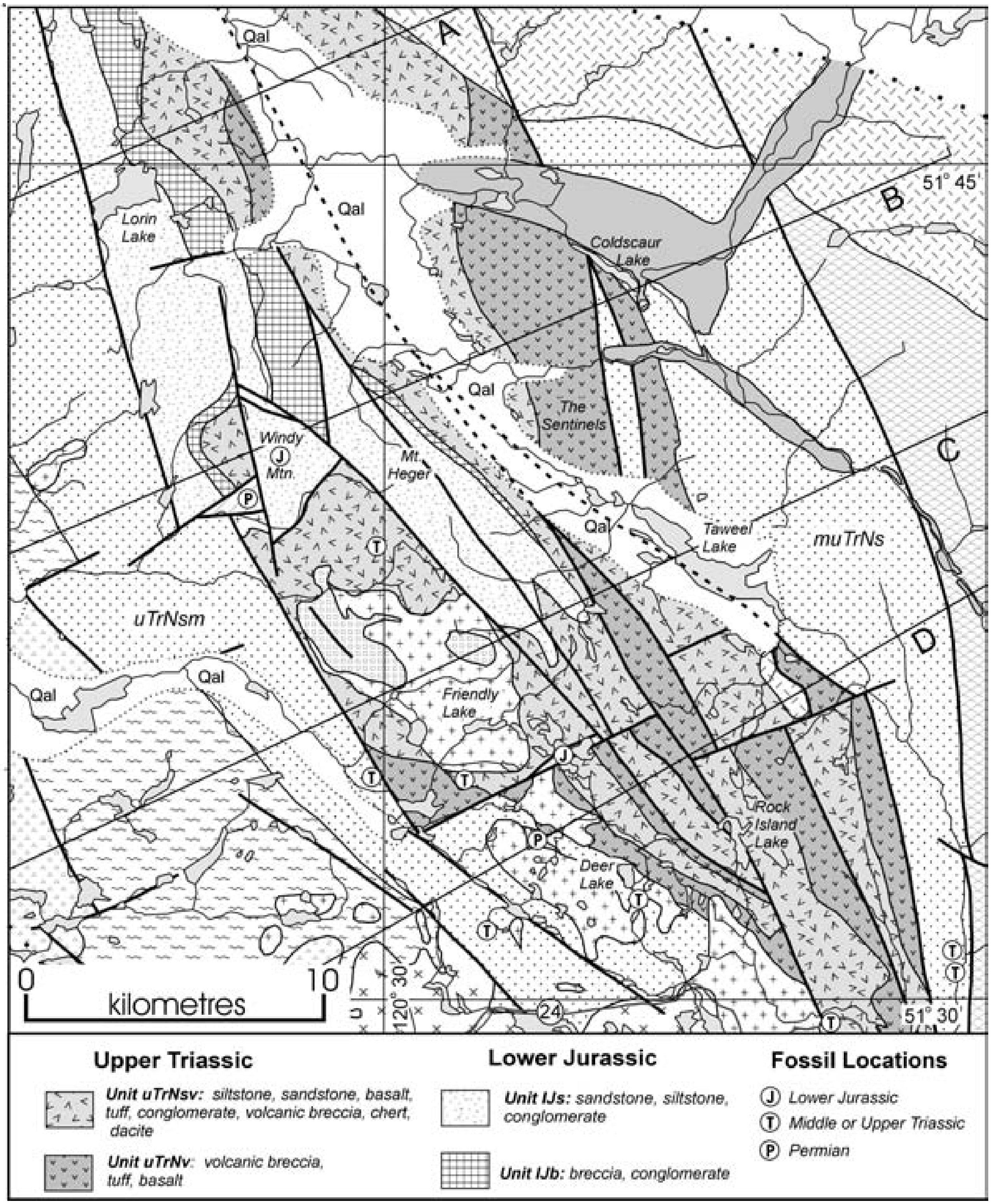

Figure 3. Generalized geology around the central part of the Nicola belt, showing subdivisions of the Nicola volcanic unit and overlying Lower Jurassic rocks. Other map units are shown with same patterns as Figure 2.

Photo 2. Well-bedded limestone from the Lemieux Creek succession, 1.5 kilometres southwest of Lemieux Lake.

Meridian Lake Succession (Unit uTrNsm)

Clastic sedimentary rocks and local limestone assigned to the Meridian Lake succession form a continuous belt that extends from the north margin of the Thuya Batholith to the northern limit of our mapping, just south of Canim Lake (Figure 2). The eastern contact is a fault along most of its length, but rocks included in the succession east of the Blowdown Lake fault may be in stratigraphic contact beneath volcanic rocks of Unit uTrNv. On its west side, the Meridian lake succession is in part underlain by the chert-rich Wavey lake succession, and in part faulted against Eocene volcanic rocks. The Meridian Lake succession includes rocks assigned to either the Nicola Group or an unnamed Lower Jurassic sedimentary unit (their Unit 15) by Campbell and Tipper (1971). It comprises the upper part of the Ripple Lake belt of Schiarizza and Israel (2001), but also includes rocks, east of the Blowdown Lake fault, that they tentatively assigned to the Paleozoic Harper Ranch Group. This assignment was based on the presence of Permian limestone at one locality, 3 kilometres northwest of Deer Lake. In the revised interpretation presented here, the Harper Ranch Group is thought to be restricted to a very small area that is either faulted against or stratigraphically beneath the Meridian Lake succession (Figure 3).

The Meridian Lake succession is dominated by thin-bedded intervals of laminated siltstone, dark grey argillite, weakly cleaved slate, and less common fine to medium-grained sandstone. Coarser-grained clastic rocks occur locally but are not common. These include layers and lenses of pebble conglomerate, up to several metres thick, that occur within a succession of mainly thin-bedded cherty argillites and siltstones east of the Blowdown Lake fault, 2.5 to 4 kilometres southeast of Monticola Lake. The conglomerate includes angular to subrounded pebbles of mainly argillite, chert and siltstone that are most commonly supported by a silty to siliceous argillite matrix. Clasts of feldspathic and pyroxene-feldspar-phyric volcanic rocks are also present, and rare limestone-matrix conglomerate units include limestone and sandstone clasts. Pebble to cobble conglomerate also occurs along the western margin of the Meridian Lake succession, southeast of Bowers Lake. There, however, it is dominated by clasts of pyroxene-phyric basalt, and is intercalated with volcanic sandstone containing mainly pyroxene and feldspar grains. Also present, to the east of Bowers Lake, are units of massive pyroxene porphyry interleaved with siltstone and argillite. It was not established, however, whether these are sills or flows.

Dark grey micritic limestone and limy argillite are fairly common in the southern part of the main Meridian Lake belt, as far north as the English Lake cross fault, and are also common in the belt east of the Blowdown Lake fault. The limestone occurs as thin to thick beds intercalated with siltstone, argillite and, locally, chert. Limestone samples collected from two separate exposures a short distance southeast of Deer Lake yielded conodonts that have been assigned Ladinian-Carnian and Early Carnian ages, respectively (M.J. Orchard, written communication, May 2001). Similar limestone on the west side of the Blowdown Lake fault, 5 kilometres west-southwest of Deer Lake, yielded conodonts that were assigned a Carnian age (Figure 3). Six kilometers northeast of this locality, just west of the Monticola Lake fault, is a fossil locality described by Campbell and Tipper (1971), comprising Halobiid fragments of probable Upper Triassic age.

The fossil dates described above indicate that the Meridian Lake succession is, at least in part, the same age as the Lemieux Creek succession. Correlation is supported by a strong lithologic similarity, although the Meridian lake succession does not apparently include the quartzites and quartzose sandstones that occur within the Lemieux Creek succession. The rocks of the Meridian Lake succession near Deer Lake are apparently in contact with rocks of the Nicola volcanic unit to the northeast, but this contact is not exposed. However, it is suspected to be a stratigraphic rather than a structural contact because diorite of probable earliest Jurassic age cuts across it, precluding a Jurassic or younger fault.

Wavey Lake Succession (Unit TrNsw)

The Wavey Lake succession is dominated by chert and volcaniclastic sandstone, but also includes substantial intervals of conglomerate and local occurrences of volcanic breccia. It forms a belt that is bounded by the Meridian Lake succession to the east, and is in fault contact with Eocene volcanic rocks to the west. This belt is close to 10 kilometres wide and extends from the northwest margin of the Thuya batholith to English Lake, where it is apparently truncated by a northeast-striking fault. The Wavey Lake succession was not recognized directly north of this fault, where the Meridian Lake succession extends westward to the Eocene volcanic rocks. It does occur locally farther north, however, where it is represented by a few exposures of chert and slate south-southeast of Bowers Lake. The rocks assigned to the Wavey Lake succession in this report were included in the Nicola Group by Campbell and Tipper (1971), and comprise the western, structurally lower part of the Ripple Lake belt described by Schiarizza and Israel (2001).

The most characteristic lithology within the Wavey lake succession is light to dark grey, locally green, chert that occurs as millimetre to centimetre-scale lenses and laminae interbedded with slate, argillite and siltstone. The chert intervals are interbedded with fine to medium-grained volcaniclastic sandstone that occurs as thin to medium beds, and locally forms channels that cut into the chert. Also common are thick lenses of poorly sorted and poorly stratified pebble to cobble conglomerate. The subangular to rounded clasts are dominated by laminated siltstone, cherty argillite and argillite, but also include chert, limestone, pyroxene and/or feldspar-phyric volcanic rocks and microdiorite. The conglomerates vary from clast to matrix-supported; the matrix commonly ranges from a siltstone to a gritty sandstone, and in places is distinctly calcareous.

A lens of coarse volcaniclastic rocks more than 200 metres thick was traced for about 4 kilometres within the eastern part of the Wavey Lake succession by Schiarizza and Israel (2001). It comprises pyroxene porphyry breccias and pyroxene-feldspar-crystal-lithic tuffs that are very similar to rocks found in units uTrNv and uTrNsv to the east. The base of the lens is defined by the (minor) Long Lake fault, but the top is a steeply-dipping northeast-facing stratigraphic contact across which the coarse volcaniclastic rocks are overlain by chert and fine to medium-grained volcaniclastic sandstone typical of the Wavey Lake succession. Isolated exposures of coarse volcaniclastic rock were noted at a few localities elsewhere in the succession, but do not constitute mappable bodies.

