Geological and U-Pb age constraints on base and precious metal vein systems in the Mount Nansen area, eastern Dawson Range, Yukon

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ABSTRACT

Epithermal vein and porphyry-related gold-silver deposits in the Mount Nansen area are mainly hosted in Paleozoic Yukon-Tanana Terrane metasedimentary rocks and Early Jurassic Big Creek Batholith intrusive rocks. Mineralization is spatially, and probably temporally, related to a northwest-trending belt of mid-Cretaceous hypabyssal felsic intrusions and dykes along the Mount Nansen Trend. The proximal relationship between the veins and mid-Cretaceous intrusive rocks suggests that mineralization may be genetically related to felsic magmatism. The Dickson stock yields a U-Pb zircon age of 108.3 ± 0.7 Ma, and proximal dykes in the Flex, Dickson, Brown-McDade and Weber zones give ages of 107.9 ± 0.9 Ma to 109.0 ± 0.7 Ma, similar to the age of the Mount Nansen Group volcanic rocks. Granodiorite that hosts the Dickson deposit gives a U-Pb titanite age of 191.5 ± 2.9 Ma, and is likely part of the Big Creek Batholith. Previous studies indicated two periods of mineralization in the Dawson Range: mid-Cretaceous and Late Cretaceous. Dating indicates that Mount Nansen mineralization is associated with the mid-Cretaceous emplacement of the high-level felsic intrusions.

RÉSUMÉ

Les gisements d'or-argent associés à des roches porphyriques et à des filons épithermaux dans la région du mont Nansen sont surtout logés dans des roches métasédimentaires paléozoïques du terrane de Yukon-Tanana et dans des roches intrusives du Batholite de Big Creek du Jurassique précoce. La minéralisation est associée, sur le plan spatial et probablement temporel, à une zone d'intrusions et de dykes felsiques hypabyssaux du Crétacé moyen à direction nord-ouest parallèle à la direction de mont Nansen. Le lien proximal entre les filons et les roches intrusives du Crétacé moyen pourrait indiquer une relation génétique avec un magmatisme felsique. La datation par la méthode U-Pb sur zircon donne un âge de 108,3 ± 0,7 Ma pour le stock de Dickson et un âge entre 107,9 ± 0,9 Ma et 109,0 ± 0,7 Ma pour les dykes proximaux des zones de Flex, Dickson, Brown-McDade et Weber. Cette datation est semblable à celle des roches volcaniques du Groupe du mont Nansen. La granodiorite dans laquelle est encaissé le gisement de Dickson donne par la méthode U-Pb sur titanite un âge de 191,5 ± 2,9 Ma; elle fait probablement partie du Batholite de Big Creek. Des études antérieures indiquaient deux périodes de minéralisation dans le chaînon Dawson : Crétacé moyen et Crétacé tardif. La datation indique que la minéralisation du mont Nansen est associée à la mise en place au Crétacé moyen d'intrusions felsiques de haut niveau.

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INTRODUCTION

The Mount Nansen area, in the eastern Dawson Range mineral belt of west-central Yukon (Fig. 1), hosts approximately 30 mineral occurrences within a 15-km-long, northwest-trending corridor known as the Mount Nansen trend (Fig. 2). Within this trend, mineralization consists of copper-molybdenum ± gold porphyries and epithermal gold-silver veins, with fewer skarns and breccias, as well as placer gold occurrences that together comprise the Mount Nansen district (Hart and Langdon, 1998). At the district's southeasterly end, five precious-metal-enriched veins comprise the Mount Nansen gold deposit: Brown-McDade, Webber, Heustis, Flex and Dickson (Fig. 2). Mineralization throughout the district has a spatial association with hypabyssal felsic porphyry stocks and dykes that intrude Paleozoic Yukon-Tanana Terrane metamorphic rocks and Mesozoic granitic rocks (Hart and Langdon, 1998). In particular, mineralized veins that comprise the Mount Nansen gold deposit are proximal to a central quartz-feldspar porphyry stock (informally termed the Dickson stock), and quartz-feldspar porphyry dykes occupy the same structures as the mineralized veins.

Most mineral deposits throughout the Dawson Range are generally considered to be associated with hydrothermal activity related to Late Cretaceous Carmacks Group magmatism (Smuk, 1999; Selby and Creaser, 2001). However, the presence of mid-Cretaceous volcanic rocks in eastern Dawson Range and Eocene magmatic rocks in western Dawson Range, indicates that other magmatic phases may be responsible for mineralization. In this study, the authors have dated five intrusive rocks in the Mount Nansen area using U-Pb methods in order to constrain aspects of the local geology and the possible age(s) of mineralization in the Mount Nansen veins.

LOCATION

The area is located ~160 km north of Whitehorse and ~42 km west of Carmacks, at latitude 62°05'N and longitude 137°08'W, on NTS map sheet 115I/13. The Mount Nansen mine is accessible via the 63-km Mount Nansen Road from Carmacks (Fig. 1). The Mount Nansen area is one of the oldest precious metal camps in the Yukon, with the discovery of placer gold on Nansen Creek in 1899, and the staking of the first lode claims in the area in 1910. The district has had a long and episodic history of exploration and mining, with most efforts focussed on the Brown-McDade, Heustis and Webber gold-silver veins, and the Cyprus copper-molybdenum porphyry.

