U-Pb Zircon and Titanite Dating in Support of British Columbia Geological Survey Regional Mapping Studies

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KEYWORDS: Geochronology, U-Pb, zircon, titanite.

INTRODUCTION

In this paper we report U-Pb zircon and titanite data and interpreted ages for sixteen rocks (Figure 1) sampled in support of regional mapping projects conducted by the British Columbia Geological Survey Branch during the mid- to late-1990s. Each sample is reported with geological context, interpretation of U-Pb data and significance of the date. The U-Pb results are also displayed on standard concordia plots (Figures 2, 3, 7 and 8) and compiled in a single table (Table 1). All aspects of sample preparation, clean laboratory work, and data acquisition, reduction and interpretation were carried out at the Geochronology Laboratory of the University of British Columbia following procedures outlined in Mortensen *et al*. (1995) and Friedman *et al*. (2001).

SAMPLE H97BC-43C: SNOWSHOE GROUP, RAMOS SUCCESSION

Geology

Sample H97BC-43c is a tuffaceous metasedimentary rock from the Ramos succession of the Snowshoe Group. The latter consists of fine to coarse siliciclastic, volcanic and carbonate rocks. The depositional age of the Ramos succession and the entire Snowshoe Group are poorly known. Although some workers have suggested lower to upper? Paleozoic ages for the Snowshoe Group, it was inferred by Struik (1988) to be Late Proterozoic in age. These rocks are part of the Barkerville Terrane, which is the northern continuation of the peri-cratonic Kootenay Terrane.

The sample locality lies near the east-verging Eureka thrust fault, which marks the western limit of the Snowshoe Group and juxtaposes this sequence against the late Paleozoic Crooked amphibolite and Mesozoic arc volcanic rocks of the Nicola Group. The rock was selected for U-Pb dating to determine the primary igneous age of its tuffaceous component, which would constrain the depositional age of the succession. The depositional age of this sample, together with that of a similar rock collected for dating from the Downie formation (H97BC-8, see below; also within the Snowshoe Group), would also test a hypothesis proposing that parts or all of the exposed Snowshoe stratigraphic sequence are overturned (Höy and Ferri, 1998).

Geochronology

This foliatied tuffaceous metasedimentary rock yielded abundant rounded and frosted or pitted zircons in a wide range of colours, interpreted to be detrital in origin. A small proportion of the recovered zircons were euhedral and thought to possibly comprise a primary igneous population from the tuffaceous component of the rock. Six single grain analyses of the most euhedral crystals gave nearly concordant to strongly discordant results (1-20% discordant), with Proterozoic and Archaen $^{207}Pb/^{206}Pb$ dates (Figure 2A; Table 1). These results are taken as strong evidence that the analysed euhedral zircons are also detrital in origin and do not reflect the depositional age of the tuffaceous component of this rock.

Significance

Dating of this sample did not yield an igneous age for the tuffaceous component of the rock and therefore does not provide information that can be used to confirm or refute the hypothesis proposing that much of the Snowshoe Group is overturned. The six analysed detrital zircons give $^{207}Pb/^{206}Pb$ dates that range from Paleoproterozoic to Neoarchean, consistent with derivation from North American cratonic sources.

SAMPLE H97BC-8: DOWNEY SUCCESSION, SNOWSHOE GROUP (NTS 93A/14)

Geology

Sample H97BC-8 is a tuffaceous metasedimentary rock from the Downey succession of the Snowshoe Group, which consists of fine to coarse siliciclastic, volcanic carbonate rocks. The Snowshoe Group comprises part of the Barkerville Terrane, a northern continuation of the pericratonic Kootenay Terrane. The Downey succession is composed of sandstone, phyllite, mafic metavolcanic rocks and limestone. This succession also hosts massive sulphide mineralization at the Ace property in the Little River area. Sample H97BC-8 comes from a highly strained zone and was interpreted as a metaclastic rock with a tuffaceous

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component. The proximity of the sample to the Ace property suggests that its depositional age is broadly coeval with local massive sulfide mineralization.

Geochronology

This tuffaceous metasedimentary rock yielded only a trace of fine grained (<104 micrometre) rounded, frosted and pitted zircons possessing a variety colours and clarities, which have been interpreted to be detrital in origin. Four single grain analyses of the largest, best quality crystals gave slightly to strongly discordant results (4-19% discordant) with Neoproterozoic to Archaen $^{207}Pb/^{206}Pb$ dates (Figure 2B, Table 1). The youngest grain (B, $^{207}Pb/^{206}Pb$ date of 641 Ma) provides a maximum age for the deposition of this unit in the vicinity of the sample locality.

Significance

This sample did not yield primary igneous zircons that could be used to date the age of the tuffaceous component of the rock; detrital zircon ages are consistent with a North American cratonic source.

FFE99-11-2 AND FFE99-12-1: BIG CREEK GROUP (NTS: 94C/12 & 94D/09, RESPECTIVELY)

Geology

The Big Creek Group, which comprises the upper part of Cassiar Terrane in north-central British Columbia, is made up of fine grained dark grey to black clastic rocks with lesser sandstone, conglomerate, limestone and felsic volcanic rocks. Regionally, these rocks lie stratigraphically above platformal carbonates of the Ordovician to Middle Devonian Echo Lake and Otter Lakes groups. The lower part of the Big Creek Group is part of the Earn Assemblage, which was deposited during Cordilleran-wide subsidence of the Ancestral North American margin. (Ferri and Melville, 1994; Ferri, 2000; Ferri *et al*., 1993a, b; 2001).

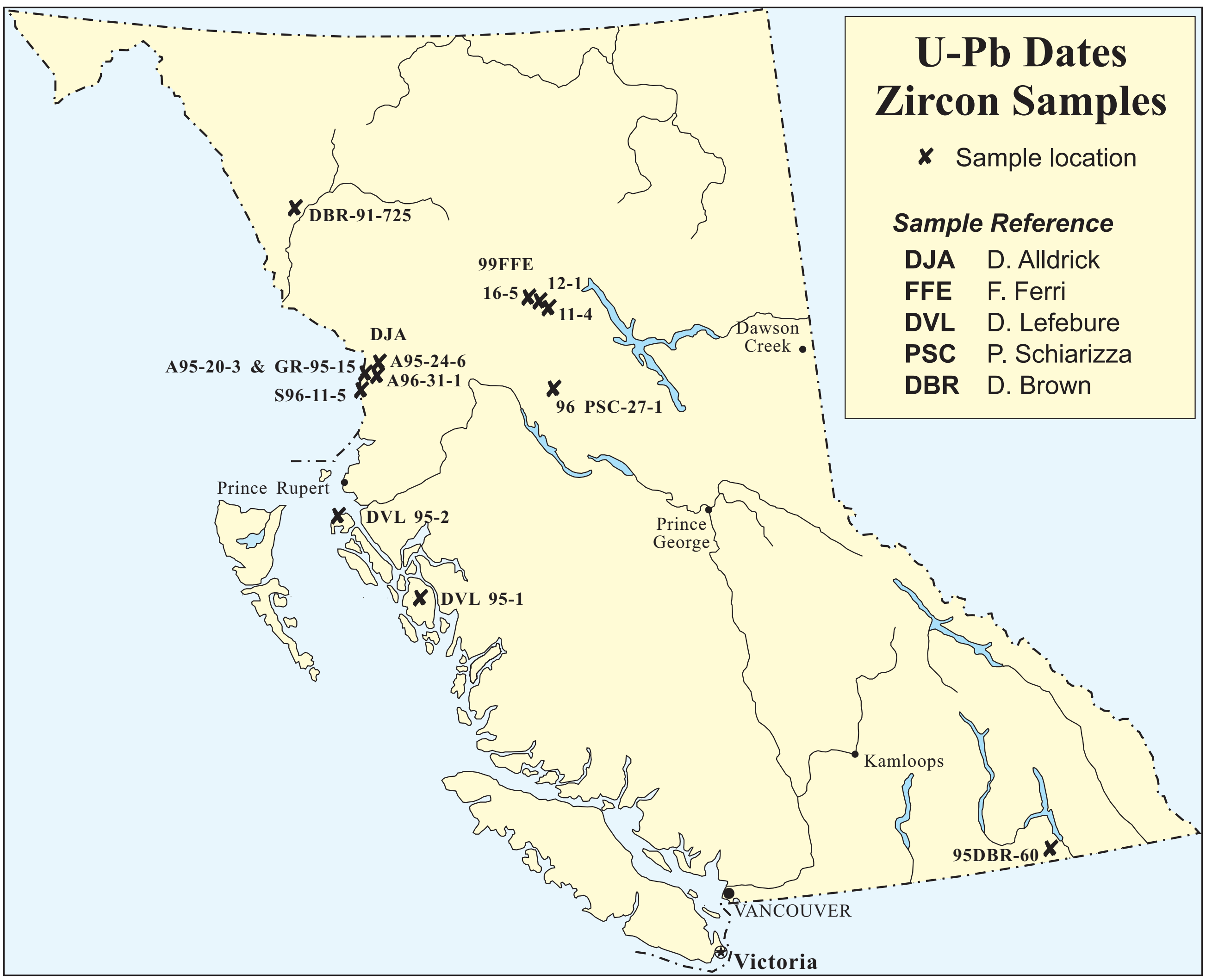

Figure 1. Map of British Columbia showing locations of dated samples.

