Geology and Mineral Occurrences of the Quesnel Terrane, Cottonwood Map Sheet, Central British Columbia (NTS 093G/01)

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INTRODUCTION

A large prospective area for Cu-Au porphyry that is mostly covered by recent basalt and glacial deposits lies between Prince George and Quesnel Lake. The high mineral potential of the Quesnel Terrane rocks that underlie the area has been mostly untested in the past due to the difficulty of seeing through the thick overburden that blankets the area. Producing porphyry Cu-Au, Au and Cu-Mo mines occur both north and south of this 20 000 km^2 area and high mineral potential is inherent with geological continuity along the length of the belt.

Regional mapping in the Quesnel area was initiated by the BC Geological Survey in 2006 and continued in 2007 as part of a multi-year program designed to study and promote exploration of BC porphyry deposits. The 2006–2007 fieldwork is a continuation of regional mapping and mineral deposit studies initiated in the area around Mount Polley (Logan and Mihalynuk, 2005; Logan and Bath, 2006; Logan et al., 2007a) and extends coverage northwestward to test the area north and east of Quesnel. The project area covers the 1:50 000 scale Cottonwood map sheet, NTS 093G/01 (Fig 1).

The project objectives are to

- determine arc history and tectonics of the Quesnel Terrane in order to understand the evolution of magmatism and porphyry mineralization over the life of the arc (ca. 230–185 Ma);
- extend geological mapping northwestward towards Prince George into the overburden-covered, poorly understood area of Quesnel Terrane rocks;
- acquire a suite of samples from the various mineralized zones as well as a suite of least-altered volcanic and intrusive rocks for major and trace-element analysis;
- continue dating intrusive rocks to establish the magmatic history of the arc.

The Cottonwood map area is covered by thick deposits of unconsolidated Holocene and Pleistocene sedimentary rocks with rock exposures confined to less than 3% of the map, usually in the main river valleys and tops of hills. The 'Rocks to Riches' low-level airborne magnetic and radiometric survey covered about two-thirds of the project area (Carson et al., 2006) and provided good baseline data that assisted exploration and mapping rock types, alteration and structure across the map.

Figure 1. Location of BC Cu-Au-Ag±PGE alkaline porphyry deposits showing the Cottonwood map area in red (093G/01), green band indicates the Quesnel Terrane, grey band indicates the Cache Creek Terrane. Abbreviation: ST, Stikine Terrane.

REGIONAL GEOLOGY

The regional setting of the central Quesnel belt is summarized by Logan et al. (2007a), and is only briefly reviewed here. The Quesnel Terrane represents an extensive (>2 000 km) west-facing, calcalkaline to alkaline Late Triassic to Early Jurassic arc that developed outboard or marginal to the western margin of North America (Mortimer, 1987; Mihalynuk et al., 1994). It is characterized by Mesozoic arc volcanic and sedimentary rocks of the Nicola, Takla and Stuhini groups and coeval plutonic rocks, which intrude and inflate the sequence. At this latitude, the temporal, chemical and facies architecture of the Nicola Group rocks reflects a shift in magmatism from the fore arc volcaniclastic-dominated successions eastward across the arc into back arc Middle to Late Triassic fine-grained clastic rocks (the black phyllite unit of Rees, 1987). The eastern boundary of the Quesnel Terrane is marked by the Eureka thrust (Struik, 1988a), an easterly verging fault zone. Variably sheared mafic and ultramafic rocks of the Crooked amphibolite that occupy this boundary are as-

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signed to the Slide Mountain Terrane, a Late Paleozoic marginal basin assemblage (Schiarizza, 1989; Roback et al., 1994) of oceanic basalt and chert that separated Quesnellia from North America until its closure in the Early Jurassic (?). The footwall to the Eureka thrust comprises the Proterozoic to Paleozoic Snowshoe Group rocks of the Barkerville subterrane (Struik, 1986), a northern extension of the Kootenay Terrane (Monger and Berg, 1984), which are pericratonic and likely represent distal sedimentation of ancestral North America (Colpron and Price, 1995). West of the Quesnel Terrane is Late Paleozoic to Jurassic oceanic rocks of the Cache Creek Terrane with Late Triassic blueschist-facies rocks (Patterson and Harakal, 1974; Ghent et al., 1996) representing the remnants of a subduction-accretionary complex (Travers, 1977; Mihalynuk et al., 2004) that generated the Quesnel Arc. Younger rocks include mid-Cretaceous granitic plutons, Eocene sedimentary and volcanic sequences and Miocene flood basalt.

STRATIGRAPHY

The Cottonwood map area is underlain by four major Canadian Cordilleran terranes that include, from east to west: Kootenay, Slide Mountain, Quesnel and Cache Creek. The rock packages that define each are fault-bounded and trend to the northwest, parallel to the dominant regional fabric in the map. Unconsolidated Holocene and Pleistocene glacial deposits are thick and cover the majority of the map area. Surficial deposits completely mask the Cache Creek Terrane, projected to underlie the southwest corner of the map (Fig 2).

Kootenay Terrane — Snowshoe Group

The Snowshoe Group, a Late Proterozoic to Paleozoic package of predominately siliciclastic rocks, dominates the Barkerville subterrane of the Kootenay Terrane. The stratigraphic nomenclature for these pelitic and psammitic rocks has evolved since the earliest work by Bowman (1889), who first designated them as the Cariboo schists. Regional maps by Struik (1988) in the Wells-Barkerville area subdivide the Snowshoe Group into 14 informal units that he correlated with Proterozoic to Paleozoic successions in the Kootenay Lake and Adams Lake areas. Recently, Ferri and Schiarizza (2006) proposed a revised stratigraphy and structural interpretation for these rocks in the Barkerville area that implied the upper Snowshoe Group is a structural repetition of the lower succession. They redefined the stratigraphy into three major units, which, from oldest to youngest, are the Downey, Harveys Ridge and Goose Peak successions. The Downey combines rocks formally assigned to the Downey, Keithley, Ramos, Kee Khan and Tregillus successions (Struik, 1988b). It consists of greenish-grey, micaceous quartzite or feldspathic quartzite, phyllite, schist, locally with a distinctive orthoquartzite at the top of the succession. The Harveys Ridge succession includes rocks formerly of the Harveys Ridge and Hardscrabble Mountain successions and comprises dark grey to black phyllite, siltstone and quartzite that become more arenaceous upsection. The Goose Peak succession includes rocks formally assigned to the Goose Peak and Eaglesnest successions: light grey and green quartz and feldspathic quartzite with interbedded grey phyllite and siltstone.

Reconnaissance mapping only was carried out over the eastern portion of the Cottonwood map area that is underlain by the Snowshoe Group (Fig 2). Building on the regional mapping of Struik (1988b), but following the stratigraphic re-interpretation of Ferri and Schiarizza (2006), traversing focused on the western contact relationships between the Snowshoe Group and the Slide Mountain – Quesnel terranes, and evaluating its Besshi-type volcanogenic massive sulphide (VMS) mineral potential. The Harveys Ridge succession of the Snowshoe Group hosts Besshi-type VMS mineralization 50 km southeast at Cariboo Lake (Höy and Ferri, 1998; Ferri, 2000) and may have the potential to host similar mineralization in the study area. Mapping determined that micaceous quartzite and schist of the Downey succession underlie the majority of the eastern one-third of the map area. Two isolated packages of dark grey to black siltite, quartzose phyllite, calcareous schist and limonitic micaceous quartzite interpreted to be Harveys Ridge succession crop out in the northern and southern parts of the map, adjacent to the Eureka thrust.

Grey and olive micaceous quartzite, schist, phyllite and calcareous schist comprise the majority of the Downey succession. The dominant rock type is a light brown-weathering micaceous quartzite consisting of recrystallized quartz, sparse feldspar and foliation-parallel metamorphic biotite and muscovite. Layers of micaceous quartzite that range from several to tens of centimetres thick are interlayered with schist. Resistant micaceous quartzite and light grey orthoquartzite occupy most of the higher peaks along the eastern boundary of the map. A distinctive white quartzite granule to cobble conglomerate overlies a sequence of orthoquartzite and interbedded grey phyllite and micaceous quartzite near the summit of a northwest-trending ridge on the eastern boundary of the map area. The quartzite weathers grey and light brown to orange. It is medium to coarse-grained and rhythmically bedded with dark grey phyllite. Micaceous units are poorly sorted with up to 20% matrix mica (muscovite>biotite), vitreous to white-coloured quartz, potassium feldspar and plagioclase grains 2 to 4 mm in size. Struik (1988b) mapped these rocks in the Wells area as the Tregillus clastic rocks. These units have been deformed and metamorphosed to upper greenschist grades. Metamorphic assemblages in the micaceous quartzite include biotite-muscovite-albite and retrograde synkinematic garnet rimmed with chlorite. Detrital mineral assemblages of quartz, muscovite and zircon populations are indicative of North American continental sources.

The Harveys Ridge succession to the east consists of black and grey siltite, micaceous quartzite, phyllite and limestone and is characterized by black and dark grey rocks (Struik, 1988b). In the map area, Harveys Ridge rocks occur at the south and north boundaries of the map. In addition, Struik (1988b) shows a 1 km wide belt projecting into the map area from the eastern boundary. The Harveys Ridge rocks in the southeast corner of the map occupy the upper limb of a northwest-plunging anticline overturned to the southwest and cored by Downey succession rocks. The rocks include interbedded black siltite, phyllite and brown-green weathering micaceous quartzite. The black siltite contains narrow (1–2 mm) sheeted white quartz veins that parallel bedding. Thinly laminated, fine-grained black quartzite and a distinctive micaceous quartzite with coarse, randomly oriented metablasts of chloritoid and/or actinolite occur within the southern sequence. At the northern occurrence, black quartzite and well-foliated argillite and phyllite of the Harveys Ridge succession comprise the

