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Uranium-lead geochronology of two intrusions in the southern Bowser Basin, British Columbia

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Abstract: We report new U-Pb data for two intrusions that cut Bowser Lake Group strata in the southern Bowser Basin. A granitic rock from the Mount Priestley stock gave a U-Pb zircon crystallization age of 51.8 ± 0.3 Ma. Zircons from a porphyritic andesite dyke on the ridge north of Stenstrom Creek gave a crystallization age of 83.2 ± 0.2 Ma. These ages are similar to others from the southern Bowser Basin and suggest two episodes of magmatism in the basin, one in the latest Cretaceous and one in the Early Eocene.

Résumé : Nous présentons de nouvelles données U-Pb pour deux intrusions qui recoupent des strates du Groupe de Bowser Lake dans la partie méridionale du bassin de Bowser. Une roche granitique du stock de Mount Priestley a fourni un âge U-Pb de cristallisation des zircons de 51,8 ± 0,3 Ma. Des zircons provenant d'un dyke d'andésite porphyrique sur la crête au nord du ruisseau Stenstrom ont donné un âge de cristallisation de 83,2 ± 0,2 Ma. Ces âges sont similaires à d'autres obtenus pour la partie méridionale du bassin de Bowser et suggèrent que le bassin a subi deux épisodes de magmatisme, l'un au Crétacé terminal et l'autre à l'Éocène précoce.

INTRODUCTION

The bedrock geology of the Kiteen River map area (103 P/07), in the east-central part of the Nass River map area of the Canadian Cordillera (Fig. 1), is dominated by Jurassic–Early Cretaceous sedimentary rocks assigned to the Bowser Lake Group (Haggart et al., 1998; Haggart, 1999). Bowser Lake Group strata are widespread north (Evenchick, 1996a, b; Evenchick and Mustard, 1996), west (van der Heyden et al., 2000), and south (Gareau et al., 1997a, b) of the Kiteen River map area. Bowser Lake Group strata are strongly deformed throughout this region (Haggart et al., 1998), related to structural development of the Skeena fold-and-thrust belt (Evenchick, 1991). To the east of the Kiteen River map area, younger Cretaceous strata of the Skeena Group outcrop extensively (Richards, 1991; Bassett and Kleinspehn, 1997), apparently conformably overlying the Bowser Lake Group, but locally in structural contact with that package as well (JWH, unpubl. data, 1997, 1999).

Igneous rocks are relatively rare in the region. Perhaps the most famous of these is Canada's youngest volcanic lava flow, the Aiyansh flow (Sutherland Brown, 1969), just southwest of the Kiteen River map area. In addition, a number of small outliers of (?) Pleistocene flow deposits are recognized in the region (Haggart et al., 1998); collectively, these young volcanic deposits have been assigned to the northern Cordilleran volcanic province (Edwards and Russell, 1999, 2000). Several small granitic stocks intrude the Mesozoic strata and have generally been thought to be Tertiary in age (e.g. Carter, 1981). Finally, igneous dykes are found locally throughout the map area, although rarely in large number. These have traditionally been considered as being related to the Eocene and Pleistocene magmatic events (Haggart et al., 1998).

We report herein new U-Pb dates for the Mount Priestly stock and for one of the dykes. Sample locations are shown in Figure 1 and a detailed summary of sample location data are given in Table 1.

ANALYTICAL METHODS

Uranium-lead TIMS analytical methods utilized in this study are outlined in Parrish et al. (1987) and Davis et al. (1997). Heavy mineral concentrates were prepared using standard crushing, grinding, Wilfley^{TM} table, and heavy liquid techniques. Mineral separates were sorted by magnetic susceptibility using a Frantz^{TM} isodynamic separator. Multigrain zircon fractions analyzed were very strongly air abraded following the method of Krogh (1982). Multigrain fractions of titanite were also lightly air abraded. Treatment of analytical errors follows Roddick et al. (1987) with errors on the ages reported at the 2σ level. A concordia age (Ludwig, 1998) is calculated for one of the samples presented herein. A concordia age incorporates errors on the decay constants and includes both an evaluation of concordance and equivalence of the data. The calculated concordia age and errors quoted in the text are at 2σ with decay constant errors included.