No macrofossils are known from the Wavey Lake succession, and chert samples processed after the 2000 field season did not yield conodonts or radiolaria. It is clearly intruded by the Early Jurassic Thuya batholith, as well as by small stocks of diorite that are suspected to be slightly older. Along its eastern margin the Wavey Lake succession rests structurally beneath the Upper Triassic Meridian Lake succession. This contact is not exposed, but is locally tightly constrained and there is no evidence of a fault or structural discordance across it. These relationships suggest that the Wavey lake succession constitutes a relatively low stratigraphic element within the Nicola Group, and that the coarse volcaniclastic lens northeast of the Long Lake fault reflects an earlier pulse of volcanism than that recorded by the main concentration of volcanic rocks that overlies the Meridian Lake succession to the east. Alternatively, the Wavey Lake succession might be a western, deeper water facies that includes stratigraphic equivalents of both the Meridian Lake succession and the overlying volcanic rocks.

Volcanic Unit (uTrNv)

Unit uTrNv comprises a thick succession of mafic volcanic rocks that overlie sedimentary rocks of the Lemieux Creek and Meridian Lake successions. It is dominated by mafic volcanic breccias containing clasts of pyroxene-phyric basalt (Photo 3), but also includes massive to pillowed pyroxene-phyric basaltic flows (Photo 4), well-bedded mafic tuffs and pyroxene-rich volcanic sandstones. This unit is represented by good exposures in several partially fault-bounded belts in the southern part of the project area, which are described by Schiarizza and Israel (2001). In the 2001 map area it is represented mainly by a

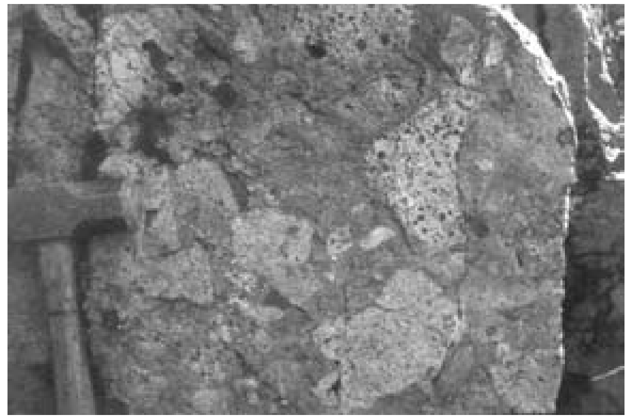

Photo 3. Volcanic breccia of Unit uTrNv, 2.5 kilometres east of Rock Island Lake.

Photo 4. Pillowed pyroxene-phyric basalt of Unit uTrNv, 3.5 kilometres east of Rock Island Lake.

wide belt of exposures that, in part, make up the Sentinels and the prominent ridges west of Coldscaur Lake (Figure 3). This belt is bounded by the Taweel Lake fault in the south, and extends northward to the Raft Batholith. It consists mainly of pyroxene porphyry breccias, but also includes massive pyroxene-phyric flows (or sills), and includes interbeds of pyroxene-rich sandstone near its basal contact with the Lemieux Creek succession. Unit uTrNv is also mapped in the northwestern part of the map area, where it is represented by sparse exposures of pillowed pyroxene-phyric basalt a short distance southwest of Canimred Creek (Figure 3).

The contact between Unit uTrNv and the Lemieux Creek succession is nowhere well exposed, but is inferred to be stratigraphic in the area east of the Sentinels, based on concordant bedding orientations and west-facing stratigraphic tops indicators in adjacent exposures of the respective units. The basal part of Unit uTrNv in this area comprises thin to thick beds of pyroxene-rich sandstone containing thin siltstone interbeds, interspersed with massive units of pyroxene porphyry breccia. In the Deer Lake area, on the opposite side of the volcanic belt, Unit uTrNv is inferred to overlie sedimentary rocks of the Meridian Lake succession, but the contact there is projected through a drift-covered area up to several hundred metres wide. However, as discussed previously, the contact is crosscut by a diorite stock of probable earliest Jurassic age, suggesting that it is more likely to be a stratigraphic contact than a fault.

Unit uTrNv is not dated directly. It is assigned an Upper Triassic age on the basis of its stratigraphic position above Middle and Upper Triassic sedimentary rocks of the Lemieux Creek and Meridian Lake successions, and below Upper Triassic rocks of Unit uTrNsv.

Mixed Volcanic-Sedimentary Unit (uTrNsv)

Unit uTrNsv comprises a succession of sedimentary, volcaniclastic and local volcanic rocks that overlies and interfingers with Unit uTrNv, and forms the uppermost unit within the Nicola Group. It includes pyroxene porphyry breccias and local flows identical to those found within Unit uTrNv, but these are intercalated with, and volumetrically subordinate to, sedimentary rocks that include siltstone, slate, pyroxene-rich sandstone and conglomerate, as well as minor amounts of chert and limestone (*see* detailed descriptions by Schiarizza and Israel, 2001). Unit uTrNsv is best represented by exposures in several fault panels on either side of the Rock Island Lake fault, between Highway 24 and Taweel Lake (Figure 3). It continues northward from there, along both sides of the Rock Island Lake - Taweel Lake fault system, to the northern limit of our 2001 mapping, but exposure is poor in this part of the area. Unit uTrNsv is also represented by fairly extensive exposures within the fault block that extends from Friendly Lake to Windy Mountain, where it is intruded by diorites and syenites of the Friendly Lake complex.

Several of the fault panels in the southern part of the map area contain the transition from Unit uTrNsv into stratigraphically lower volcanic rocks of Unit uTrNv (Schiarizza and Israel, 2001). This same stratigraphic relationship is inferred in the northern part of the map area, in separate panels on either side of the Rock Island Lake - Taweel Lake fault system (Figure 3), but is not well exposed. The stratigraphic top of Unit uTrNsv is defined by Lower Jurassic rocks of units lJb and lJs. This transition is mapped east and southeast of Mount Heger, west of Windy Mountain, and east of Lorin Lake, but is not well exposed in any of these areas (Figure 3).

A thin limestone bed intercalated with clastic and volcaniclastic rocks of Unit uTrNsv along Highway 24, 6 kilometres south-southeast of Rock Island Lake, was sampled during the 2000 field season and yielded Triassic conodonts (M.J. Orchard, written communication, May 2001). This sample comes from the west side of a west-facing fault panel that, 1.5 kilometres to the east, includes the transition into underlying volcanic rocks of Unit uTrNv (Figure 3). Campbell and Tipper (1971) report Triassic macrofossils from two separate localities within the Friendly Lake fault block, one from 1.5 kilometres south of the west end of Friendly Lake, and the other from 4.5 kilometres southeast of Windy Mountain (Figure 3). The locality south of Friendly Lake was sampled for microfossils during the 2000 field season and yielded conodonts of Early Carnian age (M.J. Orchard, written communication, May 2001). The fossils come from dark grey limestone that is intercalated with feldspathic sandstone and small-pebble conglomerate. Although these rocks are provisionally included in Unit uTrNsv, the conodont age and lithologic association suggest that they may comprise a small fault panel derived from the Meridian Lake succession. The other fossil locality within the Friendly Lake block, 4.5 kilometres southeast of Windy Mountain, was not located during our 2001 mapping program. A traverse through this area encountered well-bedded volcaniclastic sandstones and siltstones that are readily included in Unit uTrNsv.

TRIASSIC-JURASSIC PLUTONIC ROCKS

Calc-alkaline and alkaline plutons of Late Triassic to Early Jurassic age are a prominent feature of the Quesnel Terrane and are related to important porphyry Cu (±Au) and skarn deposits. Plutonic rocks are well represented in the southern part of the Bonaparte project area, which includes the northeastern part of the calc-alkaline Thuya batholith as well as numerous smaller, predominantly dioritic stocks and plugs that appear to have more alkaline affinities (Schiarizza and Israel, 2001). The latter are most prominent as a northwest-trending belt that includes, from southeast to northwest, the Dum Lake ultramafic-mafic intrusive complex, several diorite stocks near Deer Lake, and the Friendly Lake diorite-syenite intrusive complex (Figure 2). These rocks intrude the volcanic unit of the Nicola Group as well as underlying sedimentary rocks of the Meridian Lake succession and Harper Ranch Group. Small dioritic stocks are also common within more western exposures of the Meridian Lake succession and the adjacent Wavey Lake succession, particularly along the margins of the Thuya batholith (Figure 2).

Plutonic rocks are not a prominent component of the Quesnel Terrane in the central part of the Bonaparte project area, perhaps in part because a general northwest structural plunge has resulted in exposure of mainly Lower Jurassic sedimentary rocks, which may postdate much of the plutonism, along strike from the Dum Lake - Friendly Lake belt. However, a small body of diorite and syenite was mapped within Unit uTrNsv along Windy Creek, 2.5 kilometers northwest of the Friendly Lake complex, and an elongate body of microdiorite and microgabbro occurs 3 kilometres farther to the north, apparently as a fault-bounded lens along the Fourpound Lake fault (Figure 3). These intrusive units are apparently the northernmost exposed expressions of the plutonism associated with the Friendly Lake complex. The only other mappable intrusive body suspected to be this age in the 2001 map area comprises a plug of quartz-carbonate-altered microdiorite and hornblende-feldspar porphyry that intrudes sedimentary rocks of the Meridian Lake succession 7 kilometres west of Windy Mountain (Figure 3).

Age of the Deer Lake Diorite Stocks

During the 2001 field season a sample of leucocratic diorite/gabbro was collected from the largest of the Deer Lake diorite stocks, 1.3 kilometres west of the south end of Deer Lake (Figure 2). This sample yielded a U-Pb date of 197.8 ±1.4 Ma based on the overlap of 5 zircon fractions on concordia (R. Friedman, University of British Columbia, written communication, November 2001). This very Early Jurassic age is about 5 million years older than a U-Pb zircon date obtained from the Thuya Batholith (discussed below), consistent with the interpretation of Schiarizza and Israel (2001) that the Dum Lake - Deer Lake - Friendly Lake belt of intrusions predates emplacement of the batholith.

None of the other dioritic to syenitic intrusive units within the Nicola belt are dated at this time, but U-Pb work is in progress on samples collected from the Dum Lake and Friendly Lake complexes during the 2001 field season. An earlier attempt to date the largest monzonite/syenite unit within the Friendly Lake complex after the 2000 field season was unsuccessful because, due to a wide age range for inherited components and probable Pb loss in the modest amount of zircon recovered, the data could not be confidently regressed to yield a lower intercept age (R. Friedman, University of British Columbia, written communication, April 2001).

Age of the Thuya Batholith

Prior to the present study, the only U-Pb zircon date available for the Thuya batholith was an age of 205 ±9.3 Ma reported by Calderwood *et al*. (1990) for a sample of hornblende-biotite monzodiorite collected near Highway 24 a short distance east of Lac des Roches. Jung (1986) reports K-Ar dates of 186 ±6 Ma and 191 ±7 Ma on, respectively, hornblende and biotite separates from the same sample, as well as a Rb-Sr whole rock - mineral isochron date of 183.6 ±4.4 Ma, with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7042. Other K-Ar dates on unaltered samples to the south and west of the Lac des Roches sample site, summarized by Jung (1986), range from 181 ±7 Ma to 203 ±6 Ma.

