Geology of the Deer Park Map Area, Southeastern British Columbia (NTS 082E/08)

T. Höy, Consultant, Sooke, BC, V9Z 0X6

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Introduction

The Deer Park map area NTS 082E/08 (1:50 000 sheet) is located in the southern Monashee Mountains of southeastern British Columbia (Figure 1); it extends from Lower Arrow Lake in the eastern part of the sheet to west of the Granby River, covering an area of more than 1000 km^2. Nearly a third of the area, the south-central part, is taken up by Gladstone Park, a largely inaccessible wilderness area, which straddles the highlands of the Christina Range north of Christina Lake. Access to the western part of the area is mainly via numerous logging access roads that branch off a well-maintained paved, then gravel-covered road, which extends north from Grand Forks following the Granby River and Burrell Creek. Access to the southeastern part is along logging roads, which extend north from Highway 3 between the towns of Castlegar and Christina Lake, while access to the northeastern corner, on the eastern side of Lower Arrow Lake, is via the Deer Park road, which essentially follows the shoreline of the lake, north from Castlegar.

The area is relatively mountainous and heavily forested, though a considerable part has been logged. The nearest towns are Grand Forks, Christina Lake and Castlegar, all located south of the map area; there are no towns or communities within the study area.

The geology of the area, which was last mapped as part of a government survey at a scale of approximately 1:250 000 in the mid 1950s (Little, 1957) and also included in the regional compilation of the Penticton map sheet (NTS 082E) by Tempelman-Kluit (1989), is not well-known or understood. Although the area is located between the Rossland mining camp to the southeast, the Greenwood camp to the southwest and the Franklin camp in the sheet immediately to the north, exploration has been limited, possibly due to past inaccessibility to the area, lack of modern geological surveys and under appreciation of the contribution of Tertiary structures and magmatic controls to mineralization.

The 2009 Geoscience BC project involved geological mapping of a large part of the 1:50 000 sheet, with publication in 2010 of a regional geological map (NTS 082E/08) and several 1:20 000 sheets. Accompanying papers will discuss mineral deposits and exploration models for the area, with particular reference to Tertiary mineralization.

Geological and Exploration History

The Deer Park area falls within the Kettle Valley sheet (NTS 082, east half) mapped at a scale of 1:253 440 (one inch to four miles) by Little (1957). Templeman-Kluit (1989) relied on this regional map for his compilation of the Penticton sheet (NTS 082E), with only minor modifications in the Deer Park area, mainly involving structures related to Eocene extension. The geology of the Grand Forks map sheet (NTS 082E/01), located immediately to the south, was recently published by Höy and Jackaman (2005), who remapped and compiled studies by other authors (Acton et al., 2002; Laberge and Pattison, 2007) and, more notably, a Ph.D. thesis by V. Preto (1970) on the Grand Forks complex. The Greenwood mining camp, located immediately west of the Grand Forks sheet, has been studied in considerable detail, initially by Little (1979) and more recently by Church (1986) and Fyles (1990). Mapping east of the Deer Park area includes the regional study of the Lardeau (west half) area by Little (1960) and farther southeast, more detailed geological mapping of the Rossland (Höy and Dunne, 2001) and Nelson (Höy and Dunne, 2004) areas.

Mineral exploration, focused largely in the south, dates back to the mid- to late 1800s, with discovery and development of rich gold and copper deposits in the Greenwood and Rossland mining camps, as well as the building of smelters in Greenwood, Grand Forks and Trail to process the Rossland deposits. Mineralization was discovered in the early 1900s in the Franklin mining camp (Drysdale, 1915), located immediately north of the Deer Park map area; this camp produced intermittently until 1989 (MINFILE, 2009).

There have been few precious or base-metal producers in the Deer Park map area. Considerable past exploration has focused on a molybdenite deposit, formerly called 'Midas',

Keywords: Grand Forks complex, Granby fault, Kettle River fault, Jurassic Nelson intrusions, Coryell intrusions, Midas molybdenite property, JJ Main occurrence, Deer Park property, Tertiary mineralization

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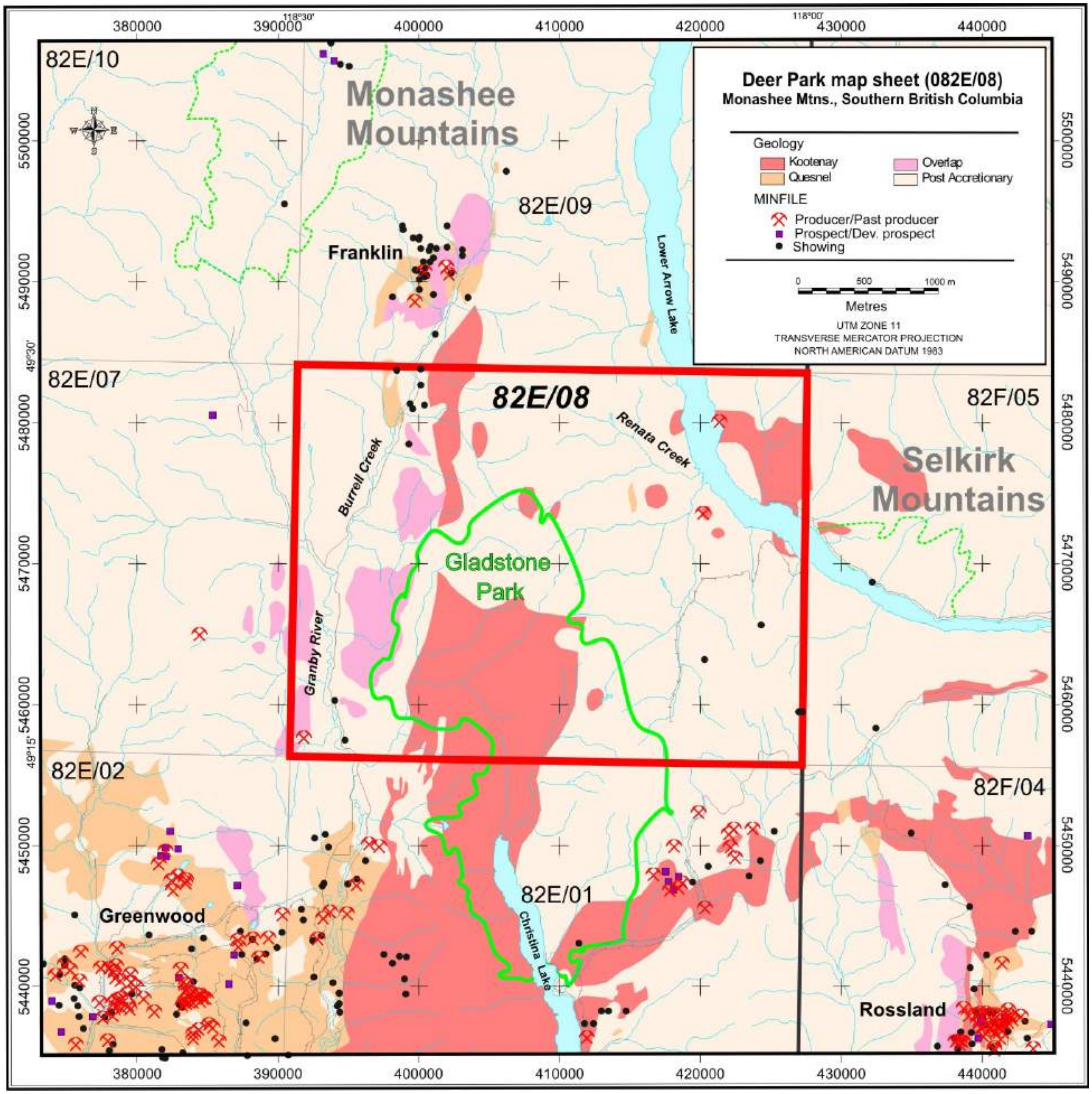