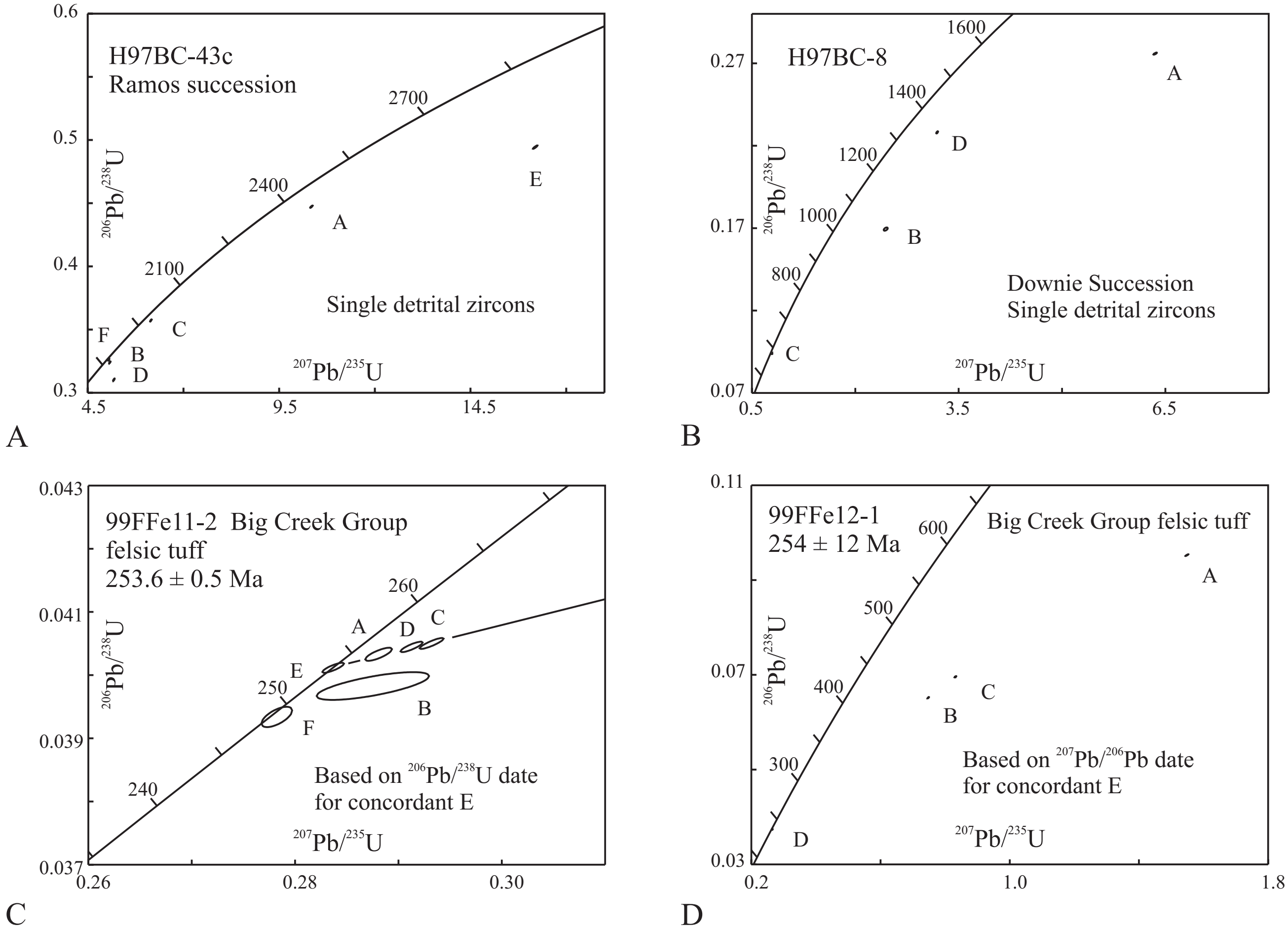

Figure 2. Standard concordia diagrams with error ellipses plotted at the 2-sigma level of uncertainty. *See* plots for sample numbers, names and dates, and text for details of interpretations.

Felsic tuffs within the upper part of the Big Creek Group were sampled for U-Pb dating at two localities near the headwaters of the Swannell River in the northern Lay Range (Fig. 1). Sample FFe99-11-2 consists of approximately 50 metres of light grey weathering, greenish grey, quartz-feldspar tuff to coarse lapilli tuff. The presence of dark grey argillaceous rip-ups indicates that it is conformable with underlying Big Creek Group sedimentary rocks. This tuff unit is sericitic and contains between 10 and 40 per cent plagioclase crystal fragments up to 5 millimetres in size. Quartz crystals are subordinate, comprising less than 10 per cent of the unit. Approximately 25 metres of dark grey argillite similar to that in the underlying Big Creek Group occurs stratigraphically above the felsic tuff. These are structurally succeeded by mafic volcanics of the Upper Mafic Tuff division of the Lay Range Assemblage, the latter having been emplaced into their present position along the east-verging Swannell Fault.

Sample FFe-99-12-1 comes from a 10 to 15 metre-thick unit of rusty to tan weathering, light to dark grey, quartz-feldspar sericitic tuff. Quartz and feldspar crystals are up to 5 millimetres in size and make up to 10 and 20 per cent of the unit, respectively. Dark grey argillaceous streaks are present within the tuffaceous horizon suggesting it is conformable with surrounding Big Creek rocks. Approximately 10 to 20 metres of black argillite lies stratigraphically above the northwest portion of the tuffaceous rocks. Finely laminated tuffs belonging to the Upper Mafic Tuff division of the Lay Range Assemblage sit structurally above this, in the hanging wall of the easterly-directed Swannell Fault. This felsic tuff unit can be traced southeastwards, where it is believed to be cut by the Swannell Fault; it is correlated with the tuff at locality FFe99-11-2 based on similar stratigraphic position, composition and age (*see* below).

Geochronology

Felsic tuff sample FFe99-11-2 yielded clear, pink, euhedral prismatic and rare slightly rounded grains. Six zircon fractions were analysed; the results of four of these plot as a co-linear array on the concordia plot in Figure 2C. A chord fit through these data yields an upper intercept of 2.5 ± 0.3 Ga (MSWD=0.56), which provides an estimate of the average age of inherited zircon in the analysed grains. An igneous age estimate of 253.6 ± 0.5 Ma is based on the $^{206}Pb/^{238}U$ date for concordant fraction E, which lies at the lower intercept of the chord. Fraction F is marginally concordant and is interpreted to have suffered minor Pb loss. Fraction B likely contains inherited zircon and underwent minor Pb loss.

A modest quantity of clear, pink, stubby to elongate, prismatic zircons were recovered from felsic tuff sample FFe99-12-1. Four fractions were analysed, three of which are strongly discordant (A, B and C). The $^{207}Pb/^{206}Pb$ date of 254±12 Ma for nearly concordant fraction D provides the best estimate for the igneous age of the rock. Upper intercept ages of about 1.9-2.7 Ga, based on regressions through the quasi-linear data array (chords ABCD, BCD and ABC; not plotted), suggest the presence of Late Archaen to Early Proterozoic old inherited zircon in three of the analysed fractions (Figure 2D, Table 1).

Significance

The Big Creek Group was previously considered to be Late Devonian to Early Permian in age on the basis of microfossils recovered from rocks that lie between Lay Range and the Omineca River. Dating of felsic tuff samples FFe99-11-2 and FFe99-12-1 extend the upper age range of the Big Creek Group to the Permo-Triassic boundary.

SAMPLE FFE99-16-5: LAY RANGE ASSEMBLAGE (NTS: 94D/09)

Geology

A felsic tuff from within the Upper Mafic Tuff division of the Lay Range Assemblage in the southern Wrede Range, approximately 1.5 kilometres north of Wrede Creek, was sampled for U-Pb dating (sample FFe99-16-5). The Lay Range Assemblage consists of two sequences: the Lower Sedimentary Division composed of peri-cratonic siliciclastics, carbonates and volcanic rocks of late Mississippian to middle Pennsylvanian age and overlying middle Pennsylvanian? to Permian arc-derived mafic volcanic rocks of the Upper Mafic Tuff division (Ferri, 2000a, b; Ferri *et al*., 1992a, b; 1993a, b; 2001a, b; Ferri, 1997). These rocks are basement to Mesozoic arc volcanic and sedimentary rocks of the Quesnel Terrane (Harper Ranch Subterrane).

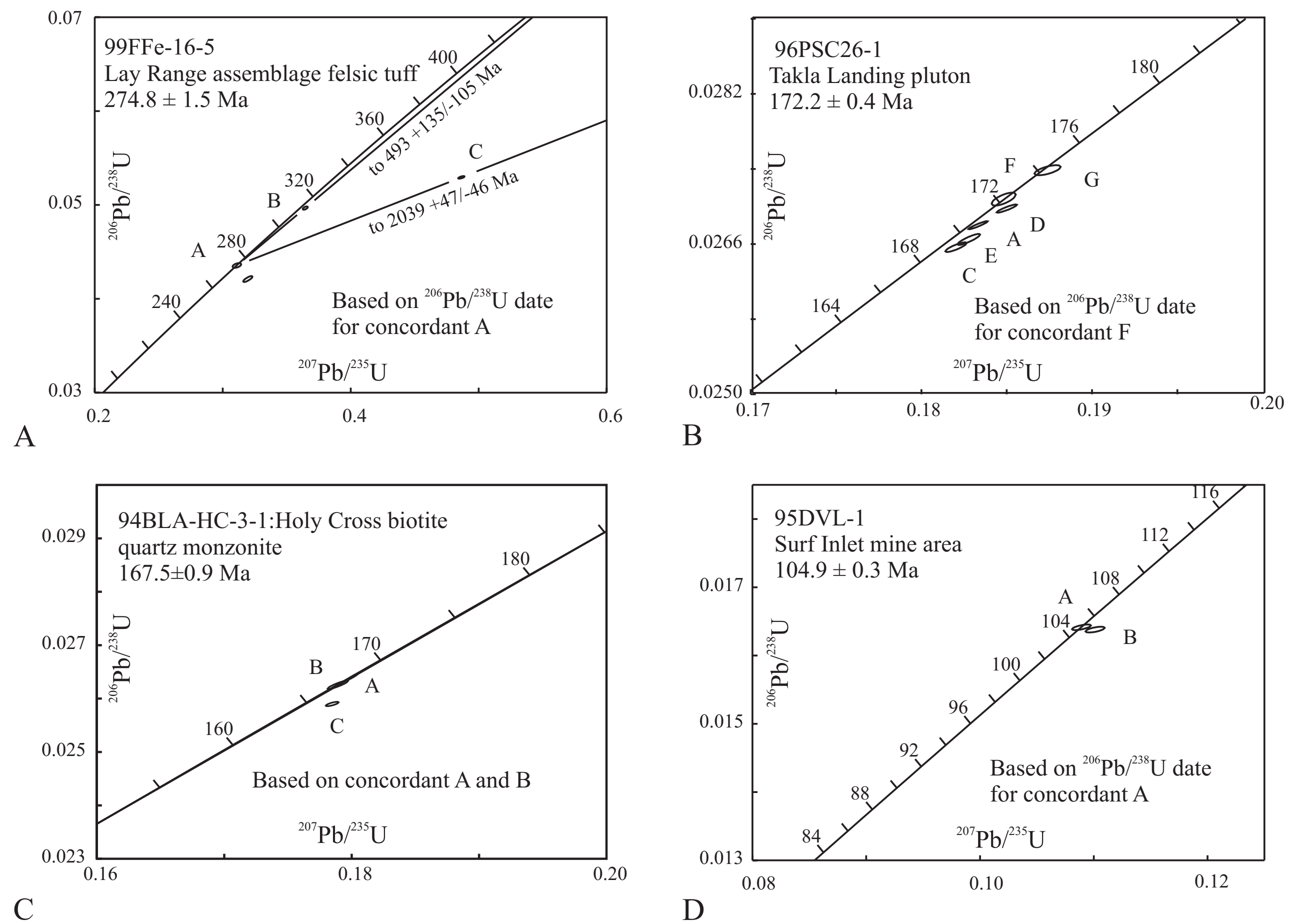

Figure 3. Standard concordia diagrams with error ellipse plotted at the 2-sigma level of uncertainty. See plots for sample numbers, names and dates, and text for details of interpretations.

