BASALTIC ROCKS OF THE MIDDLE JURASSIC SALMON RIVER FORMATION, NORTHWESTERN BRITISH COLUMBIA (104A, B, G)

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INTRODUCTION

At Eskay Creek, in the Iskut River area of northwestern British Columbia (Figure 2-10-1), the bulk of the 21 zone is hosted within the Salmon River Formation; basaltic and andesitic rocks comprise a significant component of the Salmon River Formation in this locality. The mining reserve estimate at Eskay Creek is 1.04 million tonnes grading 63.8 grams per tonne gold, 986 grams per tonne silver (operator: International Corona Inc. prior to August 1992; Homestake Canada Ltd. thereafter). One of us (JML) has coordinated a regional mapping project in the Galore Creek, More Creek and Forrest Kerr Creek areas since 1988 (Logan and Koyanagi, 1989; Logan *et al.*, 1990, 1992); work by the remaining authors is part of The University of British Columbia (MDRU) project "Metallogeny of the Iskut River Area," which commenced in mid-1990 (Macdonald, 1991; Ettlinger, 1991; Bartsch, 1992; Miller, 1992; Lewis, 1992).

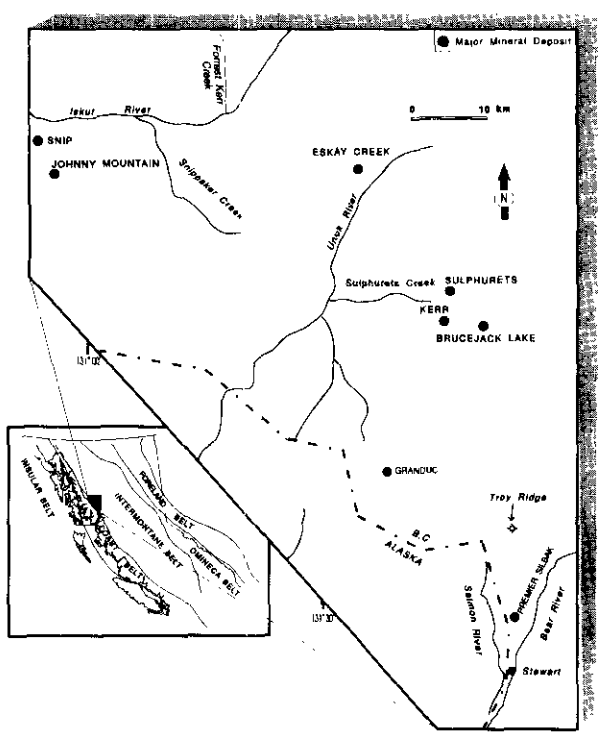

Figure 2-10-1. Location map.

Volcanogenic massive sulphide deposits are frequently associated with either a bimodal, felsic-mafic volcanic assemblage, or a polymodal dacite-andesite-rhyolite-basalt assemblage (*e.g.*, Gibson and Watkinson, 1986; Large, 1992). Recently, Edmunds *et al.* (1992) proposed that both acid and mafic volcanism, together with sedimentation of fine-grained mudstones, are approximately contemporal with mineralization in the Eskay Creek 21 zones. In addition, Bartsch (1993, this volume, and manuscript in preparation) has described regional-scale alteration spatially associated with mineralization to the south of Eskay Creek, and on the Eskay Creek mining lease. These views and observations suggest collectively that it is critical to assess both the environment in which such volcano-sedimentary processes take place, and also the effects of alteration. Hydrothermal alteration is commonly more widespread than associated base and precious metal mineralization; if zonal patterns are present, alteration may provide useful vectors towards mineralized centres of hydrothermal systems.

In this paper we address: the stratigraphy of the volcanic components of the Salmon River Formation; the petrology and lithogeochemistry of intermediate to mafic volcanic rocks in Salmon River Formation, with the long term objective of determining their provenance and the environment in which they formed; and the effects of alteration in the vicinity of known mineralization, in order to assess the effectiveness of basalt lithogeochemistry as an exploration tool. Basaltic rocks are particularly well suited to a study of this nature, being more sensitive to alteration than the associated felsic rocks, because they are in greater disequilibrium with hydrothermal fluids (which are commonly in equilibrium with minerals such as quartz, carbonate, chlorite and potassium-bearing phases such as potassium feldspar and sericite; Franklin, 1990; Large, 1992).