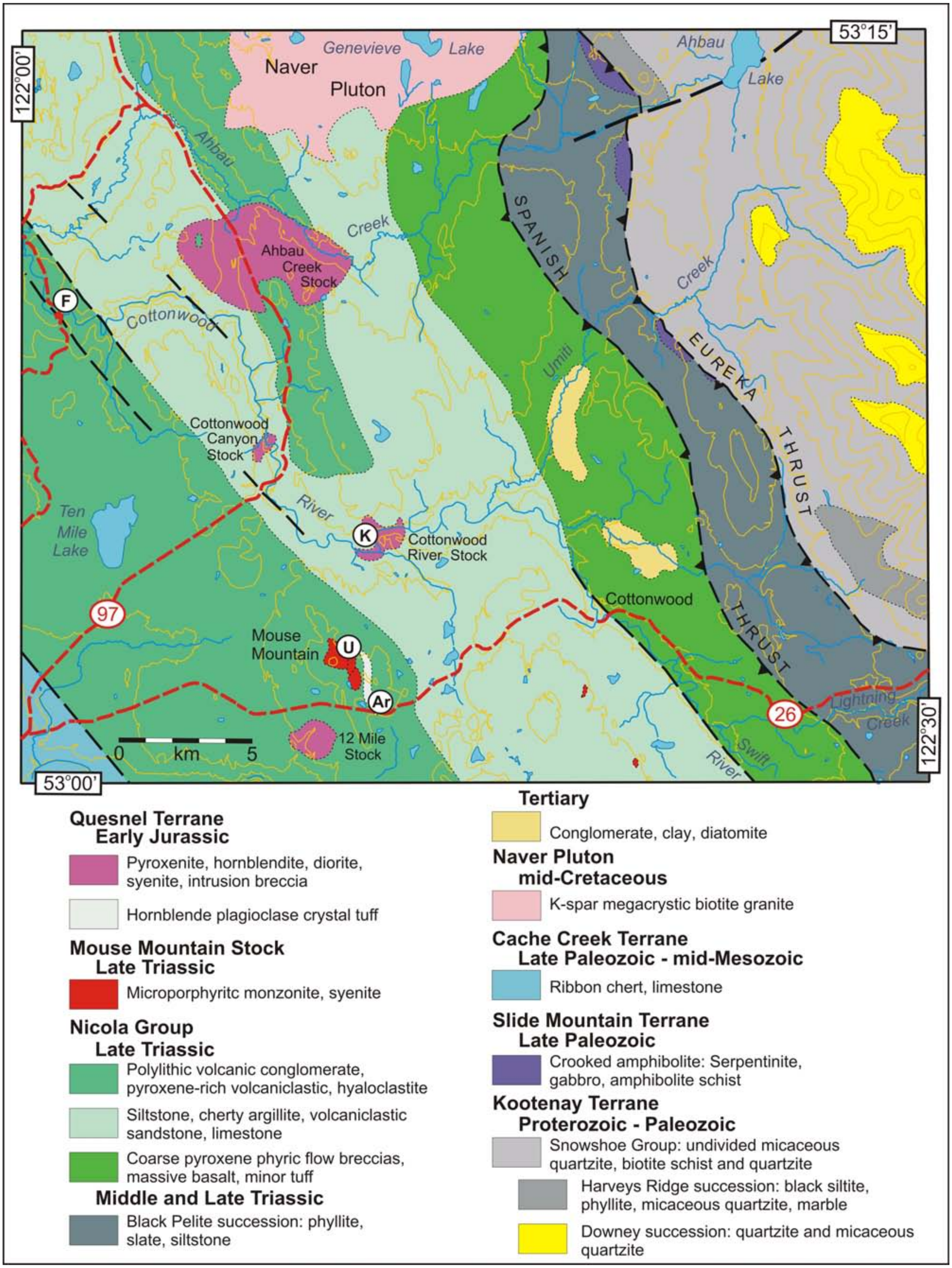

Figure 2. Generalized geology of the Cottonwood map area (093G/01), based on 2007 fieldwork and interpretation of low-level airborne geophysical survey (Carson et al., 2006). The map shows the location of macrofossil and geochronological samples.

hilltop located 5 km west of Ahbau Lake. An isolated outcrop of thinly foliated micaceous marble and quartzite is seen on the western slope of the hill forming the footwall to the Eureka thrust and the serpentinized pyroxenite exposed at the base of the hill. Bedrock exposure is limited, but anomalous base-metal soil geochemistry is known from the area underlain by the Harveys Ridge succession (Ahbau Lake Property in the Mineralization section).

Slide Mountain Terrane — Crooked Amphibolite

The Slide Mountain Terrane consists of the Antler Formation, the Crooked amphibolite (Campbell, 1978; Struik, 1982) and the Fennell Formation farther south (Schiarizza and Preto, 1987). All consist of imbricated oceanic assemblages of basalt, gabbro and chert in thrust contact with the pericratonic Kootenay Terrane. Variably sheared and tectonically thickened/thinned (?) mafic and ultramafic rocks of the Crooked amphibolite separate rocks of the Quesnel Terrane and the Barkerville subterrane over a distance of 200 km from Prince George (Struik et al., 1990) south to Hendrix Lake (Schiarizza and Macauley, 2007).

The Crooked amphibolite is well exposed in the northern part of the Cottonwood map area, southwest of Ahbau Lake and as small isolated subcrop occurrences south of Umiti Creek (Fig 2). It consists of a variety of dark green, typically $FeCO_3$-altered schistose ultramafic and mafic metavolcanic rocks and coarser-grained plutonic rocks. These rocks have high magnetic susceptibilities due to the magnetite produced during the alteration and breakdown of olivine to serpentine. As a result, follow-up of magnetic high anomalies generated from the 2005 airborne geophysical survey was successful in delineating a number of previously unknown occurrences of this unit. South of Ahbau Creek, variably foliated metavolcanic schist and coarse-grained amphibolite characterized by acicular, centimetre-long crystal aggregates of actinolite (~75%) and interstitial white plagioclase define the unit. In the southeastern corner of the map area, the Crooked amphibolite (not shown on the map) consists of a thinly foliated metavolcanic rock less than 50 m thick that strikes parallel to the dominant foliation in the micaceous quartzite and schist of the Snowshoe Group and can be traced for several hundreds of metres.

Quesnel Terrane — Nicola Group

BLACK PELITE SUCCESSION

Between the Eureka and Spanish thrusts is a low area with variable relief and few outcrops. Here, defining the eastern part of Quesnel Terrane, are scattered outcrops of silty to fine sandy black slate, calcareous slate and rare volcanic tuff interbedded with black recessive-weathering phyllite and lesser quartz sandstone.

The black fine-grained siliceous and calcareous clastic rocks structurally overlie sheared serpentinite of the Crooked amphibolite in the eastern portion of the map (Fig 2). The nature of the contact is not exposed, but it follows a north-trending magnetic high that corresponds to sheared serpentine and talc-altered mafic volcanic rocks mapped as part of the Crooked amphibolite. These fine-grained black clastic rocks are correlated with the black phyllite unit of Rees (1987), which has been dated as Middle and Late Triassic from conodont-bearing calcareous horizons at Quesnel Lake (Struik and Orchard, 1985). Thin interbedded grey and black phyllite, graphitic±pyritic argillite, buff and grey siltstone and fine quartz sandstone crop out along Highway 26 in the southeastern corner of the map area. The rocks are weakly metamorphosed to lower greenschist facies and mostly unaltered. A slaty cleavage is common, but recrystallization along it is lacking. Bedding and cleavage trend northwest. Open to subisoclinal folds that trend northwest are seen locally. On the limbs of these folds, cleavage has transposed bedding, producing lensoidal quartz sandstone breccia in a black graphitic or calcareous phyllite matrix that can be traced into interbedded quartz sandstone and black siltstone. Detrital quartz and muscovite present in sandstone imply a continental margin rather than a fore arc volcanic setting.

A coarse polylithic clastic unit, the Wingdam conglomerate of Struik (1988b), is exposed adjacent to the southeast corner of the map area. It strikes northwesterly and projects into the map area but was not encountered during current mapping. The conglomerate is included in the Middle and Late Triassic black clastic sequence of the Nicola Group (Struik, 1988b). The conglomerate contains rounded clasts of deformed and foliated serpentinite, mafic volcanic rocks and pyroxenite, micaceous quartzite, black quartzite, white vein quartz, graphitic phyllite and shale within a dolomitic and siliceous matrix. All of the clast types in the conglomerate can be derived locally from the Crooked amphibolite and the Snowshoe Group. Recognition of deformed and metamorphosed (?) Slide Mountain Terrane and Kootenay Terrane fragments deposited on the Quesnel Terrane led McMullin et al. (1990) to suggest that the Slide Mountain and Kootenay terranes must have been imbricated prior to the Middle to Late Triassic deposition of the Quesnel Terrane. This implies that the contact between the Slide Mountain and Quesnel terranes is an erosional unconformity that was later tectonized and metamorphosed in the Middle Jurassic.

Contact relations between the black pelite succession and the overlying volcanic rocks are both depositional (Bloodgood, 1987; Rees, 1987; Panteleyev et al., 1996) and structural (Struik, 1986, 1988a, 1990) in the Quesnel Lake area farther south, but not exposed in the current study area. The black pelite succession is considered to be broadly coeval with the eastern volcaniclastic Nicola Group and may be an eastern back arc facies onto which arc volcanic and volcaniclastic rocks were deposited.

EASTERN VOLCANICLASTIC SUCCESSION

An eastern belt of mafic olivine-pyroxene, pyroxene and pyroxene-plagioclase-phyric volcanic flows, breccia, fine-grained tuff and volcaniclastic rocks structurally overlie black clastic rocks of the black pelite succession (Fig 3). Outcrop is sparse but defines a 5 km wide north-trending belt of rocks, which at its northern extent appears to wrap around the southeastern margin of the Naver pluton south of Genevieve Lake. Outcrop distribution, airborne geophysical total field magnetic and first vertical derivative plots coincide to define the eastern volcaniclastic succession.

In the north part of the map area, black, vesicular, coarse-grained clinopyroxene-phyric block flow breccia, ash and lapilli-supported autoclastic breccia and coherent basalt flows occupy an east-trending belt that follows the southeastern margin of the Naver pluton. The flows are characterized by euhedral to stubby 2 to 3 mm pyroxene crystals and sparse <1 mm plagioclase laths in a weak

Figure 3. Coarse monolithic block to lapilli volcanic breccia containing pyroxene-phyric and pyroxene-plagioclase-phyric basalt fragments. Clast to matrix supported, eastern volcaniclastic succession, Ahbau Creek.

chloritic aphanitic groundmass. Outcrops show vague pillowed forms with chilled altered margins and concentrically distributed white calcite and/or albite-filled amygdules. The basalt is cut by narrow (1–2 cm wide), east-trending sheeted albite veins. The rocks have relatively high magnetic susceptibility and can be traced southward.

Outcrops in Ahbau Creek consist of coarse, angular, block to boulder clast-supported volcanic breccia dominated by pyroxene-phyric and pyroxene-plagioclase-phyric basalt. White calcite, pyroxene crystals and/or sand-sized lithic fragments comprise the matrix (<3%) to the mainly clast-supported breccia (Fig 3).

At the southern end of the belt, in the Cottonwood River and Lightning Creek drainages, pyroxene-phyric and pyroxene-plagioclase-phyric coherent flow and breccia flow units are common. Rubbly flow breccia consists of monolithic angular to rounded, block to lapilli-sized clasts of pyroxene-phyric basalt. Often clast supported, or within a matrix of ash, rarely carbonate fills the interstices. Flows are, for the most part, submarine and subordinate to clastic volcanic rocks in overall abundance.

COTTONWOOD RIVER SUCCESSION

Fine clastic sedimentary rocks dominated by thin parallel-laminated grey, green, buff and black cherty argillite, volcanic siltstone, slate and grey or buff limestone form a continuous belt of rocks approximately 9 km wide that occupies the western third of the map (Fig 2). These rock types are best exposed along the length of the Cottonwood River and have been assigned to the Cottonwood River succession (Fig 4).

The Cottonwood River succession consists mainly of grey to green or rusty weathering black cherty argillite and fine-grained, parallel-laminated, volcanic siltstone. Centimetre-thick grey limestone beds occur interlayered with the cherty argillite sequence or as tens of metres thick black and buff-coloured silty limestone interbedded with graphitic phyllite. The sequence is dominated by massive sandstone, planar-laminated siltstone units and rare wavy to small-scale crossbeds that are interpreted to represent turbidite deposition distal from the main arc. The succession is characteristically cleaved parallel to bedding into 50 mm thick cherty domains by 2 mm phyllite partings.

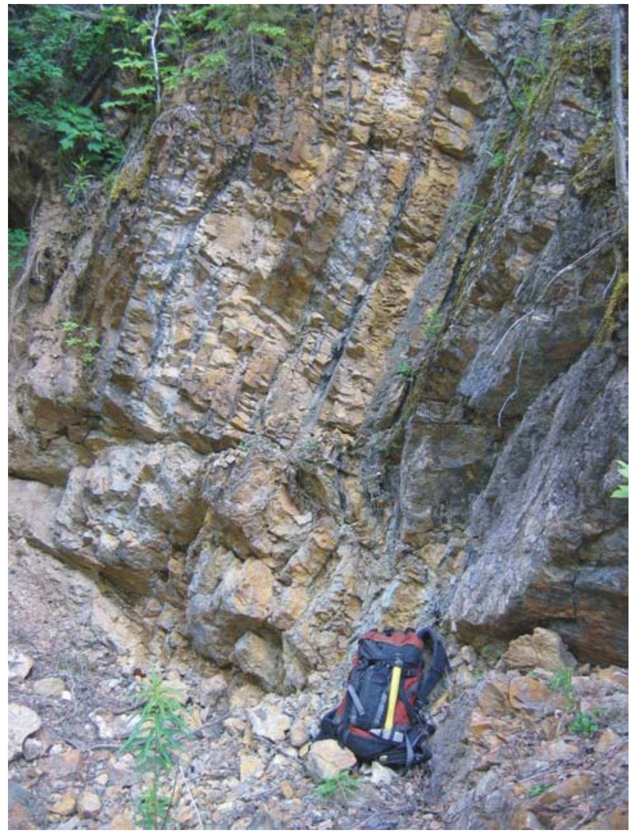

Figure 4. Rusty-weathering siltstone and cherty argillite interbedded with massive grey-green volcanic sandstone of the Cottonwood River succession. Photo is looking northwest along the sinistral fault zone, downstream of Cottonwood River.