Following the 2000 field season, a sample of relatively unaltered hornblende-biotite granodiorite collected near Thuya Creek (Figure 2) was submitted to the Geochronology Laboratory at the University of British Columbia for U-Pb dating. This sample has an interpreted age of 192.7 ±0.9 Ma, based mainly on 2 overlapping concordant zircon fractions (R. Friedman, written communication, August 2001). This Early Jurassic crystallization age is, within error, identical to a tightly constrained U-Pb zircon date of 193 ±0.6 Ma reported by Whiteaker (1996) for the Takomkane Batholith. Similar U-Pb zircon dates of 196 ±1, 194 ±1 and 193 ±1 Ma are reported by Parrish and Monger (1992) for, respectively, the Wild Horse, Pennask and Bromley batholiths to the south. These 5 large batholiths define a linear north-northwest trending belt of Early Jurassic magmatism that extends for 300 kilometres within the central to eastern part of the Quesnel Terrane.

LOWER JURASSIC ROCKS

Lower Jurassic rocks crop out in a northwest-trending belt that has been traced for close to 30 kilometres in the northern part of the map area (Figure 2). The most distinctive lithology within this belt is conglomerate containing granitoid clasts. These conglomerates are interbedded with, and overlain by, a succession of finer-grained sedimentary rocks that contain Early Jurassic fossils at Windy Mountain (Campbell and Tipper, 1971). Breccia and conglomerate containing mainly pyroxene porphyry clasts forms a unit that underlies the Jurassic sedimentary rocks throughout most of the belt. This unit is tentatively included in the Jurassic succession because contacts with overlying granitoid-bearing conglomerates appear to be gradational. Sedimentary and volcanic rocks of Unit uTrNsv underlie the breccia unit, but this contact is not well exposed.

Lower Jurassic Breccia (Unit lJb)

The Lower Jurassic breccia unit is best exposed in a belt, up to 1.5 kilometres wide, that has been traced from the Fourpound Lake fault, just north of Windy Mountain, for more than 15 kilometres to the northern limit of our mapping (Figure 3). Its western boundary is a stratigraphic contact with overlying Lower Jurassic sedimentary rocks along the full length of this belt. Its eastern contact is a system of faults in the south, but may be a stratigraphic contact with Unit uTrNsv in the north. The unit is also represented by narrower belts of similar breccia that occur between Lower Jurassic sedimentary rocks and underlying volcaniclastic rocks of Unit uTrNsv in two separate fault-bounded domains, west and east of Windy Mountain respectively (Figure 3).

Unit lJb consists mainly of green, brown-weathering breccia dominated by angular to sub-rounded fragments of pyroxene porphyry that commonly range up to several tens of centimeters in size (Photo 5). The breccia is most commonly, but not exclusively, matrix-supported, and is typically massive, but locally displays crude stratification. Subordinate clast types include hornblende-feldspar porphyry, microdiorite, aphyric mafic volcanic rock, laminated

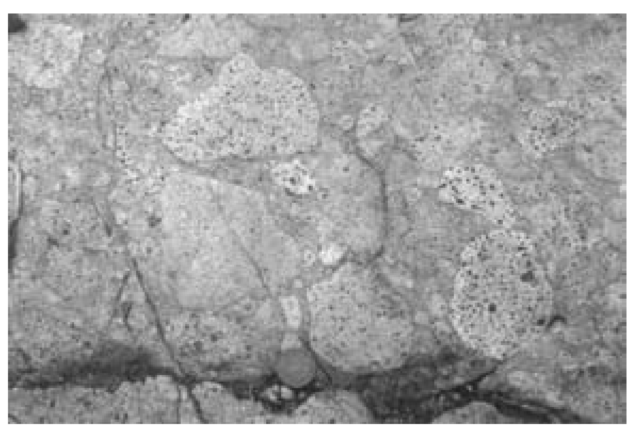

Photo 5. Matrix-supported breccia/conglomerate of Unit lJb, 5 kilometres north of Windy Mountain. Canadian one dollar coin for scale near bottom-centre of photo.

siltstone and argillite. These subsidiary clast types are most common in rare exposures of pebble to cobble conglomerate that contain a substantial proportion of sub-rounded to rounded clasts, but otherwise are similar to the more typical breccias. The unit also includes intercalations of pyroxene-rich sandstone and thin-bedded argillite/siltstone sequences that form intervals up to several metres thick. Locally, laminated siltstone/argillite sequences occur as isolated intraclasts, up to 2 metres in length, within the breccia. The unit also includes pyroxene-porphyry basalt with apparent pillow forms that was observed in a single exposure northeast of Lorin Lake (Figure 3).

Unit lJb is lithologically very similar to the Triassic breccias of Unit uTrNv, but is assigned to a separate unit on the basis of its stratigraphic position. With the exception of the pillows near Lorin Lake, most of the unit shows no evidence of primary volcanism, suggesting the possibility that much of it may have been derived from erosion of the Triassic volcanic rocks.

Lower Jurassic Sedimentary Rocks (Unit lJs)

Sedimentary rocks assigned to Unit lJs are well exposed in a fault-bounded block encompassing Windy Mountain (Figure 3). The section there includes a lower polymictic conglomerate unit containing clasts of granitic rock, which grades upwards into a succession dominated by thin-bedded sandstones and siltstones that locally contain Lower Jurassic fossils. Correlative rocks, including a basal section of granitoid-bearing conglomerates several hundred metres thick, crop out in a belt that extends north-northwestward from Windy Mountain to the limit of our mapping. This predominantly west-facing belt is stratigraphically underlain by pyroxene porphyry-dominated breccias of Unit lJb, and is inferred to be faulted against Triassic sedimentary rocks of the Meridian Lake succession to the west. Unit lJs is also represented by a northwest-trending belt of mainly sandstones and siltstones that crop out east and southeast of Windy Mountain, on the northeast side of the Fourpound Lake fault. Granitoid-bearing conglomerates, exposed locally east and southeast of Mount Heger, also occur at the base of the succession in this area, but form thin and discontinuous units. Underlying breccias of Unit lJb are likewise relatively thin and apparently discontinuous in this area.

The conglomerates at the base of Unit lJs commonly form resistant, brown-weathering exposures, as exemplified by those forming the prominent ridges south and southeast of Windy Mountain. They typically include poorly sorted pebbles, cobbles and boulders of a variety of rock types, supported by a sandy feldspathic matrix that also includes mafic mineral grains (largely hornblende), small lithic grains and quartz. The clasts range from angular to rounded, and commonly include granodiorite, tonalite, diorite, pyroxene±feldspar-phyric basalt, aphyric volcanic rocks and siltstone (Photo 6). Pebbles of limestone and chert are present in many exposures but form only a small percentage of the clast population. The conglomerates are typically unstratified, but locally exhibit very crude stratification and interbedded lenses of medium to coarse-grained arkosic sandstone.

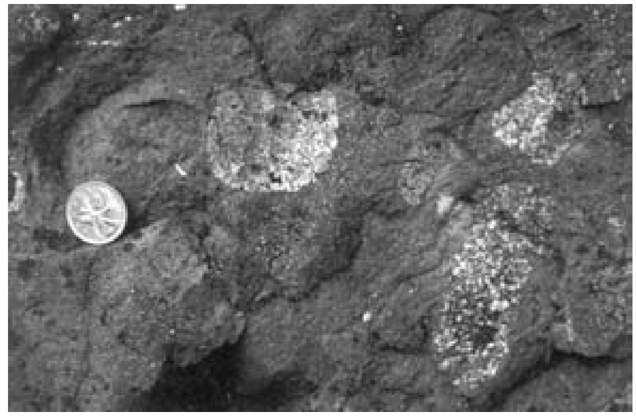

Photo 6. Matrix-supported conglomerate containing granodiorite and diorite clasts; Unit lJs south of Windy Mountain.

Photo 7. Thin bedded sandstone and siltstone of Unit lJs, Windy Mountain.

The conglomerate interval at the base of Unit lJs passes up-section into finer-grained clastic rocks across a zone of mixed-gradation that is fairly well exposed on the slopes southeast of Windy Mountain. Most of the unit above this contact zone consists of thin-bedded, fine to coarse-grained sandstones, laminated siltstones and silty argillites, with local thick beds of coarse sandstone and granule to small-pebble conglomerate (Photo 7). The sandstones are typically wackes that are rich in feldspar, mafic mineral grains and small lithic fragments.

There are no volcanic rocks within Unit lJs, but the sedimentary rocks within the unit are commonly cut by dikes of dark green pyroxene-phyric basalt that are very similar to, but clearly younger than, the pyroxene-rich basalts that characterize the volcanic rocks within the underlying Nicola Group.

Unit lJs is dated at Windy Mountain, where Campbell and Tipper (1971) made two fossil collections, which were assigned "possible Lower Jurassic" and "Sinemurian?" ages, respectively, by H. Frebold of the Geological Survey of Canada. Additional ammonite collections were made during our 2001 fieldwork, but had not yet been identified when this report was written. Nevertheless, their lithology and provisional Lower Jurassic age suggest that these rocks correlate with the Lower to Middle Jurassic Ashcroft Formation, which overlies the Nicola Group 100 kilometres southeast of the project area, and likewise contains a basal conglomerate unit that contains granitoid clasts (Travers, 1978; Monger and McMillan, 1989).

Jurassic sedimentary rocks are known from one other location within the project area, comprising a Lower Jurassic argillite-siltstone package of very limited extent that was identified by Preto (1970) just west of Lost Horse Lake. These rocks, which yielded poorly preserved ammonites of probable Late Sinemurian or Early Pliensbachian age, are mapped as a narrow fault-bounded sliver along the northeast-striking fault south of Friendly Lake (Figure 3). They are suspected to correlate with siltstones and argillites that are common in the upper parts of Unit lJs around Windy Mountain.

RAFT BATHOLITH

The Raft batholith is an elongate granitic pluton of Jurassic or Cretaceous age that extends for about 70 kilometres in a west-northwest direction, and cuts across the boundaries between Kootenay, Slide Mountain and Quesnel terranes (Figure 1). During the 2001 field season a substantial portion of the southern margin of the batholith was mapped, extending from Clearwater for about 40 kilometres westward to the west end of the pluton (Figure 2). The batholith clearly intrudes the Fennell Formation, the Lemieux Creek succession and the Nicola volcanic unit from east to west across this transect, although the contacts between these pre-batholith units are interpreted as steep faults that extend into that batholith and cause minor offsets and reorientations of its southern contact.

