GEOLOGY AND U-Pb GEOCHRONOLOGY OF INTRUSIVE ROCKS ASSOCIATED WITH MINERALIZATION IN THE NORTHERN TAHTSA LAKE DISTRICT, WEST-CENTRAL BRITISH COLUMBIA

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KEYWORDS: Bulkley Suite, U-Pb, porphyry deposit, Huckleberry, Whiting Creek, Bergette, Tahtsa Lake District, Cretaceous, Stikine Terrane.

INTRODUCTION

The Bulkley Suite of intrusions are spatially associated with numerous important mineral occurrences in west-central British Columbia. Previous K-Ar dating studies indicated that the Bulkley Suite ranges in age from 70 to 84 Ma (Carter, 1981). The purpose of this study is to better constrain the timing of Bulkley Suite magmatism and associated mineralization in the northern Tahtsa Lake District. The mineral deposits in the study area that are suggested to be related to Bulkley Suite intrusions include Huckleberry, Whiting Creek, Emerald Glacier and Bergette. There are six closely related intrusive phases in the Whiting Creek area, several of which have associated mineralization. In order to resolve the timing of emplacement of the different intrusive phases in the Whiting Creek area, as well as any regional trends in magmatism, precise age constraints are needed. Uranium-lead geochronological studies were undertaken in order to obtain the necessary precision.

LOCATION AND ACCESS

The northern Tahtsa Lake District is located in west-central British Columbia (Figure 32-1), within the Whitesail Lake map sheet (NTS 93E). The study area is situated near the western margin of the Intermontane morphogeological belt, within the transitional zone between the Coast Plutonic Complex to the west and the Interior Plateau to the east. Access to the area is by means of forestry service roads south of Houston, British Columbia. The forestry service roads are generally in good condition, and are well maintained due to continuing forestry activity and the impending opening of Huckleberry mine. The Whiting Creek property is accessible by four wheel drive vehicle on an exploration road from the main access road. Although there are roads to the north of Whiting Creek, vehicle access is not always possible beyond the creek due to occasional high water levels. Access to the inactive Emerald Glacier mine and areas to the north (the Sibola Stock) are by a steep, four wheel drive road. The Bergette property is located along the access road to the Berg property and is accessible by all terrain vehicle.

REGIONAL GEOLOGY

The project area is located near the western margin of the Intermontane Belt within the Stikine tectonostratigraphic terrane (Figure 32-1). Stikinia is composed of volcanic and sedimentary strata of Lower Devonian to Middle Jurassic age (Monger et al., 1991), and supracrustal sequences of Middle Jurassic to Early Tertiary age, which are intruded by several suites of intrusive rocks. Monger et al. (1991) suggested that all of the components of Stikinia are interrelated components of a complex island arc terrane. Stikinia is in fault contact with the Cache Creek Terrane to the east, whereas the nature of the contact with the terranes to the west has been largely obscured by Cretaceous and Tertiary intrusions. Stikinia is thought to have been accreted to the North American continent by late Middle Jurassic time or possibly earlier (Monger et al., 1991).

Stikinia is comprised of arc assemblages consisting of interbedded volcanic and marine strata. Triassic volcanic assemblages (Takla, Stuhini and Lewes River groups) are unconformably overlain by Lower to Middle Jurassic Hazelton Group volcanic and sedimentary rocks. These rocks, which are dominantly volcanic rocks (pyroclastic) of calc-alkaline composition, were deposited in both marine and non-marine settings.

Overlying the volcanic and marine strata are Middle Jurassic to Early Tertiary supracrustal sequences, which record the effects of the amalgamation and collision of the Stikine terrane (Yorath, 1991). In the study area, the supracrustal sequences are represented by the Ashman Formation of the Bowser Lake Group overlain by the Skeena Group.

Intrusive suites of various ages and compositions were emplaced into the rocks described above. These suites include the Late Triassic Stikine Suite, the Early to Middle Jurassic Topley Suite, the Middle Jurassic Three Sisters Suite, the Late Jurassic to Early Cretaceous Francois Lake Suite, the Late Cretaceous Bulkley Suite, and the Tertiary Nanika, Babine, Quanchus, and Goosly Lake Suites (Woodsworth et al., 1991).