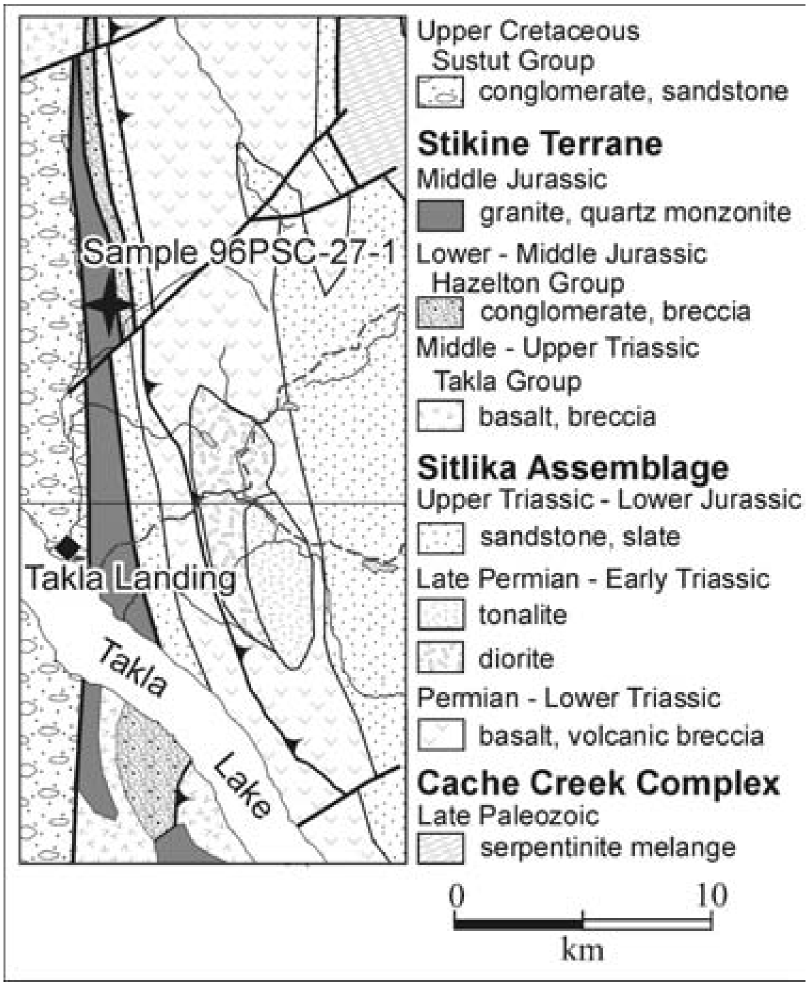

Figure 4. Geologic map showing the location of the Takla Landing pluton sample (96PSC-27-1).

The felsic tuff horizon is approximately 20 metres thick and occurs conformably within fine to coarse grained mafic and lapilli tuffs. The easterly verging Swannell Fault, which places Lay Range rocks above those of the Cassiar Terrane, occurs a few kilometres to the east. The felsic tuff unit is massive, rusty weathering, greenish-grey and distinguished by 10 to 15% quartz crystal fragments and polycrystalline quartz up to several millimetres in size. The remainder is composed of fine-grained muscovite and quartz imparting a sericitic schist or phyllite texture.

Geochronology

This felsic tuff yielded a very modest quantity of clear, pale tan euhedral to very slightly rounded prismatic zircons. The coarser zircons (>74 micrometres) were commonly broken euhedral grains. Due to the scarcity of material abrasion was not carried out. Grains were divided in four multi-grain fractions on the basis of size and shape (euhedral vs. slightly rounded). Three of the four fractions yielded discordant results, with an age estimate of 274.8 ± 1.5 Ma based on the $^{206}Pb/^{238}U$ date for concordant fraction A, which consisted of the coarsest euhedral grains. Two-point reference chords constructed through AB and AC suggest that inherited zircon components with a range of ages was present in the analysed grains (Figure 3A). Results for fraction D are consistent with the presence of minor inheritance and subsequent Pb loss.

Significance

This sample provides a new age constraints for the Upper Mafic Tuff division. The base of the sequence contains Early Permian radiolaria in the southern Lay Range immediately above middle Pennsylvanian limestone of the Lower Sedimentary division, suggesting a lower age limit. In northern Lay Range, felsic tuffs from the unit which was sampled for dating appear to interfinger with this limestone, indicating that they may be as old as middle Pennsylvanian (Ferri, 2000). Prior to the collection of this U-Pb geochronology sample, the age of the remaining section of Upper Mafic Tuff division volcanics was considered to be Permian based on a conodont collection from the Uslika Lake area (Ferri, 1996). The 274.8 ± 1.5 Ma age date demonstrates that this unit is as young as late Early Permian.

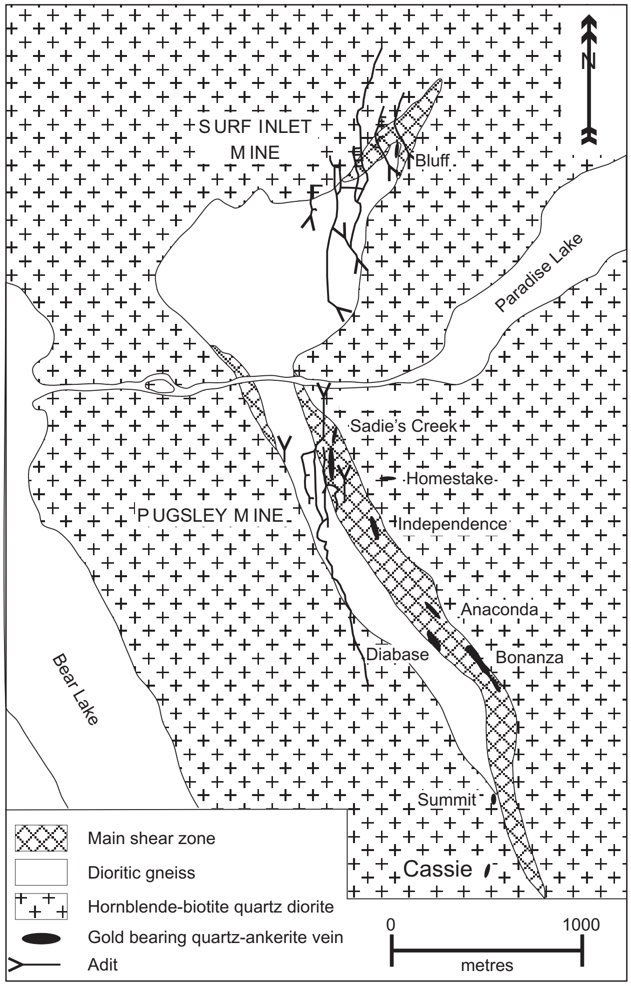

Figure 5. Geology of the Surf Inlet and Pugsley mines area. The zircon sample was collected from a drill hole collared near the Cassie showing at the southern end of the shear zone.

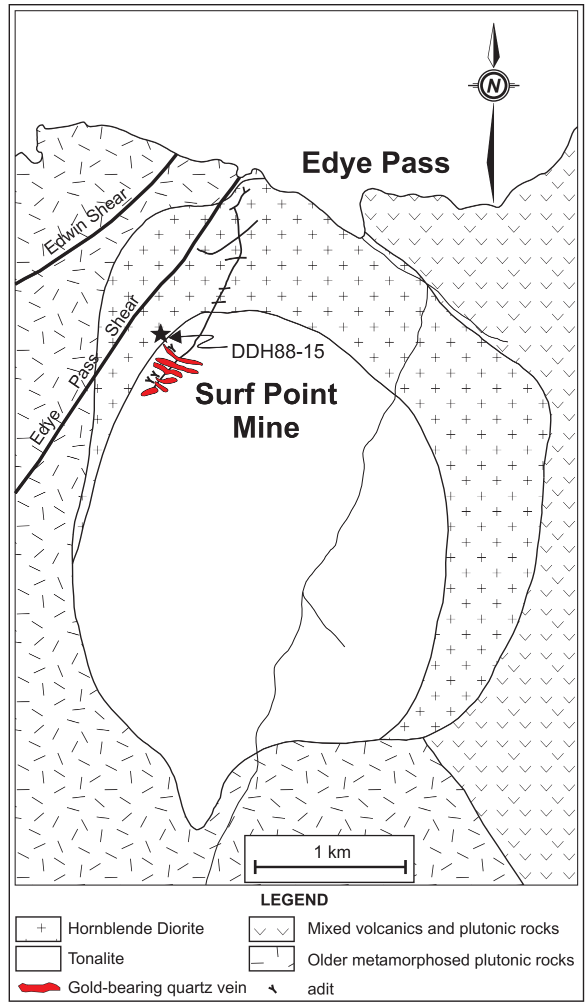

Figure 6. Geology of the Surf Point mine area on Porcher Island derived from Smith (1948). The zircon sample was collected from a drill hole collared just northwest of the mine.