Most portions of the Raft Batholith covered during our 2001 mapping program consist of light grey, medium to coarse-grained hornblende-biotite granodiorite to monzogranite of rather uniform composition and appearance. Pinkish potassium feldspar crystals tend to be slightly larger than the plagioclase and quartz, and locally form phenocrysts more than 1 centimetre in size. Mafic minerals typically make up 10 to 20 percent of the rock, with biotite predominating over hornblende. The granodiorite is commonly intruded by dikes of pegmatite, aplite and quartz-feldspar porphyry, but these younger phases typically amount to only 1 or 2 percent of the rock exposed at any given outcrop.

A distinctly different phase, comprising medium-grained hornblende-biotite diorite, locally grading to quartz diorite, underlies a relatively small area along the southwest margin of the batholith (Figure 2). Unequivocal crosscutting relationships between these more mafic rocks and the granodiorite to the northeast were not observed. Campbell and Tipper (1971) note that narrow zones of hornblende diorite also occur near the north contact of the batholith just west of the Clearwater River.

Wanless *et al*. (1967) report K-Ar biotite dates of 140 ±9 Ma and 105 ±9 Ma on two separate samples from the Raft Batholith. The older date came from a sample collected on the west bank of the Clearwater River near the northern margin of the batholith, and the younger one came from a sample collected near the south margin of the batholith, about 8 kilometres northwest of Clearwater. Jung (1986) reports biotite K-Ar and Rb-Sr whole rock-mineral separates isochron dates from a granodiorite sample collected from the west side of the Clearwater River, about 8 kilometres north of Clearwater. He provisionally accepted the 104.3 ±3.3 Ma Rb-Sr date as the magmatic age, and suggested that the older K-Ar date of 138 ±6 Ma reflected excess radiogenic Ar in the biotite. Subsequent U-Pb dating of zircons from the same sample, however, yielded an upper intercept age of 168 +14/-12 Ma (Calderwood *et al*., 1990). Regional relationships suggest that ages near the lower or upper limits of these published dates might be permissible for the Raft batholith, as plutons of both late Middle Jurassic and mid-Cretaceous age are common within a belt that overlaps the Omineca and Intermontane belts from the present study area southward to the international boundary (Logan, 2002). A sample of granodiorite collected during the 2001 field season has been submitted for U-Pb isotopic dating in an attempt to clarify the crystallization age of the main phase of the batholith.

EOCENE(?) SEDIMENTARY ROCKS WEST OF CANIMRED CREEK

Thin-bedded sedimentary rocks that were observed in only two outcrops about 4 kilometres apart are interpreted as part of a succession that overlies volcanic and volcaniclastic rocks of the Nicola Group on the west side of Canimred Creek, near the northern limit of our mapping (Figure 2). Where observed, this succession consists mainly of friable, laminated to thin-bedded mudstones and siltstones in pale shades of purple, grey and green. Bedding dips at moderate angles to the east and is apparently discordant to that in the poorly exposed Nicola rocks to the west. Relationships to the east are masked by a wide belt of unconsolidated Quaternary sediments, but it is suspected that the thin-bedded sedimentary rocks dip into, and are bounded by, the northern extension of the Rock Island Lake fault system, which is inferred to follow the valley of Canimred Creek (Figure 4, section A). The sedimentary succession may correlate with an assemblage of thin-bedded lacustrine sedimentary rocks of Eocene age that crop out in the valley of the Horsefly River, about 60 kilometres to the north-northwest (Wilson, 1977; Unit 10 of Panteleyev *et al*., 1996). They are, therefore, provisionally assigned an Eocene age.

EOCENE VOLCANIC 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 most extensive exposures of the formation within the sheet define a north-northwest trending belt that extends for almost 70 kilometres between Bonaparte and Canim lakes (Figure 1). The eastern side of this belt is in contact with Mesozoic rocks that are the focus of the Bonaparte mapping project,

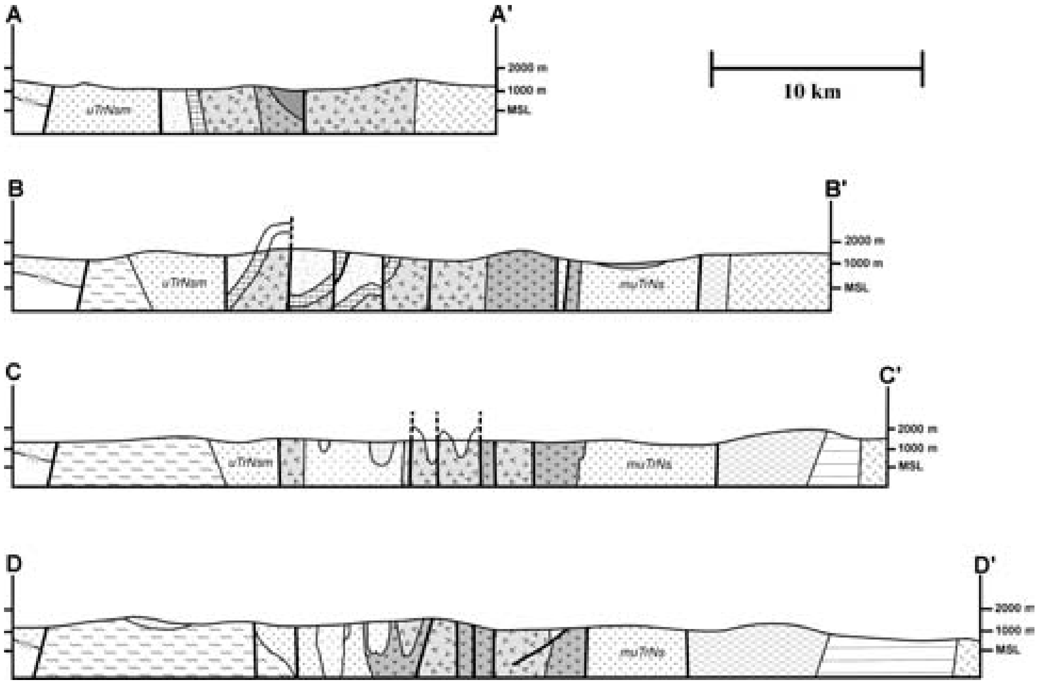

Figure 4. Schematic cross sections along lines shown on figures 2a and 3. *See* figures 2b and 3 for legend.

and was used as the western boundary of our mapping (Figure 2). The Skull Hill Formation is also represented by a small outlier of olivine-pyroxene-phyric basalt that overlies the Wavey Lake succession of the Nicola Group 3 kilometres north of Lac des Roches.

Most exposures of the Skull Hill Formation observed during the present study consist of dark grey to brown-weathered, pyroxene-phyric basalt flows. Also present are hornblende-phyric andesite flows, monolithic andesite and basalt breccias and dacite containing hornblende, biotite and feldspar phenocrysts. Minor amounts of sedimentary rock, including arkosic sandstone, granule to pebble conglomerate, and plant-rich shale, are intercalated with andesite and basalt southeast of Lac des Roches, but were not observed elsewhere. The Skull Hill Formation is suspected to be juxtaposed against the Mesozoic rocks to the east by a system of west-side-down normal faults, but evidence for such structures was observed only southeast of Lac des Roches, as described by Schiarizza and Israel (2001).

QUATERNARY VOLCANIC ROCKS

Flat-lying alkali olivine basalt flows within the Mann Creek and Clearwater River valleys comprise the south end of a volcanic field that extends 70 kilometres northward to form a prominent feature of Wells Gray Park (Figure 1). Campbell and Tipper (1971) recognized that some volcanic units in the northern part of the field were Pleistocene and younger, but correlated most of the volcanic rocks with the Miocene-Pliocene Chilcotin basalts, which cover much of the Interior Plateau to the west. More detailed study by Hickson and Souther (1984) and Hickson (1986) has shown that the Wells Gray - Clearwater volcanics are almost entirely Pleistocene and Holocene in age, and therefore are both spatially and temporally distinct from the compositionally similar Chilcotin Group.

The largest area inferred to be underlain by Pleistocene volcanic rocks within the present map area follows Mann Creek southwestward from the north boundary of the area, and then extends westward to cover a broad plateau north and northwest of Coldscaur Lake (Figures 2 and 3). Good exposures, however, are limited to the southeast corner of this lava field, along low scarps bounding Mann Creek southeast of Coldscaur Lake; the distribution elsewhere is inferred from the plateau-like topography and a positive anomaly on regional aeromagnetic maps. The volcanic rocks exposed southeast of Coldscaur Lake consist of several, thin, columnar-jointed subaerial flows with a total thickness of about 20 metres. The flows comprise dark grey to purplish-grey vesicular basalt that commonly contains small olivine phenocrysts. Similar flat-lying basalt flows are common as erosional remnants along the walls of Mann Creek for an additional 15 kilometres to the southeast (Figure 3), and a small remnant apparently occurs 5 to 6 kilometres beyond these, where Mann Creek enters the North Thompson River valley (Uglow, 1922). Hickson (1986) reports K-Ar whole rock isotopic dates from two separate sample localities along Mann Creek, southeast of Coldscaur Lake. One gave an age of 0.18 ±0.11 Ma and the other gave an age of 0.02 ±0.02 Ma.

Pleistocene volcanic rocks are also exposed along the east side of the Clearwater River at Clearwater, and in the west wall of the North Thompson River valley 3 kilometres to the south-southwest (Figure 2). These are remnants of volcanic units that become much more extensive within and adjacent to the Clearwater River valley farther north. The exposures near Clearwater are largely of subaerial flows similar to those along Mann Creek, but the base of the volcanic section 3 kilometres south-southwest of Clearwater comprises pillowed lava and pillow breccia (Walker, 1931; Hickson and Souther, 1984). Hickson and Souther report K-Ar whole rock dates of 0.35 ±0.09 Ma from the glassy rim of a quenched pillow at this locality, and 0.50 ±0.05 Ma from a subaerial flow directly overlying the pillowed deposit.

STRUCTURE

MESOSCOPIC STRUCTURES

Mesoscopic structures observed in the map area include a slaty to phyllitic cleavage that is axial planar to northwest to southeast-plunging mesoscopic folds, and a younger set of folds, with a locally developed crenulation cleavage, that deform the slaty cleavage. These structures are best developed in the Lemieux Creek succession, but comparable structures occur locally in fine-grained sedimentary intervals within all other Paleozoic and Mesozoic stratified rock units. Associated volcanic and coarse-grained clastic rocks are not generally foliated, except in local zones of high strain within fault zones or along the margins of some plutons (Schiarizza and Israel, 2001).