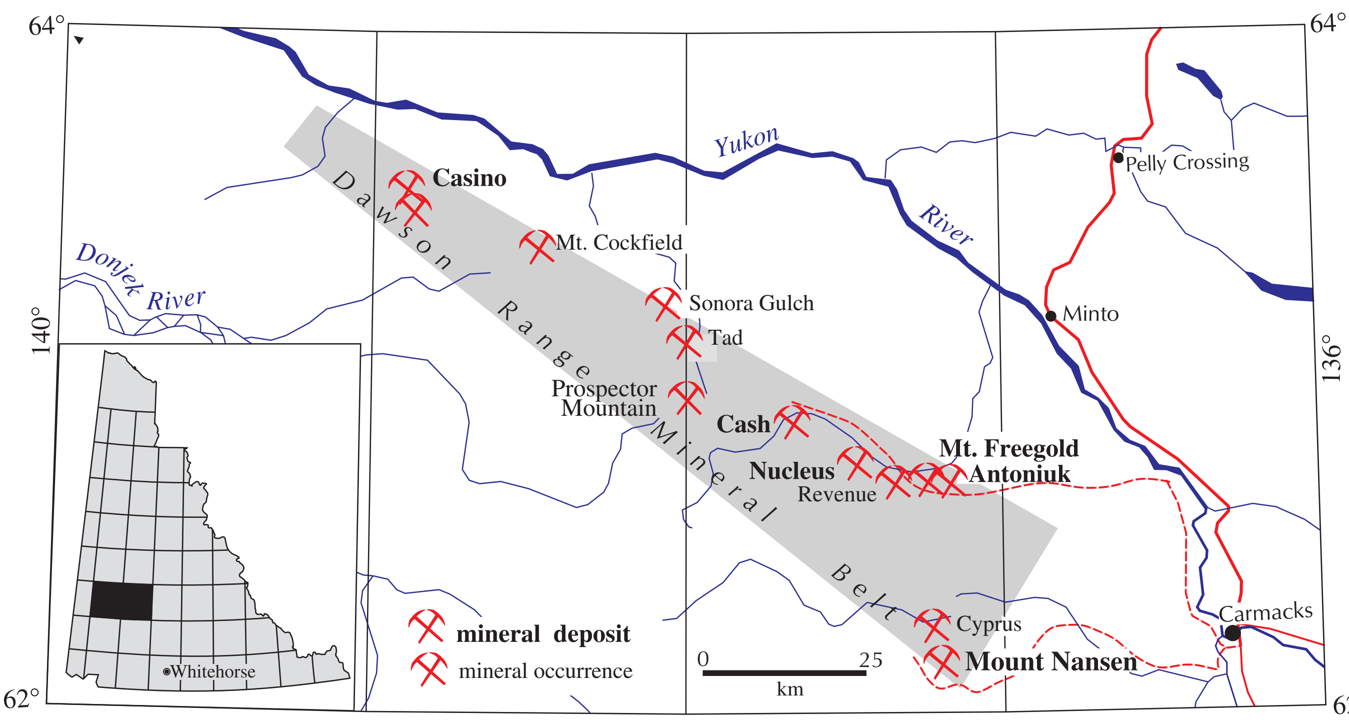


Figure 1. *Regional setting of the Mount Nansen district within Dawson Range mineral belt.*

HISTORY

Prior to recent mining operations (from November, 1996 to March, 1999), a combined resource of approximately 1 million tonnes of 7.4 g/t Au and 148 g/t Ag was calculated for these deposits (BYG Press Release, 1995), and included both open pit and underground resources. Approximately 450 000 tonnes was considered oxide ore. Approximately 140 000 tonnes of oxide ore from the Brown-McDade open pit and Webber and Brown-McDade stockpiles were processed in the late 1990s and yielded approximately 34,000 oz Au (1.1 million g) and 131,000 oz Ag (4.1 million g; Stroshein, 1999). Considerable placer mining activity also occurs in the region (LeBarge, 1995).