Figure 1. Location and regional geology of the Deer Park map area (1:50 000 sheet), southeastern British Columbia.

near the southeastern part of the map area, and recent work by Kootenay Gold Inc. is looking at both molybdenite and base-metal potential in that immediate area. Several mineral occurrences have been studied in the northwestern part of the area, immediately south of the Franklin mining camp. Recent work by prospectors T. and C. Kennedy focusing on precious-metal mineralization possibly related to Tertiary tectonics has led to the discovery of several new showings and mineralized areas, most notably in the area of the JJ showing in the southeastern part of the study area and in the Deer Park area on the eastern side of Lower Arrow Lake. The geology of these areas is described below (see 'Mineralization').

This study involved 42 days of field mapping, concentrated mainly in areas accessible by four-wheel drive truck. Where possible, it concentrated on areas of known mineralization, with field mapping done at a scale of 1:20 000 for publication at this scale and as a compilation of the entire map sheet at a scale of 1:50 000. No work was done in Gladstone Park, which covers nearly a third of the south-central part of the Deer Park map area (1:50 000 sheet).

Regional Geology

The Deer Park area is located immediately north of the Grand Forks complex (Preto, 1970), one of a number of metamorphic-core complexes in the southern Omineca Belt, which appear to be related to Eocene faulting, extension and denudation (Brown and Journeay, 1987; Parrish et al., 1988). The complex is bounded on the west by the west-dipping Granby fault and on the east by the Kettle River fault. Normal movements on these faults are determined to be Early Tertiary, constrained by ages of intrusive rocks (Carr et al., 1987, Parrish et al., 1988). Numerous paleomagnetic tilt measurements support Eocene extensional normal movement on these and several other north-trending faults and further define relative timing (Marquis and Irving, 1990; Wingate and Irving, 1994). More recent studies have focused on structure and metamorphism related to both the Granby fault (Laberge and Pattison, 2007) and the Kettle River fault (Cubley and Pattison, 2009).

Geology of Deer Park Map Area (NTS 082E/08)

The Deer Park map area is underlain by mainly Middle Jurassic (Nelson suite), Cretaceous and Early Eocene (Coryell suite) intrusive rocks (Figure 2). These intrude Late Paleozoic metasedimentary and metavolcanic rocks, exposed east of Lower Arrow Lake in the eastern part of the area, and west of the Granby fault in the western part. Structures in the area are dominated by steeply dipping, generally north-northwest-trending faults, many of which are related to the northern extensions of the bounding faults of the Grand Forks complex. These faults appear to control the distribution of most base- and precious-metal deposits or occurrences in the area.

Late Paleozoic Succession (Lower Arrow Lake Area)

A succession of mainly metasedimentary rocks is exposed in the northeastern part of the map area, east of Lower Arrow Lake. Regional mapping by Little (1957) also showed small exposures on the western side of the lake and although their presence was not confirmed during 2009 mapping, their locations are included on both the regional (1:50 000 sheet; Figure 2) and the Terrain Resource Information Management (TRIM 1:20 000 sheet; Figure 3) maps. The succession includes interlayered quartzite, siltstone, argillaceous siltstone, some dark limestone and mafic volcanic rocks. The geology of the area, including this succession, is described in more detail in a Kootenay Gold Inc. assessment report (Höy, 2008).

A schematic representation of the succession's stratigraphy is shown in Figure 4. The structurally (and probably lowest) unit is a thick (several hundred metres) sequence of mixed amphibolite, hornblende gneiss and granodiorite. It is overlain, possibly unconformably, by interlayered siltstone, minor argillite, calcsilicate schist and dark impure marble, and two sequences of mafic volcanic rocks. The top of the succession comprises mainly dark argillite and argillaceous siltstone.

The age of this succession is not known with certainty. Tempelman-Kluit (1989) correlated it with Ordovician–Devonian rocks, implying that they are part of the Kootenay Terrane. However, they could be part of the lithologically similar Carboniferous–Permian Mount Roberts Formation, which underlies Triassic and Jurassic arc volcanic rocks in the Quesnel Terrane.

Late Paleozoic Succession (Granby River Area)

Metasedimentary and metavolcanic rocks are exposed west of the Granby fault in the Granby River and Burrell Creek drainages. These rock units were not mapped in detail during this study, although some exposures in the northwestern part of the map area (Figure 2) were briefly examined.

Unit CPa, correlated with the Anarchist Group (Tempelman-Kluit, 1989), comprises dark grey weathering amphibolite and greenstone, as well as quartz-chlorite and quartz-biotite schists. Minor serpentinized peridotite and chert breccia occur locally. Small exposures mapped in the northwestern portion of TRIM map 082E049 (Figure 5), included mafic volcanic rocks, dark schist and argillite, and minor dark argillaceous limestone.

Intrusive Rocks

Intrusive rocks underlie a large part of the map area and their differentiation, and relationship to mineralization, formed a large part of the present study. As these intrusions have not been chemically analyzed, dated nor studied petrographically, the following reports are based entirely on field observations and descriptions. Previous workers (Little, 1957; Tempelman-Kluit, 1989; and several assessment reports, described below under 'Mineralization') have recognized three main suites: the Middle Jurassic Nelson plutonic suite, Jurassic–Cretaceous (?) granites and Coryell intrusions.

Middle Jurassic Nelson Plutonic Suite

Rocks that have been assigned to the Nelson plutonic suite underlie a considerable part of the central and southern part of the Deer Park map area (Figure 2). They have not been previously differentiated and have been described as generally massive to foliated granodiorite, quartz diorite and granite. As noted by Tempelman-Kluit (1989), these rocks may include younger granitic rocks. As the exposures of Nelson plutonic rocks typically represent discrete bodies, separated by younger intrusive rocks, they are described separately below.