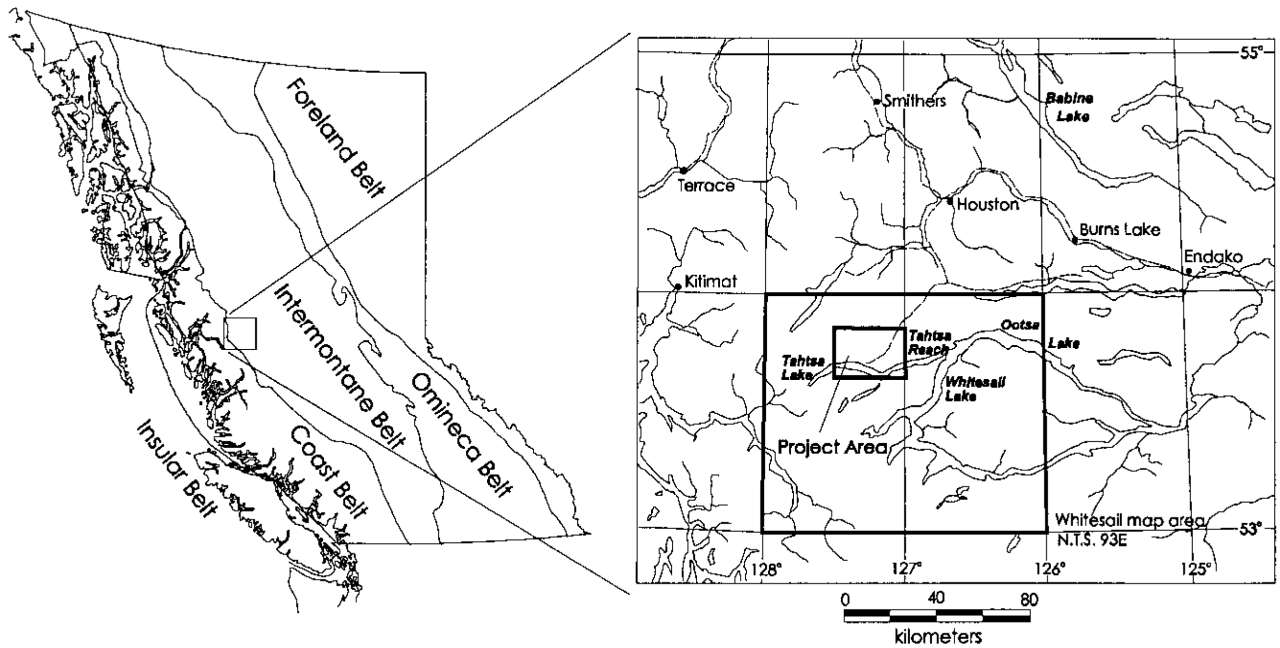

Figure 32-1. Location map for the study area with respect to the main morphogeological belts in the Canadian Cordillera, and showing the main access road.

LOCAL GEOLOGY

The general geology of the northern Tahtsa Lake District is shown in Figure 32-2. The following geological description is taken mainly from MacIntyre (1985). The most areally extensive unit in this region is the Telkwa Formation of the Lower to Middle Jurassic Hazelton Group. These rocks consist of lapilli tuff, lithic tuff, crystal tuff, tuff breccia and minor amounts of porphyritic augite andesite, dacite, tuffaceous siliceous argillite and pebble conglomerate. The Hazelton Group rocks are overlain by the Middle Jurassic Ashman Formation of the Bowser Lake Group, which are in turn overlain by the Early Cretaceous Skeena Group. The Bowser Lake Group marine sedimentary rocks, which occur in a fault-bounded block just south of the Sibola Stock (Figure 32-2), consist of interbedded pebble conglomerate, sandstone, siltstone, shale, and minor tuff. In the project area the Skeena Group consists of a basal conglomerate unit, an amygdaloidal basalt unit and a marine sedimentary unit. The Skeena Group is unconformably overlain by the Kasalka Group. The Kasalka Group as defined by MacIntyre (1985) comprises both volcanic and comagmatic plutonic rocks.

Several intrusive suites were emplaced into the volcanic and sedimentary strata described above. These include the Bulkley Suite intrusions, the Coast intrusions and the Nanika intrusions (Woodsworth et al. 1991). The known distribution of the Bulkley intrusions defines a vaguely north-south trend. Although the intrusions occupy back arc position with respect to coeval plutonism in the Coast Plutonic Complex, they are calc-alkaline in composition (MacIntyre, 1985), suggesting generation in an arc setting, rather than in a back arc setting.

Intrusives in the Huckleberry Area

Two small stocks of hornblende-biotite-feldspar porphyry intrude and hornfels Hazelton Group volcanic rocks in the Huckleberry area. Both intrusions have associated Cu +/- Mo mineralization. Post-mineral lamprophyre and microdiorite dykes crosscut both intrusions.

Intrusives in the Whiting Creek Area

Several intrusions including small stocks and northwest trending dykes that belong to the Bulkley Suite were emplaced into Hazelton Group volcanic rocks in the Whiting Creek area (Figure 32-3). The intrusive phases in the area consist of: quartz porphyry, quartz monzonite porphyry, monzonite porphyry, quartz monzonite of the Whiting Stock, hornblende-biotite-feldspar porphyry dykes, and rhyolite dykes (Cann and Smit, 1995).

Sibola Stock

The Sibola Stock is a large intrusive body that is compositionally zoned from relatively minor quartz monzodiorite to more typical quartz monzonite. It is similar in both composition and texture to the Whiting Stock. Dykes of several compositions, including biotite-feldspar porphyry and aplite, crosscut the Stock (Figure 32-2).

Intrusives in the Bergette Area

The Bergette property is located near the northern margin of the Sibola Stock. There are several intrusive