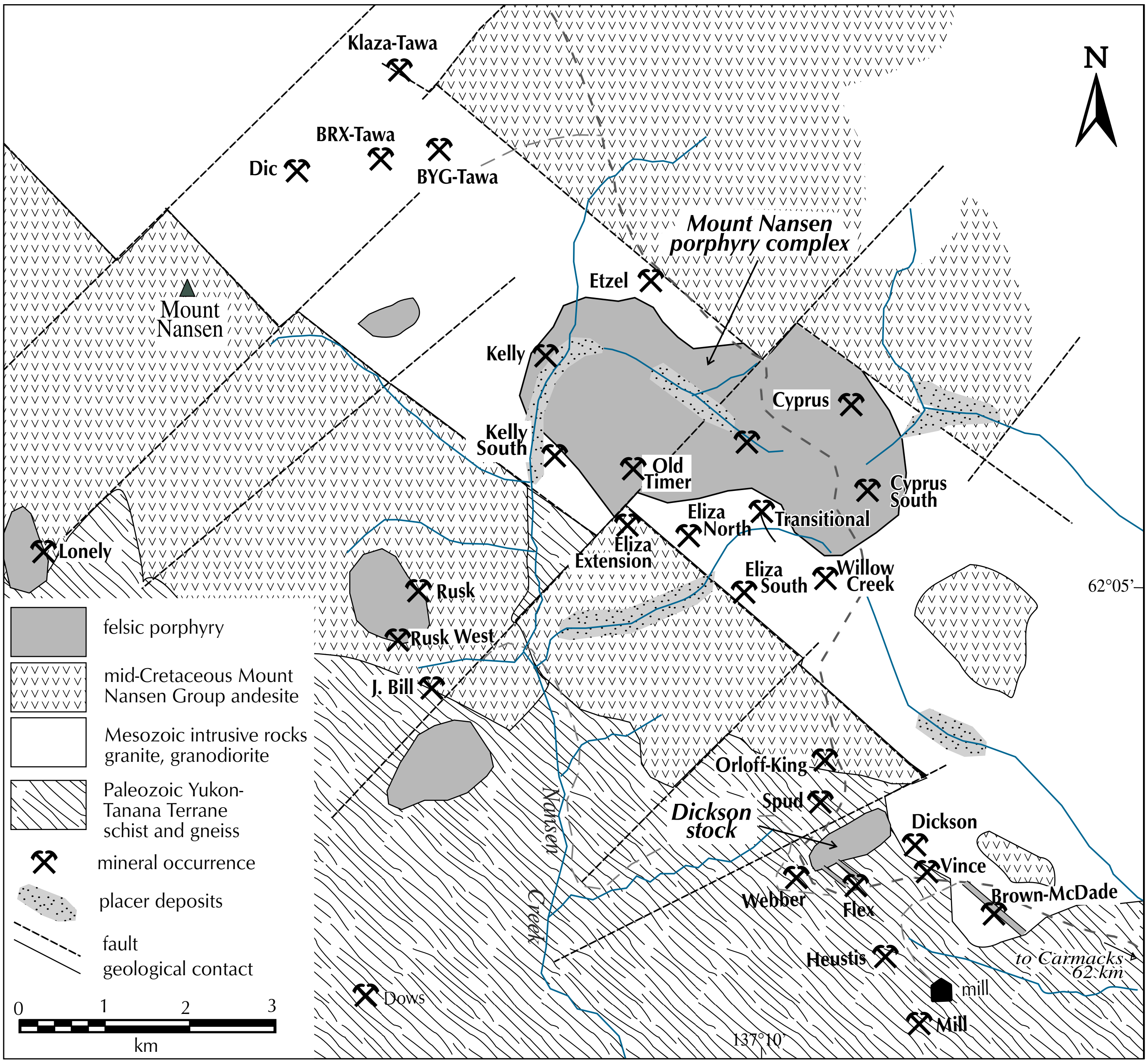


Figure 2. *Generalized geology of the Mount Nansen district. The undivided granitic rocks include coarse-grained representatives of the Early Jurassic Big Creek and Granite Mountain batholiths, and the medium-grained Dawson Range Batholith. Modified from Hart and Langdon (1998).*

REGIONAL GEOLOGY

The regional geology of the Mount Nansen area has been described by Cairnes (1916), Bostock (1934, 1936) and Tempelman-Kluit (1984). Cairnes (1916) carried out reconnaissance geological mapping and first defined a 12 x 15 km area that he called the Nansen district. The most recent study of the area's regional geology (Carlson, 1987) describes the Nansen camp in detail. Studies focussing on the mineralization of the area include Lamb (1947), Saager and Bianconi (1971), Dickinson (1972), and Sawyer and Dickinson (1976). More recently Hart and Langdon (1998) provided an overview of the district, Anderson and Stroshein (1998) described the mineralization of the Flex zone, and Stroshein (1999) summarized the mineralization of the Brown-McDade deposit.

The eastern Dawson Range lies beyond the limits of the McConnell and Reid glaciations: valley bottoms in the area are deeply buried by alluvium related to at least two earlier pre-Reid glaciations, but the upland surfaces are not affected (Bostock, 1966; Laberge, 1995). Discontinuous permafrost is present in the area, and surface weathering extends to depths of up to 75 m below ground surface. Mineralized zones are commonly at least partially oxidized, as sulphide minerals are replaced by limonite and other secondary minerals. Bedrock exposure is extremely limited in the study area (<2%) — hence much of the regional geological mapping is based on felsenmeer rather than outcrop. The most resistant rock units, including the Mount Nansen Group volcanic rocks and coeval felsic stocks and dykes, typically form substantial outcrops (Carlson, 1987). Bulldozer trenching, and stripping of some of the mineralized zones provide much-improved local exposure.

GEOLOGY OF THE MOUNT NANSEN AREA

Most of the Dawson Range is within the Yukon-Tanana Terrane, which is composed of Devonian and older meta-igneous and metasedimentary rocks (Templeman-Kluit, 1984; Carlson, 1987). In the Mount Nansen area, the metamorphic rocks are dominated by chlorite schist and felsic orthogneiss, with lesser, quartz-rich metasedimentary rocks and amphibolite. Foliation within the metamorphic rocks typically strikes northeasterly and dips steeply northwest. The metamorphic rocks are intruded by several plutonic suites. The Early Jurassic suite includes Big Creek Batholith, which is notable for its coarse grain-size, megacrystic alkali feldspars, and its variable, but generally quartz-poor, compositions such as quartz syenite. Quartz-rich, alkali feldspar megacrystic plutonic rocks, such as granite, that outcrop in the area are also considered to be Early Jurassic, but are more similar to the Granite Mountain Batholith. The Jurassic plutonic rocks are only locally, weakly foliated. Medium-grained, biotite-hornblende granodiorite of the mid-Cretaceous Dawson Range Batholith is also present in the area.