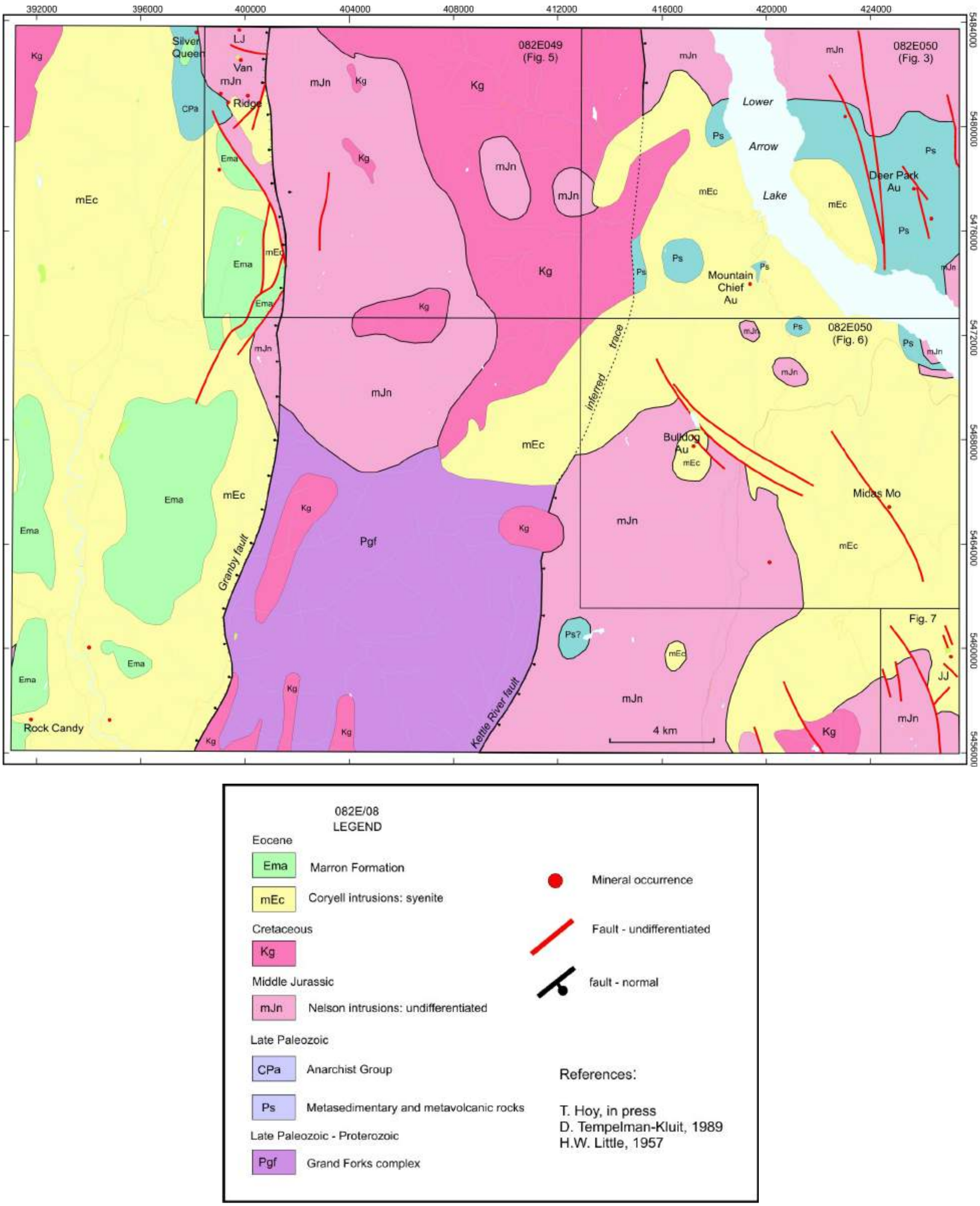
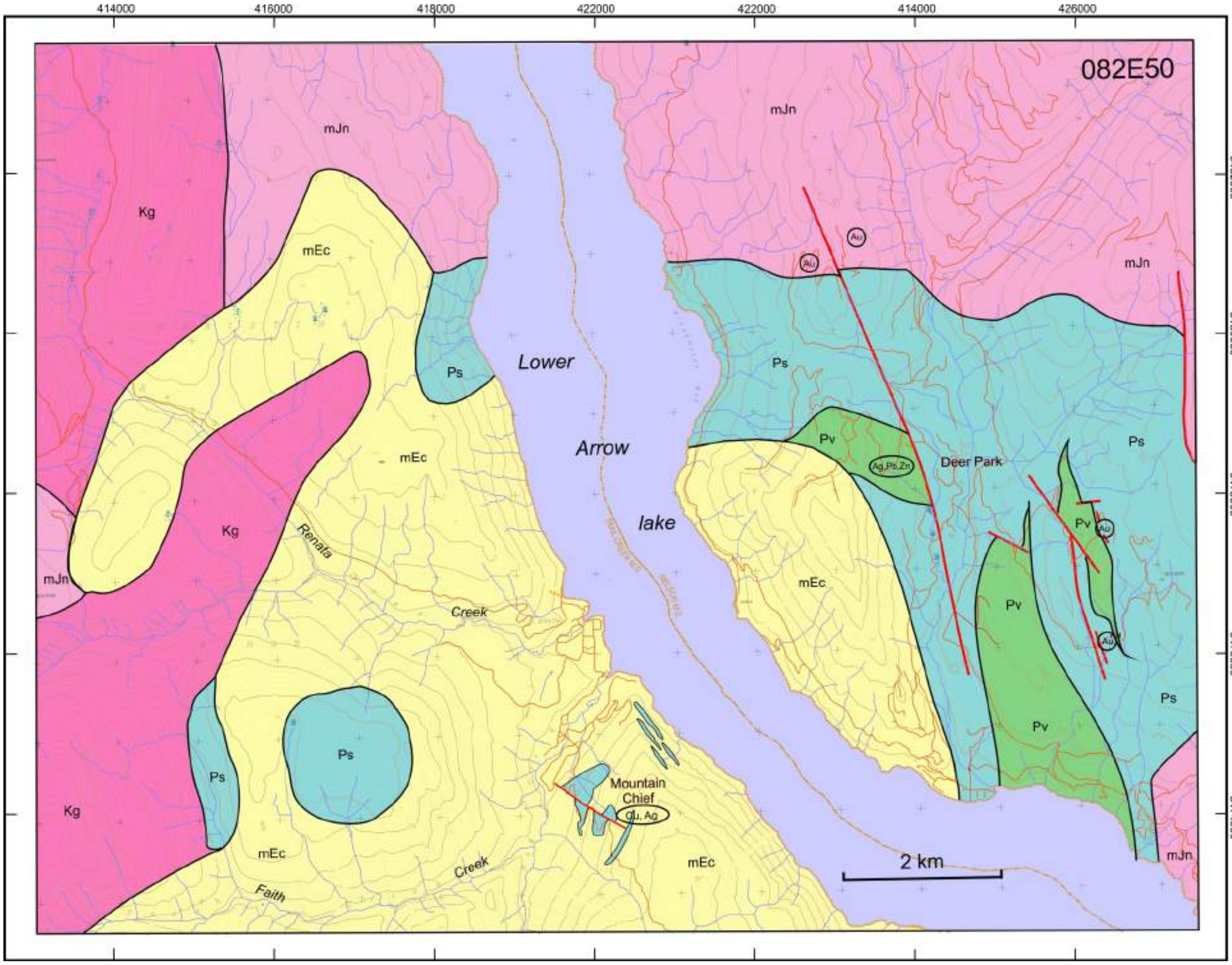


Figure 2. Geology of map area NTS 082E/08 (1:50 000 sheet), southeastern British Columbia.