SAMPLE DESCRIPTIONS AND RESULTS

Mount Priestly stock (sample 97-WV-61)

Igneous rocks are relatively rare in the region. The Mount Priestly stock (Carter, 1981) is a roughly circular body about 5 km in diameter, found in the glaciated region between Mount Hoadley to the north and Mount Priestly to the south (Fig. 1). Several smaller bodies are found in high country to the south, north of Cedar River. The Mount Priestly stock intrudes sedimentary strata of the Bowser Lake Group. Extensive stockworks of dykes and pyritized sedimentary strata characterize the intrusion margin locally. The most common rock types present in the stock are unfoliated granodiorite, tonalite, and quartz diorite (Carter, 1981; Haggart et al., 1998).

The sample from the Mount Priestly stock for U-Pb geochronology (Fig. 1, Table 1) was collected from a col at elevation 2040 m, well away from the contact with the surrounding country rock. The sample rock is fresh and free from visible inclusions, dykes, or other contamination. The sample contains abundant, good quality, euhedral zircon ranging in morphology from elongate needles through equant grains (Table 2). Five multigrain zircon fractions were analyzed from the sample (Fig. 2a). Fractions ZC, ZB1, and ZB2 are discordant and are interpreted to contain an inherited Pb component. Fraction ZA1 is concordant and has a $^{206}Pb/^{238}U$ age of 51.8 ± 0.1 Ma. The analysis from fraction ZA2 slightly overlaps ZA1 and may have undergone a minor amount of Pb loss. Two fractions of light brown, anhedral titanite fragments were also analyzed from this rock, and a weighted average of the $^{206}Pb/^{238}U$ ages is 52.3 ± 0.5 Ma. This age overlaps that of the concordant zircon fraction ZA1 and the titanite is interpreted to be magmatic in origin. A weighted average of the $^{206}Pb/^{238}U$ ages of fractions ZA1, T1, and T3 is 51.8 ± 0.3 Ma (MSWD = 1.1), which we take to be the best interpretation for the crystallization age of the Mount Priestly stock.

Stenstrom Creek dyke (sample HFB-97-79G)

This dyke is exposed at the summit of the ridge north of Stenstrom Creek, in the extreme southeast part of the Kiteen River map area (Fig. 1, Table 1), and approximately 26 km east of the dated Mount Priestly stock. The dyke is about 50 cm wide, vertical, and oriented N80°W. It is undeformed and cuts folded and foliated Upper Jurassic (to (?) Lower