A thick succession of dominantly andesitic flows, tuffs and breccias form the mid-Cretaceous Mount Nansen Group volcanic rocks (Fig. 2; Templeman-Kluit, 1984; Carlson, 1987). They are resistant to weathering and form most of the higher peaks in the vicinity. These volcanic rocks are interpreted to represent the erosional remnants of caldera complexes (Hart and Langdon, 1998). Associated quartz-feldspar-phyric stocks, plugs, dykes and sills typically consist of 1- to 3-mm-diameter altered feldspar and/or quartz phenocrysts in an aphanitic to fine-grained, buff-weathering, felsic groundmass. Dykes range from 10 cm to 12 m in width, averaging about 1.5 m, and cut all other rock units in the immediate Mount Nansen mine area. These hypabyssal felsic porphyry dykes are considered to be the intrusive equivalents of the Mount Nansen Group volcanic rocks. These high-level felsic intrusions are significant because they host, or are proximal to, both the porphyry copper mineralization and precious metal veins.

The main geological feature in the Mount Nansen mine area is a quartz-feldspar rhyolite porphyry stock informally named the Dickson stock. It is the second largest of at least six distinct bodies of felsic porphyry, and is located adjacent to or near a fault with a strike length of about 7 km (Fig. 2). Emanating from the Dickson stock are several quartz-feldspar porphyry dykes that intrude both the metamorphic rocks and the hornblende-biotite granodiorite of the Big Creek plutonic suite in the northeast part of the study area (Fig. 3).

The Late Cretaceous (~78-65 Ma) Carmacks Group volcanic rocks are mostly north and east of the Mount Nansen area (Templeman-Kluit, 1984, Carlson, 1987). They consist of flat-lying basaltic, and lesser andesitic flows, felsic pyroclastic rocks and associated felsic domes and plugs, as well as basaltic dykes.

Hart and Langdon (1998) examined the structural history of the Mount Nansen area and emphasized three main structural orientations. The Mount Nansen trend is a 2 x 15 km northwest-trending corridor controlled by bounding faults that form an uplifted block of basement rocks within the Mount Nansen volcanic rocks. These and other parallel faults define the regional structural trend at 130° to 150°. These faults bound wide (20-500 m) zones that host porphyry dykes and mineralized quartz veins. Both normal and right-lateral displacements are observed on these structures. Slickensides on veins and dykes suggest that mineralization occurred after normal movement on the faults, but before the strike-slip movement. A secondary structural trend averaging 020° is typified by locally developed joint sets, but there is a general absence of associated shearing. These structures are thought to be second-order oblique extension fractures related to the northwest-trending strike-slip movement. The second-order structures host narrow mineralized quartz veins and porphyry dykes. The third structural trend recognized in the Mount Nansen area comprises faults, fractures and joints that trend between 050° and 080°. These faults are recognizable on air photographs and geophysical magnetic surveys, and have also been observed in trenches in some areas. Most notably, they occur in the Flex zone where they have dominantly sinistral offsets (Anderson and Stroshein, 1998)

MINERALIZATION IN THE MOUNT NANSEN DISTRICT

The most significant porphyry-style deposit in the Mount Nansen area is the Cyprus porphyry. It consists of a low-grade copper-molybdenum occurrence with local supergene gold enrichments (Sawyer and Dickinson, 1976). Gold-silver veins and breccias occur throughout the Mount Nansen trend and are particularly evident adjacent, and peripheral, to the region's numerous quartz-feldspar porphyry bodies and dykes (Dickenson, 1972; Hart and Langdon, 1998).

The Mount Nansen deposits consist of five main mineralized zones within a 1 km radius — the Brown-McDade, Weber, Heustis, Flex and Dickson. Mineralization within the zones consists mainly of brittle fault- and shear-hosted sulphide-mineral-rich quartz veins with associated bleached clay-rich alteration zones that range from a few centimetres to up to 5 m wide. The vein systems range from narrow, relatively simple veins (e.g., Heustis) to complex anastomosing systems (e.g., Brown-McDade). In zones such as the Flex (Anderson and Stroshein, 1998), narrow precious metal-bearing sulphide mineral-rich veins occur along anastomosing, steeply dipping, northwest-trending faults and are best developed within metamorphic wall rocks, although they occur in all rock types.