SAMPLE 96PSC-27-1: TAKLA LANDING PLUTON (NTS: 93N/12)

The Takla Landing pluton is represented mainly by sparse exposures of pink-weathering monzogranite and quartz-feldspar porphyry that define a narrow lens that was traced for more than 20 kilometres northward from the northeast shore of Takla Lake (Figure 4), just east of the village of Takla Landing (Schiarizza and Payie, 1997; Schiarizza *et al*., 1998). This lens is juxtaposed against the Cretaceous Sustut Group to the west, across the Takla fault, and is faulted against slivers Triassic-Jurassic sedimentary rocks of the Sitlika assemblage and Stikine Terrane to the east (Schiarizza, 2000). Pink-weathering monzogranite that crops out on the south side of Takla Lake, directly south of Takla Landing, is presumed to be part of the same plutonic body. These rocks are also truncated by the Takla fault to the west, but their contact with Upper Triassic volcanic rocks of the Takla Group to the east is interpreted to be intrusive (Schiarizza *et al*., 2000).

Sample 96PSC-27-1 is a medium grained, isotropic monzongranite containing pink K-spar, saussuritized plagioclase, quartz and 5 - 10 percent chloritized mafic grains. It was collected from the north side of Takla Lake, about 11 km north of Takla Landing.

Geochronology

This sample yielded abundant, high quality, clear, pale yellow, euhedral, prismatic and tabular zircons and a small quantity of pale yellow titanite grains. Five of six analysed multigrain zircon fractions give slightly discordant results (Figure 3B), probably due to the presence of minor inherited components and subsequent Pb loss (especially for C and E). Thin tabular grains analysed in fraction F yielded concordant results. An age estimate of 172.2 ± 0.4 Ma is based on the $^{206}Pb/^{238}U$ date for this fraction.

Significance

At the time sample 96PSC-27-1 was collected it was not known if this lens of plutonic rocks along the Takla fault was derived from Stikine Terrane to the west or from the Permian-Jurassic Sitlika assemblage (western element of Cache Creek Terrane?) to the east (Schiarizza and Payie, 1997). Subsequent work, however, clearly showed that it is part of a plutonic suite within the eastern part of Stikine Terrane represented by several granite to diorite plutons which a belt that extends for more than 80 km southward to Babine Lake. MacIntyre *et al*. (2001) assigned these rocks to the Spike Peak intrusive suite. The date presented here is within the 179 to 166 Ma range of U-Pb and Ar-Ar isotopic dates presented by MacIntyre *et al*. (2001) for other plutons of the Spike Peak suite.

SAMPLE 94BLA-HC-3-1: HOLY CROSS PLUTON (NTS: 93/F15)

This pluton is located in the Intermontane Belt of central British Columbia, near the Eocene Holy Cross epithermal Au-Ag showing, about 33 km south of Fraser Lake (Lane and Schroeter, 1997). It is a poorly exposed biotite quartz monzonite body that cuts reworked andesite crystal tuffs that are mapped as Jurassic Hazelton Group and is nonconformably overlain by conglomerates of the Cretaceous Skeena Group and andesitic volcanic rocks that have given a K-Ar age of 70.3 Ma (Friedman *et al*., 2001). The age of mineralization at Holy Cross is considered to be Eocene or younger (Lane and Schroeter, 1997), because rocks that host the occurrence include rhyolites of the Eocene Ootsa Lake Group.

Geochronology

A small sample (~ 2 kg) of the Holy Cross pluton originally collected for K-Ar dating contained poor quality,

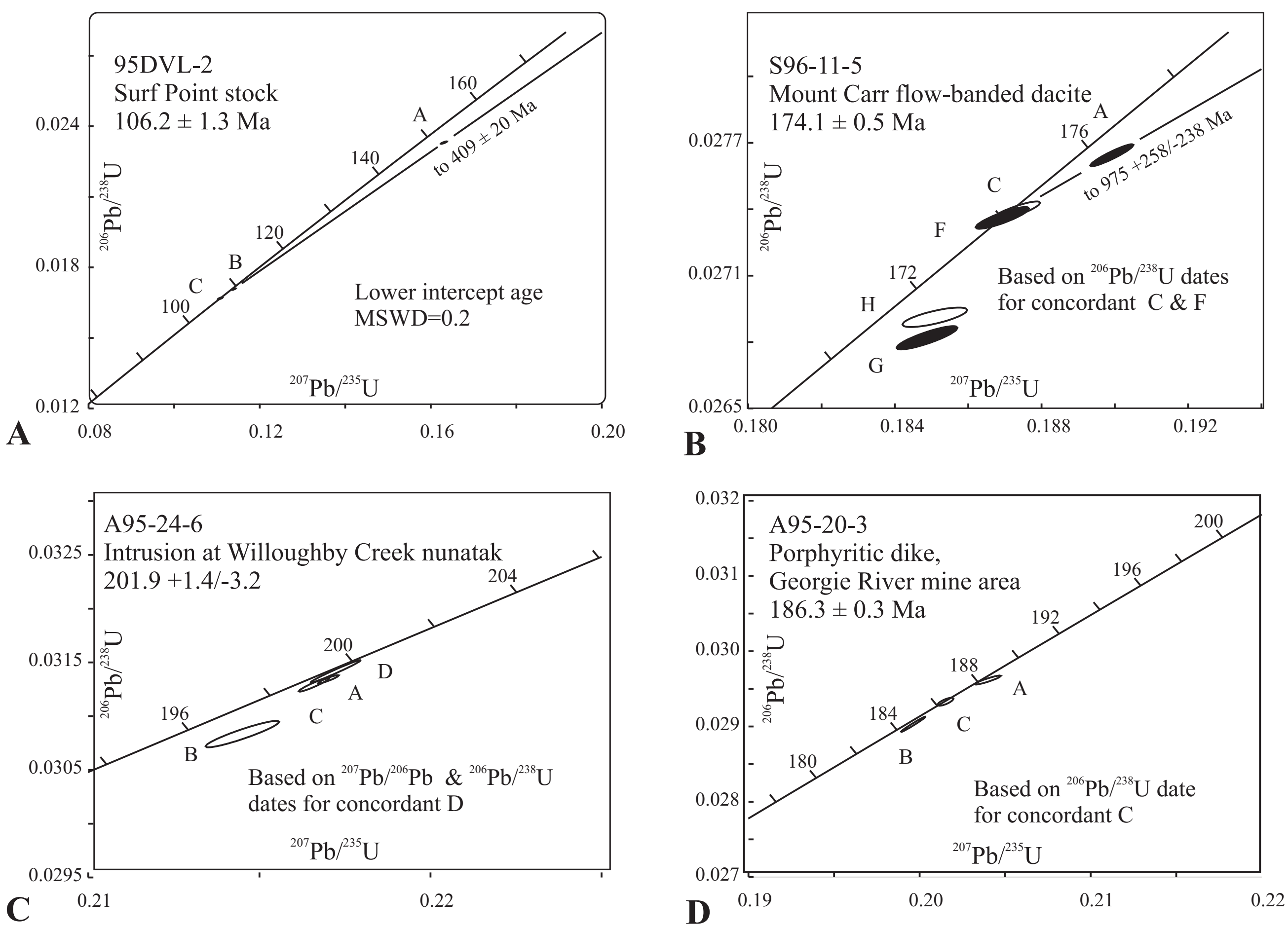

Figure 7. Standard concordia diagrams with error ellipse plotted at the 2-sigma level of uncertainty. See plots for sample numbers, names and dates, and text for details of interpretations.

chloritized biotite but a sufficient quantity of zircons for U-Pb dating. Zircons vary from very clear, pale pink, equant multifaceted and stubby prismatic grains to elongate prismatic and tabular crystals. Three multigrain zircon fractions were analysed and an igneous age estimate of 167.5±0.9 Ma is based on the median value and combined errors for $^{206}Pb/^{238}U$ dates determined for concordant and slightly overlapping A and B (Figure 3C). Discordant fraction C is interpreted to contain inherited zircon components and to have undergone minor Pb loss.

Significance

The Holy Cross pluton is associated with the Stikine terrane; the interpreted crystallization age of 167.5 ±0.9 Ma suggests it belongs to the Jurassic Stag Lake plutonic suite of Anderson *et al.* (1998) and/or the Spike Peak intrusive suite by MacIntyre *et al*. (2001).

SAMPLE DVL95-1: PRINCESS ROYAL ISLAND - SURF INLET MINE AREA (NTS: 103H/02)

Geology

The Surf Inlet and Pugsley mines (both covered by Minfile # - 103H027) are located 160 kilometres southeast of Prince Rupert on Princess Royal Island. The Surf Inlet mine operated from 1917 to 1926 and 1936 to 1942. Total production from the Surf Inlet and Pugsley mines was 918,129 tonnes grading 13.0 grams gold per tonne and 6.8 grams silver per tonne and 0.31% copper. During a regional reconnaissance of gold veins along the North Coast, a sample was collected to establish the age of the host intrusion for the gold-quartz veins. Sample DVL95-1 is a core sample taken from diamond drill hole SI88-1 from a depth of 27 to 70 feet. The drill hole collar is located near the Cassie showing (103H049), which is about 3700 metres south of the Surf Inlet mine (Carl von Einsiedel, personal communication; Figure 5).

Princess Royal Island is largely underlain by diorite to granodiorite intrusions. A large stock of hornblende-biotite quartz diorite outcrops in the centre of the island and hosts the gold mineralization at the Surf Inlet and Pugsley mines. In the area of the mines the stock is cut by westerly-dipping (30 to 60 degrees) shear zone that strikes northerly for more than 30 kilometres. The two mines and several other gold showings, including the Cassie lie along this shear zone (Figure 5). The shear zone has associated gneissic diorite, porphyroclastic diorite, dioritic gneiss, alteration zones and quartz veins. Quartz-ankerite veins with minor calcite generally are aligned parallel or subparallel to the shear zone. The ore-producing veins vary from 1 to 12 metres wide. They contain mainly pyrite with minor chalcopyrite, chalcocite, bornite, covellite, molybdenite and tellurides, but no visible gold.