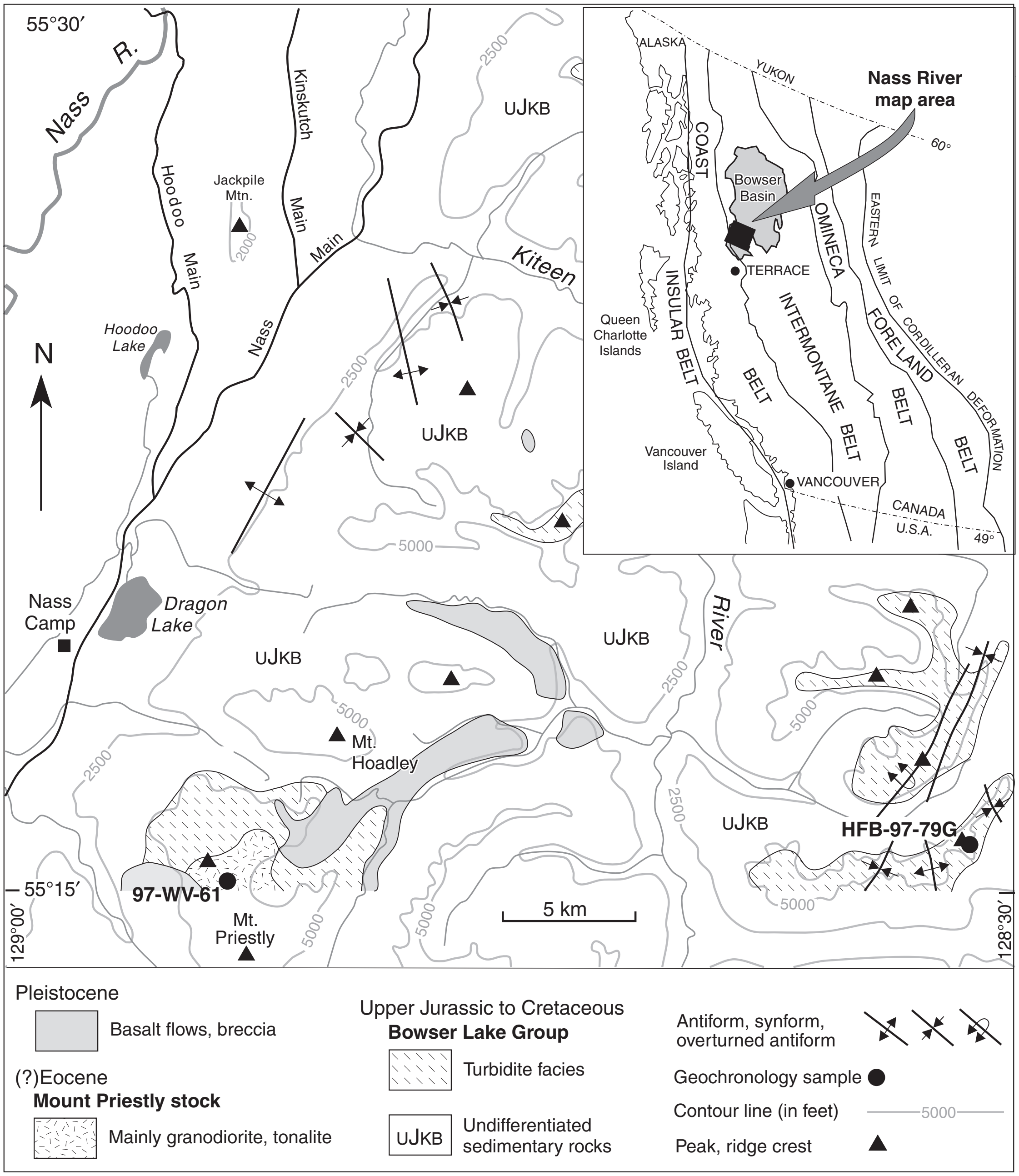

Figure 1. Location map of the Nass River 1:250 000 map area, British Columbia (inset), and generalized geology of the southeastern part of the Kiteen River map area (103 P/07) (*modified from* Haggart, 1999).

Table 1. Sample location data

Field no.	Sample no.	NTS	UTM zone	UTM Easting (NAD83)	UTM Northing (NAD83)
97-WV-61 (Mount Priestly stock)	Z5648	103P/07	9U	506500	6122800
HFB-97-79G (Stenstrom Creek dyke)	Z5205	103P/07	9U	530009	6124175

Table 2. U-Pb TIMS analytical data

Fract.[1]	Description[2]	Wt. µg	U ppm	Pb[3] ppm	$^{206}Pb/^{204}Pb$[4]	Pb[5] pg	Isotopic ratios[6] $^{208}Pb/^{206}Pb$	$^{207}Pb/^{235}U$	±1SE Abs	$^{206}Pb/^{238}U$	±1SE Abs	Corr.[7] coeff.	$^{207}Pb/^{206}Pb$	±1SE Abs	Ages (Ma)[8] $^{206}Pb/^{238}U$	±2SE	$^{207}Pb/^{235}U$	±2SE	$^{207}Pb/^{206}Pb$	±2SE
97-WV-61 (Z5648): Mount Priestly stock																				
ZA1 (Z)	Co,Clr,Eu,El,fIn	82	236	2	1887	5	0.13	0.05236	0.00010	0.00806	0.00001	0.622	0.04711	0.00007	51.8	0.1	51.8	0.2	54.8	7.0
ZA2 (Z)	Co,Clr,Eu,El,fIn	46	241	2	1343	4	0.12	0.05231	0.00014	0.00803	0.00001	0.611	0.04723	0.00010	51.6	0.1	51.8	0.3	60.8	9.9
ZB1 (Z)	Co,Clr,Eu,St,rIn	107	246	2	1640	8	0.1	0.05419	0.00011	0.00830	0.00001	0.704	0.04735	0.00007	53.3	0.1	53.6	0.2	66.8	6.7
ZB2 (Z)	Co,Clr,Eu,Pr,rIn	102	269	2	2454	6	0.11	0.05425	0.00009	0.00827	0.00001	0.664	0.04757	0.00006	53.1	0.1	53.6	0.2	77.8	6.2
ZC (Z)	Co,Clr,Eu,Eq,rIn	60	244	2	1122	7	0.13	0.05992	0.00019	0.00905	0.00001	0.559	0.04801	0.00012	58.1	0.2	59.1	0.4	99.9	12.1
T1 (T)	pBr,Clr,An,Frag	124	150	1	110	102	0.19	0.05320	0.00127	0.00813	0.00004	0.617	0.04746	0.00100	52.2	0.6	52.6	2.4	72.5	97.1
T3 (T)	pBr,Clr,An,Frag	193	157	2	68	310	0.48	0.05355	0.00239	0.00819	0.00008	0.642	0.04745	0.00184	52.5	1.1	53.0	4.6	72.1	175.2
HFB-97-79G (Z5205): Stenstrom Creek dyke																				
A1 (Z)	Co,Clr,Eu,Pr,fIn	86	528	7	7010	1	0.11	0.08541	0.00009	0.01297	0.00001	0.8784	0.04775	0.00003	83.1	0.1	83.2	0.2	87.0	2.6
A2 (Z)	Co,Clr,Eu,Pr,fIn	57	797	10	1927	19	0.12	0.08563	0.00011	0.01298	0.00001	0.8176	0.04785	0.00004	83.1	0.1	83.4	0.2	91.7	3.8
B2 (Z)	Co,Clr,Eu,El,fIn	14	614	8	1336	5	0.14	0.08552	0.00018	0.01299	0.00002	0.5714	0.04776	0.00008	83.2	0.2	83.3	0.3	87.3	8.0