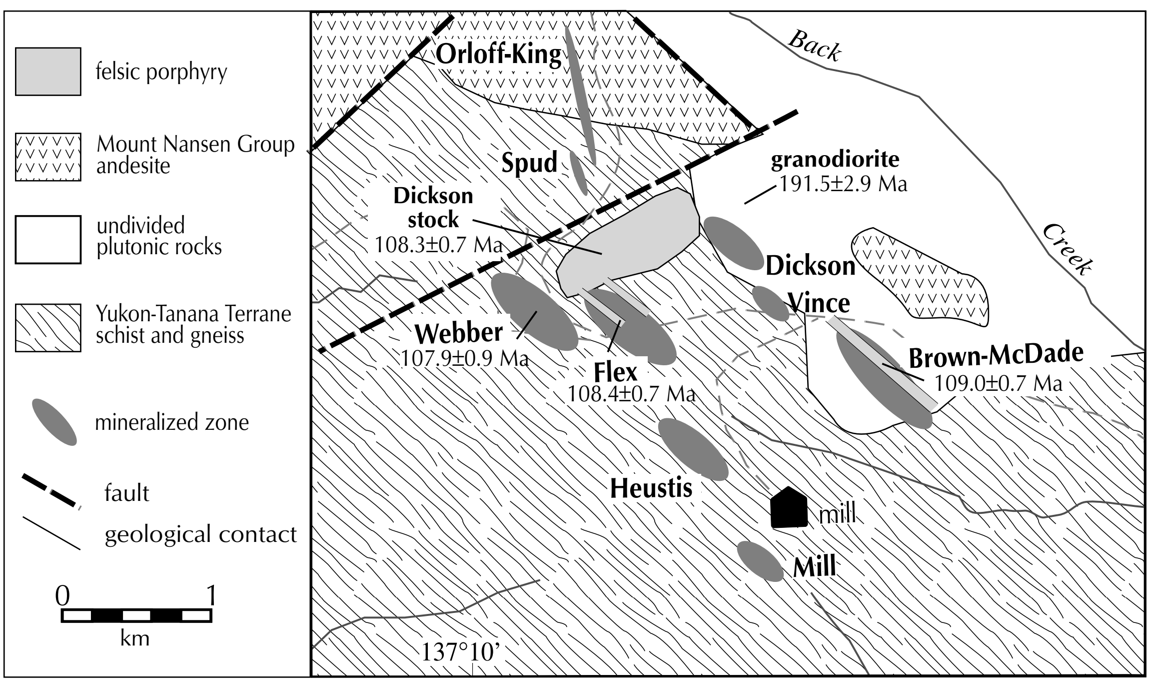


***Figure 3.** Detailed geology of the Mount Nansen deposits and locations of age dates reported in the text.*

Complex vein and breccia zones such as the Brown-McDade (Stroshein, 1999) share many characteristics with the narrow veins, but mineralization and alteration is more widely distributed. There is also a stronger spatial association with feldspar porphyry dykes that are hosted in the faults. These zones are considerably wider due to an abundance of either parallel, or intersecting structures that generate highly fractured and altered zones; they are up to 50 m wide and largely developed within the quartz-feldspar porphyry. Some mineralized veins locally change character into a brecciated zone, and then into a porphyry dyke, either along strike or down-dip. Webber zone veins also occur within felsic dykes.

Quartz in veins throughout the area is typically finely crystalline to chalcedonic, and dark grey to bluish due to sparsely disseminated, fine-grained sulphide minerals. Sulphide minerals include abundant pyrite and arsenopyrite with lesser galena, sphalerite, stibnite, andorite (Pb-Ag sulphantimonide) and chalcopyrite (mineralogy from unpublished company reports, BYG Natural Resources Inc.). Supergene minerals in addition to limonite and geothite include scorodite and cerussite; plumbojarosite, stibiconite and cervantite have also been reported. Precious metal values (>3.5 g/t Au and >35 g/t Ag) are confined to quartz-sulphide mineral-rich zones, and values drop off rapidly to less than 0.7 g/t Au and 17 g/t Ag in the surrounding altered wallrock. Wallrocks adjacent to the veins are typically bleached with intense phyllic and kaolinitic alteration envelopes.

GEOCHRONOLOGY

U-Pb dating of zircon and titanite was carried out to establish the crystallization ages of the Dickson stock and three related porphyry dykes. The dykes are spatially associated with vein mineralization in that they occupy the same fault structures and are locally cut by mineralized veins. The felsic dykes were nowhere