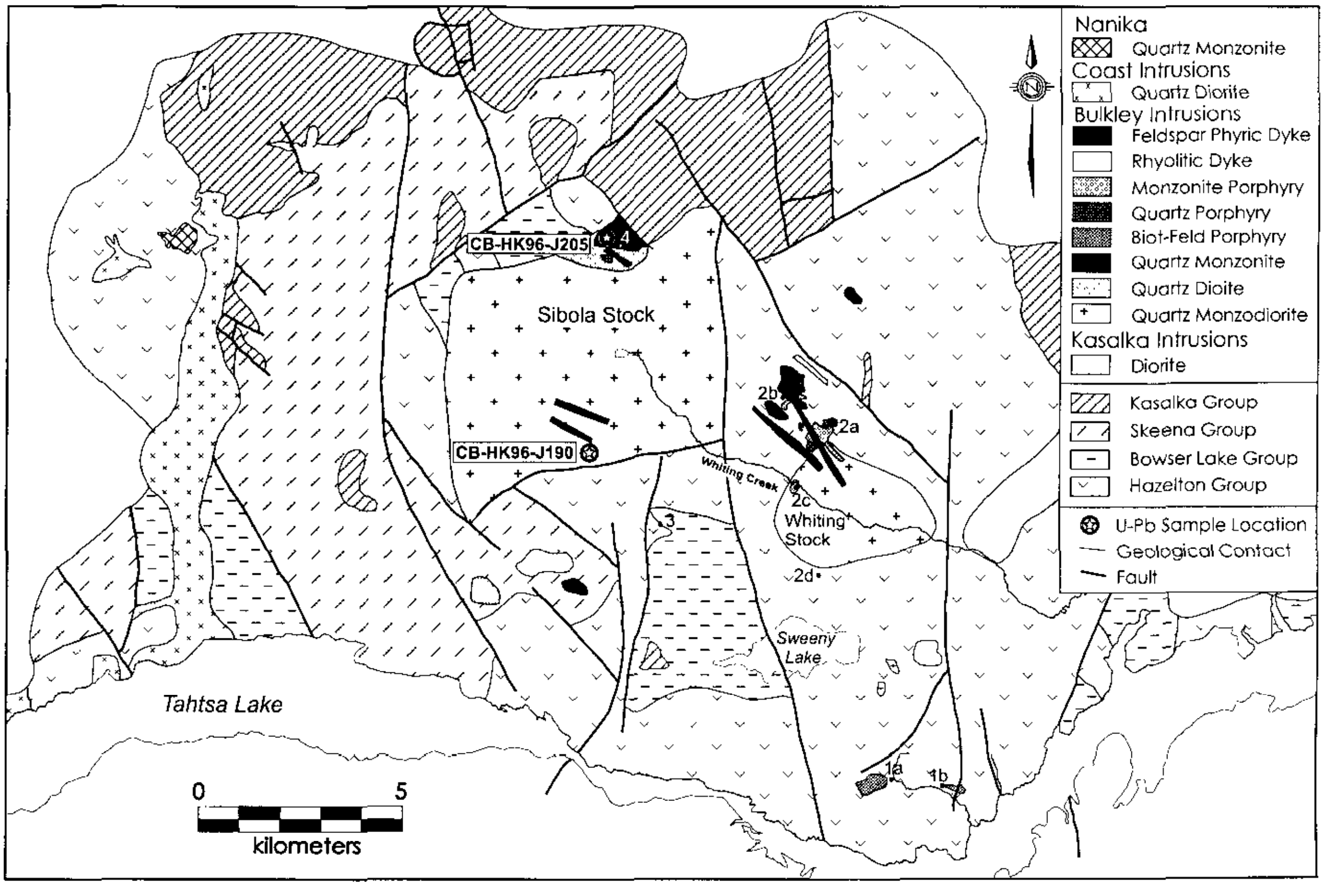

Figure 32-2. Map showing the general geology of the northern Tahtsa Lake District, the locations of the deposits studied, and the locations of U-Pb samples dated in this study. 1. Huckleberry (a) Main Zone (b) East Zone; 2. Whiting Creek (a) Ridge Zone (b) Rusty Zone (c) Creek Zone (d) Sweeny Zone; 3. Emerald Glacier; 4. Bergette.

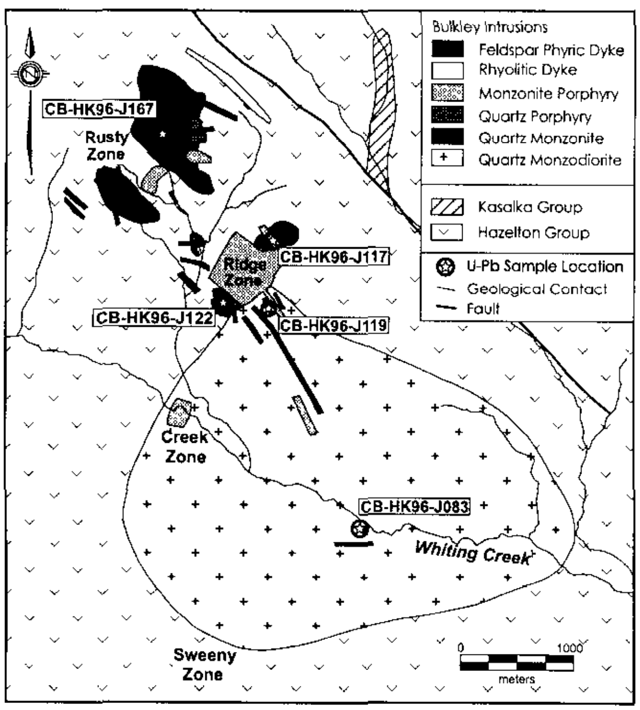

Figure 32-3. Map of the geology of the Whiting Creek area, showing the mineralized zones and the U-Pb sample locations.

phases assigned to the Bulkley Suite in the Bergette area (Figure 32-4). The intrusive phases as described by Church (1971) include a fine grained biotite-hornblende quartz diorite (border phase of Sibola Stock), a porphyritic biotite hornblende quartz monzonite, a quartz porphyry, a breccia body, and northwest-trending feldspar porphyry dykes.