South of Highway 26, the sedimentary rocks are coarser grained, consisting of thinly bedded volcanic sandstone, poorly sorted volcanic debris flows or greywacke and black cherty argillite. Relatively minor amounts of dark green coarse pyroxene-phyric basalt breccia occur interbedded with the sedimentary rocks in the central sedimentary sequence.

The upper contact with the western volcaniclastic succession is not well established, although east of the Cottonwood River it appears that volcaniclastic material increases in grain size and proportion upsection, passing gradationally into volcanic breccia of the western volcaniclastic succession. The Cottonwood River succession is not dated within the map area, but samples of limestone and calcareous black siltstone have been submitted to the Geological Survey of Canada Micropaleontology Laboratory in Vancouver.

WESTERN VOLCANICLASTIC SUCCESSION

The western volcaniclastic succession of the Nicola Group is the most heterogeneous unit in the map area. It forms a north and northwest-trending belt, 2.5 and 9 km wide, respectively, of pyroxene-phyric basalt breccia, heterolithic volcanic conglomerate, crystal-lithic sandstone and fine-grained heterolithic volcaniclastic rocks (Fig 2). The north-trending belt follows Highway 97 for 20 km from the Cottonwood River to the northern edge of the map. Contact relationships are apparently gradational with fine clastic rocks of the Cottonwood River succession exposed along the Umiti Creek Road. Contact relationships for the western belt are less understood. On the east it is bound by northwest-trending faults and to the southeast its relation to the Cache Creek Terrane is obscured by thick overburden.

Volcaniclastic rocks of the western succession are well-exposed in the CN Rail quarry north of Ahbau Creek. They consist of northwest-trending units of massive coherent basalt flows, hyaloclastite, coarse pyroxene-phyric breccia and clastic deposits. Rare 1 m wide fine-grained tuffaceous cherty siltstone defines the regional trend. Basalt flows are approximately 5 m thick and characterized by brecciated margins. Flows vary from coarse crowded pyroxene porphyry to sparse and aphyric, commonly highly vesicular, varieties. The volcaniclastic package is hornfelsed and flooded by pyrite and/or pyrrhotite, abundant calcite and chlorite probably related to the emplacement of the Naver pluton.

Interbedded with the volcaniclastic rocks are well-sorted planar laminated argillite and siltstone units and 10 m thick channel deposits of unsorted chaotic slump deposits of sedimentary and volcanic-derived material. These coarse-grained intervals consist of angular boulder to granule-sized volcanic clasts and centimetre-sized rip-up clasts of cherty argillite supported within a matrix of pyroxene and plagioclase-rich sand and/or mud. The grain flow deposits are dominated by clasts of pyroxene-phyric basalt. The pyroxene crystal-rich sandstone, volcaniclastic breccia and conglomerate horizons contain abundant detrital magnetite and a relatively high magnetic susceptibility, which is evident on the airborne magnetic maps. Stratigraphically low in the volcaniclastic succession are sedimentary units characterized by bedding couplets generally less than 1.0 mm thick of olive grey sandstone and orange-black thinly laminated cherty siltstone and 10 to 12 m thick massive outcrops of pale green, fine to medium-grained, well-sorted pyroxene and plagioclase crystal (1–4 mm) sandstone.

The western belt of volcaniclastic rocks is best exposed in the area between Highways 97 and 26, where it extends from Mouse Mountain northwestward as a 5 km wide belt of pyroxene-phyric breccia, heterolithic maroon pyroxene and plagioclase-phyric volcaniclastic and massive green tuffaceous rocks (Fig 2). The majority of outcrops in the western belt consist of massive, heterolithic pyroxene-dominated volcaniclastic to conglomeratic units. Bedding is rarely observed and often preserves slumping and soft sedimentary deformation. Rocks are variably green and/or maroon and hematitic, suggesting marine and subaerial deposition. In the vicinity of Mouse Mountain, the breccia contains detrital biotite, orthoclase and altered intrusive rocks related to the Cu-Au mineralizing system.

The minimum age of the western volcaniclastic succession is constrained by the Late Triassic age of the Mouse Mountain pluton.

Early Jurassic

SEDIMENTARY ROCKS

Rocks exposed at the old Prince George highway bridge crossing the Cottonwood River comprise a structurally disrupted and sheared sequence of heterolithic maroon volcanic breccia, calcareous green volcaniclastic rock and grey limestone. Overlying this Triassic (?) volcanic sequence is a grey and brown sedimentary sequence of fine sandstone, siltstone and shale. Ten to twenty millimetre thick beds of olive sandstone with black siltstone partings are interbedded with thinly laminated sooty black shale and siltstone. Poorly preserved ammonoids and bivalves were collected from the sandstone and shale. The fossils have been assigned an Early Jurassic Sinemurian age (T. Poulton, pers comm, 2007).

The contact relationship between the two packages is believed to be depositional because similar stratigraphic relationships occur at Morehead Lake in the Mount Polley area (Bailey, 1978; Logan et al., 2007b).

VOLCANIC ROCKS

Grey to white plagioclase-hornblende porphyritic volcanic and subvolcanic intrusive rocks crop out in a north-northwest-trending belt in the vicinity of Mouse Mountain (Fig 2). The rocks are coarsely porphyritic with tabular white plagioclase phenocrysts up to 2.5 cm in diameter and noticeably finer acicular hornblende crystals in a green, grey or maroon aphanitic matrix. Brecciated lithic fragments, crystal shards and eutaxic textures indicate that the unit represents a welded crystal-ash flow (ignimbrite). The rock was mapped and interpreted variably as a subvolcanic intrusive to flow unit (Jonnes and Logan, 2007) that cross-cut or overlay the pyroxene porphyry and volcaniclastic units. Observations from the summer mapping recognized heterolithic breccia at Mouse Mountain and along strike to the south that contain plagioclase-hornblende porphyritic volcanic clast-rich horizons interbedded with coarse pyroxene-phyric breccia flows, suggesting temporal relationships for these units (Fig 5).

Major and trace-element rock geochemistry of the plagioclase porphyry unit plots in the andesite field on Winchester and Floyd (1977) rock discrimination diagram. On the SiO_2 vs. K_2O andesite series plot of Gill (1981), the hornblende-plagioclase crystal tuff unit occupies the high-potassium andesite field.

Hornblende was separated from the plagioclase crystal tuff and analyzed to constrain the cooling age of the ignimbrite. Argon-argon plateau ages for hornblende separates determined at the Geochronology Laboratory, the

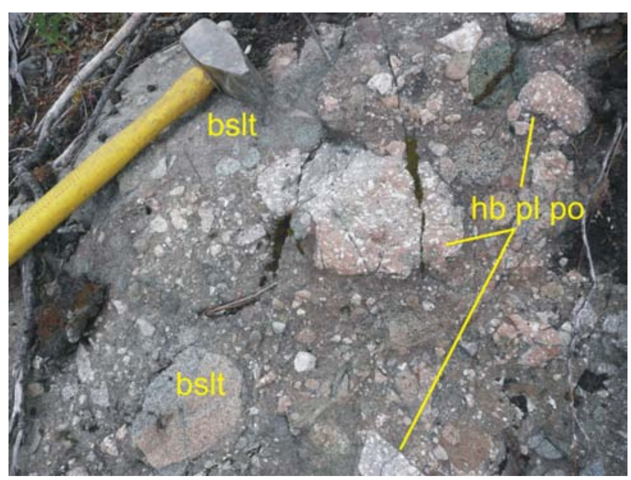

Figure 5. Heterolithic volcanic breccia composed primarily of subangular to rounded pyroxene-phyric basalt (bslt) and hornblende-plagioclase-phyric andesite (hb-pl po), in a sand-sized, crystal-rich volcaniclastic matrix, 1 km southeast of Mouse Mountain.

University of British Columbia returned an Early Jurassic cooling age of 192 ±1.3 Ma (T. Ullrich, pers comm, 2007). This Early Jurassic age coincides with the ca. 193 Ma plutons of the Takomkane–Thuya suite (Parrish et al., 1987; Breitsprecher and Mortensen, 2004), suggesting that these high-potassium andesite units may represent extrusive equivalents to a well-established Early Jurassic plutonic event in the Quesnel Terrane.

Intrusive Rocks

Intrusive rocks within the Cottonwood map area include a Late Triassic and Late Triassic to Early Jurassic suite that comprise the constructive period of the Quesnel magmatic arc and a younger post-accretionary suite of Cretaceous age. A Middle Jurassic suite of plutons intrudes the Quesnel Arc north and south of the current study area (Struik et al., 1992; T. Ullrich, pers comm, 2006; Logan et al., 2007a), but has not been recognized in the Cottonwood map area.

LATE TRIASSIC

Mouse Mountain Monzonite

Small, isolated, quartz undersaturated stocks interpreted to be Late Triassic in age intrude the Cottonwood River succession of fine-grained clastic rocks in the south-central part of the map area (Fig 2). Most are less than 0.5 km^2 in area and occur south of Highway 26. They are similar in composition, regional distribution and temporal relationships to the suite of latest Triassic alkaline intrusive rocks that define the medial arc axis and magmatic centres at Mount Polley, QR and Cantin Creek, where they are associated with alteration and Cu-Au mineralization (Logan and Mihalynuk, 2005; Jonnes and Logan, 2007). The Mouse Mountain pluton is also characteristic of this suite, is larger and intrudes the western volcaniclastic succession.

Leucocratic fine-grained intrusive rocks underlie the main area of Mouse Mountain, encompassing an area of approximately 1.3 km^2 (Jonnes and Logan, 2007). Microporphyritic monzonite to monzodiorite rocks characterize the main intrusive sequence, but coarse orthoclase megacrystic syenite dikes are also known to intrude the area. Contact relationships with the Late Triassic Nicola Group country rock are presumably intrusive, but unseen. Separating the monzonite into two bodies is a monolithic breccia made up primarily of intrusive clasts of monzonite in a rock flour matrix. Jonnes and Logan (2007) interpreted this breccia to be a hydrothermal breccia or eruptive diatreme located near the top of the intrusive pile.

A 20 kg sample of least-altered, pink pyroxene monzonite was collected from the Valentine zone and dated using laser ablation inductively coupled plasma – mass spectrometry (ICP-MS) U-Pb techniques at the University of British Columbia. Zircon grains extracted from the sample yielded a Late Triassic crystallization age for the monzonite of 207.42 ±0.58 Ma (R. Friedman, pers comm, 2007), thus providing a maximum age for Cu-Au mineralization at the Valentine zone.

Additional intrusive bodies in the map include a distinctive white-weathering plug of crowded megacrystic orthoclase porphyritic syenite that crops out approximately 3 km south of the community of Cottonwood (Fig 2). The main body of the syenite consists of aligned orthoclase crystals up to 5 cm in length, which comprises 80% of the rock. Equigranular pyroxene-hornblende monzodiorite containing sparse (2–3%) megacrysts of orthoclase define 25 m wide marginal phases to the plug. Trace amounts of chalcopyrite and pyrite replace mafic xenoliths and mafic minerals along weak alteration fronts cutting the monzodiorite.

Three kilometres west-northwest of the megacrystic syenite is a poorly exposed fine to medium-grained, equigranular to microporphyritic pyroxene monzodiorite plug. Both the intrusion and the country rock contains 1 to 1.5% pyrrhotite and elevated Cu and Zn (07GLE22-111, Table 1).

LATE TRIASSIC TO EARLY JURASSIC (?)