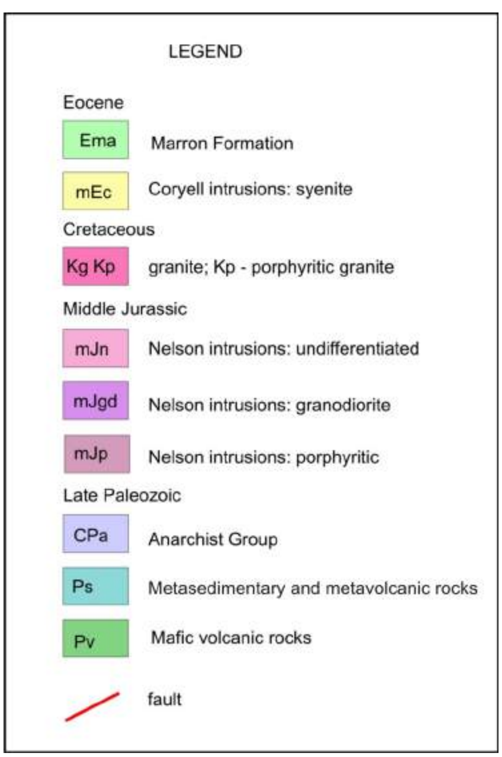


Figure 3. Geology of TRIM map 082E/050 (1:20 000 sheet), southeastern British Columbia.

TRIM Map Sheet 082E/050: unit mJn

The dominant phase on the eastern side of Lower Arrow Lake (northern portion of sheet 082E/050; Figure 3) is a relatively fresh biotite-hornblende granodiorite to granite. It is typically medium- to coarse-grained, with local minor propylitic alteration, rusted fractures and common inclusions of country rock. Numerous north-trending Eocene (?) dikes cut the intrusion.

TRIM Map Sheet 082E/040: units mJn, mJp

Exposures farther south, in TRIM map sheet 082E/040 (Figure 6), have been subdivided into two main units, a coarse-grained 'K-feldspar' megacrystic 'granite' (unit mJp) and a more massive, equigranular granite to granodiorite phase (unit mJn). The megacrystic granite includes large (typically several centimetres) subhedral to euhedral pink to beige feldspar phenocrysts in a medium- to coarse-grained granite or granodiorite matrix. Megacryst content ranges from widely scattered crystals to more than 50% of the rock. With decreasing megacryst content, this

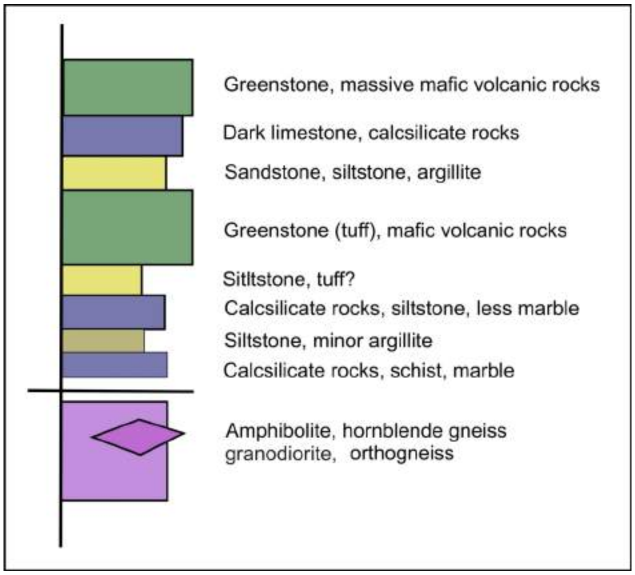


Figure 4. Paleozoic succession in the northeastern part of the Deer Park property, southeastern British Columbia.

phase grades into the more massive, equigranular granite or granodiorite. Propylitic alteration of the matrix is fairly common, particularly in the more eastern exposures, and possibly jarosite coated fractures, minor disseminated pyrite, quartz-pyrite veins and pervasive silicification occur locally.

The massive 'granite' typically surroundings the porphyritic granite is medium- to coarse-grained, with only minor (usually <10%) mafic rocks and biotite+hornblende+ magnetite. It locally shows evidence of either propylitic or potassic alteration, particularly in more eastern exposures. Potassic alteration includes both pink K-feldspar and pale sericitic alteration, both accompanied by silicification—thin quartz veins with minor sulphides including pyrite, chalcopyrite and, locally, galena.

These intrusive phases are included in the Nelson plutonic suite, though they appear to be less deformed, more felsic and more homogeneous than Nelson intrusive rocks elsewhere. It is possible that they are part of the more leucocratic Jurassic–Cretaceous granitic suite, but are included in the Nelson suite until conclusive radiometric analyses can determine their age.

TRIM Map Sheet 082E/049: units mJn-mJp

A large exposure of Nelson granitic rocks occurs in the footwall of the Granby fault in the western part of the area. On TRIM map 082E/049 (Figure 5), it extends from the northern part of sheet southward into Gladstone Park on sheet 082E/039. As on sheet 082E/040, it comprises both massive to porphyritic granodiorite and, nearer the Granby fault, intensely foliated or gneissic granodiorite, which was included in unit Pgf (undifferentiated Grand Forks gneiss) by Tempelman-Kluit (1989).

The porphyritic granite-granodiorite (unit mJp) is the most common phase, underlying a large part of the map area, and undoubtedly extending beyond its mapped limits as shown in Figure 5. It is a distinctive phase containing large (commonly up to 10 cm), subhedral, pink to beige to occasionally white feldspar crystals in a medium- to coarse-grained, typical granodiorite matrix, which contrasts with the previously described, more typical, pink granitic matrix in exposures on sheet 082E/040. The porphyritic phase is variably altered, ranging from relatively fresh to propylitic; potassic alteration was not noted, except very locally in contact exposures with Coryell syenite. The unit varies from massive to foliated to gneissic, particularly in western exposures near the Granby fault.

The massive undifferentiated Nelson intrusion (unit mJn) is typically a medium- to coarse-grained granodiorite, with variable though generally higher hornblende content than the porphyritic phase. Near the faulted (?) contact with the Coryell suite on the western portion of the sheet, this unit is termed 'granite', probably due to potassic alteration. Banded hornblende and granodiorite gneisses in the western part of the area are included in the undifferentiated mJn unit. Banded to foliated granodiorite (unit mJgd) also occurs along the eastern side of the intrusion, along the contact with Coryell syenite.