Within the Lemieux Creek succession the phase 1 slaty cleavage is highly variable in orientation, although steep west to southwest dips associated with east to northeast vergent folds are most common. The younger crenulation cleavage, which is best developed in exposures east of Taweel Lake, generally dips at moderate angles to the north-northeast. This pattern may relate to regional contractional deformation that is well documented along the Quesnel/Slide Mountain/Kootenay terrane boundaries to the north, where late Early Jurassic east-vergent thrust faults and associated folds are overprinted by early Middle Jurassic west-vergent backfolds (Brown *et al*., 1986; Rees, 1987).

MAP-SCALE STRUCTURES

The macroscopic structure of the study area is dominated by systems of northwest to north-striking faults, and less common northeast-striking cross faults (Figure 2). This intricate network of faults was recognized by Campbell and Tipper (1971) who noted that many of the faults cut Eocene rocks, but predate the Miocene. Schiarizza and Israel (2001) mapped the structures in the southern part of the Bonaparte project area in more detail, and confirmed that many of the faults were Eocene in age. However, like Campbell and Tipper, they suspected that some of the structures were older, but of uncertain age or sense of displacement. Schiarizza and Israel noted that Eocene faults in the western part of the area showed mainly west-side-down normal displacement, but that the structure in the east was dominated by a prominent system of dextral strike-slip faults, which they referred to as the Rock Island Lake fault system.

Schiarizza and Israel (2001) suggested that the structure of the south-central Bonaparte project area includes a northwest-trending syncline, which they called the Nehalliston syncline. The map pattern and stratigraphic relationships established during the 2001 field season confirm that the Nicola belt is generally synclinal in nature, comprising a core of Lower Jurassic rocks underlain by Nicola volcanic and volcaniclastic rocks, which in turn are flanked by underlying sedimentary rocks of units muTrNs and uTrNsm to the east and west, respectively. However, this synclinal structure has been fragmented by faults, mainly of Eocene age, to such an extent that no simple axial trace can be drawn to represent it. It is suspected that this synclinal structure developed as a Mesozoic compressional fold that was subsequently dissected and modified by younger faults. An alternative interpretation is that it reflects mainly a graben-like pattern of faulting during the Eocene.

Lemieux Creek Fault

The Lemieux Creek fault separates the Fennell Formation of the Slide Mountain Terrane from the Lemieux Creek succession of the Quesnel Terrane from the town of Little Fort to the south margin of the Raft Batholith (Figure 2). Parts of the fault zone are exposed locally over a distance of about 15 kilometres northward from where it crosses Highway 24. In this area the northerly-trending fault zone, in places more than 100 metres wide, is marked by brecciated and carbonate-altered rocks cut by anastomosing networks of steeply-dipping brittle faults with north-northeast to northwest strikes (Schiarizza and Israel, 2001). The fault's position is well constrained, but not exposed, northward from there, where it gradually changes to a north-northwesterly strike. It coincides with a prominent topographic lineament and a change in orientation of the southern contact of Raft Batholith, so is inferred to extend into, and cause minor offset of, these Jura-Cretaceous granitic rocks.

The relationships described above suggest that the latest movement on the Lemieux Creek fault postdates the Raft batholith, but that the post-batholith displacement is only minor. Nevertheless, this relatively young faulting, which is suspected to be Eocene in age, masks the pre-Tertiary configuration of the Fennell/Nicola contact in this area. Campbell and Tipper (1971) map this contact as a northeast-dipping thrust fault directly north of the Raft Batholith, while farther to the north the contacts between Quesnel, Slide Mountain and Kootenay terranes are mapped as a system of east-directed thrust faults that are overprinted by southwest-vergent folds (Brown *et al*., 1986; Rees, 1987). Campbell (1971) and Rees (1987) suggest that these Early to Middle Jurassic deformations may have overprinted an original stratigraphic relationship and that Middle to Upper Triassic rocks equivalent to the Lemieux Creek succession were deposited above Paleozoic rocks of the Slide Mountain Terrane, represented in that area by the Crooked Amphibolite.

Rock Island Lake Fault System

The system of steep faults that extends northwestward from Little Fort, through the eastern part of the Nicola belt, is referred to as the Rock Island Lake fault system by Schiarizza and Israel (2001). Brittle faults within the system cut rocks as young as the Eocene Chu Chua Formation, and kinematic indicators suggest mainly dextral strike-slip movement. The two main strands of this system, the Rock Island Lake fault and the Taweel Lake fault, are inferred to merge northwest of Taweel Lake and continue to the northern limit of our mapping (Figure 2). Their trajectories are not well constrained over most of this distance, however, as they are projected through a broad drift-covered area that extends from Taweel Lake to Canimred Creek. Evidence for a fault within the valley of Taweel Lake is provided by the apparent truncation of structures and a stratigraphic contact between units muTrNs and uTrNv that are mapped north of the lake (Figure 3). The faults' projected trace along Canimred Creek, at the northern limit of our mapping, is supported by the presence of east-dipping Eocene(?) sedimentary rocks west of the creek that may be bounded by the fault (Figure 4, section A).

Caverhill Lake Fault System

The Caverhill Lake fault is a southwest-side-down normal fault that separates Eocene volcanic rocks from Mesozoic rocks in the southwestern corner of the map area (Figure 2; Schiarizza and Israel, 2001). A related system of northwest to northerly-striking faults, locally offset by northeast-striking structures, is inferred to mark the eastern limit of the Eocene volcanic rocks along the full length of the map area (Figure 2). None of these faults was observed, however, and their presence is inferred mainly from the linear nature of the Eocene contact. Outliers of Eocene volcanic rocks are preserved east of the fault system, southeast and southwest of Wavey Lake (Figure 2), whereas inliers of Mesozoic rocks are exposed beneath the Eocene at Bridge Lake (Campbell and Tipper, 1971). These relationships suggest that west-side-down movement along the Caverhill Lake system amounts to only a few hundred metres of vertical offset.

Other Faults

The central part of the map area is transected by numerous northwesterly trending faults of unknown age, although it is suspected that most of these faults, like the adjacent Rock Island Lake and Caverhill Lake systems, formed in the Eocene. Several of the more prominent faults, such as those forming the eastern boundary of the Meridian Lake succession, the fault west of Windy Mountain and the Fourpound Lake fault, juxtapose older rocks on their west side against younger rocks to the east. These might be east-side-down conjugates to the Caverhill Lake fault system, but the fault dips and movement vectors along them are unconstrained. Some short fault segments are clearly truncated by other faults and cause duplications of local portions of the stratigraphy. These might be relicts of Mesozoic contractional structures. One of these faults duplicates the Jurassic stratigraphy northeast of Windy Mountain, and another duplicates Triassic stratigraphy between Deer Lake and the Rock Island Lake fault. Both are displayed as east-dipping faults, implying reverse movement, on Figure 4 (sections B and D), but their actual dip directions are unconstrained so other interpretations are equally viable.

MINERAL OCCURRENCES

Mineral occurrences within the southern and central parts of the Bonaparte project area are shown on Figure 5. These were extracted mainly from the B.C. Geological Survey Branch's MINFILE database, which was updated for the western part of the Bonaparte Lake (92P) map sheet in the late winter and spring of 2001. Most occurrences are within the southern part of the area, and were described by Schiarizza and Israel (2001). Here, we describe the MINFILE occurrences in the 2001 map area, as well as mineralization and alteration encountered during our mapping (Table 1 and Figure 5). We also provide updates on occurrences in the south that have been active subsequent to the report of Schiarizza and Israel.

RECENTLY ACTIVE PROSPECTS

Golden Loon Platinum (MINFILE 92P 043)

Cusac Gold Mines Limited optioned the Golden Loon claim group and initiated an exploration program for platinum group elements within ultramafic rocks of the Dum Lake igneous complex in the summer of 2000 (Clearwater Platinum project of Schiarizza and Israel, 2001). This program culminated in a drilling program during the spring of 2001. However, the option was subsequently dropped and there was little or no exploration work on the claim group during the following summer.

Worldstock (MINFILE 92P 145)

The Worldstock showing, comprising an isolated outcrop of carbonate-chlorite-pyrite-silica-altered rock with traces of chalcopyrite, was discovered in 1997 and returned 0.78 % copper over a 4 metre by 3 metre panel sample (Wells, 2000). Subsequent exploration by Christopher James Gold Corporation included soil geochemical, induced polarization and magnetic surveys. These programs generated a north-trending zone, more than 1200 metres long and 300 to 400 metres wide, with coincident copper-in-soils and IP chargeability anomalies. The more interesting targets were tested with a trenching and diamond drilling program during late spring 2001. Results of the diamond drilling had not been released when this report was written, but several trenches examined in June showed extensive areas of pyrite-sericite-silica-carbonate-altered rock cut by quartz and quartz-carbonate stockwork veins containing pyrite and chalcopyrite. The extent and nature of the alteration/mineralization are consistent with a porphyry-style environment. Host rocks appear to be mainly pyroxene porphyry breccias typical of Unit uTrNv. Outcrops of massive hornblende-pyroxene porphyry and