Mafic-Ultramafic Plutonic Complexes

The map area contains a number of small, generally less than 1 km^2 composite mafic-ultramafic intrusive bodies (Fig 2). These and other Alaskan-type complexes in BC are confined to the Quesnel and Stikine terranes and are spatially and genetically associated with Late Triassic to Early Jurassic volcanic arc rocks of the Nicola-Takla-Stuhini groups (Irvine, 1974; Mortimer, 1986; Nixon et al., 1997). The mafic biotite-bearing phases of these plutons have elevated concentrations of magnetite and hand samples typically display high magnetic susceptibility readings that correspond to magnetic highs on residual total magnetic field plots. Two apparently similar composite plutons exposed in the Cottonwood River consist of pyroxenite, pyroxene-hornblende diorite and monzodiorite. In detail, the pyroxene-biotite diorite phase is absent and both stocks have much lower magnetic susceptibilities and no magnetic high signature.

The Ahbau Creek stock is the largest of these mafic complexes. It is centred on Highway 97 at the Greening rail siding and is interpreted primarily on the basis of its magnetic signature to cover an elliptical area of just over 20 km^2 between Ahbau Creek and the Cottonwood River. The northwestern margin of the stock is exposed for approximately 3 km in Ahbau Creek from the railroad trestle upstream to the upper falls. Outcrop exposures include clinopyroxenite, pyroxene-biotite diorite and intrusion breccia comprising fragments of pyroxenite, gabbro and diorite within an intermediate to felsic, medium-grained hornblende monzodiorite matrix (Fig 6). The pyroxene-biotite diorite to monzodiorite is medium grained; plagioclase and pyroxene crystals are subequal in size and display intergranular texture, while interstitial coarse poikilitic biotite envelops the plagioclase and pyroxene (Fig 7). Coarse (1.5 mm) euhedral apatite crystals and magnetite are evenly disseminated throughout the matrix is greater than 5 vol%. Magnetic susceptibility values for this unit average between 75 and 100 SI units. The matrix to the igneous breccia is leucocratic, medium to coarse grained and enriched in alkali minerals compared to the earlier crystallized phases. Orthoclase occurs as megacrysts and late optically continuous interstitial crystals that together with coarse poikilitic hornblende envelop subhedral crystals of apatite and pyroxene. Hornblende also locally replaces clinopyroxene. Magnetite is noticeably less abundant, present in only trace amounts. Coarse euhedral sphene crystals and andradite garnet occupy cuspate late-stage voids that trapped hydromagmatic fluids.

The 12 Mile stock is a similar mafic plutonic complex to the Ahbau Creek stock. It is located south of Highway 23, approximately 19.3 km (12 mi) east of Quesnel. Like the Ahbau Creek stock, it has a distinctive circular magnetic high anomaly on the residual total magnetic field plot and is poorly exposed. Exposures are limited to a creek gully located approximately 3 km south of Mouse Mountain. Outcrops consist of pyroxenite and pyroxene-biotite diorite and intrusion breccia with angular blocks of gabbro, pyroxenite and diorite within an equigranular pyroxene-hornblende monzodiorite. Joints and fractures are coated with chlorite, serpentine and calcite. The plagioclase is extensively sericitized, particularly along outer zones of the phenocrysts and/or sausseritized (epidote+sericite±carbonate±chlorite), chiefly in the interior of the phenocrysts. Apatite and magnetite are abundant and associated with poikilitic biotite. At the northern end of the outcrop the intrusion breccia is cut by an 8 m wide northwest-trending dike of microporphyritic pink biotite-pyroxene monzonite similar to the Mouse Mountain monzonite.

The Cottonwood River (Bailey, 1988) and the Cottonwood Canyon stocks are two additional mafic plutonic complexes that occur within the study area. Both crop out along the Cottonwood River, are <1 km^2 and intrude fine-grained cherty tuff, siltstone and volcaniclastic rocks of the central Nicola facies. The plutons are complexly zoned, composite bodies of igneous breccia comprising coarse-grained clinopyroxenite, hornblende clinopyroxenite, gabbro and/or monzodiorite, veined by more felsic medium to coarse-grained hornblende-pyroxene monzodiorite to monzonite phases. The youngest intrusions consist of crowded orthoclase megacrystic monzonite to pegmatitic syenite dikes. These latter orthoclase megacrystic phases commonly exhibit a well developed trachytic flow fabric defined by aligned orthoclase phenocrysts (Fig 8).

A sample of pyroxene-hornblende gabbro collected by D. Bailey from the Cottonwood River stock was dated using K-Ar isotopic techniques at the University of British Columbia by J. Harakal. Hornblende from the gabbro yielded an Early Jurassic cooling age of 187 ±7 Ma (Panteleyev et al., 1995). Schiarizza and Macauley (2007) describe similar ultramafic-mafic plutonic complexes that intrude the eastern side of the Quesnel Terrane in the Canim Lake area (150 km southeast of the study area). They report

TABLE 1. ASSAYS OF ROCK SAMPLES COLLECTED DURING SUMMER 2007 FIELDWORK, COTTONWOOD MAP SHEET (093G/01); ANOMALOUS SAMPLES HIGHLIGHTED IN YELLOW.

		Element	Ag	Al	As	Au	Ba	Bi	Ca	Cd	Ce	Co	Cr	Cu	Fe	Hf	K	La	Li	Mg	Mn	Mo
		Units	(ppm)	(%)	(ppm)	(ppb)	(ppm)	(ppm)	(%)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(%)	(ppm)	(%)	(ppm)	(ppm)	(%)	(ppm)	(ppm)
		Method	TICP	TICP	TICP	FA	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP
Station Number	Easting	Northing																				
07GLE10-53	541694	5893709	1	6.74	14	4	78	2.9	0.13	2.6	60	0.5	57.4	3.8	0.63	3.5	3.93	33.7	10.9	0.1	69	14.2
07JLO10-54	540602	5897830	1	7.1	7	34	1667	0.2	2.57	0.1	36	15.8	102.5	127.3	3.38	0.9	3.14	18	78.5	2.27	414	0.8
07JLO14-87	567045	5877649	<.1	10.87	<1	19	17	0.5	14.54	0.3	107	11.3	84.2	0.5	10.04	0.8	0.02	55.7	15.8	2.82	3215	0.2
07JLO18-118	554373	5879944	<.1	3.99	324	5	35	0.1	0.63	0.7	82	62.4	685.1	59.9	5.94	2	1.63	40.5	10	0.52	2273	0.2
07JLO18-126	554332	5875955	0.1	11.09	1	18	737	<.1	4.91	0.1	10	9.9	36.2	47.3	3.33	1.1	4.42	4.7	9.9	0.95	894	0.1
07GLE20-106	542139	5894516	0.5	9.5	3	17	307	<.1	7	0.3	18	34.6	85.8	283.1	8.85	2.4	1.5	7.9	39.5	4.06	1673	0.7
07JLO20-131	551661	5881262	0.2	8.23	2	<2	1024	0.1	6.95	0.2	12	20	52.9	173.9	4.88	1.5	2.41	5.9	12.1	1.72	1133	0.2
07JLO21-141	546726	5881716	0.1	5.46	14	<2	440	<.1	8.66	0.1	33	13.6	55.7	85.1	3.96	1.2	2.77	17.8	33.2	3.56	2392	0.5
07JLO22-147-2	547698	5881795	0.2	11.55	106	6	1247	<.1	3.31	0.7	16	13.5	28.8	96.4	4.02	1.1	3.51	7.8	11.7	0.64	445	1.5
07GLE26-119	546480	5876166	0.1	7.03	6	19	1158	0.1	8.43	<.1	22	29.2	70.2	53.1	6.37	1.2	3.45	11.6	55.8	2.36	1328	0.5
07GLE29-137	535507	5889129	0.1	7.47	5	8	81	<.1	10.62	0.1	18	15.7	24.9	37.8	4.76	2.5	0.33	7.2	15.2	1.13	1354	0.4
07GLE23-114	555518	5895807	<.1	9.09	1	70	158	0.1	6.45	0.2	35	43.7	354.1	32.1	6.97	1.6	0.63	17.6	34.3	3.26	996	0.3
07JLO13-83	544811	5902426	<.1	7.54	2		1216	0.2	1.2	0.1	67	2.8	96.7	6	1.36	1.3	3.88	37.4	65	0.38	365	0.3
07GLE3-10	546610	5896809	0.1	8.08	3		1264	0.1	1.77	0.1	55	4.9	83.2	8.4	1.84	1.3	3.22	29.2	42.6	0.76	420	0.4
07GLE31-147	544702	5895672	0.1	8.74	12		1816	0.1	4.04	0.4	108	16.1	61.3	21.5	4.55	3.4	2.34	57.9	26.6	2.02	839	1.8
07JLO13-80	555424	5898275	0.1	0.86	11		29	0.1	0.29	0.2	10	121.3	1201.1	14.8	6.92	<.1	0.02	5.3	10.3	21.32	538	0.1
07JLO20-134	546542	5881292	<.1	8.97	2		1453	<.1	6.38	0.1	15	21.5	45.1	30.3	6.19	1.4	5.05	6.5	22.6	1.81	1303	0.6
07GLE26-126	546469	5881403	0.2	9.13	1		874	<.1	8.44	0.2	15	34.8	52.1	421.5	7.44	1.4	3.23	7	24.4	3.21	1507	0.2
07GLE22-111	551521	5876622	0.1	8.6	<1		568	<.1	6.18	0.3	18	35	73.5	116	8.03	2.2	1.5	7.4	20.6	3.48	1450	0.1
07JLO25-177	542458	5885376	<.1	7.57	1		1209	<.1	6.24	0.1	19	26.4	47.9	55.1	6.91	1.7	3.23	9	35.1	2.56	1438	<.1
07JLO27-190	544116	5892126	0.1	9.14	3		1152	<.1	7.46	0.1	14	38.4	17	165.3	9.09	0.5	2.45	6.7	30.5	3.59	1424	0.1
Std CANMET WPR1			0.6	1.67	-1	43	21	0.1	1.6	0.2	5	202.2	2595.2	1722.9	10.56	0.5	0.09	2	5.7	18.09	1397	0.3
Recommended			0.7	1.64	1.4	42.2	22	0.19	1.43	0.43	6	180	3300	1640	9.93	0.61	0.165	2.2	4.2	18.69	1549	0.9
% Difference			15.4	1.8	1200	1.9	4.7	62.1	11.2	73.0	18.2	11.6	23.9	4.9	6.1	19.8	58.8	9.5	30.3	3.3	10.3	100