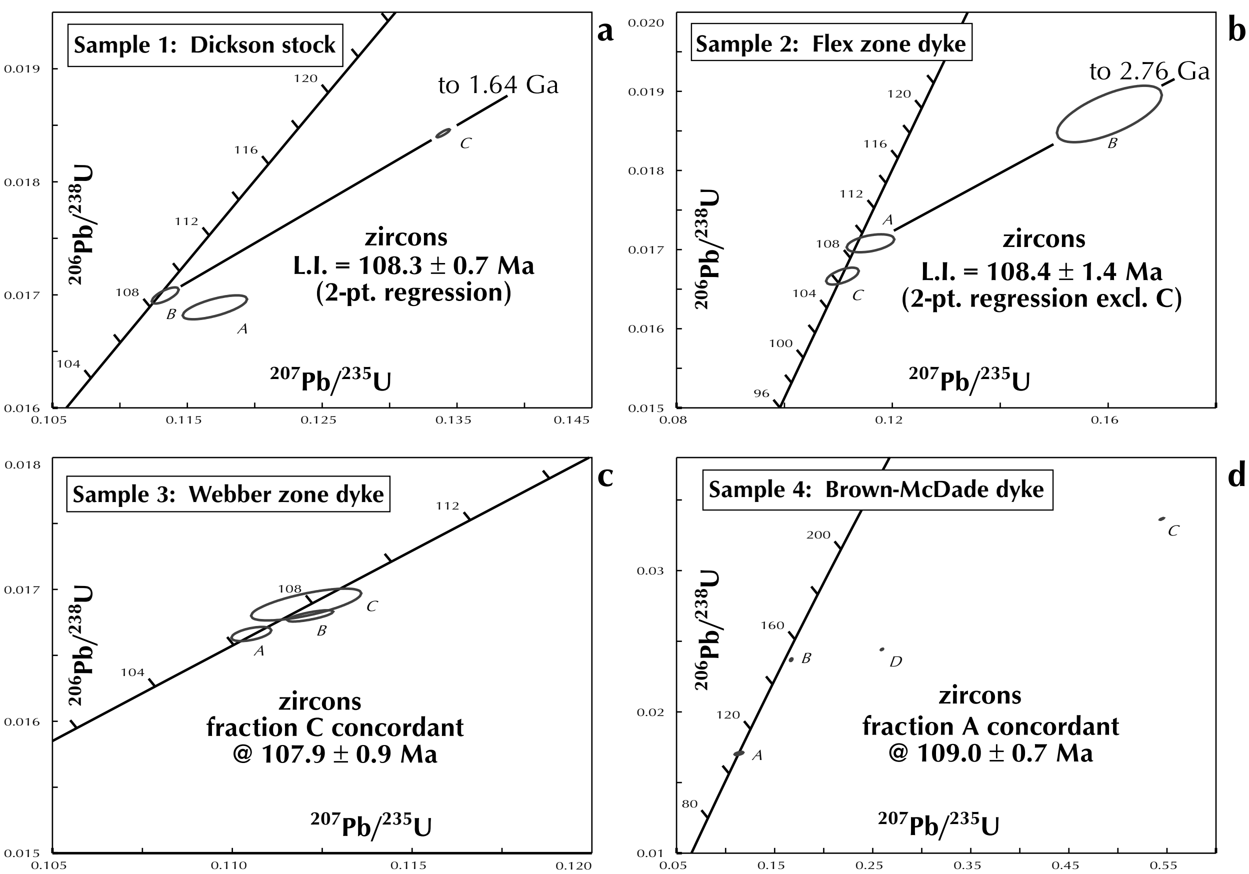
Table 1. *U-Pb analytical data.*

Sample description[1]	Wt (mg)	U content (ppm)	Pb[2] content (ppm)	$^{206}Pb/^{204}Pb$ (meas.)[3]	total common Pb (pg)	% ^{208}Pb[2]	$^{206}Pb/^{238}U$[4] (± % 1σ)	$^{207}Pb/^{235}U$[4] (± % 1σ)	$^{207}Pb/^{206}Pb$[4] (± % 1σ)	$^{206}Pb/^{238}U$ age (Ma; ± % 2σ)	$^{207}Pb/^{206}Pb$ age (Ma; ± % 2σ)
Sample 1 (97VIK-47: Dickson stock)											
A: N2,+105,a	0.061	164	3.0	205	57	17.4	0.01689(0.31)	0.1170(1.02)	0.05026(0.84)	108.0(0.7)	207.0(39.0)
B: N2,+105,a	0.055	151	2.9	899	10	20.2	0.01699(0.21)	0.1134(0.44)	0.04838(0.33)	108.6(0.5)	117.8(15.4)
C: N2,+105,a	0.099	322	7.0	2958	13	22.9	0.01843(0.10)	0.1340(0.18)	0.05272(0.11)	117.7(0.2)	316.9(5.0)
Sample 2 (97VIK-33: Flex zone porphyry)											
A: N2,+105,a	0.067	176	3.7	416	31	25.9	0.01708(0.33)	0.1160(1.91)	0.04924(1.78)	109.2(0.7)	159.1(83.2)
B: N2,+105,a	0.055	193	4.4	56	329	53.3	0.01872(0.95)	0.1602(3.04)	0.06210(2.50)	119.5(2.3)	677.4(107.0)
C: N2,+105,a	0.047	94	2.3	220	23	37.9	0.01667(0.32)	0.1108(1.37)	0.04820(1.21)	106.5(0.7)	109.1(57.0)
Sample 3 (97VIK-41: Webber zone porphyry)											
A: N2,+105,a	0.068	153	2.8	2608	4	18.0	0.01666(0.16)	0.1105(0.25)	0.04811(0.22)	106.5(0.3)	104.8(10.2)
B: N2,+105,a	0.056	209	4.5	1086	12	29.0	0.01680(0.13)	0.1122(0.28)	0.04843(0.21)	107.4(0.3)	120.1(9.7)
C: N2,+105,a	0.023	174	3.9	975	4	31.6	0.01688(0.36)	0.1120(0.66)	0.04809(0.47)	107.9(0.8)	103.8(22.1)
Sample 4 (97VIK-50: Brown-McDade zone porphyry)											
A: N2,+134,a	0.035	33	0.6	117	12	16.4	0.01706(0.33)	0.1136(1.94)	0.04830(1.76)	109.0(0.7)	114.0(83.5)
B: N2,+134,a	0.052	154	3.8	1353	9	14.2	0.02370(0.18)	0.1669(0.38)	0.05108(0.31)	151.0(0.5)	244.3(14.4)
C: N2,+134,a	0.070	176	7.8	1546	17	27.0	0.03366(0.09)	0.5447(0.18)	0.11738(0.11)	213.4(0.4)	1916.7(3.8)
D: N2,+134,a	0.087	192	6.3	1172	22	30.4	0.02442(0.09)	0.2595(0.22)	0.07705(0.15)	155.5(0.3)	1122.5(5.9)
Sample 5 (97VIK-48: biotite-hornblende granodiorite)											
A: N2,+105,a	0.091	358	11.5	14960	4	9.8	0.03201(0.09)	0.2223(0.16)	0.05036(0.08)	203.1(0.4)	211.6(3.8)
B: N2,+105,a	0.072	264	8.6	10640	4	10.4	0.03239(0.25)	0.2248(0.27)	0.05034(0.16)	205.5(1.0)	210.8(7.3)
C: N2,+105,a	0.046	220	7.7	15090	1	10.7	0.03447(0.11)	0.2427(0.17)	0.05106(0.10)	218.5(0.5)	243.7(4.4)
T1: titanite,u	1.36	111	4.5	94	3750	32.3	0.03014(0.72)	0.2071(2.55)	0.04984(2.12)	191.4(2.7)	187.4(98.8)
T2: titanite,u	0.78	118	4.7	102	2090	30.4	0.03023(0.65)	0.2103(1.24)	0.05045(1.85)	192.0(2.4)	215.9(85.7)