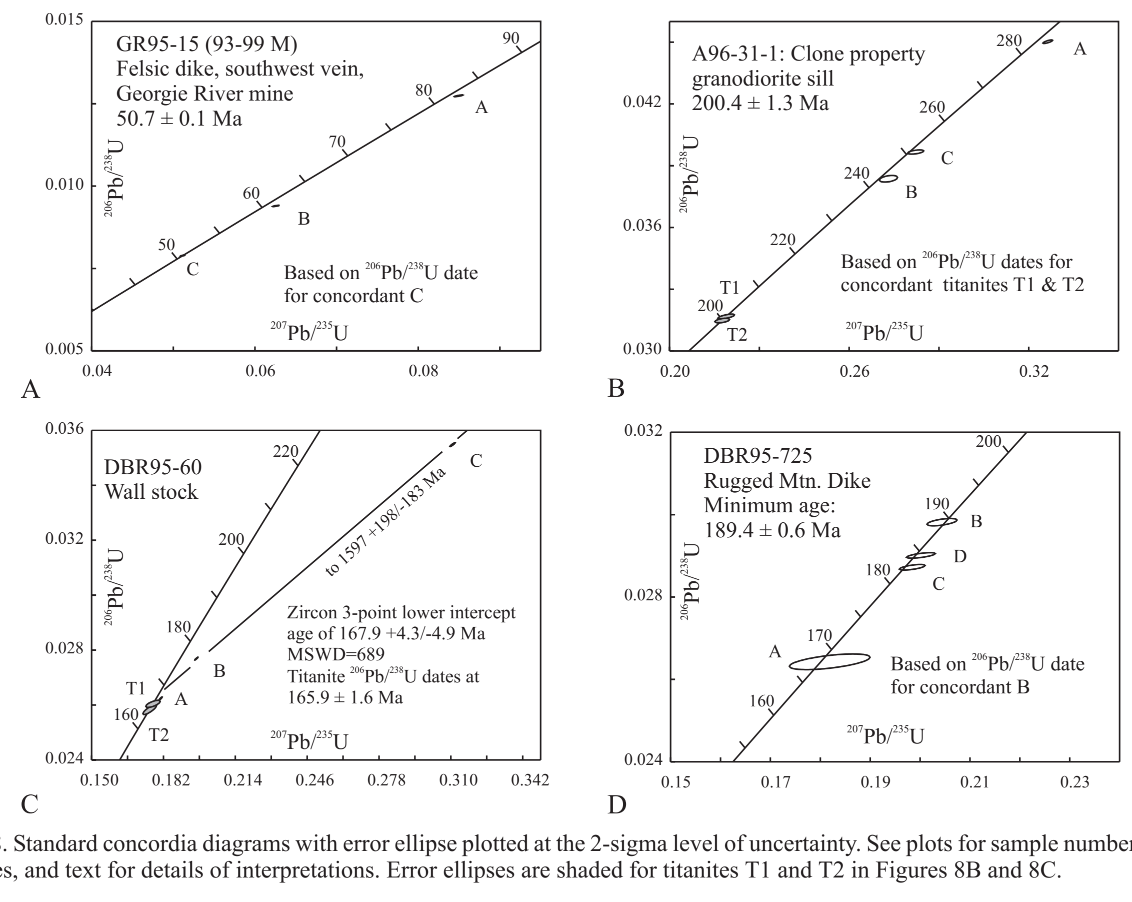

Figure 8. Standard concordia diagrams with error ellipse plotted at the 2-sigma level of uncertainty. See plots for sample numbers, names and dates, and text for details of interpretations. Error ellipses are shaded for titanites T1 and T2 in Figures 8B and 8C.

TABLE 1
U-PB ANALYTICAL DATA

Fraction[1]	Wt	U[2]	Pb*[3]	^{206}Pb[4]	Pb[5]	^{208}Pb[3]	Isotopic ratios (±1-sigma, %)[6]			Apparent ages (±2-sigma, Ma)[6]		
	mg	ppm	ppm	^{204}Pb	pg	%	$^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{207}Pb/^{206}Pb$
Ramos Succession, H97BC-43c: Single Detrital Zircon Grains; UTM: Zone 10, Easting 566797, Northing 5878051												
A c,N2,pp,b,p,1	0.041	77	38	22466	3.9	8.2	0.44728 (0.10)	10.342 (0.16)	0.16771 (0.07)	2383.1 (3.9)	2466 (2.9)	2534.9 (2.4)
B c,N2,pp,b,p,1	0.025	92	30	8717	5.3	5.2	0.32403 (0.12)	5.0765 (0.17)	0.11363 (0.08)	1809.4 (3.9)	1832.2 (3.0)	1858.2 (3.0)
C c,N2,pp,b,p,1	0.016	74	30	11384	2.3	15.7	0.35719 (0.11)	6.1488 (0.16)	0.12485 (0.07)	1968.8 (3.6)	1997.2 (2.8)	2026.7 (2.6)
D m,N2,co,p,1	0.009	53	19	2962	3.1	17.7	0.31033 (0.16)	5.1823 (0.21)	0.12112 (0.10)	1742.3 (4.8)	1849.7 (3.6)	1972.7 (3.5)
E m,N2,pp,b,p,1	0.011	195	122	13437	4.9	15.9	0.49441 (0.13)	16.191 (0.18)	0.23751 (0.07)	2589.7 (5.5)	2888.2 (3.4)	3103.4 (2.3)
F m,N2,co,p,1	0.009	44	14	2733	3.0	4.3	0.32628 (0.12)	5.0483 (0.18)	0.11222 (0.11)	1820.3 (3.9)	1827.5 (3.1)	1835.6 (3.9)
Downie Succession, H97BC-8: Single Detrital Zircon Grains; UTM: Zone 10, Easting 622600, Northing 5853200; NTS 93A/14												
A f,N2,pp,ov,1	0.005	118	37	839	12	10.7	0.27589 (0.11)	6.3524 (0.20)	0.16700 (0.12)	1570.6 (3.1)	2025.7 (3.5)	2527.8 (4.2)
B f,N2,pp,p,1	0.005	74	14	693	5.8	14.3	0.16941 (0.29)	2.4413 (0.60)	0.10451 (0.52)	1008.9 (1.3)	1254.9 (8.7)	1706 (19)
C f,N2,co,cl,t,1	0.005	232	21	1660	4.1	6.6	0.09385 (0.12)	0.7899 (0.24)	0.06105 (0.18)	578.3 (5.4)	591.1 (2.2)	640.9 (7.9)
D f,N2,pp,b,p,1	0.005	78	19	1125	5.0	9.4	0.22808 (0.14)	3.1877 (0.22)	0.10136 (0.14)	1324.4 (3.3)	1454.2 (3.4)	1649.2 (5.4)
99FFE11-2 Big Creek Group felsic tuff: 253.6±0.5 Ma; UTM: Zone 10, Easting 686921, Northing 6279179; NTS: 94C/12												
A cc,N2,p,1	0.020	364	15	2206	8.4	12	0.04033 (0.13)	0.2881 (0.22)	0.05181 (0.15)	254.9 (0.6)	257.0 (1.0)	276.9 (6.8)
B c,N2,p,7	0.030	696	29	224	255	13	0.03983 (0.28)	0.2875 (0.95)	0.05236 (0.77)	251.8 (1.4)	256.6 (4.3)	301 (35/36)
C c,N2,p,13	0.050	680	28	2328	38	11	0.04050 (0.11)	0.2932 (0.20)	0.05251 (0.12)	255.9 (0.5)	261.1 (0.9)	307.5 (5.3)
D m,M2,p,30	0.040	409	17	3023	14	12	0.04045 (0.10)	0.2913 (0.18)	0.05223 (0.11)	255.6 (0.5)	259.6 (0.8)	295.5 (5.1)
E f,N2,p,p,e	0.040	403	16	5614	7.1	10	0.04012 (0.10)	0.2837 (0.18)	0.05129 (0.12)	253.6 (0.5)	253.6 (0.8)	253.8 (5.3)
F ff,N2,p,p,e	0.015	331	13	5460	2.2	11	0.03934 (0.20)	0.2782 (0.27)	0.05130 (0.21)	248.7 (1.0)	249.3 (1.2)	254.2 (9.6)
99FFE12-1 Big Creek Group felsic tuff: 254±12 Ma; UTM: Zone 10, Easting 683447, Northing 6281436; NTS: 94D/09												
A m,N2,p,s,3	0.025	505	52	16530	4.5	12	0.09526 (0.10)	1.5484 (0.16)	0.11789 (0.07)	586.6 (1.1)	949.9 (1.9)	1924.5 (2.6)
B f,N2,p,s,15	0.035	385	26	4537	12	11	0.06518 (0.10)	0.7475 (0.17)	0.08319 (0.09)	407.0 (0.8)	566.8 (1.5)	1273.5 (3.4)
C f,N2,p,s,23	0.030	215	16	2354	12	15	0.06959 (0.10)	0.8318 (0.18)	0.08669 (0.11)	433.7 (0.8)	614.6 (1.6)	1353.6 (4.2)
D ff,N2,p,e,25	0.010	256	9.8	1336	4.5	11	0.03741 (0.15)	0.2646 (0.31)	0.05130 (0.26)	236.7 (0.7)	238.4 (1.3)	254 (12)
99FFE 16-5 Lay Range assemblage felsic tuff: UTM: Zone 10, Easting 679334, Northing 6283755; NTS: 94D/09												
A f,N2,p,na	0.015	113	5.4	1853	2.5	17	0.04356 (0.29)	0.3110 (0.54)	0.05179 (0.47)	274.8 (1.5)	275.0 (2.6)	276 (22)
B f,N2,b,na	0.015	176	9.7	3794	2.2	19	0.04967 (0.17)	0.3645 (0.27)	0.05322 (0.22)	312.5 (1.1)	315.6 (1.5)	338 (10)
C ff,N2,p,b,na	0.010	357	21	1840	6.5	16	0.05294 (0.13)	0.4864 (0.26)	0.06664 (0.19)	332.5 (0.9)	402.5 (1.7)	826.5 (7.9)
D ff,N2,p,na,3	0.007	154	7.1	755	3.8	17	0.04211 (0.38)	0.3196 (0.57)	0.05504 (0.35)	265.9 (2.0)	281.6 (2.8)	414 (15/16)
96PSC26-1 Takla Landing pluton: 172.2 ± 0.4 Ma; UTM: Zone 10, Easting 313970, Northing 6163330; NTS: 93N/12												
A cc,N2,p	0.072	639	18	10415	7.4	14.5	0.02680 (0.08)	0.1833 (0.15)	0.04961 (0.08)	170.5 (0.3)	170.9 (0.3)	176.7 (3.8)
C m,N2,p	0.058	638	18	6421	9.6	13.8	0.02657 (0.10)	0.1820 (0.17)	0.04969 (0.10)	169.0 (0.3)	169.8 (0.5)	180.7 (4.8)
D m,N2,p,s	0.032	715	20	7181	5.4	12.7	0.02698 (0.08)	0.1850 (0.16)	0.04974 (0.09)	171.6 (0.3)	172.4 (0.5)	182.7 (4.3)
E m,N2,p,s	0.030	647	18	5508	5.9	13.3	0.02665 (0.11)	0.1828 (0.18)	0.04974 (0.10)	169.5 (0.4)	170.4 (0.6)	183.0 (4.6)
F m,N2,t	0.020	487	14	4516	3.7	12.7	0.02708 (0.13)	0.1848 (0.19)	0.04950 (0.14)	172.2 (0.4)	172.2 (0.6)	171.7 (6.4)
G m,N2,t	0.018	528	15	3059	5.3	14	0.2739 (0.10)	0.1874 (0.21)	0.04963 (0.16)	174.2 (0.3)	174.4 (0.7)	177.5 (7.3)
94BLA-HC-3-1 Holy Cross biotite quartz monzonite: 167.5 ± 0.9 Ma; UTM: Zone 10, Easting 370615, Northing 5963860; NTS: 93/F15												
A cc,N2,eq	0.209	487	14	13360	12	15.2	0.02641 (0.11)	0.1801 (0.11)	0.04945 (0.03)	168.0 (0.4)	169.4 (0.4)	169.4 (1.5)
B cc,N2,eq	0.264	605	17	8570	29	16.6	0.02626 (0.15)	0.1789 (0.22)	0.04942 (0.11)	167.1 (0.5)	167.1 (0.7)	167.7 (5.0)
C ff,p,e,na	0.145	553	16	1642	76	18.1	0.02590 (0.08)	0.1785 (0.14)	0.04998 (0.09)	164.8 (0.3)	166.7 (0.4)	194.1 (4.4)
DVL-95-1 (DDH SI-88-1 -27'-70'): 104.9 ± 0.3 Ma; Princess Royal Island: Surf Inlet mine area; NTS: 103H/02												
A cc,N2,eq	0.087	152	2.5	1232	11	8.7	0.01641 (0.12)	0.1089 (0.38)	0.04813 (0.31)	104.9 (0.3)	105.0 (0.8)	106 (15)
B cc,N2,eq	0.094	134	2.2	1089	12	8.1	0.01638 (0.13)	0.1101 (0.38)	0.04876 (0.32)	104.7 (0.3)	106.1 (0.8)	136 (15)
DVL-95-2 (DDH PI-88-15-10'-30') Surf Point stock: 106.2 ± 1.3 Ma; Porcher Island: Surf Point - Edye Pass mine site; NTS: 103J/02												
A cc,N2,p,s	0.224	191	4.5	2448	25	11	0.02330 (0.11)	0.1631 (0.23)	0.05075 (0.14)	148.5 (0.3)	153.4 (0.6)	229.5 (6.3)
B c,N2,p,e,na	0.240	299	4.8	4443	17	7.1	0.01708 (0.10)	0.1139 (0.20)	0.04840 (0.12)	109.1 (0.2)	109.6 (0.4)	118.9 (5.6)
C c,N2,p,t,na	0.119	333	5.3	2576	16	6.1	0.01669 (0.12)	0.1108 (0.25)	0.04815 (0.17)	106.7 (0.3)	106.7 (0.5)	106.7 (8.0)