		Element	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Sn	Sr	Ta	Th	Ti	U	V	W	Y	Zn	Zr
		Units	(%)	(ppm)	(ppm)	(%)	(ppm)	(ppm)	(%)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(%)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
		Method	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP
Station Number	Easting	Northing	0.001		0.1	0.001	0.01		0.02	0.02	0.1		0.5	0.1	0.2	0.001	0.5	2	1		0.1	
07GLE10-53	541694	5893709	2.903	36.5	2.1	0.005	627.6	185.6	<.1	1.3	2	10	52	2.7	28.7	0.064	8.6	5	6.2	10.9	289	81.6
07JLO10-54	540602	5897830	1.155	7.9	38.9	0.076	12.6	102.6	0.5	4	14	1.3	472	0.6	5.3	0.335	1.4	141	1.3	15	58	31.3
07JLO14-87	567045	5877649	0.111	19	26.7	0.073	27.2	2	<.1	0.9	12	4.8	2075	1.4	15.7	0.405	4.6	86	0.8	27.6	85	17.4
07JLO18-118	554373	5879944	0.016	19.7	540	0.196	8.4	55.9	<.1	122.2	16	1	228	1	6.2	0.421	1.6	142	0.8	13.5	99	75.7
07JLO18-126	554332	5875955	3.272	2.9	8.9	0.13	13.2	106.6	0.2	0.4	8	0.5	1684	0.2	0.8	0.18	0.5	135	0.2	7.8	52	38.8
07GLE20-106	542139	5894516	1.933	3.8	45.1	0.132	2.7	53.2	0.1	4	31	1.2	1165	0.3	1	0.868	0.6	399	0.8	23.8	84	63.3
07JLO20-131	551661	5881262	2.974	1.7	25.9	0.063	5.5	58.8	<.1	0.7	25	0.9	345	0.1	0.8	0.415	1.3	256	1.3	12.9	84	43.8
07JLO21-141	546726	5881716	0.643	5.7	38.4	0.043	6	49.4	0.2	32.5	14	1.1	284	0.5	3.8	0.259	1.2	199	3.6	12.3	79	30.7
07JLO22-147-2	547698	5881795	3.09	2.8	16.5	0.21	12.1	91.7	1.5	1.7	9	1.8	1455	0.2	1.5	0.255	0.8	176	0.5	11.6	89	39.9
07GLE26-119	546480	5876166	1.188	1.9	30.9	0.293	6.6	44.1	0.2	0.4	21	0.6	382	0.2	1.3	0.328	1.5	273	0.9	10.8	85	30.3
07GLE29-137	535507	5889129	2.854	2.4	6.1	0.098	5.3	5.6	0.1	0.6	21	1	195	0.2	0.8	0.537	0.8	175	0.2	24.6	64	61.8
07GLE23-114	555518	5895807	2.575	9.7	149.2	0.188	5.1	13.4	0.4	0.2	30	1.3	513	0.7	2.3	0.931	0.5	269	0.3	25.9	80	43.9
07JLO13-83	544811	5902426	3.171	15.9	5	0.055	25.1	157.3	0.1	<.1	4	2.2	311	1.2	19.4	0.171	7.6	28	0.3	14	45	32.3
07GLE3-10	546610	5896809	3.06	15.7	15.5	0.075	17.4	128.2	<.1	0.2	5	2.2	373	1.2	13.9	0.281	3.2	48	0.2	11.6	42	31.7
07GLE31-147	544702	5895672	3.557	23.3	20.8	0.277	15.5	55.1	0.1	0.6	11	1.4	1228	0.9	11.6	0.634	4.1	155	0.8	16.6	88	125.4
07JLO13-80	555424	5898275	0.013	1.5	2304.3	0.001	2.7	2.1	<.1	2.5	10	0.6	23	0.1	0.2	0.012	0.9	31	0.6	1.5	55	1.6
07JLO20-134	546542	5881292	1.967	1	12.7	0.23	5.8	87.3	0.2	0.1	15	0.7	1923	0.1	0.5	0.39	0.2	309	2.6	13.5	80	42.4
07GLE26-126	546469	5881403	1.733	2.1	29.4	0.322	4.6	63.2	0.1	<.1	24	0.6	1326	0.1	0.6	0.46	0.2	299	0.5	14.6	101	45.2
07GLE22-111	551521	5876622	2.945	4.2	28.6	0.139	3	36.5	0.6	0.2	34	1.2	1081	0.2	1.2	0.923	0.5	370	0.2	26.4	113	79.7
07JLO25-177	542458	5885376	1.796	2.5	16.6	0.335	8.5	56.9	0.1	0.3	23	0.7	1358	0.1	1	0.448	0.6	319	0.2	15.4	101	61
07JLO27-190	544116	5892126	1.475	1.8	13.9	0.235	1.9	59.2	0.3	0.2	32	0.7	909	0.1	0.6	0.626	0.3	437	0.1	12.4	85	12.8
Std CANMET WPR1			0.021	1.7	3293	0.02	5.7	4.7	0.7	0.8	11	0.8	8	0.1	0.2	0.192	0.1	81	-0.1	3.8	96	14.6
Recommended				2.4	2900	0.013	6	5	0.9	0.9	12	1.1	7		0.4	0.179	0.2	65			95	18
% Difference			200.0	34.1	12.7	42.4	5.1	6.2	25.0	11.8	8.7	31.6	13.3	200.0	66.7	7.0	66.7	21.9	200.0	200.0	1.0	20.9

06JLO: TICP= Four acid digestion - inductively coupled plasma emission/mass spectrometry analysis. FA - Lead collection fire assay - ICPES Finish. Acme analytical, Vancouver

Figure 6. Intrusion breccia, Ahbau Creek mafic-ultramafic complex, upper falls on Ahbau Creek.

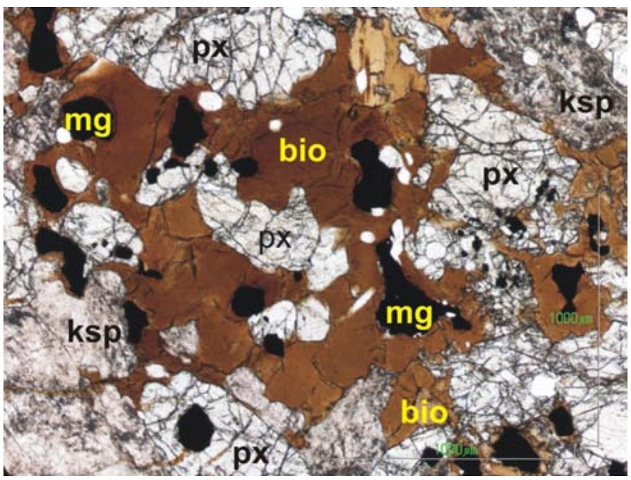

Figure 7. Photomicrograph of pyroxene-biotite diorite from the Ahbau Creek mafic-ultramafic complex, shows subhedral pyroxene, plagioclase and magnetite grains enveloped by large poikilitic biotite (07JLO10-59). Plane-polarized light. Abbreviations: bio, biotite; ksp, K-feldspar; mg, magnetite; px, pyroxene.

a number of overlapping Early Jurassic ages that include a concordant U-Pb titanite age of 188.3 ±0.5 Ma, and Ar-Ar plateau ages from hornblende (187.7 ±1.1 Ma) and biotite (186.34 ±0.96 Ma). Another Early Jurassic U-Pb zircon age of 186 ±2 Ma is reported for late-stage pegmatite from the Polaris complex (Nixon et al., 1997). Samples of the Ahbau Creek and Cottonwood River stocks have been collected for Ar-Ar dating. Results are pending.

CRETACEOUS PLUTONS

Naver Pluton

The Naver pluton is a north-trending 500 km^2 body of mainly granite composition that underlies the area from Mount George southward into the current map area at Genevieve Lake (Fig 2; Struik et al., 1992). North of the map area, it intrudes the Eureka thrust, providing a minimum age for the suture between the Quesnel, Slide Mountain and Kootenay terranes. The southern end of the pluton extends into the study area and is represented by three isolated, well-rounded and subdued outcrops of white weathering granite. The texture of the granite varies from feldspar megacrystic to coarsely equigranular. Mafic minerals commonly form less than 7% of the rock. Biotite predominates with hornblende present in some of the more mafic border phases. The southern border of the pluton is characterized by a narrow zone (20–200 m) containing xenoliths of metavolcanic and metavolcaniclastic rocks.

Figure 8. Medium-grained melanocratic pyroxene-hornblende monzodiorite and trachytic orthoclase megacrystic syenite phases of the Cottonwood mafic-ultramafic complex, Cottonwood Creek.

Modal mineral contents based on point counts and nomenclature following the classification of Streckeisen (1973) indicates primarily granite composition and rare granodiorite (Struik et al., 1992). Thin sections show 30 to 40 % plagioclase, 30 to 35 % orthoclase, 25 to 30% rounded quartz and 5 to 7% biotite±muscovite. Accessory minerals include sphene, zircon and magnetite. Alteration of plagioclase includes minor sericite, clay and saussurite±calcite. The texture and mineralogy of the granite is well exhibited in staining off-cut thin-section blocks with sodium cobaltinitrate (Fig 9).

Northerly trending porphyritic granite dikes intrude hornfelsed Nicola Group volcanic and volcaniclastic country rocks peripheral to the southern margin of the Naver pluton. The dikes trend southerly, dipping steeply to the east and rarely exceeding 5 m in width. Mineral composition is similar to the main pluton and comprises 2 to 3 mm phenocrysts of euhedral to resorbed quartz, 2 to 5 mm plagioclase and finer grained 1 mm crystals of chloritic and/or sericitic biotite in a fine orthoclase-rich matrix. The fine-grained groundmass with resorbed porphyritic phenocrysts suggest the rapid cooling and quenching characteris-

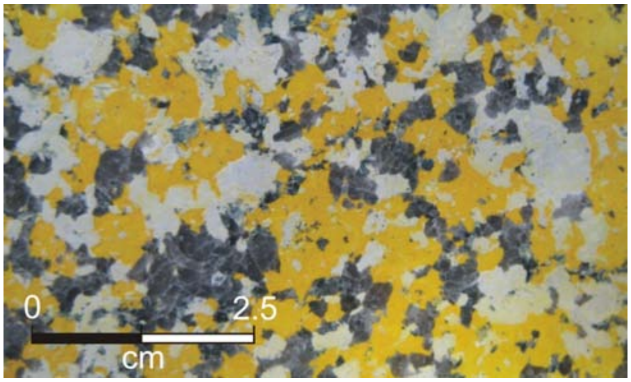

Figure 9. Equigranular granite phase of the Naver pluton stained with sodium cobaltinitrate to determine the percentages of plagioclase, potassium feldspar and quartz.

tic of narrow dikes; the composition and proximity to the Naver pluton suggest consanguinity.

The Naver pluton was assigned a mid-Cretaceous age by Wanless et al. (1967) on the basis of K-Ar biotite ages of 107.3 ±5 Ma and 109 ±6 Ma. Hunt and Roddick (1988) confirmed the age with new K-Ar isotopic ages of biotite that yielded 98 ±3 and 101 ±2 Ma dates. Uranium-lead age determinations on zircon and monazite fractions from an additional two samples suggest a 113 ±1 Ma crystallization age for the pluton (Struik et al., 1992). The ca. 100 Ma K-Ar biotite dates are cooling ages indicating relatively slow cooling after crystallization.

Tertiary Sedimentary Rocks

Struik et al. (1990) mapped a narrow belt of poorly consolidated and generally undeformed Tertiary sedimentary rocks exposed on Umiti and Mary creeks in the eastern portion of the map (Fig 2). These areas were not visited during the current study and the following description summarizes earlier work.

Struik et al. (1990) correlated these sedimentary rocks with three mid-Tertiary formations, the Australian Creek, Fraser Bend and Crownite, which are confined to a belt no more than 15 km wide along the Fraser River, west and south of Quesnel. Rouse and Matthews (1979) interpreted the preservation of these Oligocene to Late to Middle Miocene fluvial and paludal sedimentary rocks exposed along the Fraser River to their position in postdepositional downfaulted blocks rather than a valley-fill deposition model. The Australian Creek and Fraser Bend formations consist of well-sorted gravel, alternating finer and less well-sorted gravel and silt, clay and seams of lignite; the overlying Crownite Formation is almost pure diatomite with some clay.

Quaternary Cover

Unconsolidated Holocene and Pleistocene sediments cover much of the area. Bedrock is limited to deeply incised creeks and rivers and hilltops. Deglaciation outwash, lake and drift deposits comprise much of the sediments.