[1]*N2=non-magnetic 2 degrees side slope on Frantz isodynamic magnetic separator; grain size given in microns; a = abraded; u = unabraded.*
[2]*radiogenic Pb; corrected for blank, initial common Pb, and spike*
[3]*corrected for spike and fractionation*
[4]*corrected for blank Pb and U, and common Pb*

observed cutting mineralized veins. A sample of granodiorite that hosts mineralization in the Dickson zone was also dated. Zircons were recovered from 10-15 kg samples of the Dickson stock and porphyritic dykes from the Flex, Webber and Brown-McDade zones. The zircons are very similar in appearance, comprising clear, equant to stubby prismatic, euhedral grains with rare to abundant colourless bubble-, rod- and tube-shaped inclusions. All zircon fractions were subjected to strong air abrasion prior to dissolution in order to minimize the effects of post-crystallization Pb-loss. Analytical work was done in the UBC Geochronology Laboratory, using techniques as described by Mortensen et al. (1995). Analytical data are reported in Table 1 and are plotted on conventional U-Pb concordia plots in Figure 4. Relatively high contents of common Pb were measured in many of the zircon fractions; this likely results from common Pb contained within the abundant inclusions.

Three fractions of the coarsest, least magnetic zircon recovered from the Dickson stock sample (Sample 1) were analysed. Fraction B is nearly concordant at 108.3 ± 0.7 Ma (Fig. 4a), which is the best estimate for the



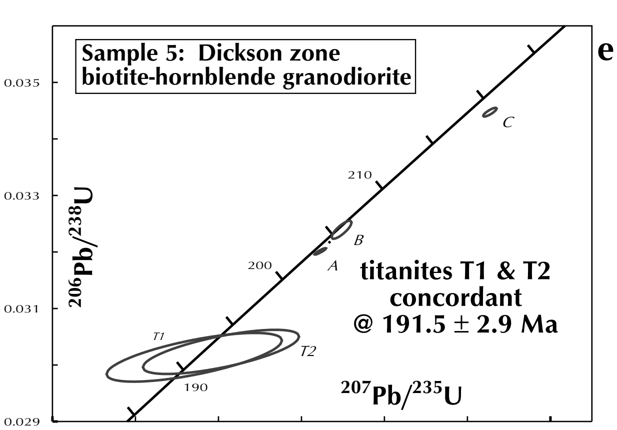


Figure 4. *Concordia plots of age dates reported for rocks from the Mount Nansen deposits:* ***(a)*** *Dickson stock,* ***(b)*** *Flex zone dyke,* ***(c)*** *Webber zone dyke,* ***(d)*** *Brown-McDade dyke,* ***(e)*** *Dickson zone biotite-hornblende granodiorite. L.I. – lower intercept.*

crystallization age of the sample. The other two fractions yield considerably older $^{207}Pb/^{206}Pb$ ages, suggesting the presence of an older, inherited zircon component. A regression through fractions B and C gives a calculated upper intercept age of 1.64 Ga, which is interpreted as an average age for the inherited zircon component. Fraction A falls below this line, suggesting that this analysis reflects Pb-loss effects that were not completely removed by the strong abrasion.

A sample was collected from a quartz-feldspar porphyry dyke from a freshly stripped area at the south end of the Flex zone (Sample 2). This phase is within the same structure and adjacent to well mineralized veins and was interpreted to be a mineralizing dyke related to the Dickson stock. Three strongly abraded zircon fractions were analysed (Fig. 4b). A two-point regression through fractions A and B gives a lower intercept of 108.4 ± 1.4 Ma, which is interpreted as the crystallization age of the sample. The upper intercept is 2.76 Ga, which indicates the presence of a Late Archean inherited zircon component in this sample. Fraction C is concordant but gives a slightly younger $^{206}Pb/^{238}U$ age of 106.5 Ma. Zircons in this fraction were finer than in fractions A and B, and it is thought that the younger age reflects minor post-crystallization Pb-loss.