TABLE 1
U-PB ANALYTICAL DATA, CONTINUED

S96-11-5 Mount Carr flow-banded dacite: 174.1 ± 0.5 Ma; UTM: Zone 9, Easting 435567, Northing 6171200; NTS: 103O												
A c,N5,p	0.027	2014	56	16726	5.6	10.9	0.02764 (0.09)	0.1899 (0.16)	0.04983 (0.08)	175.8 (0.3)	176.8 (0.3)	187.0 (3.7)
C m,N5,p,s	0.023	1499	41	3707	16	10.5	0.02739 (0.08)	0.1873 (0.18)	0.04959 (0.12)	174.2 (0.3)	174.3 (0.6)	175.9 (5.5)
F m,N5,p,e	0.035	831	23	2494	20	11	0.02736 (0.09)	0.1869 (0.19)	0.04955 (0.13)	174.0 (0.3)	174.0 (0.6)	174.0 (5.8)
G m,N5,p,s	0.026	1268	34	1480	38	10.4	0.02682 (0.10)	0.1849 (0.22)	0.05000 (0.15)	170.6 (0.3)	172.2 (0.7)	194.8 (7.0)
H f,N5,p,e	0.013	648	18	2246	6.4	11.4	0.02691 (0.08)	0.1851 (0.24)	0.04988 (0.19)	171.2 (0.3)	172.4 (0.8)	189.5 (8.7)
A95-24-6 Intrusion at Willoughby Creek nunatak: 201.9 +1.4/-3.2 Ma; UTM: Zone 9, Easting 463850, Northing 6201900; NTS:												
A cc,N2,p,s,t	0.215	481	15	13985	14	6.6	0.03134 (0.06)	0.2170 (0.07)	0.05022 (0.03)	199.0 (0.2)	199.4 (0.2)	205.0 (1.2)
B cc,N2,p,s,t	0.130	421	12	18443	5.4	5.9	0.03083 (0.20)	0.2145 (0.25)	0.05046 (0.10)	195.8 (0.8)	197.3 (0.9)	216.0 (4.6)
C cc,N2,p,s,t	0.213	427	13	21186	8.4	5.8	0.03129 (0.10)	0.2166 (0.10)	0.05020 (0.03)	198.6 (0.4)	199.1 (0.4)	204.3 (1.5)
D cc,N2,p,s,t	0.328	506	15	28514	11	6.9	0.03142 (0.17)	0.2172 (0.17)	0.05015 (0.03)	199.4 (0.7)	199.6 (0.6)	201.9 (1.4)
A95-20-3 Porphyritic dike from Georgie River mine area: 186.3 ± 0.3 Ma; UTM: Zone 9, Easting 434720, Northing 618390; NTS 103O												
A cc,N2,p	0.175	385	11	9643	13	7.5	0.02962 (0.10)	0.2040 (0.19)	0.04995 (0.10)	188.2 (0.4)	188.5 (0.6)	192.8 (4.7)
B cc,N2,p	0.371	419	12	16204	17	7.3	0.02903 (0.18)	0.1996 (0.18)	0.04987 (0.03)	184.5 (0.7)	184.8 (0.6)	189.2 (1.4)
C cc,N2,p	0.257	407	12	4557	42	7.7	0.02933 (0.09)	0.2015 (0.12)	0.04983 (0.07)	186.3 (0.3)	186.4 (0.4)	187.2 (3.5)
GR-95-15 (93-99 m) Felsic dike, Georgie River mine: 50.7 +/- 0.1 Ma; UTM: Zone 9, Easting 434295, Northing 6183685; NTS103O												
A cc,N2,p,s,eq	0.201	205	2.6	911	37	8.2	0.01274 (0.11)	0.0849 (0.32)	0.04835 (0.23)	81.6 (0.2)	82.8 (0.5)	117 (11)
B cc,N2,p,s,eq	0.230	196	1.9	888	31	11.2	0.00940 (0.11)	0.0626 (0.33)	0.04829 (0.25)	60.3 (0.1)	61.6 (0.4)	113 (12)
C f,N2,p,e,na	0.088	354	2.9	1477	11	11.9	0.00789 (0.10)	0.0512 (0.28)	0.04703 (0.21)	50.7 (0.1)	50.6 (0.3)	51 (10)
A96-31-1 Clone property granodiorite sill: 200.4±1.3 Ma; UTM: Zone 9, Easting 453470, Northing 6185920; NTS: 103P/13												
A c,N5,p,s	0.110	77	3.6	1256	19	13.6	0.04502 (0.10)	0.3264 (0.25)	0.05257 (0.18)	283.9 (0.5)	286.8 (1.2)	310.5 (8.3)
B c,N5,p,s	0.061	98	3.7	871	17	9.4	0.03837 (0.21)	0.2731 (0.56)	0.05163 (0.51)	242.7 (1.0)	245.2 (2.4)	269 (23/24)
C c,N5,p,s	0.082	84	3.2	817	21	5.6	0.03966 (0.13)	0.2822 (0.47)	0.05161 (0.42)	250.8 (0.6)	252.4 (2.1)	268 (19/20)
T1 cc,M20	0.360	162	7.5	268	468	38.4	0.03167 (0.19)	0.2189 (0.64)	0.05013 (0.53)	201.0 (0.7)	201.0 (0.7)	201 (24/25)
T2 cc,M20	0.430	184	8.5	395	419	37.9	0.03148 (0.18)	0.2176 (0.56)	0.05013 (0.50)	199.8 (0.7)	199.9 (2.0)	201 (23/24)
DBR95-60 Wall stock: 167.9 +4.3/-4.9 Ma; NTS: 082/02; UTM: Zone 11, Easting 503750,												
A cc,N2,p,e,10	0.21	352	9	7801	16	6.8	0.02624 (0.11)	0.1807 (0.19)	0.04996 (0.10)	167.0 (0.4)	168.7 (0.69)	193.0 (4.8)
B c,N2,p,e,17	0.163	361	10	8757	12	8.9	0.02769 (0.09)	0.1966 (0.19)	0.05151 (0.10)	176.1 (0.3)	182.3 (0.6)	263.6 (4.6)
C m,N2,p,e	0.055	433	16	6241	8.5	10.8	0.03548 (0.10)	0.3107 (0.19)	0.06352 (0.10)	224.8 (0.4)	274.8 (0.9)	725.5 (4.4)
T1 cc,M5,b	1.29	199	5	241	188	5.3	0.02604 (0.25)	0.1773 (0.90)	0.04939 (0.75)	165.7 (0.8)	165.8 (2.8)	166 (35)
T2 cc,M5,b	1.31	216	5	250	198	4.6	0.02583 (0.35)	0.1759 (0.87)	0.04938 (0.61)	164.4 (1.1)	164.5 (2.6)	166 (29)
DBR91-725 Rugged Mountain dike: minimum age 189.4 ± 0.6 Ma; NTS: 104G/13; UTM: Zone 9, Easting 343550, Northing 6412100												
A f,p,s,na	0.031	2206	67	107	1250	21.2	0.02643 (0.36)	0.1819 (2.22)	0.04991 (2.04)	168.2 (1.2)	169.7 (6.9)	191 (92/98)
B m,p,s	0.010	1319	46	524	46	23.2	0.02982 (0.15)	0.2044 (0.74)	0.04972 (0.66)	189.4 (0.6)	188.8 (2.5)	182 (31)
C m,p,s	0.010	993	34	474	40	25	0.02872 (0.12)	0.1984 (0.65)	0.05011 (0.58)	182.5 (0.4)	183.8 (2.2)	200 (27)
D m,p,s	0.010	2071	69	398	100	21	0.02901 (0.12)	0.2002 (0.72)	0.05004 (0.65)	184.4 (0.4)	185.3 (2.4)	197 (30)