MINERALIZATION

The Late Cretaceous Bulkley Suite intrusions are associated with numerous mineral occurrences in west-central British Columbia, including copper-molybdenum and molybdenum-tungsten porphyry deposits (McMillan et al., 1995). Several different styles of porphyry-style Cu and/or Mo mineralization are observed in the study area, as well as a quartz-base metal vein deposit.

Huckleberry

Mineralization occurs in two zones in the Huckleberry area: the Main Zone and the East Zone (Jackson and Illerbrun, 1995). The sulfide mineralization occurs as a system of stockwork fractures and veins hosted both within

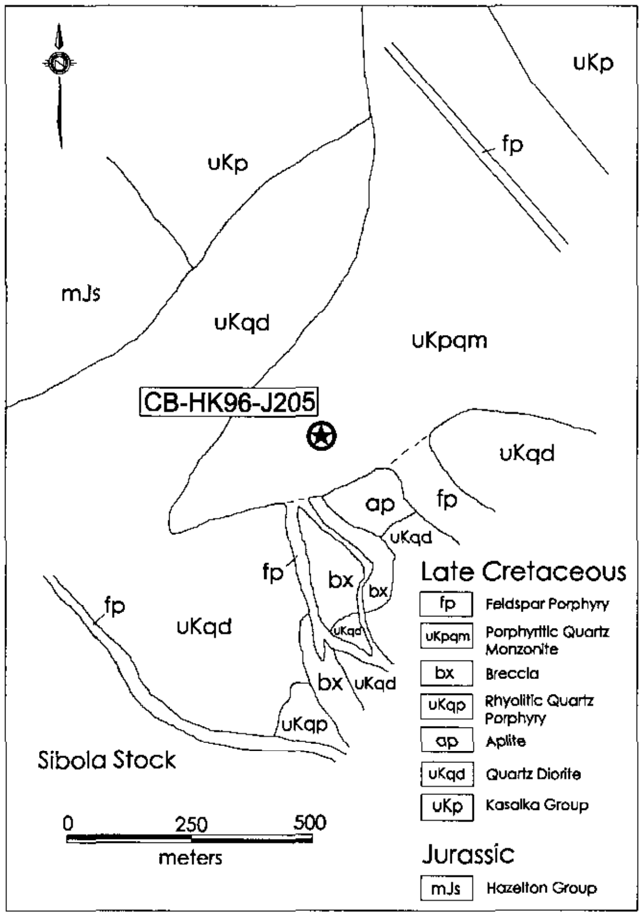

Figure 32-4. Geology of the Bergette area after Church (1971). U-Pb sample location is shown as a circled star.

hornfelsed volcanic rocks and the East Zone Stock. Copper mineralization occurs as chalcopyrite and rare bornite, and minor molybdenum mineralization is present as molybdenite.

Whiting Creek

In the Whiting Creek area, mineralization is divided into four zones: The Ridge Zone, the Rusty Zone, the Creek Zone, and the Sweeny Zone (Figure 32-3). In the Ridge Zone, mineralization occurs as a quartz-molybdenum stockwork hosted by both the quartz porphyry and the surrounding hornfelsed volcanic rocks. Copper is relatively minor in this zone, except where it is associated with the monzonite porphyry which intrudes the quartz porphyry. The Rusty Zone is a poorly defined zone of Cu-Mo mineralization that appears to be spatially associated with an altered quartz monzonite porphyry stock, which lies immediately to the north of the mineralized zone. Copper grades appear to be somewhat higher here than in the Ridge Zone (Cann and Smit, 1995). Mineralization in the Creek Zone occurs peripheral to a small stock of monzonite porphyry that lies entirely within the Whiting Stock. Sweeny Zone mineralization occurs in hornfelsed volcanic rocks near a small granodiorite intrusion to the south of the Whiting Stock. The area is covered in overburden and the mineralized zone is very poorly defined. Minor disseminated Cu and Mo mineralization is present and appears to decrease rapidly away from the intrusion.

Emerald Glacier

The Emerald Glacier deposit is a northwest-trending, sheared quartz vein which cuts the Bowser Lake Group south of the Sibola Stock (Figure 32-2). Sulfides present in the vein include galena, sphalerite, chalcopyrite and pyrite. MacIntyre (1985) suggested that the Emerald Glacier deposit is genetically related to the Sibola Stock based mainly on the close spatial association.

Bergette

Two styles of mineralization were observed in the Bergette area by Church (1971). These styles were: (1) healed cracks containing gypsum, pyrite, and minor molybdenite with quartz and fluorite hosted in the quartz porphyry; and (2) thin fracture fillings and disseminations of pyrite, chalcopyrite and minor molybdenite with quartz hosted within the west marginal section of Sibola Stock. Although the copper mineralization at the Bergette property appears to be associated with the porphyritic quartz monzonite and the margin of Sibola Stock, formally described mineralized zones have not been assigned (MacIntyre, 1985).