TRIM Map Sheet 082E/030

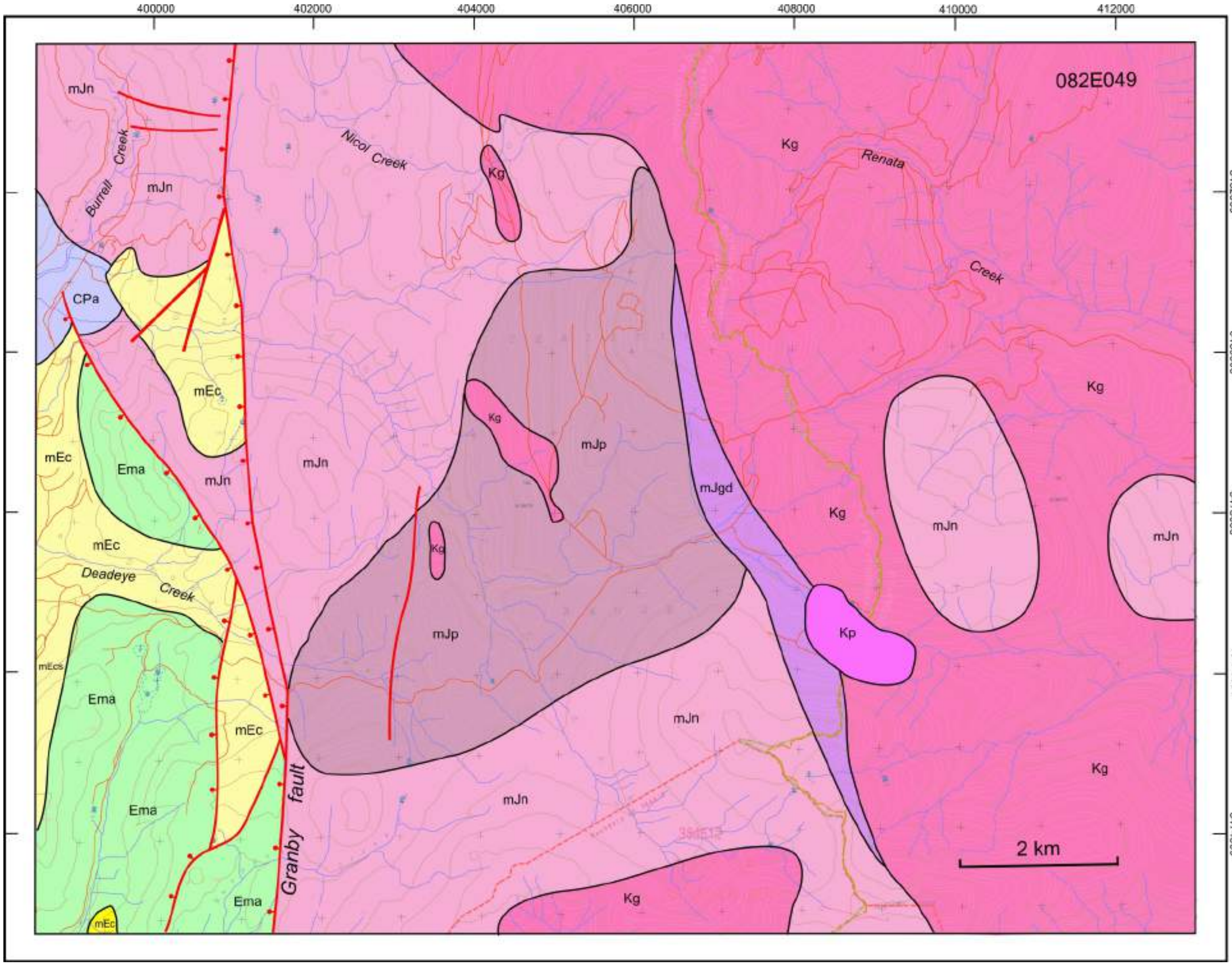
Nelson plutonic rocks in the southeastern part of the area have been mapped by Dunne (2004) and included in an assessment report on the JJ property (Höy, 2006). Dunne (2004) separated the Nelson granitic rocks into four phases:

- unit mJg: a fine- to medium-grained, equigranular granite–granodiorite with 10–15% biotite+hornblende and host to the JJ Main showing
- unit mJlg: a distinctive fine- to medium-grained leucocratic granite with up to 5% mafic minerals, which commonly occur as irregular 'box-shaped' segregations with quartz
- unit mJd: a fine-grained diorite to quartz diorite with up to 50% mafic minerals
- unit mJgd: a medium- to coarse-grained porphyritic 'granite' characterized by white feldspar and distinctive prismatic hornblende phenocrysts

These Nelson plutonic rocks contrast with those farther north in the variety of their phases, typically finer grain size and the number of associated dikes.

Cretaceous (?) Granite

A large exposure of mainly granitic rock occurs in the north-central part of the map area. Its age is not known, although it is similar to granitic rocks farther east referred to by Little (1960) as the 'Valhalla plutonic rocks', which were interpreted to be Late Cretaceous by Parrish et al.



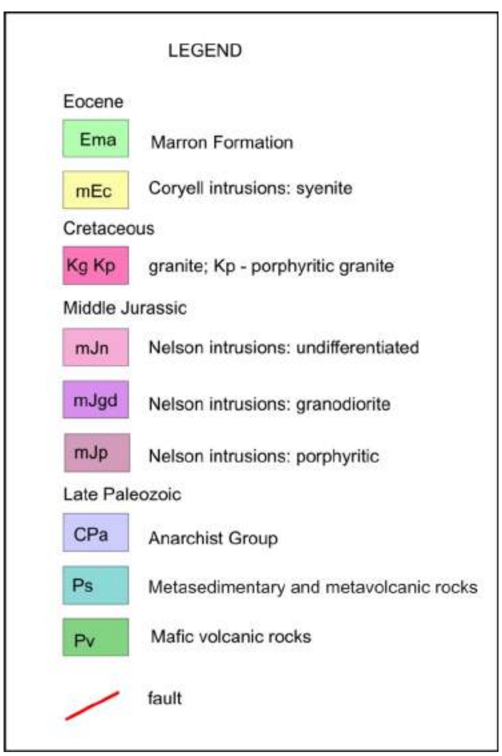


Figure 5. Geology of TRIM map 082E/049 (1:20 000 sheet) in the Deer Lake area, southeastern British Columbia.

(1988). It is also similar to 'Okanagan batholith' rocks exposed mainly west of the Deer Park area, which Templeman-Kluit (1989) indicated were 'Cretaceous and/or Jurassic' and Parrish et al. (1988), 'Early Eocene'. If Cretaceous in age, the granites may be part of the mid-Cretaceous Bayonne suite, which Logan (2000) described and related to a variety of gold and other deposit types.

The granite is exposed mainly in the northern part of the Deer Park map area, on TRIM map sheets 082E/049 and 082E/050. Only the western part of it has been mapped, which can be divided into a massive medium- to coarse-grained phase and a porphyritic phase. The massive unit (Kg) is a leucocratic, medium- to coarse-grained, white to pink granite with only minor (generally <10%) mafic content. It is locally foliated and occasionally banded, due to variable grain size or mafic content. Pegmatite phases are locally observed. The massive granite grades into a porphyritic phase (unit Kg) characterized by pink K-feldspar phenocrysts, typically several centimetres across, in a granitic matrix. The porphyritic granite is similar to the previ-