BASALTIC ROCKS OF THE SALMON RIVER FORMATION

Basaltic rocks are a significant component of the Jurassic stratigraphic succession in the Iskut River area. Original mapping of the area included all of these mafic volcanic strata in the Unuk River and Betty Creek formations of the Hazelton Group, and reserved the Salmon River Formation for strictly sedimentary successions higher in section (Grove, 1986), consistent with Schofield and Hanson's (1922) original definition for that unit. Second generation regional mapping by provincial and federal government surveys revised the lithologic definitions of Hazelton Group units, and recognized that the Salmon River Formation contained an upper, basaltic member in the eastern Iskut

River area (Eskay Creek facies of Anderson and Thorkelson, 1990). Descriptions of the Mount Dilworth formation by Alldrick and Britton (1988) and Alldrick *et al.* (1989) provided a regional marker unit dividing the Salmon River Formation from older Hazelton Group rocks, and greatly assisted in its recognition. We now know that the basaltic portion of the Salmon River Formation is quite extensive in the eastern Iskut River, Unuk River and Forrest Kerr Creek areas, (*e.g.*, Anderson and Thorkelson, 1990; Logan *et al.*, 1990; Lewis, 1992) and that it locally forms accumulations up to 2000 metres thick (Read *et al.*, 1989). Anderson and Thorkelson (1990), and more recently Lewis *et al.* (1992) suggest that a belt of pillowed basaltic rocks along the eastern bank of the Unuk River, previously defined as the Unuk River formation, are probably part of the Salmon River Formation and may extend southward to the Granduc area. This correlation implies a significantly younger age for the Granduc deposit than previously assumed.

Salmon River Formation basalts vary significantly in lithologic character and thickness. Sections of pillowed flows hundreds of metres thick occur immediately adjacent to stratigraphic sections completely lacking correlative strata, suggesting either local volcanic centres or considerable basin relief during deposition. The most common lithotype in the eastern Iskut River area is pillowed to massive volcanic flows. At Treaty Creek, possible correlatives to these flows pass upward into a thick sequence of hydroclastic volcanic breccias. On the western Prout Plateau, basaltic rocks undergo a southward transition from pillowed flows on Mount Shirley, to broken-pillow breccias and volcanic breccias just south of Mount Shirley, to massive volcanic flows farther south.

North of the Iskut River, rocks of the Salmon River Formation underlie the area east of the Forrest Kerr fault (Read *et al.*, 1989), and extend 30 kilometres northward into the More Creek area, where fossil collections indicate early Middle Jurassic (Aalenian) ages (Logan *et al.*, 1992). The volcanic succession comprises up to 2000 metres (Read *et al.*, 1989) of well-preserved, predominantly pillowed lava flows, sparsely pyroxene-phyric, mafic lava flows, scoriaceous lapilli-tuff breccia (Logan *et al.*, 1992) and subordinate, interbedded, cherty, black siltstones and white tuffs (pajama beds) characteristic of the Eskay Creek facies (Anderson and Thorkelson, 1990). Flow tops and facing directions are easily recognized. Interbedded fine-ash tuff and siltstone constitute less than 10 per cent of the section. The basalt is dense, amygdaloidal and made up of fine-grained vitreous plagioclase and rare pyroxene phenocrysts. Subvolcanic gabbroic sills and dikes intrude the volcanic

Plate 2-10-1. Pillow lavas, Eskay Creek mining lease.

pile. Their mineralogy and textures are similar to pillowed and brecciated extrusive rocks for which they probably represent feeders.

Contact relationships between the Salmon River Formation basaltic rocks and enclosing strata are varied through the area: one of the most extensively studied localities is Eskay Creek, where pillowed (*e.g.*, Plate 2-10-1) and brecciated basaltic flows (*see* Plate 2-12-4, in Roth, 1993, this volume) are separated from underlying felsic volcanic rocks of the Mount Dilworth formation by a thin mudstone layer. Well-bedded siltstone to fine-grained wacke overlies the mafic rocks in the Argillite Creek watershed; it is not clear whether these sediments are part of the Salmon River Formation or the overlying Bowser Lake Group (*see* Bartsch, this volume). On the southern Prout Plateau, Salmon River basalts overlie a mudstone and volcanic rock sequence similar in character to Eskay Creek, and the upper contact is eroded. At John Peaks and Mount Madge, east of the Unuk River, Salmon River basalts are tectonically interleaved with mudstones and felsic volcanic rocks along an imbricate thrust fault system, and original stratigraphic contacts are obliterated.