Three zircon fractions from a quartz-feldspar porphyry dyke sample from a trench cutting the Webber zone (Sample 3) all yield concordant or nearly concordant analyses between 106 and 108 Ma (Fig. 4c). Fraction C yields the oldest $^{206}Pb/^{238}U$ age of 107.9 ± 0.9 Ma, which is interpreted as the crystallization age of the sample.

A quartz-feldspar porphyry dyke that is crosscut by mineralization in the Brown-McDade zone was sampled from drill core (Sample 4). Four zircon fractions were analysed (Fig. 4d). Fraction A is concordant with a $^{206}Pb/^{238}U$ age of 109.0 ± 0.7 Ma, which gives the crystallization age of the sample. The other three fractions are all discordant, with considerably older $^{207}Pb/^{206}Pb$ ages; however the data do not define a linear array. This scatter is interpreted to reflect the presence of older, inherited zircon components of more than one age, possibly compounded by post-crystallization Pb-loss effects that were not completely removed by abrasion.

Medium-grained, equigranular, biotite-hornblende granodiorite was sampled in freshly stripped exposures in the Dickson Zone northeast of the Dickson stock (Sample 5). Zircons from the sample form clear, stubby to elongate, euhedral prisms with no visible zoning or cores. Three fractions of the best quality, inclusion-free grains were analysed following strong abrasion. The analyses are all slightly discordant, falling below concordia between ~203 and 220 Ma (Fig. 4e). Two unabraded fractions of coarse, high-quality titanite from the sample were also analysed, and yielded overlapping concordant analyses with a total range of $^{206}Pb/^{238}U$ ages of 191.5 ± 2.9 Ma. The titanite ages are interpreted to give the crystallization age of the sample, whereas the slightly older zircon analyses appear to indicate the presence of a component of slightly older inherited zircon.

DISCUSSION AND CONCLUSIONS

Field relationships and age-dating results from deposits in Mount Nansen mine area indicate that the main magmatic event associated with mineralization, specifically the emplacement of the Dickson stock and intrusion of related porphyry dykes, occurred at ~ 108 ± 1 Ma. These dates suggest that mineralization and associated hydrothermal activity may have also occurred at this time. Previous age determinations for samples related to mineralization in the Mount Nansen mine area have given conflicting results. Hydrothermal adularia from the Huestis zone yielded a K-Ar age of 122.9 ± 1.9 Ma (Hunt and Roddick, 1987). This is an unexpected age and likely results from excess Ar contained with the adularia. A whole rock Ar-Ar date from an altered rhyolite dyke in the Brown-McDade zone yielded a date of 77 ± 1 Ma (M.E. Villeneuve, pers. comm., 1997). The significance of this single date is uncertain, but may be interpreted to result from partial resetting due to thermal or hydrothermal overprinting associated with Carmacks Group magmatism at ~ 70 Ma. Such resetting is widespread in the central Yukon (Hart, 1995). Further afield within the Mount Nansen trend, molybdenite associated with potassic alteration in the Cyprus porphyry deposit yielded a Re-Os date of 71.1 ± 0.3 Ma (Selby and Creaser, 2001) that is similar to a K-Ar biotite age of 70.5 ± 2.2 Ma (Stevens et al., 1982) for quartz-feldspar porphyry from the Rusk showing. Similarly, three whole rock K-Ar analyses on feldspar-porphyry bodies yielded dates between 70 and 61 Ma (Hunt and Roddick, 1991). Unlike the Ar-Ar and K-Ar dates, which may be reset, the Re-Os date is unlikely to have been reset and therefore indicates that mineralization in the Cyprus porphyry complex is Late Cretaceous.

These data indicate that hypabyssal intrusions and associated mineralization within the Mount Nansen area are likely of two generations — Late Cretaceous (Cyprus intrusion) and mid-Cretaceous (Dickson stocks and dykes). The aforementioned and other geochronological and metallogenic studies (i.e., Carlson, 1987; Smuk et al., 1997; Smuk, 1999) emphasized a single, Late Cretaceous mineralizing event for the Dawson Range that was associated with Carmacks Group volcanism. Although the Late Cretaceous magmatic-hydrothermal event is responsible for the bulk of Dawson Range mineralization (i.e., Casino, Cash), it also is likely that it may have disturbed or reset Ar isotopic systematics in older rocks throughout the district such that the Late Cretaceous mineralizing event may be over-represented.

New U-Pb zircon and titanite age data reported here help constrain the nature and timing of magmatism in the Mount Nansen area. The data show that high-level felsic intrusions that are spatially and possibly genetically associated with base and precious metal-rich veins in the area are part of the mid-Cretacous Dawson Range Batholith. These results provide additional evidence for a mineralizing event in the eastern Dawson Range that is considerably older than the Late Cretaceous mineralization age indicated by previous studies. This reinforces the regional prospectivity of the hypabyssal phases of the mid-Cretaceous intrusions within the Dawson Range mineral belt. The Early Jurassic U-Pb titanite age reported here for the biotite-hornblende granodiorite body in the northeast portion of the study area supports a correlation of this body with either the Big Creek or Granite Mountain batholith.

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