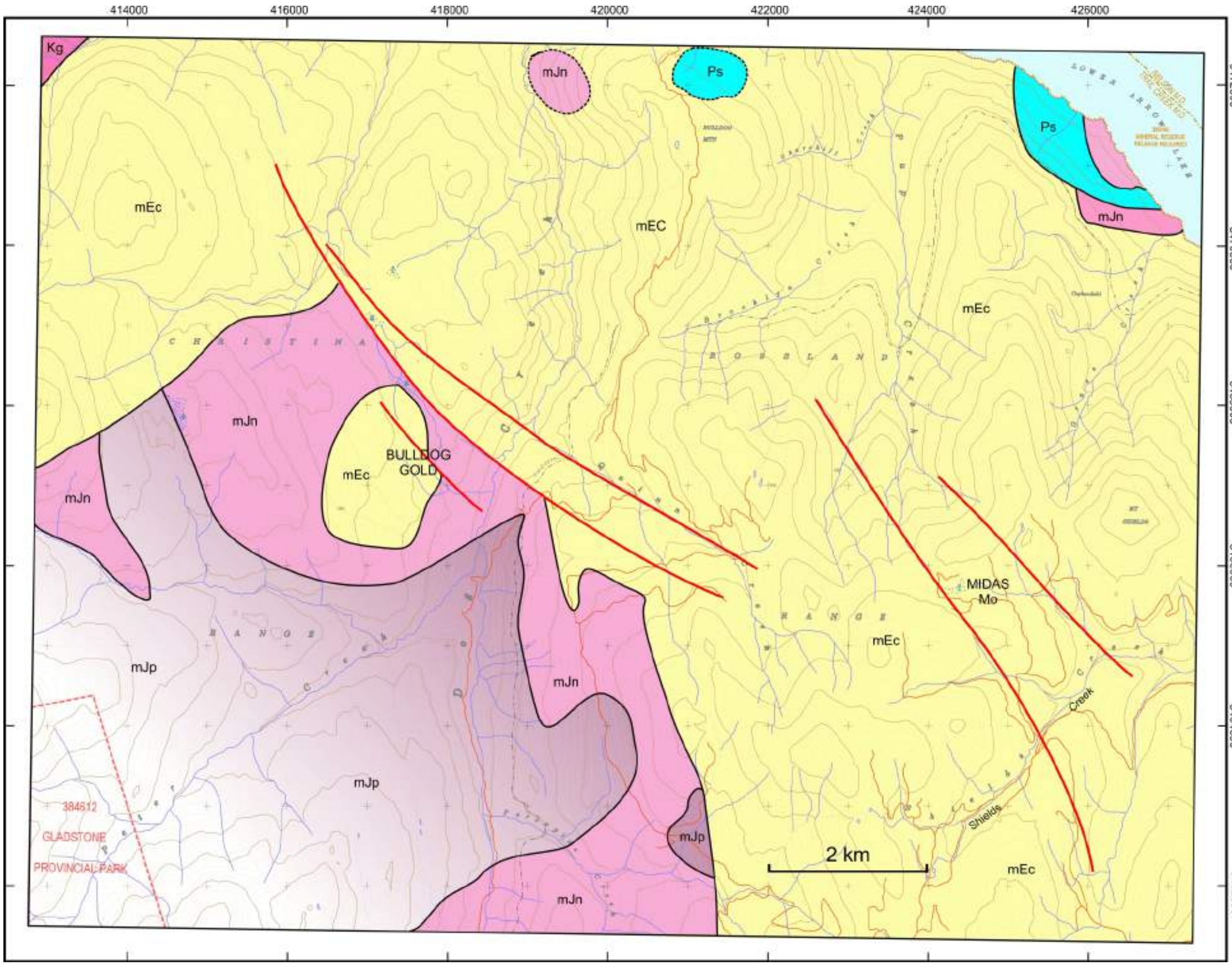
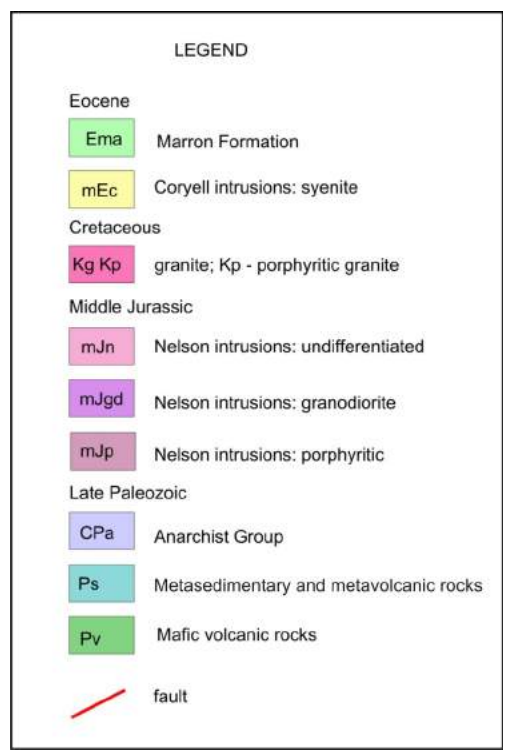


Figure 6. Geology on TRIM map 082E/040 (1:20 000 sheet) in the Deer Lake area, southeastern British Columbia.



ously described porphyritic K-feldspar megacrystic phase of the Nelson suite, but more detailed work (e.g., petrographic and radiometric analyses) is required to establish this distinction with certainty.

A number of small isolated granitic stocks and bodies included in the Cretaceous (?) suite intrude Nelson plutonic rocks west of the main granitic body on TRIM map sheet 082E/049. The larger body, near the centre of the map sheet (Figure 5), contains some pegmatite, brecciation with silicification, druse quartz, minor pyrite and pervasive jarosite alteration.

Coryell Plutonic Suite

Coryell intrusions are a Middle Eocene, alkalic to calcalkalic plutonic suite. In the Deer Park map area (Figure 2), Coryell intrusive rocks are exposed as two large bodies separated by the extensive central uplifted block that marks the northern extension of the Grand Forks complex. The western Coryell body, which has been dated at ca.

51 Ma (U-Pb zircon: Carr and Parkinson, 1989), is largely restricted to an area west of the Granby fault and, in many cases, is truncated by the fault. The eastern Coryell body appears to occur mainly east of the northern projection of the Kettle River fault, though a western lobe in the central part of the map area was shown by Little (1957) to lie west of the fault extension.

The eastern Coryell body is mainly coarse-grained pink syenite with variable (generally <10%) biotite+ hornblende; it commonly grades to a white feldspar-biotite rock with similar texture, but locally higher mafic mineral content. In the field, and on the accompanying maps, phases with mixed pink and white feldspar are termed 'monzonites' and those with mainly white feldspar are termed 'leucocratic diorite'. These phases appear to have gradational rather than intrusive contacts, with an apparent random distribution. The eastern Coryell body is finer grained near its margins, and numerous fine-grained feldspar-porphyry dikes cut the marginal phases and the immediate country rock. In addition, finer grained syenite phases, commonly with intrusive contacts, are frequently observed in the southern part of the eastern Coryell body, in the area within the central and southern portions of TRIM map sheet 082E/040 and on sheet 082E/030.

Only a small part of the western Coryell body was mapped, in the northern and central part of the Deer Park map area. Exposures were similar to those in the east, consisting dominantly of pink syenite with some 'monzonite' phases. Feldspar-porphyry dikes were also common, particularly close to contacts with the Nelson intrusions.

Structural Geology

Structure in the Deer Park map area is dominated by generally north-trending faults that are related to the northern extension of the Grand Forks complex, which is bounded on the west by the west-dipping Granby fault and on the east by the east-dipping Kettle River fault. Detailed structural and metamorphic studies of both the hangingwall and footwall rocks suggest that depth contrasts reach approximately 5 km across both the Granby (Laberge and Pattison, 2007) and Kettle River faults (Cubley and Pattison, 2009).