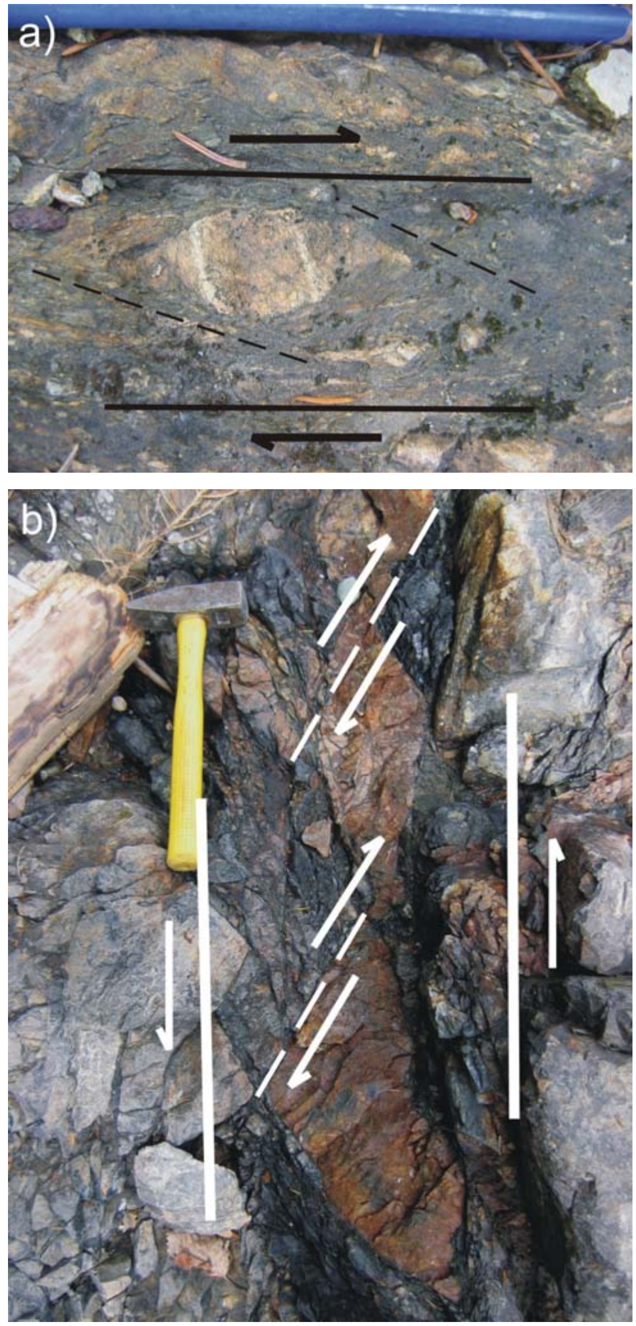

Figure 10. a) Northwest-trending brittle shear zone showing shear bands and asymmetry suggestive of dextral shear in a fault, cutting Cottonwood succession fine-grained volcaniclastic and sedimentary rocks, Ahbau Creek; coloured pencil for scale. b) Brittle shear zone, cutting Cottonwood succession fine-grained sedimentary rocks in Cottonwood River, same location as Figure 4. The antithetic slip along fracture planes indicates a sinistral sense of shear along the fault.

STRUCTURE

The general accepted structural evolution of the Cordillera at this latitude invokes from three to as many as five phases of regional folding (Rees, 1987; Struik, 1988a; McMullin, 1990). Evidence for the earliest deformation that affects rocks of the Barkerville subterrane is not recorded in Quesnellia. The second phase of deformation produced tight to isoclinal northwest-trending folds, which Rees (1987) suggested had northeast to easterly vergence. This second phase of folding was synmetamorphic (i.e., phyllosilicate mineral growth parallels foliation). The third phase of regional deformation (McMullin, 1990), D_2 in Quesnellia, produced upright to inclined southwest to westward-verging backfolds. These northwest-trending fold structures are responsible for much of the regional map-scale patterns. The D_2 phase is responsible for the z-shaped folded terrane boundary (Barkerville subterrane and Quesnel Terrane) demarked by the Crooked amphibolite. Younger deformation (D_3) is evidenced by open upright folds and warps that lack a penetrative axial planar cleavage. Younger structures include prominent systems of Eocene dextral strike-slip and extensional faults (Panteleyev et al., 1996).

Structure in the Cottonwood map area is not well known due primarily to the poor exposure and lack of any distinctive marker units within the fine-grained clastic and volcaniclastic units that dominate the map. The study area lies on the west flank of a broad northwesterly plunging arch, cored by Snowshoe Group rocks and the Naver pluton. The regional trend of the units is northwesterly; faults trend north-northwest and northeast.

The Eureka and Spanish thrust faults separate the imbricated terranes and are the earliest structures recognized (Struik, 1986, 1988a). The Eureka thrust (Struik, 1983) separates the Quesnel Terrane in the hangingwall from the Barkerville subterrane in the footwall. It trends northerly and is marked by discontinuous serpentinite and amphibolite of the Crooked amphibolite and/or isolated magnetic highs on the residual total magnetic field plots reflecting covered serpentinized ultramafic rocks. The hangingwall Nicola Group sedimentary rocks and footwall Snowshoe Group rocks are penetratively foliated adjacent to the structure. The Spanish thrust trends northerly and imbricates the eastern volcaniclastic succession with Nicola Group sedimentary rocks of the black pelite succession (Struik et al., 1990). The contact between the eastern sedimentary rocks and the eastern volcaniclastic succession was not located and therefore evidence for, or the degree of, imbrication along this structure could not be evaluated.

A number of northwest-trending parallel lineaments are defined by the drainage patterns of the Cottonwood River and Ahbau Creek in the northwestern portion of the map area. Northwest-trending discrete brittle fault structures from several metres up to tens of metres wide have been mapped in creek exposures along both of these drainage systems. Shear band orientation and asymmetric rotation of augen indicate a consistent dextral sense of shear for some of the northwest-trending faults (Fig 10a). Alternatively, similar northwest-trending brittle shears exposed along strike have shear sense indicators, which show sinistral motion along these fault structures (Fig 10b).

Struik et al. (1990) mapped a northeast-striking fault at the south end of Ahbau Lake that shows apparent dextral offset. The distribution of serpentinite and amphibolite units across the fault is consistent with dextral offset of the Crooked amphibolite and Eureka thrust across this lineament (Fig 2).

The volcaniclastic and sedimentary rocks of the Quesnel Terrane are tightly folded, locally refolded and sheared with intensity of deformation increasing eastward (i.e., down section). The sedimentary rocks of the black pelite and Cottonwood River successions and some of the finer-grained volcaniclastic rocks show minor fold structures that consistently show northwest-trending, northeast-verging folds. Sparse structural data for the western volcaniclastic succession along Umiti Road suggest these rocks occupy the upper limb of a northeast-verging antiform.

METAMORPHISM

Metamorphism increases from west to east across the map area from prehnite-pumpellyite and zeolite grades to greenschist for the Mesozoic arc rocks and as high as garnet to amphibolite (?) facies for some of the Barkerville subterrane rocks (Greenwood et al., 1991; Read et al., 1991). A sharp transition from low to higher metamorphic grade is apparent at the terrane boundary between the Quesnel Terrane, the Crooked amphibolite and the Barkerville subterrane. Metamorphic mineral assemblages of the black pelite unit are characterized by chlorite-muscovite without biotite. Penetrative deformed rocks of the Crooked amphibolite are characterized by chlorite-epidote-amphibolite±biotite and/or antigorite-chlorite±tremolite and talc assemblages, whereas micaceous quartzite and schist of the Snowshoe Group contain a synkinematic metamorphic assemblage of biotite, muscovite±garnet and actinolite, locally retrograded to biotite and chlorite.

Rocks of the Quesnel Terrane and Barkerville subterrane, the black pelite and Snowshoe Group are penetratively deformed in the vicinity of the terrane boundary. West from this tectonic boundary, rocks of the Quesnel Terrane are not penetratively deformed or metamorphosed beyond lower greenschist facies.

Contact metamorphism affects a 1.5 to 2.0 km wide zone adjacent to the southern margin of the mid-Cretaceous Naver pluton. The volcaniclastic rocks are variably altered to a fine-grained, brown to dark purple biotite, chlorite, actinolite±pyrrhotite hornfels, with limited skarn and calcsilicate development in thin calcareous horizons. Overprinting the dark hornfels are fracture-controlled pale anastomosing bleached zones of Na and/or K-enriched hydrothermal alteration. No sulphide introduction was recognized.

MINERALIZATION

MINFILE indicates ten mineral occurrences and three different mineral deposit models applicable to the Cottonwood map area that include seven past-producing surficial placer gold deposits located along the Cottonwood River and tributaries, four zones of alkaline porphyry Cu-Au mineralization known to occur at Mouse Mountain and auriferous polymetallic veins that have been the focus of past and current exploration on the G-South developed prospect (Table 2). North of the area, limited production is recorded for gold-quartz veins near Hixon and showings of molybdenum and tungsten mineralization occur near the western margin of the Naver pluton. South of the map area, Cu±Mo porphyry mineralization associated with calcalkaline intrusive complexes at the Gibraltar mine and Cu±Au porphyry and propylitic Au replacement associated with alkaline intrusive centres at the Mount Polley mine and the QR mine,

TABLE 2. MINFILE OCCURRENCES WITHIN THE COTTONWOOD MAP SHEET (093G/01).

MINFILE #	Name (Status)	Easting	Northing	Commodity	Description
Surficial Placers					
093G 009	**Hannador Lightning Creek** (past producer)	552929	5882203	Au	region underlain to the west by Mesozoic sedimentary and volcanic rocks of the Quesnel Terrane and to the east by Proterozoic to Paleozoic dominantly metasedimentary rocks of the Omineca Belt quartz veins in greenschist facies rocks of the Omineca Belt are commonly auriferous the Hannandor deposit occurs on Lightning Creek at the junction of Angus Creek in the southeastern corner of the map area. This deposit is one of several past placer gold producers on Lightning and other creeks draining the Omineca Belt. These placer deposits occur in late Tertiary (Miocene) gravels
093G 022	**MacMillian, Cottonwood River** (past producer)	550695	5882365	Au	the pre-Tertiary geology of this area consists of mafic volcanic and sedimentary rocks of the Upper Triassic Nicola Group and Lower Jurassic volcaniclastic rocks of the Quesnel Terrane the Cottonwood workings produced alluvial platinum and gold
093G 025	**Cottonwood Placer** (past producer)	560751	5880164	Au, Pt	mafic volcanic and sedimentary rock of the Upper Triassic Nicola Group of the Quesnel Terrane Cottonwood workings produced alluvial platinum and gold
093G 026	**Mary Creek, Norton Creek, Old San Juan** (past producer)	562718	5873544	Au	ultimate source of gold may have been the auriferous veins of the Barkerville subterrane from which the Cottonwood River drains pre-Tertiary geology of this area consists of mafic volcanic and sedimentary rocks of the Upper Triassic Nicola Group and Lower Jurassic volcaniclastic rocks of the Quesnel Terrane gold from the Mary Creek placer deposit produced from pay gravels a few centimetres to a few metres thick. The roundness of the
093G 059	**Gagen Creek** (past producer)	562718	5873544	Au	well-worn, fairly coarse placer gold in bench-type deposits primarily basalt
093G 060	**Mostique Creek** (past producer)	565811	5875007	Au	primarily underlain by argillite cut by intrusions at the mouth of Mostique Creek, coarse placer gold occurs in a buried channel deposit, and fine gold originated mainly from post-glacial gravels overlying the deposit
Polymetallic veins					
093G 007	**G-South** (developed prospect)	542976	5894496	Au, Cu, Zn, Pb, Ag	sulphide mineralization occurs disseminated in the country rocks and in stockworks and breccia infillings with quartz, calcite, epidote and chlorite; two main types of mineralization: 1) disseminated and fracture-controlled pyrite, pyrrhotite and rare chalcopyrite in volcanic or along contacts with rhyolite dikes and 2) massive sulphide mineralization within gouge zones up to 1.9 m wide consisting of pyrite, arsenopyrite and sphalerite and occasionally chalcopyrite and galena high gold and silver values are not coincident and do not appear to be associated with the percentage of sulphides present. The best mineralization is suggested to occur at or near the intersection of regional fault structures that trend northerly and southeasterly
Porphyry Cu-Au; alkalic					
093G 003	**Mouse Mountain** (past producer)	545508	5878048	Cu, Ag, Au	Mineralization is mainly chalcopyrite, with bornite and minor tetrahedrite. Mineralization occurs within felsic to intermediate breccias as fracture fillings. Disseminated copper mineralization also occurs within the feldspar porphyry stock. Associated alteration in the volcanic rocks is mainly argillic and propylitic with some potassic alteration of the stock small felsic to intermediate alkaline plutons of Late Triassic and Early Jurassic intrude basalt and volcaniclastic rocks of the upper part of the Nicola Group
093G 005	**Mouse Mountain** (showing)	543824	5876796	Cu	Upper Triassic to Lower Jurassic sedimentary and volcanic rocks; Intruding these rocks are small felsic to intermediate alkalic plutons of Late Triassic and Early Jurassic age. These are in part comagmatic with the volcanic rocks of the upper part of the Nicola stratigraphy. Mouse Mountain is underlain by one of these alkalic plutons (Mouse Mountain Stock). The stock is composed of syenite, syeno-monzonite, with minor gabbro. The stock has intruded Late Triassic basaltic rocks and is mantled unconformably (?) by Early Jurassic intermediate tuffs and polylithic breccias Chalcopyrite mineralization is reported to occur within gabbro bodies

respectively, comprise important exploration models for this part of the Nicola Arc (Fox, 1975; Bailey, 1990).