[1] Upper case letter is fraction identifier; T1, T2, etc, for titanites. All zircon fractions air abraded; Grain size, intermediate dimension in micrometres: cc=>149, c=149-134, m=134-104, f=104-74, ff=<74; Magnetic codes: Franz magnetic separator sideslope at which grains are nonmagnetic (N) or Magnetic (M); e.g., N1=nonmagnetic at 1°; Field strength for all is 1.8A; Front slope for all is 20°; Grain codes: b= broken fragments, e=elongate, eq=equant multifaceted ,ov=ovoid; p=prismatic, s=stubby, t=tabular, ti=tips; Additional for detrital grains: colour: co=colourless; pp= pale pink; vp = vivid pink; py= pale yellow; tan = tan; clarity; cl = clear; tr = translucent; Numeral some fractions (listed last) gives number of grains dissolved.

[2] U blank correction of 1pg ± 20%; U fractionation corrections were measured for each run with a double ^{233}U-^{235}U spike (about 0.004/amu).

[3] Radiogenic Pb.

[4] Measured ratio corrected for spike and Pb fractionation of 0.0037-0.0043/amu ± 20% (Daly collector) and 0.0012/amu (Faraday collector), which were determined by repeated analysis of NBS Pb 981 standard throughout the course of this study.

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

[6] Corrected for blank Pb (2-10 pg, zircon; 20 pg, titanite), U (1 pg, all) and common Pb concentrations based on Stacey and Kramers (1975) model Pb at the age or the $^{207}Pb/^{206}Pb$ age of the rock.

Sample DVL95-1 is a strongly foliated quartz diorite with a colour index of approximately 30%. It consists of plagioclase, amphibole, quartz, opaques and apatite with minor secondary biotite, epidote and chlorite.

Geochronology

Zircons separated from this sample are very clear and pale pink, with shapes that vary from multifaceted and equant to elongate prismatic. Results for multigrain fractions A and B, composed of strongly abraded equant multifaceted grains, are plotted on Figure 3D. A estimate of 104.9 ± 0.3 Ma for the crystallization age of this intrusion is based on the $^{206}Pb/^{238}U$ date for concordant fraction A. Discordant results for fraction B are interpreted to indicate the presence of inherited zircon and later Pb loss.

Significance

The host intrusion has been considered to be Jurassic to Upper Cretaceous (Harris and Gardiner, 1986) by analogy with other intrusions in the region. This zircon age date shows that the intrusion is 104.9 ± 0.3 Ma or mid-Cretaceous. M. McLaren collected a sample of sericite-altered diorite adjacent to a mineralized quartz vein from drill hole 81-2 (120 to 123.3 feet), and a whole K-Ar date of 80.1 ± 2.8 Ma was obtained by K. Dawson. These two dates therefore constrain the age of the mineralization to between a minimum age of ~80 Ma and a maximum age of ~105Ma.

Acknowledgment

The assistance of Art Freeze, Murray McLaren and Joe Shearer was much appreciated. Surf Inlet Mines Ltd. generously supplied data and permitted use of their camp.

SAMPLE DVL95-2: PORCHER ISLAND - SURF POINT STOCK (NTS: 103J/02)

Geology

The Surf Point (Minfile # 103J017) and Edye Pass (103J015) gold mines, located on the northwest corner of Porcher Island are 30 km south-southeast of Prince Rupert. The Surf Point gold mine produced an estimated 58,962 tonnes grading 10.3 grams gold per tonne and 3.43 grams silver per tonne between 1919 and 1938. Approximately 11,700 tonnes of similar grade ore was mined from the Edye Pass mine.

Sample DVL95-2 consists of core taken from diamond drill hole PI-88-15 from a depth of 10 to 30 feet. The drill collar is located approximately 1 kilometre inland from Edye Pass within the Surf Point stock (Figure 6). The Surf Point stock has a core of light coloured, biotite hornblende tonalite surrounded by a border phase of foliated hornblende quartz diorite (Smith, 1948). In drill core contacts between the two phases are sharp and do not exhibit chilled margins, although distinction of the two phases can be difficult at times. The stock intrudes gneissic diorite with associated pegmatite dikes and agmatite and mixed weakly metamorphosed volcanics and intrusive rocks. Andesite porphyry and basaltic dykes cut the stock.

Gold occurs in mesothermal quartz veins and veinlets throughout the general area, however, ore has only been mined from veins hosted by the tonalite core of the Surf Point stock. These veins trend 070 degrees to 090 degrees and generally dip 60 to 90 degrees north. Individual veins are less than 120 metres in strike length.

The pyritic quartz veins contain lesser amounts of chalcopyrite, sericite, ankerite, calcite and chlorite. Microscopic tetrahedrite with associated free gold has been identified. Individual veins vary from hairline fracture fillings to veins up to several metres in width and "silicified zones" up to 6 metres wide were mined in some cases.

Geochronology

Zircons separated from this sample are clear, colourless, stubby to very elongate prisms and thin tabular grains. The results of three analysed multigrain fractions plot as a co-linear array. A chord fit through these data yields a lower intercept of 106.2 ± 1.3 Ma (Figure 7A), which is interpreted as the best estimate for the crystallization age of the Surf point stock. Results for fraction C, composed of unabraded tabular grains, plot on concordia within error of the lower intercept age. Older, discordant results for strongly abraded stubby prisms of fraction A indicate the presence of inherited zircon. An upper intercept age of 409 ± 20 Ma provides an estimate of the average age of inheritance in the analysed grains. This age is characteristic of Alexander Terrane basement (Gehrels and Saleeby, 1987).

Significance

The sample comes from the northwestern part of the Surf Point stock. It is a fine-grained, equigranular biotite hornblende quartz diorite with a colour index of approximately 40. At least some of the biotite along with epidote is seen to replace the hornblende. Based on its lack of foliation, the sample is interpreted to represent the core tonalite phase of the intrusion. However, the collar of the drill hole is just within the foliated horneblende quartz diorite based on existing maps.

The intrusion was previously believed to be either Cretaceous or Tertiary in age (Smith, 1948). This age date of 106.2 ± 1.3 Ma shows the host intrusion is mid-Cretaceous and provides an upper age constraint on the age of the gold mineralization. Given the spatial relationship of the gold mineralization with Cretaceous age stocks at both Surf Point and Surf Inlet and the Cretaceous age of gold occurrences associated at other gold occurrences, such as Bralorne and Surf Inlet, the Surf Point gold mineralization is most likely Cretaceous age as well.

Acknowledgment

Cathedral Gold Corporation provided logistical support for two field visits and geologist Allan Taylor graciously shared his knowledge of the area.

SAMPLE S96-11-5: MOUNT CARR FLOW-BANDED DACITE (NTS: 103O)

Geology

Flow-banded dacite was sampled (A96-11-5) in the Carr Ridge area, a chain of peaks strung out south of the mouth of the Georgie River in northwestern B.C., in the Stewart area. The northernmost peak on this chain is Mount Carr, which has a ring-like summit. The sample was collected on the southern part of the ridgecrest, just 200 metres west of the southernmost, and highest, point on the rim (TRIM map sheet 103O-070).

The southern half of the summit Mount Carr, and its southern slopes, are composed of a thick (1200 metre) succession of dacite to rhyodacite, which is exposed over a strike length of 4.5 kilometres. These rocks display a variety of textures ranging from flow banding, to fragmental rocks (tuff breccias to lapilli tuffs) to massive felsite. These rocks are variably pyritic ranging up to 10% fine disseminated pyrite. To the north, adjacent black fine-grained metasedimentary rocks are weakly pyritic. To the south, adjacent strata is obscured by Eocene intrusions of the Coast Range batholith.

Due to the high elevation and steep terrain of this peak, these pyritic strata are well exposed and extremely gossanous. Mount Carr is the site of the strongest iron oxide anomaly detected by the LandSat thematic mapper in the Stewart region.

The felsic volcanic textures, lithological associations and widespread pyrite content are similar to features near the Eskay Creek gold-silver mine to the north. There was no clear evidence to indicate whether felsic strata at Mount Carr are deposited in a subaerial or subaqueous setting. This is an important distinction; subaqueous settings are prospective for precious metal enriched volcanogenic massive sulphide deposits (Eskay Creek mine), and subaerial settings are prospective for subvolcanic epithermal and porphyry-style deposits (Premier mine and Sulphurets camp).

Geochronology

A small quantity of clear, colourless, stubby to elongate, prismatic zircons were recovered from this rock. Five multi-grain fractions were analysed. An age estimate of 174.1 ± 0.5 Ma is based on concordant and overlapping results for two fractions composed of elongate prisms. Three fractions of stubby prisms that give discordant results suggest the presence of inherited zircon and two of these (G and H) have likely also undergone subsequent Pb loss. A three point chord through fractions A, C and F with an upper intercept of 975 +258/-238 Ma provides an estimate of the average age of inherited components in the grains analysed in fraction A (Figure 7B).