The Granby fault can be traced the length of the Grand Forks (Höy and Jackaman, 2005) and Deer Park map areas (Figure 2). Immediate hangingwall rocks comprise mainly Coryell intrusive rocks structurally (?) overlain by Eocene Marron Formation volcanic rocks; footwall rocks comprise Middle Jurassic Nelson intrusive rocks and a younger (Cretaceous?) granitic suite. The fault, which is defined as the most eastern splay separating the Coryell and Nelson suites, is constrained to a few metres along the Deadeye Creek road on TRIM map sheet 082E/049 (Figure 5). It is marked there by steeply dipping, closely spaced fractures, brecciation, silicification, potassic (K-feldspar) alteration and pyrite mineralization. Several fault splays with mainly west-side-down–inferred movement are also mapped in the hangingwall (Figure 5), and thin zones of steep west-dipping mylonite continue for up to 1 km into Nelson rocks in the footwall. Similar splay faults and more complex geometry were also noted in the Granby fault zone farther south where they were mapped in detail by Laberge and Pattison (2007).

The Kettle River fault, on the eastern side of the Grand Forks complex, is extended into the central part of the Deer Park map area (Figure 2) and was inferred by Tempelman-Kluit (1989) to be truncated by the eastern Coryell intrusion (Figure 2); his compilation was based on regional mapping by Little (1957) and the exact distribution of units is not known here. Hence, both the Coryell and older (Tertiary?) intrusion could either cut, or be offset by, the Granby fault. More detailed mapping (Figure 6) indicates that east of the fault the western extension of the Coryell intrusion lies farther north, thereby making an offset of the Coryell by the fault permissive.

Numerous other faults have been recognized in the map area, and the larger of these are shown on the regional (Figure 2) and more detailed TRIM maps (Figures 3, 5, 6). Most have been recognized by offsets or truncations of units, including the youngest intrusions (the Coryell), and many are marked by topographic features. These faults are generally north-trending, parallel to the north-trending Kettle River and Granby faults, or north-northwest-trending, particularly in the eastern part of the map area. They are also generally brittle and marked by minor brecciation, commonly silicification and rare shear fabrics. Quartz veining, with or without minor sulphide minerals, occurs locally along many of these faults and many of the mineralized (gold or precious metal) occurrences are intimately associated with these large structures.

A number of mineral occurrences are known in the map area, but few have had any past production. This report focuses only on the base- and precious-metal occurrences, not on industrial minerals, which are shown on Figure 2 using descriptions from BC MINFILE.

Most occurrences are in the north-trending Granby fault structural zone, or along north- to northwest-trending faults in the eastern block, east of the Kettle River fault. Few, if any, occurrences are noted in the central block, which is underlain by mainly deeper level Middle Jurassic Nelson granites and the younger Cretacous (?) granitic suite.

Mineralization

The following sections describe briefly some of these mineral occurrences, with specific reference to their structural controls. These descriptions include several occurrences discovered in recent years and not included in BC

MINFILE, and some that have been recently explored; descriptions of other occurrences are given in BC MINFILE.

Deer Park

The Deer Park property, located on the eastern side of Lower Arrow Lake, includes a variety of mineral occurrences discovered by T. Kennedy and optioned to Kootenay Gold Inc. There are no BC MINFILE occurrences here, although there is evidence of past exploration, including a number of trenches and pits. Numerous small copper veins occur within mafic volcanic rocks, a massive north-trending pyrrhotite vein contains anomalous copper and gold, and several areas with silicification and gold-quartz veining occur along prominent north-trending faults and Coryell dikes. These latter occurrences have been the focus of recent exploration by Kootenay Gold Inc. and are described in more detail by Kennedy (2007) and Höy (2008).

The gold-quartz veins appear to be related to late, mainly north-trending faults and shears. These structures are the loci for a suite of steeply dipping dikes of the Coryell suite. The dikes are particularly common in the western part of the Deer Park area where they form a swarm (approximately 700 m wide) extending south over a distance of >3 km toward a large Coryell intrusive body. Several similar and parallel dikes occur approximately 4–5 km to the southeast and also occur parallel to or within steeply dipping faults.

Gold mineralization occurs in both these areas, typically as thin quartz veinlets and extension veins within the shears. Assays of hand samples, collected by T. Kennedy, returned values of 6.3 g/t and 9.5 g/t Au in the northwestern area, and up to 23 g/t Au in the southeastern area.

The north-trending structures are interpreted to be Eocene; they are steeply dipping, trending parallel to regional Eocene structural trends and clearly associated with Coryell dikes. Mineralization, mainly gold with minor sulphide minerals and quartz, commonly occurs in these structures as small extensional veins, which are oblique to the main northerly structural grain.

Bulldog

Bulldog is a recent gold discovery, located near the centre on TRIM map sheet 082E/040 (Figure 6). A series of prominent northwest-trending shears associated with intense propylitic alteration cut an isolated body of Coryell syenite and monzonite within Nelson intrusive rocks. Several parallel faults located to the northeast extend toward the Midas molybdenite property, 12 km to the southeast; they are steeply dipping and at least one of them has minor serpentinized peridotite (?) along it. Mineralization at Bulldog occurs as thin quartz veins and silicification, commonly with pyrite and jarosite alteration, and anomalous gold values.

JJ

The northern part of the JJ property, optioned by Kootenay Gold Inc. to Astral Mining Corporation, extends into the southeastern part of the Deer Park map area. The property includes a large area that encompasses the past-producing Granville Mountain gold mining camp and several new gold discoveries. These new discoveries, termed 'JJ West' and 'JJ Main', were the focus of an extensive drilling program by Astral in 2007–2008 and are described below.

The JJ showings occur just north of Blueberry Pass and Nancy Green Lake along Highway 3 (Figure 7) between Castlegar and Christina Lake. They occur mainly in the contact zone between the Middle Eocene Coryell intrusions and host Middle Jurassic Nelson intrusions (Figure 7). The area is structurally complex, with a variety of Nelson intrusive phases and numerous mostly north- to northwest-trending dikes which follow prominent fault and shear zones and extend from the Nelson rocks into the Coryell suite.

The JJ property comprises the two main gold showings, JJ Main and JJ West, as well as the former Wewa occurrence. The Wewa is reported to be a vein, breccia and stockwork showing containing fluorite, chalcopyrite, pyrite and magnetite, and associated with a fault-breccia and molybdenite-bearing quartz vein (MINFILE 082ESE167). The JJ West showing occurs as a number of north-trending shear zones of silicified rock and quartz veining, up to several metres wide, cutting Coryell intrusions. Gold values are locally high, but mostly range up to 1 g/t. The JJ Main showing occurs as a number of roughly northeast-trending shear zones with mineralized quartz veins in fine- to medium-grained 'granite' of the Nelson intrusions (Dunne, 2004; Höy, 2006).

The showings occur as quartz stockworks, vein-breccias, ladder veining and a series of parallel-sheeted veins within the shear zones. Larger quartz veins (up to 30 cm thick) consist of quartz with trace pyrite, arsenopyrite and galena. Maximum assay values of 19 g/t Au were obtained from some surface exposures of the veins, although values of up to 2 g/t Au are more common. Höy (2006) established that mineralization at JJ Main appears spatially associated with Coryell 'syenite' and mafic dikes, and inferred that mineralization was Eocene.