TABLE 1
GEOCHEMICAL DATA FOR SELECTED ROCK SAMPLES COLLECTED DURING THE 2001 FIELD SEASON

Element	Mo	Cu	Pb	Zn	Ni	Co	As	Cd	Sb	Bi	Cr	Ba	W	Hg	Ag	Au	Pt	Pd
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppb	ppb	ppb	ppb
Method	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	ARMS	FA	FA	FA
Lab	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM	ACM
Detection	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.01	0.02	0.02	0.5	0.5	0.2	5	2	2	2	2
Field #																		
O1PSC-122	107.51	114.7	163.36	35.7	12.9	6.5	2.9	0.48	0.28	232.09	118.6	70	86.6	< 5	42030	45	3	< 2
O1PSC-177	0.1	170.92	2.82	37.1	37.5	26.2	60.2	0.08	0.39	1	65.8	222	< .2	8	174	3	< 2	< 2
O1PSC-178	0.34	113.57	1.28	80.5	68.2	50.9	13.7	0.08	1.69	0.08	134.6	153	< .2	6	23	4	4	2
O1PSC-319	0.21	98.44	2.68	43.5	7.6	16.2	0.9	0.09	0.07	0.06	12.1	263.6	0.5	5	144	24	4	6
O1PSC-326	15.3	116.43	2.86	84	8.9	18.3	3.3	0.18	0.25	0.05	16	41.5	< .2	35	54	2	7	3
01SHE-36	2.27	6.19	8.07	3.5	4	1.2	2.5	0.1	0.09	0.14	133.4	13.9	< .2	7	183	77	4	< 2
01SHE-128-1	1.92	156.86	6.97	75.9	34.1	33.1	5.5	0.11	8.4	0.03	52.9	11.1	0.7	82	96	14	< 2	12
01SHE-128-2	1.37	53.55	4.5	13.8	25	21.2	122.1	0.18	6.53	0.02	18.1	32.5	< .2	33	70	14	7	5
01SHE-128-3	0.94	30.82	2.19	21.1	4.4	7.8	40.4	0.09	5.47	< .02	27.8	23.8	< .2	34	27	18	2	2
01SHE-172	0.75	322.95	40.33	257	178.5	47.8	69.5	8.31	7.14	1.25	237.9	114.7	10.3	6	2166	8	14	14
01SHE-174	7.6	2954.9	9199.2	15949	13.6	12.2	8.1	317.77	1.8	71.88	49.8	3.9	2.2	379	62027	3	3	2
01SHE-302	4.23	701.67	971.88	15988	89.5	35	99999	449.04	108.09	259.29	17.8	13.8	2.6	126	59273	810	2	2
01SHE-306	53.59	82.75	16.53	59	10.4	14.2	185.8	0.52	0.95	0.26	28	66.6	0.4	62	234	20	7	3
01SHE-378	7.03	41.38	69.37	188.4	20.9	6.3	7	4.16	0.54	1.66	61.2	62	1.2	7	886	4	3	2
01SHE-379	13.27	110.5	6.49	311.3	59.9	11	8.1	10.58	0.95	0.56	86.3	83	0.7	8	541	5	< 2	5
01SHE-397	0.56	565.32	6.66	35.7	5.7	8.4	9.1	0.31	0.32	0.25	39.3	72	< .2	< 5	235	8	3	9
01SHE-404	4.88	208.53	9.78	152.8	49.2	22.1	8.3	1.61	2	0.18	46.1	70.5	0.3	97	379	5	6	5
01SHE-405	14.78	122.12	18.87	126.7	18.5	6.5	87.9	2.01	4.47	0.4	32.6	121.6	< .2	184	592	6	5	3

Analysis of steel milled sample prepared by GSB.
ARMS = Aqua regia digestion - ICPMS
FA = Lead fire assay-ICP finish
ACM = ACME Analytical, Vancouver

fine-grained hornblende-pyroxene-feldspar microdiorite are located about 200 metres northeast of the mineralized rock, and may represent a small Late Triassic - Early Jurassic intrusive body.

Silver Lake - New Discovery

The Silver Lake property of Christopher James Gold Corporation includes the Worldstock showing and several precious metal vein systems on the PGR claims to the northwest (Schiarizza and Israel, 2001). In 2000, chalcopyrite-rich pebbles were discovered in glacial drift at two separate localities, 4.7 and 5.7 kilometres west-northwest, respectively, of the Worldstock showing, prompting an exploration program over this part of the property during the 2001 field season. The property was visited in early August, shortly after a trench had been excavated on a strong geophysical anomaly about 50 metres north-northeast of the southeastern float occurrence (referred to as New Discovery A). The trench exposed an impressive zone of copper mineralization, averaging about 1 metre wide, over a northwest strike-length of 25 metres. The mineralization comprises patches of massive chalcopyrite-pyrite and quartz within multiply-sheared, pyrite-magnetite-chlorite-altered pyroxene porphyry basalt. Systematic chip-panel sampling across the zone returned copper values in the 2 to 15 percent range with 34 to 177 grams per tonne silver and up to 0.33 gram per tonne gold over 0.6 to 1.5 metre sample widths (Christopher James Gold Corporation, News Release, July 30 2001). A diamond drilling program to test the geometry of this zone over an 85 metre strike-length returned encouraging copper and silver values in 3 of 6 holes. A phase two drilling program encountered copper values over a 700 metre strike-length along a strong northwest-trending geophysical and copper-in-soils anomaly between the original two float discoveries (Christopher James Gold Corporation, News Release, November 20 2001).

Crazy Fox Property (MINFILE 92P 185)

The Crazy Fox property, centred about 4 kilometres east of Rock Island Lake, was initially staked in the spring of 1998 to cover a multi-element anomaly detected by a BCGS till geochemical survey (Bobrowsky *et al*., 1998; Paulen *et al*., 2000). Subsequent work in 1998 and 1999 by Bourdon and Addie (2000a, 2000b) outlined a north-northwest trending belt, up to 500 metres wide and 10 kilometres long, containing highly anomalous values for Ag, As, Ba, Cd, Co, Cu, Se, Sb and Zn in till and soil samples. Coincident with this geochemical anomaly is a strong magnetic anomaly evident on the regional aeromagnetic map, and confirmed by a ground magnetic survey carried out by Inmet Mining Corporation in 2000 (Burge, 2001). The property is currently optioned by Cassidy Gold Corporation, who drilled one hole in August 2001. In an October news release, Cassidy management stated that more detailed geological mapping, slated for the spring of 2002, would be undertaken prior to any further drilling.

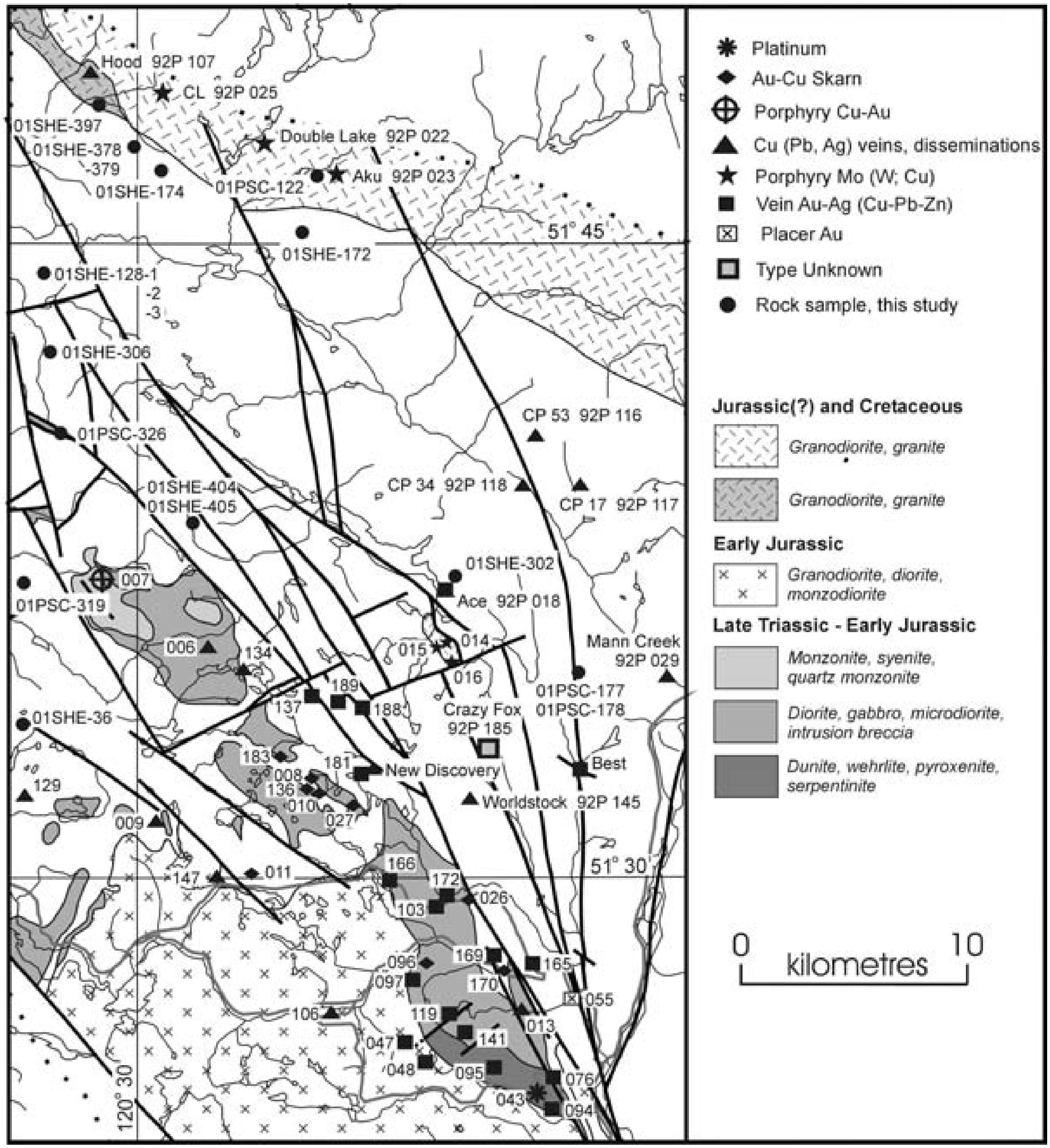

Figure 5. Locations of MINFILE occurrences in the southern and central parts of the Bonaparte project area, and selected rock samples collected during the 2001 field season. Base map is derived from Figure 2, with only plutonic rocks and faults shown. Occurrences discussed in text are shown with name and full MINFILE number. Other occurrences, discussed by Schiarizza and Israel (2001), are designated with only the last 3 digits of their 92P MINFILE number. *See* figures 2a and 3 for Place Names mentioned in text.

The Crazy Fox property straddles the contact between units uTrNv and uTrNsv of this report, and is underlain by a moderately to steeply west-dipping succession of volcanic breccias, pillowed flows and thick sedimentary intervals dominated by siltstone, argillite and volcanic sandstone. Flow-banded rhyolite to dacite occurs locally and is either part of the volcanic stratigraphy or a series of younger (Eocene?) sills. No mineralization is exposed on the property, but the current exploration program is targeting a potential volcanic-hosted massive sulphide occurrence.

VEIN OCCURRENCES IN THE LEMIEUX CREEK AND FENNELL BELTS

Ace (MINFILE 92P 018)

The Ace occurrence is hosted by metasedimentary rocks of Unit muTrNs along upper Lemieux Creek, a little more than 100 m downstream from the outlet of Taweel Lake (Davis, 1925, p. B152; Schiarizza and Israel, 2001). Mineralization at an old shaft on the southwest bank of the creek comprises lenses of massive pyrrhotite-pyrite-arsenopyrite with minor chalcopyrite. Individual sulphide lenses are up to several tens of centimetres wide, and are enclosed in dark grey phyllite containing contorted layers and fragments of lighter grey siltite and fine-grained quartzose metasandstone. Mineralization also occurs in trenches located about 700 metres northeast of the Lemieux Creek shaft, where massive sulphide lenses, including arsenopyrite, sphalerite, galena, chalcopyrite and pyrite, are hosted by similar brecciated and quartz-carbonate-pyrite-altered metasedimentary rocks (Jenks, 1999). A sample collected from one of these sulphide lenses during the 2001 field season returned 15 988 ppm Zn, 972 ppm Pb, 702 ppm Cu, 259 ppm Bi, 59273 ppb Ag and 810 ppb Au (Sample 01SHE-302 on Figure 5 and Table 1).