Proven and probable reserves at Gibraltar (0.2% Cu cutoff) total 232 Mt of 0.318% Cu and 0.010% Mo with an addition 554 Mt of measured and indicated at 0.28% Cu and 0.008% Mo and 15 Mt of oxide (0.10% acid-soluble Cu) at 0.148% Cu (Taseko Mines Limited, 2007). Proven and probable reserves at the Mount Polley mine incorporate the open pit mining of the Southeast zone, the C2 zone and the Springer zone in addition to the Wight and Bell pits and totals 59.9 Mt of 0.36% Cu, 0.27 g/t Au and 0.73 g/t Ag (Imperial Metals Corporation, 2007), with an addition of measured and indicated resources of 73.5 Mt of 0.356% Cu, 0.302 g/t Au and 1.42 g/t Ag. Reserves for the QR estimated by Kinross Gold Corporation at January 1, 1997 were 1.57 Mt grading 3.99 g/t Au, with the main zone hosting an estimated 0.6 Mt of 4.4 g/t Au (MINFILE 093A 121). The mill and related surface facilities have been rehabilitated by Cross Lake Minerals Ltd. and the restart of operations and development of the QR mine is projected to commence in the third quarter of 2007 (Cross Lake Minerals Ltd., 2007).

Twenty-one rock geochemical samples were collected during the course of the summer mapping program of alteration and mineralization to assess the mineral potential of the area (Table 1). Sampling of the mineralization at Mouse Mountain was carried out last year (Jonnes and Logan, 2007).

EXPLORATION ACTIVITY

With the exception of placer leases, Richfield Ventures Corporation holds the majority of mineral claims that cover the 093G/01 map area and have been actively exploring the Quesnel belt since 2004. They have completed soil geochemical sampling programs, following up multi and single-element regional geochemical survey anomalies and geophysical anomalies generated by the low-level helicopter-borne geophysical survey completed in 2005 over the G-South, Ahbau Lake and Mary Creek targets (Tempelman-Kluit, 2006).

The multisensor (gamma-ray spectrometric and magnetic) airborne geophysical data for the Cottonwood-Wells area was collected by Fugro Airborne Surveys under contract to the Geological Survey of Canada (Carson et al., 2006). It was one of ten areas flown in the summer months of 2004 and 2005 in central British Columbia. Funding was derived from a joint 'Rocks to Riches' program involving a number of provincial, industry and First Nations partners and supported by Natural Resources Canada. The K, K-Th, magnetic total field and magnetic vertical gradient maps can be used to identify potassic alteration, and magnetite enrichment/depletion zones associated with Cu-Au mineralization (Fig 11) and have been used successfully to define porphyry targets elsewhere in the Quesnel Terrane (Shives, 2004).

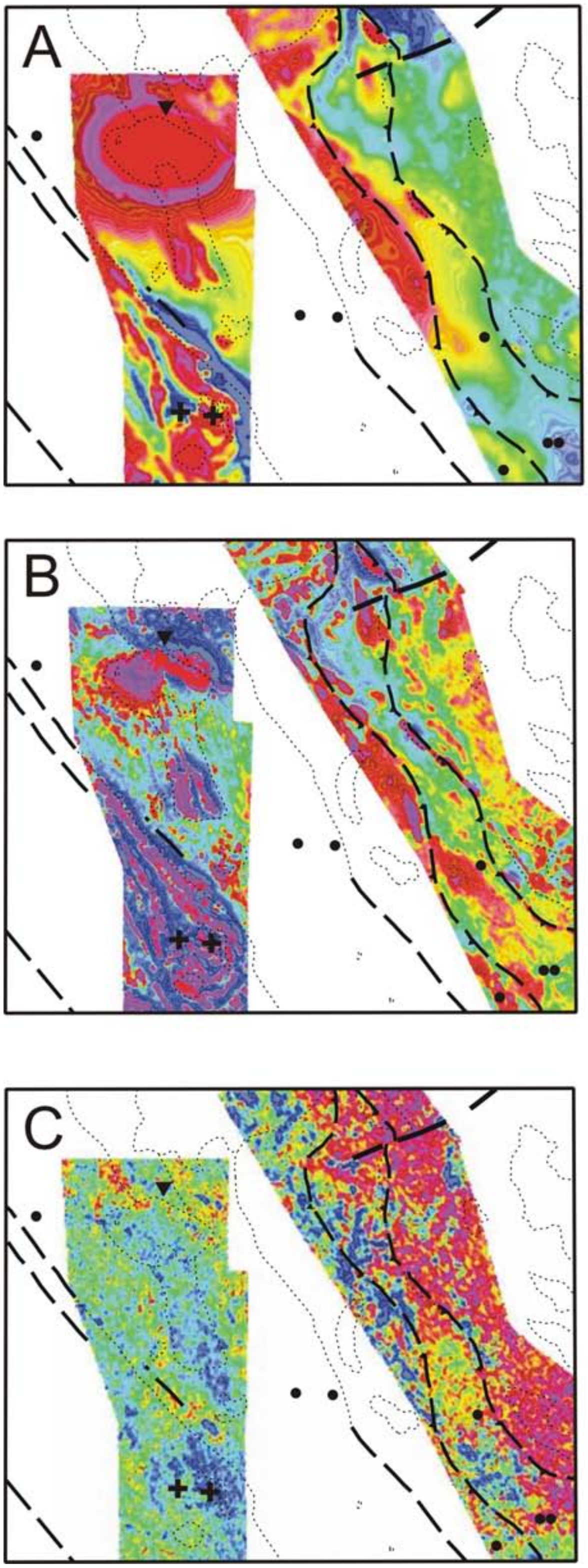

Figure 11. Contacts and faults from Figure 2 are shown together with airborne magnetic total field (a) for NTS 093G/01 (each map is 33.5 by 27.7 km); magnetic vertical gradient (b) and potassium-thorium ratio maps (c). Also shown are MINFILE occurrences for 093G/01: filled circles denote surficial placer gold, the inverted filled triangle denotes auriferous base-metal vein mineralization and crosses represent alkalic Cu-Au.

In the map area, the magnetic total field map can be used to recognize the distribution of magnetite-bearing intrusions, serpentinized ultramafic rocks of the Crooked amphibolite and demark the location of most of the pyroxene-phyric breccia and volcaniclastic rocks (Fig 11a). Utilizing the first vertical gradient magnetic plot (Fig 11b) provides a more precise location for variations in the magnetic field that can reflect lithological contacts and provide a means to trace contacts beneath overburden. From Figure 11b, the large first-order magnetic anomaly centred in the map can be seen to be composed of a number of discrete magnetic identities which, upon mapping, reveal small isolated plugs of the pyroxene-biotite-magnetite diorite coincident with the northern margin of a probable composite intrusion. Figure 11c is a plot of the ratio of eTh/K, which provides a negative anomaly (dark blue colour) that corresponds to anomalous K screened against equivalent Th values.

The Cu-Au mineralized showings on Mouse Mountain have become the main focus of Richfield Ventures Corporation's exploration efforts since 2006.

Mouse Mountain

Mouse Mountain is a Cu, Au and Ag past producer situated 9 km east-northeast of Quesnel in central BC. Some time around 1950, 20 t of hand-sorted ore grading 1.55 g/t Au, 15.5 g/t Ag and 5.6% Cu was produced from open pits and shipped to the Tacoma smelter (Sutherland Brown, 1957). A thorough account of the background history and development of the property is provided by Greig and Tempelman-Kluit (2007). Recent exploration work carried out on the Mouse Mountain property includes ground geophysical surveys, excavator trenching, mapping and rock sampling (Jonnes, 2006; Greig and Tempelman-Kluit 2007; Jonnes and Logan, 2007).

Mouse Mountain is underlain by a roughly equant stock of very fine grained, leucocratic syeno-monzonite, which coincides with a 1 km by 0.5 km airborne magnetic high and a much broader coincident airborne radiometric (K-Th) anomaly (Carson et al., 2006). The monzonite appears to be intimately related to the mineralization identified along the northeast flank of Mouse Mountain (Jonnes, 2006). Three discrete zones of Cu-Au mineralization are known and include, from north to south, the Rainbow, Valentine and High-grade zones. The character of mineralization, alteration and metal tenor for each of the three zones is reported in Jonnes and Logan (2007).

A deep-focus three-dimensional induced polarization (IP) survey has defined an 800 m long, northeast-trending chargeability target and eastward-offset resistivity target on the west flank of the mountain. A 10 000 m diamond drill program initiated October 2007 is currently underway to test the chargeability, resistivity and magnetic highs that flank Mouse Mountain on the west. Results from the current drilling program have not been released.

Alteration assemblages at the Valentine zone include a pervasive K-feldspar replacement of the monzonite (?) matrix, alteration and replacement of plagioclase crystals with orthoclase rims and at the same time introduction of magnetite, pyrite and chalcopyrite (Fig 12a). A secondary green pyroxene diopside occurs as vein and breccia fillings associated with minor chalcopyrite (Fig 12b). Following the main Cu-Au mineralization is a structure-controlled $FeCO_3$-silica-pyrite alteration event, which is texture and grade destructive.