Significance

This date correlates well with published ages for the host-rock strata at the Eskay Creek mine and hanging wall strata in the Sulphurets camp (Childe, 1996, 1997). Recent GSC research has corroborated these results with a U-Pb zircon age of ca. 176 Ma collected from a site 750 metres northwest of the BCGS sample site (Evenchick *et al*., 1999). The striking gossans along the ridgecrest of Mount Carr has been repeatedly sampled for assay. Results have been only weakly anomalous. However, the steep forested flanks of Mount Carr where most of the 4500-metre strike length of the unit is exposed have not yet been prospected. The Mount Carr area merits thorough prospecting, bearing in mind that the Eskay Creek ores are not localized in the pyritic dacites and rhyolites of the mine sequence, but in adjacent black mudstone units. Stream sediment geochemistry of the many creeks draining of Mount Carr would be useful reconnaissance tool.

SAMPLE A95-24-6: INTRUSION AT WILLOUGHBY CREEK NUNATAK (NTS: 103P/13,14)

Geology

The outcrop area is mapped as intrusive rock of the Texas Creek plutonic suite, which is locally termed the "Goldslide Intrusions" after a prominent stock at the Red Mountain property to the west. The rock is fine to medium grained porphyritic granodiorite with hornblende plus feldspar phenocrysts. Hornblende phenocrysts range up to 6 millimetres across and feldspars up to 1.2 centimetres long. Moderately aligned phenocrysts indicate that the rock is weakly flow-foliated or else tectonically foliated. This sample was collected on the Willoughby Creek property, on the summit of the small peak on the Wilby Zone nunatak. The sample site is just southwest of the Wilby Zone, the North Zone and the North-North Zone (*see* Figure 7 in Alldrick *et al*., 1996 and Gabites *et al*., 1996).

Geochronology

Zircons separated from this felsic porphyry sample are clear, pale pink, stubby prismatic and thick tabular grains with multifaceted terminations. Results for three of four analysed multi-grain fractions composed of strongly abraded, relatively coarse zircons are marginally concordant to slightly discordant and lie in a cluster near concordia at ca. 198-200 Ma (Figure 7C). A crystallization age estimate of 201.9 +1.4/-3.2 Ma is based Pb/U and Pb/Pb dates for marginally concordant fraction D. This fraction is interpreted to have undergone minor Pb loss; the other three are likely to contain traces of inherited zircon and to have also undergone minor Pb loss.

Significance

This Late Triassic-Early Jurassic pluton is probably coeval and cogenetic with the several adjacent mineral prospects. These showings are good examples of the style of intrusion-related gold deposits commonly associated with Early Jurassic plutons throughout the Stewart-Iskut area.

SAMPLE A95-20-3: PORPHYRITIC DIKE FROM GEORGIE RIVER MINE AREA (NTS: 103O)

Geology

The sampled rock is a dike of hornblende-feldspar porphyritic granodiorite identical to the Premier Porphyry dikes of the Early Jurassic Texas Creek plutonic suite in the Stewart mining camp to the north. This medium grained dike is about 15 metres wide and shows chilled margins. It is one of a set of parallel dikes that transect this part of the Georgie River mine property. These dikes are overprinted by the alteration and mineralization of the Southwest Vein, the main mineralized structure at the Georgie River mine. The sample was collected in an area of small knobby hilltops near the Pond Vein, towards the north end of the Georgie River mine property.

Geochronology

Zircons separated from this felsic porphyry sample are clear, pale pink, stubby to elongate multifaceted prismatic grains. Results for three multi-grain fractions of strongly abraded, relatively coarse zircons plot on or near concordia between 184 and 189 Ma (Figure 7D). A crystallization age estimate of 186.3 ± 0.3 Ma is based on the $^{206}Pb/^{238}U$ date for concordant fraction C. Slightly discordant fraction A appears to contain minor inherited zircon and grains in discordant B have probably undergone minor Pb loss.

Significance

The Early Jurassic age of this dike constrains the age of the pyroxene porphyritic basalt flows and interlayered sedimentary rocks cut by the dikes, which must predate these Premier Porphyry dikes. The date also constrains the age of the Southwest Vein, which must postdate the age of this dike (Alldrick *et al*., 1996; Gabites *et al*., 1996).

SAMPLE GR-95-15-93/99: FELSIC DIKE, SOUTHWEST VEIN, GEORGIE RIVER MINE (NTS: 103O)

Geology

The dike rock is fresh, equigranular, unfoliated light grey biotite-hornblende granite. The rock hosts rare xenoliths. This is one of the "Tertiary biotite granodiorite dikes" interpreted to be penecontemporaneous with the main north-trending vein set on the mine property (Alldrick *et al*., 1996, p.105). Dike rock was collected from a diamond drillhole on the Georgie River mine property. DDH 95-15 was sampled from 93 to 95 metres depth. The drillhole intersects the Southwest Vein (see sample site plotted in Figure 6 in Alldrick *et al*., 1996). Lead isotope data from a sample collected from this same vein is reported in Gabites *et al*. (1996)

Geochronology

Two fractions of strongly abraded, relatively coarse-grained zircon, and one fraction of slightly finer, unabraded zircon were analysed. The unabraded fraction (C) is concordant with a $^{206}Pb/^{238}U$ date of 50.7 ± 0.1 Ma, which is taken as a good estimate for the crystallization age of the rock (Figure 8A). The other fractions give somewhat older Pb/U and Pb/Pb ages, indicating the presence of a minor inherited zircon component. Because the data form a non-linear array an upper intercept age was not calculated.

Significance

This mid-Eocene date confirms a Tertiary age for these dikes, which are associated with the north-trending veins on the property. Together with the previously reported lead isotope data from these veins, it supports the interpretation of Tertiary mineralization in the north-trending vein set on the Georgie River mine property. This age contrasts sharply with the Early Jurassic age determined for the east trending veins set on the property, such as the Granodiorite and Pond Veins. These latter veins are probably contemporaneous with the intrusion of the Early Jurassic Premier porphyry dikes reported for the preceding sample.

SAMPLE A96-31-1: CLONE PROPERTY GRANODIORITE SILL (NTS: 103P/13)

Geology

The Clone prospect is characterized by gold-cobalt rich shear zone-hosted mineralization within a mixed volcano-sedimentary succession of Mesozoic age. The sampled rock unit is a sill that cuts strongly hematitic volcaniclastic (epiclastic?) strata near the main mineralized shear zone on the Clone property. Small apophyses from this sill extend out into the enclosing country rock strata of alternating mafic flows, intermediate tuffs and epiclastic sedimentary rocks. The rock is massive to weakly foliated, fine-grained, slightly porphyritic, hornblende granodiorite.

Geochronology

Good quality zircon and titanite were recovered from this sample. Three analysed multi-grain zircon fractions consisting of clear, very pale yellow, stubby prismatic grains contain significant inherited zircon, and were not useful in determining the precise age of this rock. An age estimate of 200.4 ± 1.3 Ma is based on the results for two concordant titanite analyses (Figure 8B). Given the high closure temperature for titanite (greater than 650° C; Frost *et al*., 2000) and the upper crustal emplacement level of the sill, this titanite cooling age can also be regarded as a magmatic age.

Significance

The interpreted age of this sill constrains the minimum age of host-rock strata to Late Triassic. The adjacent shear-hosted gold-cobalt mineralization cuts across the same strata. The mineralized shear zone strikes roughly parallel to the dated sill and may be the same age or younger than the dated intrusion.

SAMPLE 95DBR-60: WALL STOCK (NTS: 082/02)

Geology

The Wall Stock is a biotite hornblende epidote granodiorite intrusion that was emplaced into Proterozoic sedimentary rocks of the Purcell Supergroup in southeastern British Columbia.

Geochronology

This sample of biotite hornblende epidote granodiorite from the Wall stock yielded clear, pale pink, stubby to elongate prismatic zircons and pale yellow, clear to slightly cloudy titanites. The results of three analysed multigrain zircon fractions plot as a quasi-linear array, due to the presence of varying amounts and to a lesser extent variable ages of inherited zircon (Figure 8C). A lower intercept age of 167.9 +4.3/-4.9 Ma is statistically identical to the median $^{206}Pb/^{238}U$ date and combined errors for titanites T1 and T2, 165.9 ± 1.6 Ma. We quote the former value as a conservative age estimate for the Wall Stock. An upper intercept 1597 +198/-183 Ma provides an estimate for the average age of inherited zircon in the analysed grains.

Significance

The interpreted crystallization age of 167.0 +4.3/-4.9 Ma for the Wall Stock confirms that this intrusion is correlative with other bodies of the Nelson suite (Woodsworth *et al*., 1991).

DBR-91-725: RUGGED MOUNTAIN DIKE (NTS: 104G/13)

Geology

A suite of alkaline dikes crop out in the Telegraph Creek map area in northwestern British Columbia (Figure 1; also see Brown *et al*., 1996, Figure 3-4, p. 59). They are spatially associated with Early Jurassic Rugged Mountain pluton, a zoned alkaline body that intrudes Triassic Stuhini Group volcanic rocks of the Stikine terrane. Dikes of the Rugged Mountain swarm are texturally trachytic to subtrachytic and contain potassium feldspar or albite pheoncrysts. A potassium feldspar megacrystic dike from the Rugged Mountain swarm was sampled for U-Pb dating (Brown *et al*., 1996).

Geochronology

A very small quantity of turbid, fractured, subhedral to euhedral, stubby, prismatic zircons were recovered from this sample. The results of four multi-grain zircon fractions plot on concordia between about 167 Ma and 190 Ma with no mutual overlap (Figure 8D). All of the fractions have high U concentrations (~1000-2200 ppm U) and the spread of data is likely due to Pb loss, as there is no visible or analytical evidence of inherited zircon in these grains. Fraction B, which was composed of the coarsest analysed grains, gives the oldest results. The $^{206}Pb/^{238}U$ date of 189.4 ± 0.6 Ma for fraction B is interpreted as a minimum age for the crystallization of the dike. The true age is probably several million years older, as it is likely that these poor quality, high U grains experienced at least some post-crystallization Pb-loss.

Significance

An interpreted minimum crystallization age of 189.4 ± 0.6 Ma for the Rugged Mountain dike and by extension, the swarm as a whole, suggests a possible temporal link with the Early Jurassic Texas Creek plutonic suite or the Early Jurassic-Late Triassic Copper Mountain plutonic suite. The minimum age for the dike is slightly younger than an ^{39}Ar-^{40}Ar plateau date of 195±3 Ma for the spatially associated Rugged Mountain pluton, which has been correlated with the latter suite (Brown *et al*., 1996).

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