Alteration and Mineralization along the Lemieux Creek Fault

Brecciated, altered and locally mineralized rocks occur along the Lemieux Creek fault for a distance of at least 6 kilometres west of Lemieux Lake and Skwilatin Mountain. The southern part of this zone was covered by the Best claims and explored for epithermal gold mineralization from 1984 to 1989. There, brecciated and carbonate±quartz±pyrite-altered rocks of the Fennell Formation and Lemieux Creek succession, together with similarly altered feldspar porphyry dikes, are interleaved within a complex system of north to northwest-striking faults. Gilmour (1985) reports that an 18-metre chip sample that crossed the Nicola/Fennell contact, defined in that area by an altered feldspar porphyry dike, returned .007 oz/ton Au (located as “Best” on Figure 5).

About 5 kilometres north of the sampled area described above, a recently-constructed logging road exposes altered and mineralized rocks of the Fennell Formation that are within, or just east of, the projected trace of the Lemieux Creek fault. The rocks closest to the fault are breccias, comprising angular greenstone fragments within a matrix of carbonate with disseminated to semi-massive pyrite. Cutting the breccia are veins and stringers of white to pinkish calcite containing pyrrhotite and local traces of chalcopyrite, as well as rusty, vuggy quartz and quartz-calcite veins containing limonite-altered sulphides that may include pyrite, arsenopyrite, sphalerite, chalcopyrite and galena. The veins commonly strike northwest and dip steeply. Two samples were collected during our mapping, one from a pyrite-calcite-cemented breccia (01PSC-178), and one from a calcite vein containing pyrrhotite and traces of chalcopyrite (01PSC-177). Both samples contain anomalous arsenic and copper values, but are not enriched in other base or precious metals. A sample from one of the vuggy quartz-calcite-sulphide veins collected by prospector Paul Watt, who recently staked the Silver Pipe claims over this ground, returned 6.09% Zn, 0.15%Cd, 1666 ppm Cu, 128 ppm Pb, 55.8 ppm Ag and 20 ppb Au. In addition, a sample of semi-massive sulphides from the matrix of a calcite-pyrite-cemented breccia returned 330 ppb Au and 20.3 g/t Ag.

Mann Creek (MINFILE 92P 029)

The Mann Creek occurrence comprises several small showings containing either chalcopyrite or galena along the lower reaches of Mann Creek (Figure 5). This area was mentioned briefly by Uglow (1922), who reported that a modest exploration program was being directed at malachite and azurite-stained rocks on the south bank of the creek. More recent exploration included a program of geological mapping and soil and rock geochemistry in 1973 (McLeod, 1973), and prospecting in 1980 (Mirko, 1980). The mineralization is hosted in metabasalts of the Fennell Formation. It includes three separate occurrences of pyrite and minor chalcopyrite in calcite-epidote veins, and a single occurrence of galena in a quartz-carbonate stringer (McLeod, 1973). All four showings are contained within an area of about 0.15 square kilometre.

CP Occurrences (MINFILE 92P 116, 117, 118)

The CP showings comprise three separate occurrences of chalcopyrite within quartz veins between Clearwater Peak and Mann Creek (Figure 5). The mineralization was discovered in 1972 during an exploration program that was initiated after reconnaissance geochemical prospecting in the area revealed slightly anomalous values in copper, zinc and molybdenum (Dawson, 1972). Two of the occurrences are within metabasalts of the upper Fennell Formation, while the other, on the southwest bank of Mann Creek, is within slate of Unit muTrNs on the opposite side of the Lemieux Creek fault. Each occurrence comprises minor amounts of chalcopyrite within a single, narrow quartz vein. The only other mineralization discovered during the 1972 exploration program was a trace of galena in a quartz-carbonate vein cutting Unit muTrNs, 1300 metres northwest of the CP 34 showing (Dawson, 1972). There has been no exploration work recorded on any of the occurrences since their initial discovery.

OCCURRENCES ASSOCIATED WITH THE RAFT BATHOLITH

Aku (MINFILE 92P 023)

The Aku showings are located within the Raft Batholith, about 1.5 kilometres north of its south contact, 2 kilometres east of Patricia Lake (Figure 5). The area was first staked in 1966 after anomalous molybdenum values were encountered in stream silt samples. The mineralization was discovered during an exploration program carried out over the following two years, which included geological, geochemical and geophysical surveys, together with limited trenching and diamond drilling. Additional geochemical and geophysical surveys were carried out in 1974 and 1976, and again in 1980 after the showings were restaked as the D.D. claim group.

The area of the Aku showings is underlain by medium to coarse-grained monzogranite, cut by veins and patches of quartz-orthoclase pegmatite, and northwest-striking dikes of aplite and quartz-feldspar porphyry. Mineralization comprises molybdenite and pyrite, locally with traces of chalcopyrite, disseminated along hairline fractures and within narrow quartz veinlets. The mineralized veinlets typically dip steeply to the north-northeast, and are sporadically developed within a northwest-trending zone about 1 kilometre long and up to 400 metres wide (Gareau, 1981). However, narrow zones of sheeted quartz veinlets, dipping steeply to the north-northeast and containing pyrite, specularite and molybdenite, were also encountered more than 1 kilometre west of this main zone of mineralization. A sample of this western mineralized material contains 107.5 ppm Mo, 42030 ppb Ag and 45 ppb Au, and is highly anomalous in bismuth and tungsten (Figure 5 and Table 1, Sample 01PSC-122).

Double Lake (MINFILE 92P 022)

The Double Lake showing, located within the Raft Batholith about 1 kilometre south of Sicily Lake, was originally staked at the same time as the Aku showings, which are about 3 kilometres to the east-southeast. The most recent work recorded over the showing was in 1979, when it was covered by the Moly claims. This work included geological and soil geochemical surveys as well as a trenching and percussion drilling program (DeLeen, 1980). Mineralization consists of molybdenite, pyrite and chalcopyrite along fracture planes and as disseminations within coarse-grained monzogranite, and occurs discontinuously over a distance of at least 800 metres along a northeast-trending system of trenches (DeLeen, 1980).

CL (MINFILE 92P 025)

The CL molybdenum showing is located in the southwestern part of the Raft Batholith, about 4 kilometres west-southwest of Corsica Lake. The area was explored by soil sampling, geophysical surveys and 3 shallow diamond drill holes during the period 1966 through 1969. It was restaked as part of the DL claim block, which also included the Hood occurrence to the west, and explored with additional soil and geophysical surveys in 1980. The mineralization was not located during the present study but is reported to consist of molybdenite in quartz veins and on fracture surfaces (Dawson, 1981). The predominant host rock is granite to granodiorite of the main phase of the Raft Batholith.

Hood (MINFILE 92P 107)

The Hood showing is located near the southwest margin of the Raft Batholith, about 4.5 kilometres east of Canimred Creek. It comprises disseminated sulphides, including pyrrhotite, pyrite, chalcopyrite and traces of molybdenite, scattered over an area of about 500 metres by 200 metres within diorite that forms the western border phase of the batholith (Ney, 1972). The Hood claims were staked in 1971 after mineralized float was discovered along logging roads. The *in situ* mineralization was located during an exploration program that same year that included geological mapping, soil and rock geochemical sampling and an induced polarization survey (Ney, 1972). The showing was subsequently restaked as part of the DL claim block, and investigated with soil and geophysical surveys in 1980 (Dawson, 1981).

The Hood showing occurs along the northeast margin of the diorite border phase of the Raft Batholith, near its contact with granite that is typical of most of the batholith. During our 2001 mapping program additional mineralization was encountered along the south margin of the diorite unit, about 1.5 kilometres south of the Hood occurrence. The diorite there is rich in magnetite and biotite, contains disseminated pyrite, and locally hosts narrow, sheeted chlorite-sulphide veinlets that contain pyrite and traces of chalcopyrite. A sample that included this sheeted vein material returned 565 ppm Cu and 235 ppb Ag (Table 1 and Figure 5, Sample 01SHE-397).

Mineralization in Country Rocks on the Southwest Side of the Batholith

During the 2001 field season, mineralization was located at three separate localities, over a distance of 8.5 kilometres, within hornfelsed country rock near the southwest margin of the Raft Batholith. One occurrence, 3.5 kilometres southeast of the Hood showing, consists of pyrite and minor galena within quartz-epidote veinlets that cut fine-grained silicified metasedimentary rocks. Two separate samples of this material contained anomalous base metal and silver concentrations (Table 1 and Figure 5, Samples 01SHE-378 and 01SHE-379). The second locality, 1.5 kilometres to the south-southwest, comprises chalcopyrite, galena and sphalerite within a steeply-dipping, west-northwest striking brecciated fault zone that is up to 20 centimetres wide and cuts fine-grained silica-pyrite-pyrrhotite-altered metasedimentary rocks. A sample of this material contains 2955 ppm Cu, 9199 ppm Pb, 15949 ppm Zn and 62027 ppb Ag, and also yielded high values of bismuth and mercury (Sample 01SHE- 174). The third locality is 7 kilometres east-southeast of the second, and about 3.5 kilometres southwest of the Aku prospect. There, pyrite, pyrrhotite and traces of chalcopyrite occur in fractures and quartz-epidote veins within a west-northwest