Astral Mining Corporation completed a 5070 m drilling program on the JJ property in late 2008 and reported that the JJ Main zone has been extended to a strike length of 900 m and to a vertical depth of 240 m. Together with their joint venture partner, Kootenay Gold Inc., they reported "results up to 4 m at 21.04 g/t gold from infill drilling at the

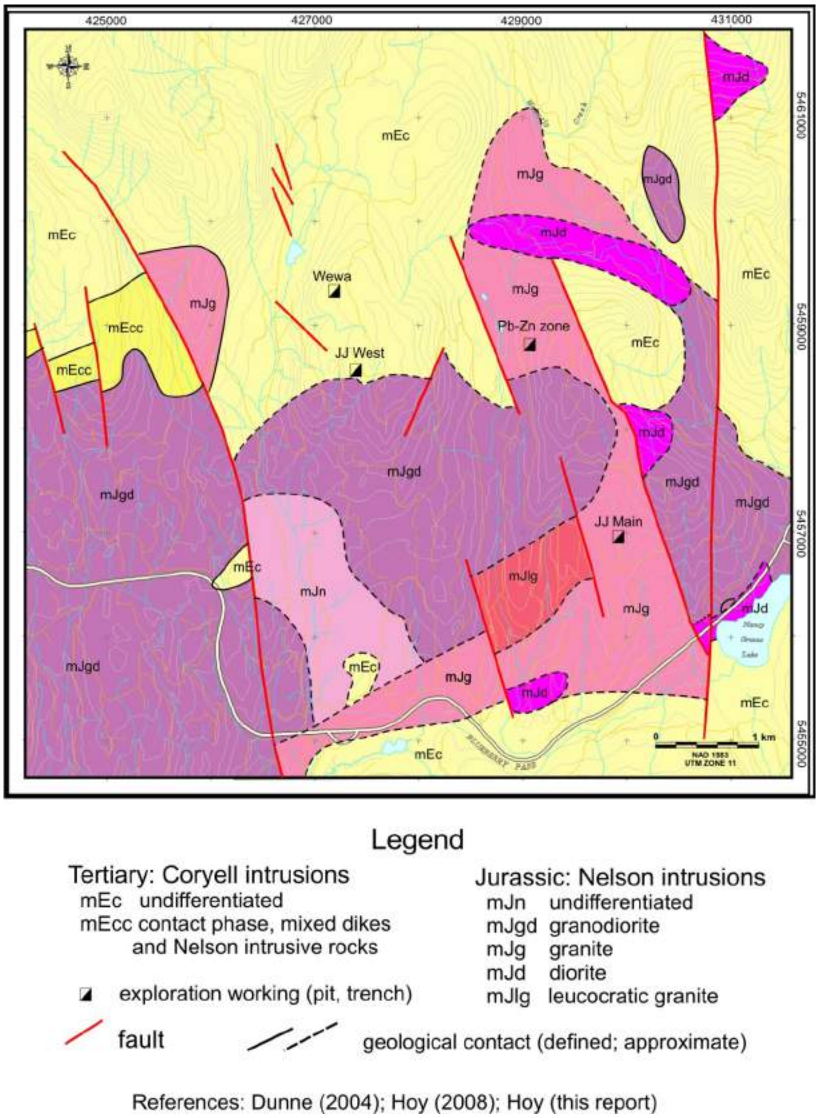


Figure 7. Geology of the JJ property in the Deer Park map area, southeastern British Columbia.

discovery zone" (Astral Mining Corporation and Kootenay Gold Inc., 2008), supporting previous work (Brittliffe, 2008).

These JJ showings are exciting new gold showings related to Eocene structures and located within several kilometres of the past-producing Granville Mountain gold mining camp.

Midas

Midas is a molybdenite property in Coryell intrusive rocks near the centre on TRIM map sheet 082E/040 (Figure 6). It has seen considerable past exploration, including diamond drilling (Sellmer and DePaoli, 1974), and has recently been acquired by Kootenay Gold Inc.

A variety of Coryell intrusive rocks underlie the Midas property, including coarse-grained syenite, porphyritic quartz syenite and aphanitic feldspar porphyry. These are intruded by dominantly northwest-trending, steeply dipping syenite-porphyry, andesite and lamprophyre dikes. A breccia zone "of nearly the same age as the dyke swarm trends east-west across the intrusive grain" and "a variable, locally intense quartz vein and/or quartz/magnetite vein stockwork cuts all rock types" (Sellmer and DePaoli, 1974), but is most intense next to the breccia zone.

Molybdenite mineralization is found in a variety of environments on the property, including the breccia zone and its margins, quartz veining in highly fractured medium-grained quartz monzonite and with chlorite-magnetite alteration in shear zones cutting the subporphyritic coarse-grained syenite. Sellmer and DePaoli (1974) noted that a mineralized zone intersected in a drillhole at the edge of the breccia contained 0.3% MoS^2 across approximately 16 m.

Mineralization-related structures on the Midas property trend north to northwest, cutting all units. This structural trend is prominent in the eastern part of the Deer Park map area; as these structures cut Coryell rocks, they are syn- to post-Middle Eocene and likely developed late in the extensional history of the area. Furthermore, based on regional mapping, the variety of Coryell rock types and the abundance of dikes suggest emplacement of late porphyritic intrusions at relatively high levels within the main Coryell body.

Summary and Discussion

The Deer Park map area straddles the northern extension of the Grand Fork complex, an uplifted, exhumed-core complex bounded on the west and east by north-trending Eocene extensional faults. Eocene intrusions, the Coryell suite, dominate in the hangingwall of these faults and extend locally from the east into the central uplifted block. Middle Jurassic and Cretaceous (?) intrusions dominate in the central part of the area, north of para- and orthogneisses that define the complex in much of the Gladstone Park area.

The Granby fault defines the western limit of the complex, and extends north the entire length of the Deer Park map area. It cuts and truncates Coryell intrusive rocks and the (structurally?) overlying Eocene age Marron volcanic rocks. The Kettle River fault defines the eastern boundary. It has been traced or extrapolated northward into the Deer Park sheet and, based on early regional mapping (Little, 1957) is inferred to be cut by the Coryell intrusions (Templeman-Kluit, 1989), constraining its age to pre-ca. 51 Ma. This relationship is not well established and requires more detailed mapping before it can be verified.

The area has been traditionally underexplored, despite the importance of the Greenwood, Rossland and Franklin mining camps located to the south and north. This may be due, in part, to lack of recent government or university surveys, inaccessibility, and perceived nonprospective environment (i.e., lack of structures and area dominated by mainly large Middle Jurassic or Middle Eocene intrusions). However, recent exploration has led to the discovery of several significant new gold occurrences and prospects, most notably mineralized vein systems on the Deer Park property east of Lower Arrow Lake and on the JJ property in the southeastern part of the map area. Furthermore, the exploration and mapping done during this study have shown that the relatively complex internal structure of the Coryell suite in some areas shows a variety of late, high-level intrusive phases and dike swarms, as well as numerous Eocene or younger north- and northwest-trending faults. These faults are commonly the loci for Eocene intrusive activity and, locally, brecciation, as well as for a variety of mineral deposits or occurrences. The faults and associated mineralization appear to be developed at various structural levels, ranging from high-level breccias with epithermal-style mineralization to shear and mylonitic fabrics developed at intermediate structural levels, all of which is evidence that relatively rapid uplift and exhumation of the Grand Forks complex occurred during the Tertiary.

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