Notes:
[1]Z=zircon; T=titanite
[2]Description: Co=colourless, pBr=pale brown, Clr=clear, fIn=few inclusions, rIn=rare inclusions, El=elongate, Eq=equant, Eu=euhedral, Frag=fragment, Pr=prismatic, St=stubby prism, An=anhedral
[3]Radiogenic Pb
[4]Measured ratio, corrected for spike and fractionation
[5]Total common Pb in analysis corrected for fractionation and spike
[6]Corrected for blank Pb and U and common Pb, errors quoted are 1 sigma absolute; procedural blank values for this study ranged from 0.1 to 0.3 pg for U and from 2 to 5 pg for Pb; Pb blank isotopic composition is based on the analysis of procedural blanks; corrections for common Pb were made using Stacey-Kramers compositions
[7]Correlation coefficient
[8]Corrected for blank and common Pb, errors quoted are 2 sigma in Ma

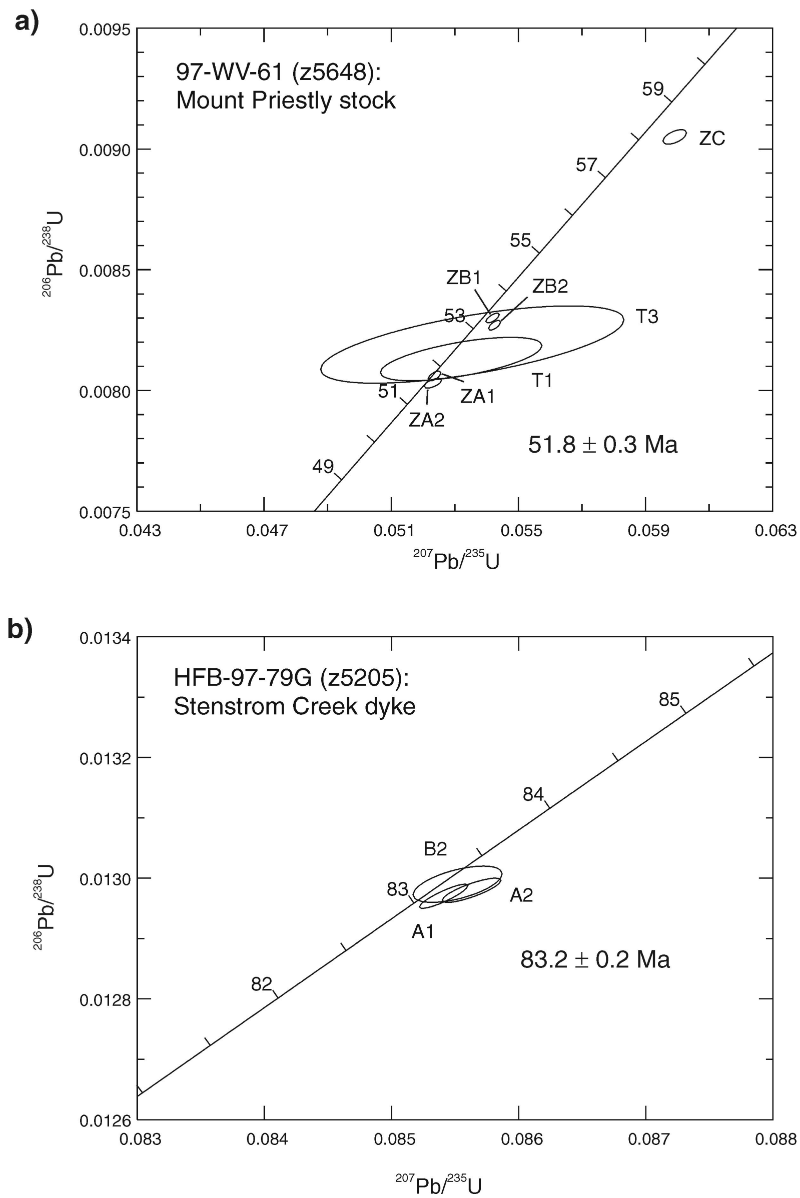

Figure 2. U-Pb concordia diagrams. a) Sample 97-WV-61. b) Sample HFB-97-79G.

Cretaceous) strata of the Bowser Lake Group (Haggart, 1999). It is one of a number of rhyolitic to basaltic dykes that cut Bowser Lake Group rocks throughout the Kiteen River map area, although dykes are most abundant adjacent to the Mount Priestly stock.

The dyke sample collected for U-Pb geochronology is a feldspar-phyric andesite, with individual feldspar grains up to several millimetres in length. The sample contains abundant euhedral, prismatic zircon grains. Three multigrains zircon fractions were analyzed; the results overlap each other and are concordant to slightly discordant (Table 2, Fig. 2b). A concordia age is calculated using all three analyses to be 83.2 ± 0.2 Ma (MSWD of concordance and equivalence = 2.0), which is interpreted to be the crystallization age of the dyke.

DISCUSSION

Potassium-argon dating of biotite from the Mount Priestley stock gave an average age of 48.4 ± 1.5 Ma (Carter, 1981). This is only slightly younger than the 51.8 ± 0.3 Ma U-Pb (zircon) age reported here and indicates rapid cooling of the stock after emplacement in the Early Eocene.

High-level stocks similar in appearance to the Mount Priestley body and intruding Bowser Lake Group strata form a chain extending about 75 km southward from Mount Priestley. The only other age from this chain is a preliminary U-Pb age of 86 Ma from a stock in the Terrace map area (R. Friedman, pers. comm. to GJW, 1997), indicating that multiple ages are present in the chain. Immediately south of this belt, the large Carpenter Lake pluton and its satellites have been dated (U-Pb, zircon) at 52.6 Ma (Gareau et al., 1997a).