PREVIOUS GEOCHRONOLOGICAL STUDIES

Several previous geochronological studies have been completed on Bulkley Suite intrusions in the northern Tahtsa Lake District. Results of these studies are summarized in Table 32.1. Carter (1981) obtained a K-Ar biotite age of 82 +/- 6 Ma for the Main Zone Stock at Huckleberry. New U-Pb zircon dates of 83.5 +/-0.3 Ma for both the Main Zone and the East Zone stocks were reported by Friedman and Jordan (1997). Several intrusive phases at Whiting Creek have been dated by K-Ar methods, including the quartz monzonite (Whiting Stock), the monzonite porphyry, and a biotite-feldspar porphyry dyke. The K-Ar ages obtained for these intrusions are 81.3 +/- 5.4 Ma, 84.1 +/- 5.8 Ma, and 76.0 +/- 4.4 Ma, respectively (MacIntyre, 1985). No isotopic dating studies have previously been undertaken for the Sibola Stock. Church (1971) reported a K-Ar age of 76.7 +/- 5 Ma for the quartz monzonite porphyry at Bergette. Based on this previous work in the study area and other more regional studies (summarized in Christopher and Carter, 1976) the Bulkley Suite is considered to range in age from 70 to 84 Ma (Carter, 1981).

Table 32.1 Summary of previous geochronological studies completed on Bulkley Suite intrusions in the northern Tahtsa Lake District.

LOCATION	ROCK TYPE	METHOD	AGE	REFERENCE
HUCKLEBERRY	Granodiorite Porphyry	K-Ar (biotite)	82 +/-6 Ma	Carter, 1981
	East Zone Stock	U-Pb (zircon)	83.5 +/-0.3 Ma	Friedman and Jordan, 1997
	Main Zone Stock	U-Pb (zircon)	83.5 +0.3/-0.4 Ma	Friedman and Jordan, 1997
WHITING CREEK	Quartz Monzonite (Whiting Stock)	K-Ar (biotite)	81.3 +/-5.4 Ma	MacIntyre, 1985
	Monzonite Porphyry	K-Ar (biotite)	84.1 +/-5.8 Ma	MacIntyre, 1985
	Quartz-biotite-feldspar porphyry Dyke	K-Ar (biotite)	76.0 +/-4.4 Ma	MacIntyre, 1985
BERGETTE	Quartz Monzonite Porphyry	K-Ar (biotite)	76.7 +/-5.0 Ma	Church, 1971

U-Pb GEOCHRONOLOGY

Previous geochronological studies completed in the Northern Tahtsa Lake District have consisted mainly of K-Ar biotite ages (Table 32.1). These analyses are relatively imprecise, and biotite, which has a relatively low closure temperature, is susceptible to resetting during even minor thermal events. With the existing database it was therefore impossible to resolve individual intrusive events in the region. A uranium-lead geochronological study of the various intrusive phases in the project area was undertaken in order to better constrain the timing of magmatism and related mineralization.

Analytical techniques

Accessory minerals were separated from the samples using conventional crushing, grinding, Wilfley table, heavy liquid, and magnetic separation techniques. All sample preparation and analyses were completed in the Geochronology Laboratory at the University of British Columbia as described by Mortensen et al. (1995).

Analytical Results

Seven samples were collected for U-Pb dating from the northern Tahtsa Lake District. Five of these samples are representative of the various intrusive phases in the Whiting Creek area. The other two samples are from the Sibola Stock and the quartz monzonite porphyry at Bergette. Sample locations are shown on Figures 32-2, 32-3 and 32-4.

Whiting Stock (CB-HK96-J083)

Abundant high quality zircon was recovered from a sample of the Whiting Stock. The zircon grains form euhedral stubby to elongate prisms (l:w = 2-3), with rare clear inclusion and no visible zoning or cores. Three fractions were analyzed (fractions A-C, Table 32.2). Two fractions of clear, honey yellow euhedral titanite were also analyzed (fractions T1-T2, Table 32.2). All fractions of both zircon and titanite gave concordant analyses (Figure 32-5a), although fractions B and T1 appear to have experienced minor Pb loss. A crystallization age of 81.9 +/- 0.5 Ma, based on the total range of $^{206}Pb/^{238}U$ ages for the three oldest concordant fractions that did not suffer Pb loss, is assigned to the rock unit. The titanite age is identical to the zircon age, indicating that the Whiting Stock cooled rapidly through the closure temperature of the U-Pb system in titanite (~600°C; Heaman and Parrish, 1991).

Monzonite Porphyry (CB-HK96-J117)

Good quality, clear, euhedral zircon in the form of stubby to elongate prisms (l:w = 2-3), was recovered from a sample of the monzonite porphyry. Excess pyrite in the sample was removed prior to hand-picking the zircon fractions for dating by floating it off in dilute nitric acid. Three zircon fractions were analyzed (Table 32.2), all of which yielded overlapping concordant ages (Figure 32-5b). Fraction A gave an imprecise analysis, and the best estimate for the crystallization age of the unit, based on the total range of $^{206}Pb/^{238}U$ ages for the other two fractions, is 80.4 +/- 0.3 Ma.

Biotite Feldspar Porphyry Dyke (CB-HK96-J119)

Abundant good quality clear, euhedral zircon with few inclusions and no visible zoning or cores was recovered from a sample of the biotite feldspar porphyry dyke. Three zircon morphologies were observed: elongate prisms (l:w = 3), stubby prisms (l:w = 2), and equant grains. One fraction of each morphology was analyzed (Table 32.2). Fraction A and B yielded concordant ages with overlapping error ellipses (Figure 32-5c). Fraction C falls to the right of concordia and gives older Pb/U ages and is interpreted to have contained an inherited zircon component. The crystallization age for this sample, based on the total range of $^{206}Pb/^{238}U$ ages of concordant fractions A and B, is 79.6 +/- 0.5 Ma.