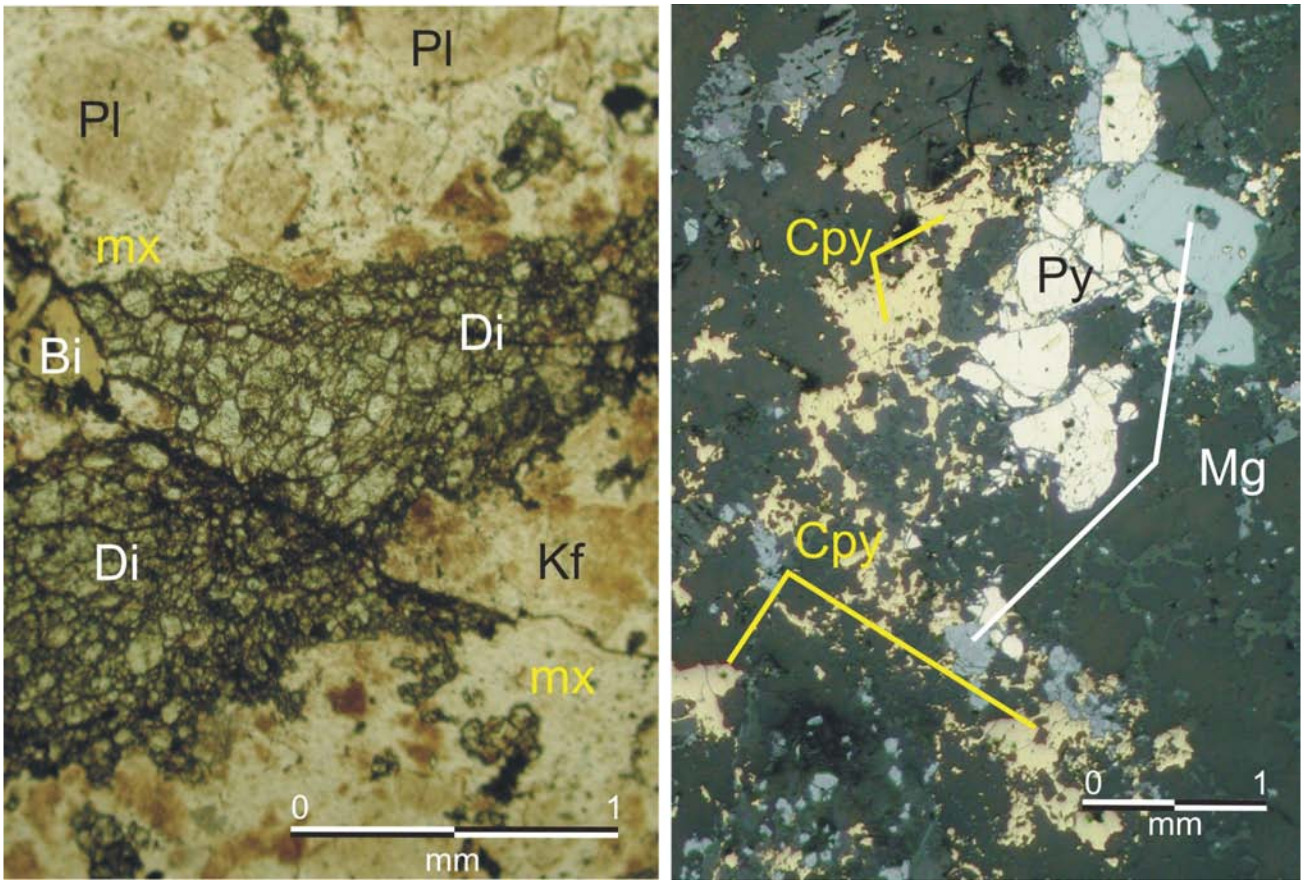

Figure 12. Polished thin section photomicrographs of Mouse Mountain monzonite from the Valentine zone: a) K-flooded microporphyritic monzonite breccia, altered by secondary diopside; plane polarized light; b) opaque mineralogy consists of subhedral, coarse-grained, early pyrite and magnetite and relatively younger chalcopyrite and magnetite intergrowths occupying interstices in the breccia; reflected light. Abbreviations: Cpy, chalcopyrite; Di, diopside; Kf, K-feldspar; Pl, plagioclase; Py, pyroxene; Mg, magnetite; mx, matrix.

The distribution of multiple intrusive rocks of composite composition, the magnetic signature, alteration assemblages, chalcopyrite-magnetite mineralization are similar to the characteristics of alkalic Cu-Au porphyry mineralization known to be hosted by Nicola volcanic and plutonic rocks of the Quesnel Arc. Uranium-lead (zircon) dating of the monzodiorite that hosts mineralization at the Valentine zone returned a crystallization age of 207.4 ±0.58 Ma. Alteration and mineralization overprint, however, appear to be closely linked to the monzodiorite and were probably generated from late-stage fluids associated with the Mouse Mountain monzonite.

G-South

The G-South developed prospect (MINFILE 093G 007) is located approximately 28 km north-northeast of Quesnel in a 2 by 1 km^2 area north of Ahbau Creek. Here, auriferous base-metal veins occupy north and northeasterly trending brittle shears that cut hornfelsed Nicola Group volcanic and volcaniclastic sedimentary rocks. The volcanic rocks are intruded to the south by a Late Triassic to Early Jurassic ultramafic-mafic plutonic complex and to the north by the mid-Cretaceous Naver pluton. Narrow northeast-trending dikes of granite related (?) to the Naver pluton occupy mineralized structures and are weakly mineralized.

Gold-bearing sulphide veins of the Ahbau Au zone were staked and explored beginning in the 1960s. In 1968, Equatorial Resources Ltd. and then in 1971, Texas Gulf Sulphur explored the property for volcanogenic massive sulphide mineralization. Several narrow zones of subeconomic auriferous sulphide vein mineralization were delimited, but the economic potential of the property (i.e., continuity) was considered low due to disruption by faulting (Newell and Podolsky, 1971). Between 1982 and 1988, Gabriel Resources Inc. conducted fieldwork over the property that included heavy-mineral concentrate sampling, soil and rock geochemistry, very low frequency electromagnetic (VLF-EM) and magnetometer surveys, geological mapping, an airborne geophysical survey, backhoe trenching and percussion and diamond drilling (Troup and Ridley, 1982; Ridley et al., 1983; Butterworth et al., 1985; Walcott, 1986; Kowalchuk, 1987; Kowalchuk and Mathison, 1987; Lechow, 1987a, b; Newton, 1988). Diamond drilling completed in 1986 (1896 m in 25 holes) and 1987 (2809 m in 21 holes), while relatively shallow (all less than 200 m), did intersect considerable Au grades in narrow discontinuous brittle fault structures. Newton (1988) reported anomalous Au values in more than 120 drill intersections of greater than or equal to 0.34 g/t Au.

Gold mineralization occurs in north-trending brittle shear zones, a northwest-trending apparently younger fault, the Discovery zone and as disseminated and stockwork replacements localized in cherty tuff and fine-grained volcaniclastic rocks.

Mineralization associated with the north-trending structures consists primarily of pyrite and pyrrhotite with lesser amounts of sphalerite, galena, chalcopyrite and arsenopyrite and is confined to <1.0 m and often <0.5 m wide breccia zones. The mineralized zones are sulphide-rich and either gangue-poor massive sulphide or intergrown with variable amounts of quartz-carbonate±chlorite gangue in veins, stockworks and breccia. Leucocratic, variably but characteristically $FeCO_3$ and clay altered, northerly trending quartz and orthoclase porphyritic dikes intrude along and across the north-trending structures at the G-South. The dikes are characterized by crystal aggregates of euhedral quartz, fine-grained relict biotite and disseminated pyrite and associated with sparse chalcopyrite and gold±galena mineralization.

Mineralization at the Discovery zone is hosted within a massive sulphide vein that strikes 227° and dips 35° to the northwest. It has been traced for about 50 m by trenching, but along-strike extension of the mineralized structure could not be demonstrated with follow-up drilling (Kowalchuk and Mathison, 1987). Selected assay results from Trench 1 on the Discovery zone show consistent mineralization over widths of 1.0 and 2.0 m. Mean values from three 1.0 m wide samples from the Discovery zone trench are 8.48 g/t Au, 38.74 g/t Ag, 0.75% Cu, 0.76% Zn, 0.04% Pb, 0.95% As; from three 2.0 m wide samples also from the Discovery zone trench are 6.74 g/t Au, 38.79 g/t Ag, 0.43% Cu, 0.40% Zn, 0.08% Pb, 0.49% As (Kowalchuk and Mathison, 1987). The Discovery zone trench was not located during regional mapping and could not be sampled.

Irregular sulphide stockworks, in fractured cherty tuffaceous argillite and fine volcaniclastic units (east zone of Newell and Podolsky, 1971), have returned grab samples with impressive 1 to 3% Cu values. Mapping and sampling in this area could not duplicate the high-grade mineralization reported.

Auriferous base-metal mineralization on the G-south property occupy north and southwest-trending structures that locally host weakly mineralized porphyritic granite apophyses of the Naver pluton and infer a temporal and possible genetic relationship with mid-Cretaceous plutonism.

Ahbau Lake Property

The Ahbau Lake property comprises two exploration targets situated approximately 2.5 km west and 3 km south of the outflow of Ahbau Lake. The claims straddle the boundary between micaceous quartzite, phyllite and schist of the Snowshoe Group and black pelite of the eastern Nicola Group (Tipper, 1960; Struik et al., 1990) and cover 25 anomalous values of Au (>20 ppb) in silt and pan concentrate samples obtained in a regional geochemical survey ca. 1980. Follow-up work by Leishman (1986, 1987) resulted in the recognition of a small (1 by 0.5 km) ultramafic body of Crooked amphibolite in the northern grid area that R. Wells studied petrographically and described as serpentinized pyroxenite. Dark, fine-grained Harveys Ridge rocks crop out east of the serpentinite and include calcareous, quartz, muscovite schist and micaceous (biotite+muscovite) marble.

A 2006 soil sampling program was undertaken to assess the continuity of previously determined Au anomalies and to test for anomalous soil geochemical signatures in other metals. A total of 2834 samples were collected and analyzed by ICP-MS for 24 elements. The results for the southern grid were geochemically flat, but the north grid area shows a strong geochemical responsiveness with two distinctive multi-element anomalous areas (Tempelman-Kluit, 2007). In addition, each geochemical anomalous zone corresponds to a distinctive target generated from the 2005 airborne multiparameter survey, a U target and a total field magnetic high. Anomalous Au values in the north grid cluster locally, defining areas of prospecting interest but with no consistent trend or spatial relationship to other elements.

The airborne magnetic high trends northwest (Fig 11a) and shows a direct spatial relationship to outcrops of serpentinized pyroxenite and a strong multi-element soil geochemical response for Ni, Co, Cr and Mg. The U airborne target is a tabular 1 km^2 zone within fine-grained, dark-coloured Harveys Ridge phyllite and micaceous quartzite in the footwall to the Eureka thrust. Coincident with the U target is a large, northwest-trending (1 km by 0.5 km) multi-element soil geochemistry anomaly defined by Zn but also includes Cu, Cd, Pb, Ag, Ba and P. Copper-zinc and low Pb content is typical of Besshi deposits together with anomalous concentrations of a number of metals, including Co, Mo, Bi, As and Ni (Slack, 1993).

CONCLUSIONS

The Cottonwood map area is underlain by Proterozoic to Paleozoic siliciclastic rocks of the Kootenay Terrane, Late Paleozoic mafic schist of the Slide Mountain Terrane and Middle Triassic to Early Jurassic sedimentary, volcanic and plutonic rocks of the Quesnel Terrane. Middle Jurassic and mid-Cretaceous post-accretionary granitic stocks intrude this part of the Quesnel Terrane. Isolated Miocene sedimentary rocks are preserved beneath a thick Quaternary cover of glaciofluvial, lacustrine and lodgment till deposits.

The Nicola Group in the Cottonwood map area includes four main subdivisions: a Middle to Late Triassic eastern black pelite succession comprising dark phyllite, siltite and slate; a Late Triassic eastern volcanic package of pyroxene-phyric flow breccia and tuff that structurally overlies the black pelite; a central belt of siltstone, cherty argillite, limestone and volcaniclastic sandstone of the Cottonwood River succession; and a pyroxene-rich volcaniclastic succession characterized by polylithic volcanic conglomerate containing sedimentary, plutonic and volcanic clasts that overlies the Cottonwood River succession in apparent depositional contact. The Cottonwood River succession and conformably overlying western volcaniclastic succession are Late Triassic or older because the upper part of the succession is cut by monzonite of the Late Triassic Mouse Mountain stock.

Small isolated exposures of Early Jurassic sedimentary and volcanic rocks have been recognized through fossil and radiometric dating techniques, respectively.

Intrusive rocks in the map area include the Late Triassic (ca. 205 Ma) Mount Polley, Early Jurassic (ca. 187 Ma) Polaris and mid-Cretaceous (ca. 110 Ma) Naver intrusive suites.

Copper-gold mineralization at Mouse Mountain probably formed from late-stage fluids associated with the Late

Triassic (ca. 207 Ma) Mouse Mountain monzonite. The auriferous base-metal-mineralized brittle shear zones, cutting mid-Cretaceous hornfelsed volcanic and volcaniclastic rocks of the Nicola Group at the G-South property, probably formed from fluids related to the quartz porphyritic granite apophyses of the Naver pluton. Base-metal soil geochemical anomalies reported from the Ahbau Lake property are consistent with a Besshi-type of volcanogenic massive sulphide mineralization, but further work is required to test this hypothesis. The Early Jurassic (?) mafic-ultramafic intrusive complexes that intrude the Cottonwood River succession do not appear to have anomalous associated Au or Cu sulphide mineralization.

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