The Mount Priestley age is similar to a 55.4 Ma U-Pb (zircon) age from the Motase pluton, which intrudes Bowser Lake Group rocks near the eastern edge of the Bowser Basin (Evenchick and McNicoll, 1993), and to several K-Ar ages on small stocks that cut the Bowser Lake Group near the town of Hazelton (Richards, 1991).

The age of 83.2 ± 0.2 Ma for the Stenstrom Creek dyke is similar that from a stock south of Mount Priestley (discussed above) and to a U-Pb (zircon) age of 84.1 ± 0.5 Ma for the Poison pluton that intrudes Bowser Lake Group rocks near their eastern margin (Evenchick and McNicoll, 1993). Scattered K-Ar (biotite and hornblende) ages from Bulkley intrusions within the Bowser Lake Group north and north-east of Hazelton range from 61 to 82 Ma (Carter, 1981; Richards, 1991).

Collectively, these ages, although sparse, suggest an episode of magmatism in the southern Bowser Basin beginning in the late Late Cretaceous (Campanian) and extending into the earliest Paleogene, and another pulse of magmatism in the Early Eocene.

Both dated intrusions postdate local contractional structures. The age from the Stenstrom Creek dyke shows that at least some of the deformation of the Bowser Lake Group is older than 83.2 ± 0.2 Ma.

In the eastern Coast Plutonic Complex to the west and south, the Central Gneiss Complex was the locus of fairly continuous, deep-seated plutonism from about 87 Ma to about 65 Ma (Andronicos et al., 2003; Rusmore et al., 2005). This interval coincides well with the 84 to 61 Ma episode of magmatism within the southern Bowser Basin postulated above. From about 54 Ma to about 48 Ma, the Central Gneiss Complex cooled very rapidly following exhumation along a detachment along its east side; this time coincides well with the approximately 55 Ma to 48 Ma range of ages from Eocene plutons intruding the southern Bowser Basin. We suggest that Late Cretaceous and Paleogene magmatism within the southern Bowser Basin may be a high-level response to more deep-seated processes occurring in the Coast Plutonic Complex to the west.

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