Table 32.2. U-Pb Analytical Data.

Fraction description[1]	Wt (mg)	U[2] (ppm)	Pb*[3] (ppm)	$^{206}Pb/^{204}Pb$[4]	Pb[5] (pg)	^{208}Pb[6] (%)	$^{206}Pb/^{238}U$[7] (+/- % 1σ)	$^{207}Pb/^{235}U$[7] (+/- % 1σ)	$^{207}Pb/^{206}Pb$[7] (+/- % 1σ)	$^{207}Pb/^{206}Pb$ Age[7] (Ma +/- % 2σ)
Whiting Stock (sample: CB-HK96-J083)										
A: N1,+180,s	0.15	454	6	3153	17	8.8	0.01278 (0.16)	0.0842 (0.23)	0.04777 (0.16)	87.9 +7.6/-7.7
B: N1,+180,s	0.097	469	6	2518	14	8.6	0.01260 (0.13)	0.0827 (0.22)	0.04762 (0.15)	80.5 +7.2/-7.2
C: N1,+180,e	0.069	469	6	2174	12	8.9	0.01274 (0.10)	0.0838 (0.24)	0.04768 (0.20)	83.5 +9.4/-9.5
T1: 0.6-1.8,eq,u	0.32	353	5	481	196	16.6	0.01262 (0.14)	0.0831 (0.51)	0.04771 (0.42)	85 +20/-20
T2: 0.6-1.8,eq,u	0.54	475	7	541	402	17	0.01283 (0.19)	0.0843 (0.45)	0.04767 (0.33)	83 +16/-16
Monzonite Porphyry (sample: CB-HK96-J117)										
A: N1,+134,e	0.094	239	3	103	214	12.5	0.01262 (0.65)	0.0828 (2.2)	0.04758 (1.9)	78 +86/-91
B: N1,+134,s	0.105	229	3	970	20	12.1	0.01254 (0.11)	0.0822 (0.28)	0.04758 (0.21)	79 +10/-10
C: N1,+134,s	0.118	251	3	2784	8	12.9	0.01257 (0.12)	0.0827 (0.22)	0.04772 (0.16)	85.5 +7.4/-7.4
Biotite Feldspar Porphyry Dyke (sample: CB-HK96-J119)										
A: N2, +180,e	0.48	629	8	6631	35	10	0.01244 (0.21)	0.0816 (0.23)	0.04761 (0.08)	79.8 +3.8/-3.8
B: N2,134-180,s	0.238	720	9	4576	29	9.4	0.01238 (0.13)	0.0812 (0.22)	0.04755 (0.14)	76.7 +6.6/-6.6
C: N2,134-180,eq	0.166	766	10	7323	14	10	0.01260 (0.11)	0.0831 (0.18)	0.04781 (0.09)	89.8 +4.3/-4.3
Quartz Porphyry (sample: CB-HK96-J122)										
A: N2,-104,e	0.06	894	11	3629	12	8.3	0.01288 (0.09)	0.0846 (0.19)	0.04766 (0.13)	82.4 +6.0/-6.0
B: N2,-104,e	0.057	851	11	4833	8	8.2	0.01296 (0.13)	0.0852 (0.20)	0.04767 (0.10)	83.1 +4.9/-4.9
C: N2,-104,e	0.048	1108	14	2529	17	7.7	0.01284 (0.09)	0.0844 (0.21)	0.04767 (0.15)	83.0 +7.2/-7.2
Quartz Monzonite Porphyry (sample: CB-HK96-J167)										
A: N)1,+134,e	0.108	541	7	5541	9	8.8	0.01320 (0.10)	0.0873 (0.17)	0.04796 (0.10)	97.5 +4.7/-4.8
B: N1,+134,s	0.132	552	7	5026	12	8.5	0.01294 (0.08)	0.0851 (0.17)	0.04766 (0.11)	82.4 +5.0/-5.0
C: N1,-134,e	0.152	550	7	9467	7	8.8	0.01285 (0.09)	0.0849 (0.16)	0.04793 (0.09)	95.6 +4.1/-4.1
Sibola Stock (sample: CB-HK96-J190)										
A: N1,+134,eq	0.11	165	2	1543	9	11.6	0.01230 (0.27)	0.0808 (0.53)	0.04766 (0.39)	83 +18/-19
B: N1,+134,s	0.17	177	2	2121	11	11.7	0.01233 (0.08)	0.0809 (0.21)	0.04759 (0.15)	79.0 +7.1/-7.1
C: N1,+134,e	0.098	191	2	1677	9	13.4	0.01230 (0.09)	0.0807 (0.23)	0.04757 (0.17)	77.8 +8.0/-8.0
D: N1,+134,t,u	0.101	220	3	1472	12	12.1	0.01221 (0.09)	0.0801 (0.24)	0.04759 (0.18)	78.8 +8.4/-8.5
Bergette Quartz Monzonite Porphyry (sample: CB-HK96-J205)										
A: N1,+134,e	0.2	577	7	3159	28	11.2	0.01212 (0.11)	0.0796 (0.22)	0.04765 (0.16)	82.0 +7.4/-7.4
B: N1,+134,e	0.155	505	6	4203	14	11.6	0.01169 (0.25)	0.0775 (0.29)	0.04807 (0.16)	102.6 +7.7/-7.7
C: N1, +134,s	0.18	509	6	3246	22	11.1	0.01218 (0.10)	0.0799 (0.19)	0.04757 (0.11)	78.1 +5.4/-5.4
D: N1,-134,e	0.127	372	5	2202	16	11.6	0.01209 (0.12)	0.0793 (0.26)	0.04759 (0.19)	78.8 +9.2/-9.2