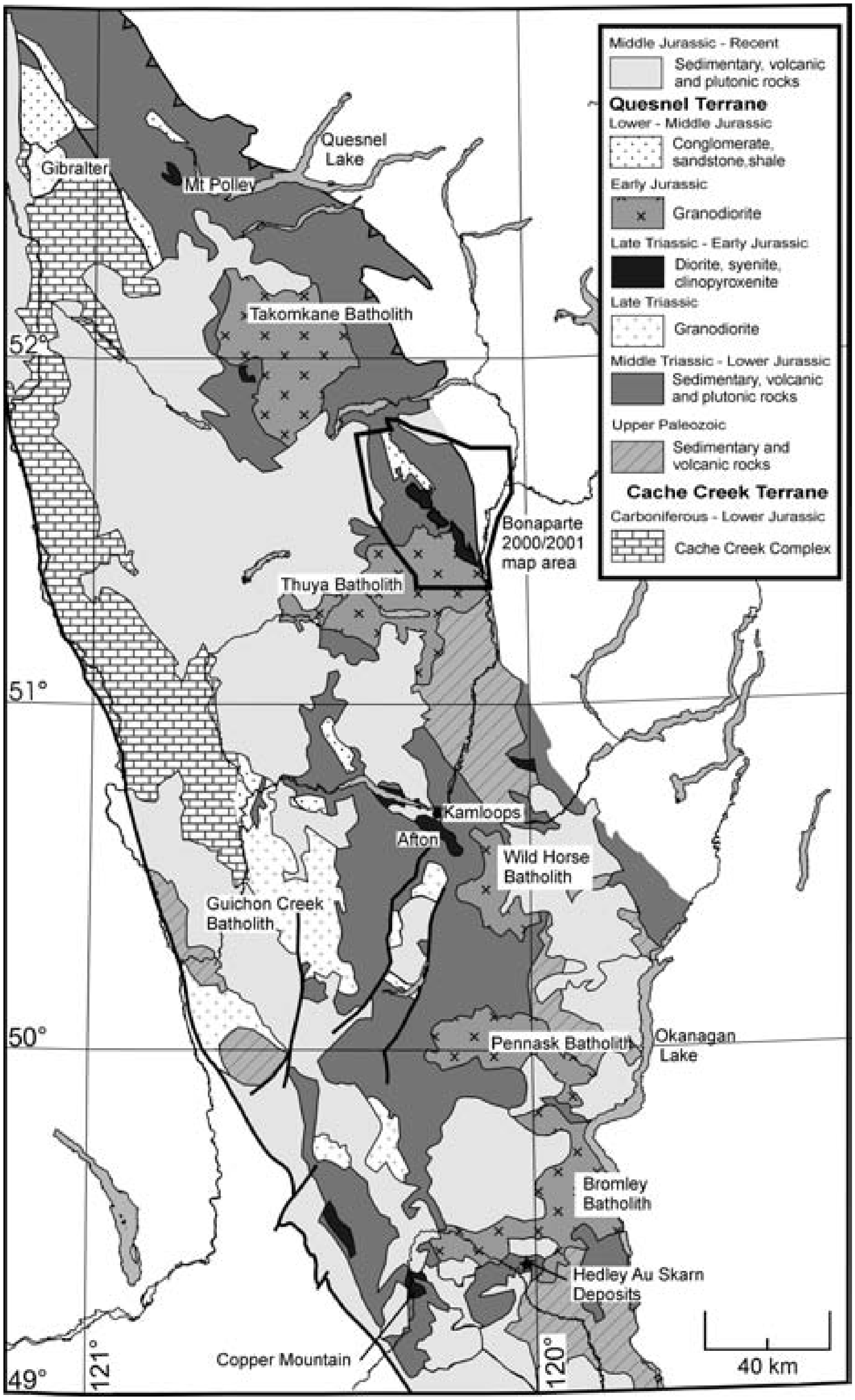

Figure 6. Simplified geologic map of south-central British Columbia highlighting the major belts of Late Triassic - Early Jurassic plutons of the Quesnel Terrane. Geology after Wheeler and McFeely (1991), modified with data from Parrish and Monger (1992), Ray and Dawson (1994), Mortensen *et al*. (1995), Whiteaker (1996), Ray and Webster (2000) and Ash and Riveros (2001).

striking, steeply north-dipping fault zone that cuts metasedimentary rocks of Unit muTrNs. A sample of this material returned 323 ppm Cu, 2166 ppb Ag, 8 ppb Au, 14 ppb Pt and 14 ppb Pd (Sample 01SHE-172).

INDICATIONS OF MINERALIZATION IN THE WEST-CENTRAL PART OF THE STUDY AREA

Southwest of Canimred Creek

The sparse bedrock exposures of Unit uTrNv and overlying Eocene(?) sedimentary rocks directly west of the broad area of drift covering the valley of Canimred Creek are commonly altered with disseminated pyrite and cut by quartz-carbonate veins containing variable amounts of pyrite and/or pyrrhotite. Samples 01SHE-128-1, 128-2 and 128-3 (Table 1 and Figure 5) were collected from, respectively, a brittle fault zone, a quartz-carbonate vein and pyritic volcanic host rocks of Unit uTrNv. All three samples returned weakly anomalous gold values of 14 to 18 ppb, as well as elevated concentrations of mercury, antimony and arsenic. A sample of carbonate-altered conglomerate from Unit lJs, 3.5 kilometres to the south, returned 53.59 ppm Mo and 20 ppb Au, and was also anomalous in mercury and arsenic (Sample 01SHE-306). These indications of epithermal-style alteration may be related to the systems of northwest and east-northeast trending Eocene(?) faults that transect this area.

Near the Fourpound Lake Fault

An exposure of microdiorite 1 kilometre north of Windy Mountain, apparently part of a lens of intrusive rocks enclosed by strands of the Fourpound Lake fault, is in large part altered to a rusty gossanous rock containing pyrite, pyrrhotite and relict feldspar grains. Sample 01PSC-326 from this rusty material returned 15.3 ppm Mo and 116.43 ppm Cu (Figure 5 and Table 1).

Eight kilometers to the southeast of the sample described above, and about 1 kilometre northeast of the trace of the Fourpound Lake fault, two adjacent outcrops of sedimentary rock within Unit lJs include areas of pyrrhotite-bearing gossan. Samples collected from these outcrops (01SHE- 404 and 01SHE-405) returned slightly elevated base metal and mercury values, and 379 and 592 ppb Ag, respectively.

West of the Monticola Lake Fault

An exposure about 1.4 kilometres north of the north end of Wavey Lake includes a complex mixture of microdiorite, diorite and granodiorite cutting chert and associated sedimentary rocks of the Wavey Lake succession. Pyrrhotite occurs as disseminations and stringers within the intrusive rocks and the adjacent country rock. A sample of altered country rock returned 77 ppb Au (Figure 5 and Table 1, Sample 01SHE-36). Similar dioritic intrusions are common within the Wavey Lake succession to the southeast, and host sparse chalcopyrite and molybdenite mineralization at the Ellen occurrence (MINFILE 92P 129; Wares and MacDonald, 1972).

A traverse through the eastern part of the Meridian Lake belt, west of the Friendly Lake intrusive complex, encountered several exposures of rusty silicified rock with variable amounts of disseminated pyrite, at least in part derived from sedimentary rocks of the Meridian Lake succession. Sample 01PSC-319 (Figure 5 and Table 1) from an exposure of this silicified rock returned 24 ppb Au. These exposures are just east of the recently-staked Need claims, which cover several zones of highly anomalous gold in soil and rock grab samples (Cassidy Gold Corporation, News Release, October 22 2001).

SUMMARY OF MAIN CONCLUSIONS

The Nicola Group is represented in the southern and central parts of the Bonaparte project area by Upper Triassic volcanic and volcaniclastic rocks together with underlying Middle to Upper Triassic sedimentary rocks represented by the Lemieux Creek succession in the east and the Meridian Lake succession to the west. The Wavey Lake succession is an undated assemblage of mainly cherts and volcaniclastic sandstones that occurs west of and structurally beneath the Meridian Lake succession. It is interpreted as a western facies of the Nicola Group.

The Meridian Lake succession is underlain by Upper Paleozoic carbonate, chert and siltstone of the Harper Ranch Group. The Lemieux Creek succession is faulted against the Upper Paleozoic Fennell Formation of the Slide Mountain Terrane, and north of the study area is inferred to have been deposited above the Crooked Amphibolite, an oceanic assemblage also included in the Slide Mountain Terrane. The Meridian Lake and Lemieux Creek successions contain similar assemblages of siltstone, slate and limestone, but the Lemieux Creek succession also includes quartzites and quartzose metasandstones, perhaps reflecting a depositional setting more proximal to Proterozoic and Paleozoic quartzose metasedimentary rocks of the pericratonic Kootenay Terrane.

The Thuya batholith, part of which intrudes the Nicola Group in the southwestern part of the Bonaparte project area, has yielded an Early Jurassic U-Pb crystallization age of 192.7 ±0.9 Ma. It is one of five large calc-alkaline batholiths, also including the Takomkane Batholith to the north, and the Wild Horse, Pennask and Bromley batholiths to the south, that define a linear north-northwest trending belt of Early Jurassic magmatism that extends for 300 kilometres within the central to eastern part of the Quesnel Terrane (Figure 6).

A prominent belt of ultramafic - mafic - syenitic plutonic rocks, only partially shown on previous maps, extends northwestward from the northeast margin of the Thuya batholith. One of these stocks, a diorite unit near Deer Lake, has yielded a U-Pb crystallization age of 197.8 ±1.4 Ma. These pre-Thuya intrusive rocks are correlated with a suite of small alkaline plutons of latest Triassic to earliest Jurassic age that are scattered along and just west of the magmatic axis defined by the large Early Jurassic calc-alkaline plutons described above (Figure 6). Within the project area, base and precious metal mineral occurrences are concentrated within and adjacent to this belt of Late Triassic(?) - Early Jurassic plutons. These include copper-gold skarns associated with the Deer Lake diorite stocks, and porphyry-style copper mineralization within the Friendly Lake diorite-syenite complex. Correlative rocks elsewhere along this magmatic belt host economic copper-gold porphyry deposits at Mount Polley, Afton and Copper Mountain, and potentially correlative dioritic rocks are associated with the gold skarns at Hedley (Figure 6).

The Nicola Group is stratigraphically overlain by a succession of Lower Jurassic sedimentary rocks that includes distinctive granitoid-bearing conglomerates in its lower part. These sedimentary rocks are correlated with the Lower to Middle Jurassic Ashcroft Formation, which overlies the Nicola Group in the western part of the Quesnel Terrane to the south. The granitic clasts in Lower Jurassic conglomerate must be older than the Thuya batholith. They are most prominent in western exposures, and may have been derived from a source now buried beneath Tertiary and Quaternary deposits to the west of the map area. A buried pre-Jurassic granitic pluton in this area might have economic potential, as the western part of Quesnel Terrane includes a belt of Late Triassic calc-alkaline plutons that host the important copper porphyry deposits of the Highland Valley (Guichon Creek Batholith) and(?) Gibralter (Figure 6).

The Middle Jurassic or younger Raft Batholith, and the mid-Cretaceous Tintlhohtan Lake stock represent younger magmatism in the project area. These belong to suites of plutons that extend across the boundaries between Kootenay, Slide Mountain and Quesnel terranes. Within the Bonaparte project area, both the Raft Batholith and the Tintlhohtan Lake stock host porphyry molybdenum mineralization.

The structure of the Bonaparte project area is characterized by panels of steeply-dipping strata bounded by systems of mainly northwest-striking Eocene faults. Epithermal-style alteration and mineralization occurs along or adjacent to some of these faults. The Eocene structures include a network of dextral strike-slip faults referred to as the Rock Island Lake fault system. The main strands of this system, the Rock Island Lake and Taweel Lake faults, have been traced from Little Fort to Canimred Creek, a distance of more than 50 kilometres, and may be part of a significant dextral strike-slip system that has not been well documented in this part of the cordillera.

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