[1]Upper case letter = fraction identifier; All zircons are air abraded, except were indicated (u=unabraded); N1, N2 = non-magnetic at given degrees side slope on the Frantz isodynamic separator; 0.6-1.8 = magnetic at 0.6 amps field strength and non-magnetic at 1.8 amps field strength (20° side slope) on the Frantz; Front slope for all fractions = 20°; Grain size (intermediate dimension) is given in microns; Grain character codes: e=elongate; s=stubby; eq=equant; t=tabular.

[2] U blank correction of 1pg +/- 20%; U fractionation corrections were measured for each run with a double ^{233}U-^{235}U spike (approximately 0.005/amu).

[3] Radiogenic Pb.

[4] Measured ratio corrected for spike, Pb fractionation of 0.0035 to 0.0043/amu +/- 20% (Daly collector; based on repeated analysis of Pb standard NBS 981), and laboratory blank Pb of 10pg +/- 20%. Laboratory blank Pb concentrations and isotopic compositions based on total procedural blanks analyzed throughout the duration of this study.

[5] Total common Pb in analysis based on blank isotopic composition.

[6] Radiogenic Pb.

[7] Corrected for blank Pb, U and common Pb. Common Pb corrections based on Stacey Kramers model (Stacey and Kramers, 1975) at the age of the rock or the $^{207}Pb/^{206}Pb$ age of the fraction.

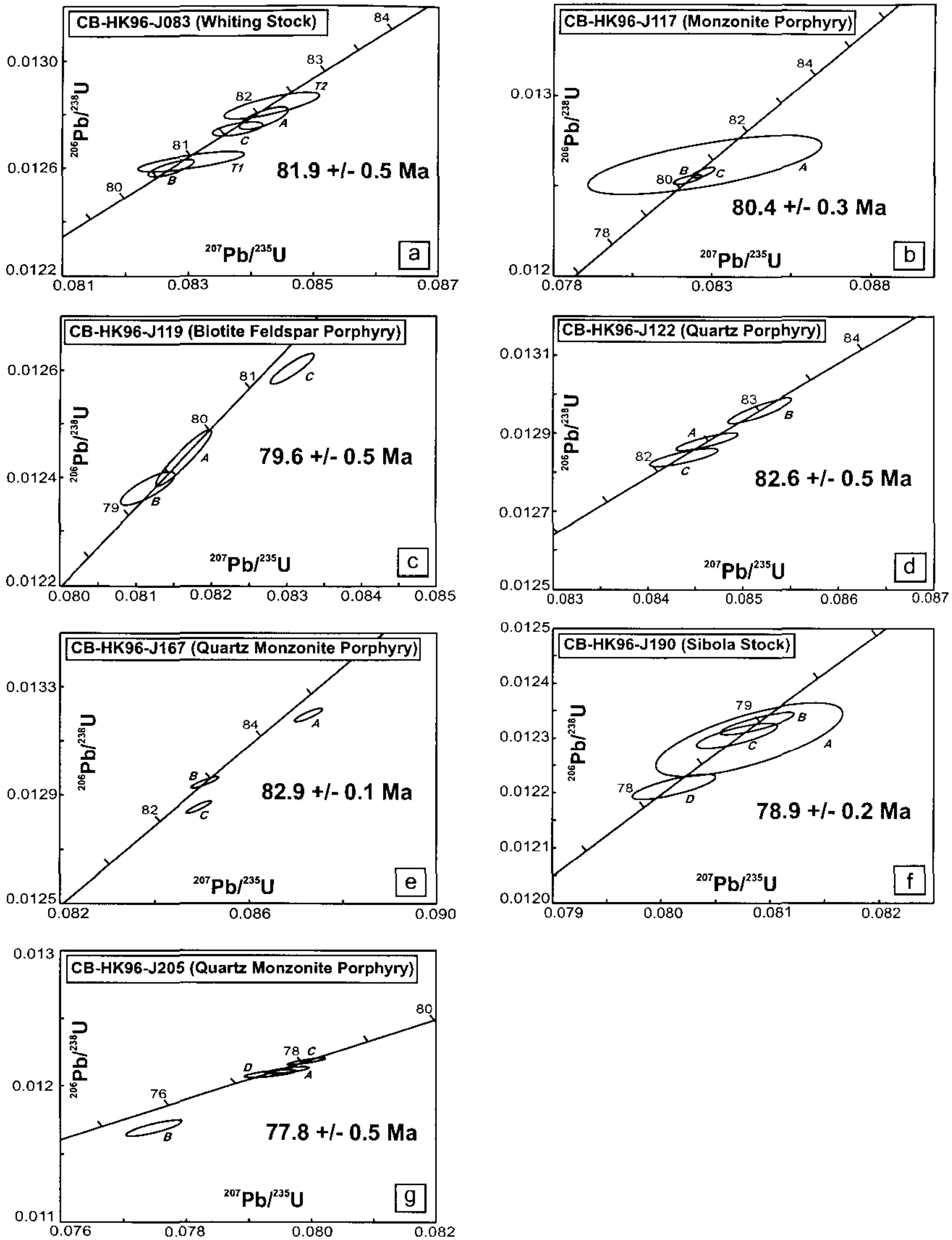

Figure 32-5. U-Pb concordia plots for samples from the Whiting Creek area (Figure 32-5a-e), Sibola Stock (Figure 32-5f) and the Bergette area (Figure 32-5g).

Quartz Porphyry (CB-HK96-J122)

Clear, elongate (l:w = 3-4) euhedral zircon with no visible inclusions, zonation or cores was recovered from a sample of the quartz porphyry. Excess pyrite was removed using dilute nitric acid. Three fractions were analyzed (Table 32.2), all of which gave concordant ages (Figure 32-5d). The age based on the total range of $^{206}Pb/^{238}U$ ages for these three fractions is 82.6 +/- 0.5 Ma.

Quartz Monzonite Porphyry (CB-HK96-J167)

Abundant clear, euhedral zircon was recovered after excess pyrite was removed by nitric acid floatation. Zircon was elongate (l:w = 2-3) with no visible zonation, cores or inclusions. Three fractions were analyzed (Table 32.2). The data shows considerable scatter (Figure 32-5e), and the following interpretation is preliminary. Fraction A is interpreted as having contained an inherited zircon component, whereas fraction C appears to have suffered Pb loss as well as having contained an inherited component. A preliminary age of 82.9 +/- 0.1 Ma is assigned to this unit, based on concordant fraction B.

Sibola Stock (CB-HK96-J190)

Abundant excellent quality, euhedral zircon was recovered from a sample of the Sibola Stock. Four zircon morphologies were observed, including elongate (l:w = 4), stubby (l:w = 2), equant and tabular grains. No zoning, cores or inclusions were visible. One fraction from each morphology was analyzed (Table 32.2). All of the analyses plot on concordia (Figure 32-5f). The analysis for fraction A is relatively imprecise and unabraded fraction D displays minor Pb loss. An age of 78.9 +/- 0.2 Ma, based on the range of $^{206}Pb/^{238}U$ ages for overlapping concordant fractions B and C, is therefore assigned to the unit.

Quartz Monzonite Porphyry (CB-HK96-J205)

Abundant good quality euhedral zircon was recovered from a sample of the quartz monzonite porphyry from Bergette. Zircons were elongate to stubby (l:w = 2-3) and showed no visible zoning, cores or inclusions. Four fractions were analyzed (Table 32.2), three of which yielded overlapping concordant ages (Figure 32-5g). Fraction B is interpreted as having undergone Pb loss. An age of 77.8 +/- 0.5 Ma is assigned to the rock unit, based on the range of $^{206}Pb/^{238}U$ ages for the three concordant fractions.

DISCUSSION

The new high precision data generated in this study, together with the U-Pb data reported by Friedman and Jordan (1997) clearly demonstrates that magmatism in the northern Tahtsa Lake District spanned at least 5 to 7 million years. The data also shows a younging trend in the age of magmatism from south to north within the project area. Porphyry-style mineralization with wide variations in Cu/Mo ratios has been recognized in the area. Friedman and Jordan (1997) argued that the age of mineralization at Huckleberry is approximated by the age of the associated intrusions (83.5 +/- 0.5 Ma), based on inferred rapid cooling through the biotite closure temperature (Carter, 1981). The mineralization in the Bergette area cannot be older than 77.8 +/- 0.5 Ma, which is the age of the host intrusion. The main phases of mineralization in the Whiting Creek area occurred at 82.6 +/-0.5 Ma in the Ridge Zone and 82.9 +/- 0.1 Ma in the Rusty Zone, based on the ages of the associated intrusions. Mineralization in the Whiting Creek area is therefore intermediate in age between that at Huckleberry and that at Bergette. Although mineralization at the Ridge and Rusty zones is very similar in age, the two zones have quite different proportions of Cu and Mo, possibly suggesting two separate mineralizing events. The intrusive contact relationship of the Whiting Stock into the quartz porphyry in the Ridge Zone inferred from drill hole data by Cann and Smit (1995) is confirmed by the new age data.

As previously noted, the calc-alkaline nature of the Bulkley Suite in the study area (MacIntyre, 1985) suggests generation in an arc rather than a back arc setting. Broadly coeval magmatism has been documented in the Coast Plutonic Complex up to 100 km to the west of the study area (Woodsworth et al., 1991). However, the isotopic age constraints for the igneous rocks to the west are relatively imprecise, and it is therefore possible that the intrusions in the study area represent a brief eastward excursion of the locus of arc magmatism. It is interesting to note that Engebretson et al. (1985) have postulated an increase in orthogonal relative motion between the subducting oceanic plate to the west (Kula Plate or Farallon Plate) and the North American Plate from 100 to 75 Ma, based on fixed hotspot reference frame studies. This could provide a possible mechanism for the suggested eastward shift of the locus of arc magmatism. Further geochronological and geochemical studies of both the Bulkley Suite intrusions and the Coast Plutonic Complex to the west of the study area are necessary in order to fully evaluate this hypothesis.

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