PETROGRAPHY

Thin sections of basalt from the Eskay Creek mining lease contain plagioclase as microphenocrysts and radiating microlites, very locally accompanied by minor pyroxene, which is more commonly obliterated by alteration (*e.g.*, Plate 2-10-2). There is no petrographic evidence for the timing of pyroxene-destructive alteration. Along the western edge of the Prout Plateau, where the unit forms a thick succession of pillowed flows on Mount Shirley textures are characterized by ophitic pyroxene enclosing feldspar (Plate 2-10-3). Basalts in the hangingwall of the 21 zone retain

Plate 2-10-2. Sample AJM-ISK90-117. Plagioclase microphenocrysts and radiating microlites, pillowed basalt flow, Argillite Creek, southern margin of Eskay Creek property; field of view = 1.15 mm.

Plate 2-10-3. Sample S106. Ophitic pyroxene enclosing plagioclase from basalt flow, Mount Shirley area, north Prout Plateau, field of view = 2.5 mm.

primary volcanic textures and plagioclase laths, although plagioclase and glass groundmass are locally altered by sericite and chlorite, respectively. Very locally, carbonate alteration is considerable (visual estimates to 20%), resulting in a buff-grey, fine-grained rock (*e.g.*, exposed in Tom MacKay Creek on the Eskay Creek mining lease) in which carbonate (+ quartz) veinlets cut earlier magnetite veinlets in the mafic rock.

North of the Iskut River, in quenched basaltic rock (close to pillow margins), acicular plagioclase laths form an open intersertal texture with dark iron oxide stained, devitrified glass and variolitic intergrowths of clinopyroxene and plagioclase. In other thin sections, an intergranular texture of randomly oriented, interlocking, subhedral grains of plagioclase and clinopyroxene is more common. Alteration is mainly lower greenschist facies: calcite, chlorite, chalcedonic quartz and rare epidote line vesicles. Prehnite +quartz+chlorite±albite assemblages occur in thinly bedded, intraflow volcanic siltstone and tuffs. Radiating and "bow-tie" structures of prehnite (Plate 2-10-4) are similar to the "crystallites" described at Eskay Creek (Ettlinger, 1991). North of the Iskut River, however, these assemblages are not associated with known mineralization. Locally, plagioclase laths and microlite groundmass are altered to sericite, and chlorite forms pseudomorphs after clinopyroxene.

LITHOGEOCHEMISTRY

The locally pillowed and brecciated volcanic rocks associated with tuffaceous turbidites and argilliceous rocks of the Salmon River Formation in the Eskay Creek area were termed, informally, "andesites" by earlier workers (*e.g.*, Idziszek *et al.*, 1990). Lavas at a similar stratigraphic level in the Forest Kerr Creek area, on the other hand, are basaltic, subalkaline tholeiitic composition, lying on an iron-enrichment trend on an AFM diagram (Logan and Drobe, in preparation). In addition, the Forrest Kerr Creek basaltic rocks plot as ocean-floor basalts on the discrimination diagrams of Pearce and Cann (1973).

Here we present data (Table 2-10-1) comparing relatively unaltered and altered lavas from the Prout Plateau and Forrest Kerr Creek areas, including samples of subvolcanic dikes interpreted to be feeders to overlying flows within the Salmon River Formation. These mafic dikes do not intrude overlying Bowser Lake Group sediments. The Prout Plateau samples have been further divided into a set collected from surface and samples from diamond-drill core in the vicinity of the Eskay Creek 21 zone. Total weight per cent oxides for a small number of samples (*e.g.*, AJM-ISK90-040, total = 96.8 weight %) are low; in most of these cases, carbonate alteration (and, hence, loss on ignition) is considerable, commonly greater than 10 per cent. Other samples included a significant sulphide component (*e.g.*, CA-90-423-55.5, S

Plate 2-10-4. Sample 89-JDR-4-5 : Prehnite in low-grade volcanic rocks from the Forrest Kerr area.

TABLE 2-10-1
OXIDE AND SELECTED TRACE ELEMENT ANALYSES OF VOLCANIC ROCKS, SALMON RIVER FORMATION, NORTHWESTERN B.C.

[Wt.%]	89-JLO-12-3	89-JLO-12-4	89-JLO-12-5	89-JLO-33-7	89-JLO-7-11	89-JLO-9-3.2	89-JLO-9-6.2	89-VKO-11-4	90-VKO-8-1	91-PL-526	AJM-ISK90-008	AJM-ISK90-016	AJM-ISK90-018a	AJM-ISK90-018b	AJM-ISK90-031	AJM-ISK90-040
SiO2	48.00	49.10	46.20	47.50	43.60	46.70	46.50	46.70	48.60	56.50	49.40	51.00	43.70	44.90	57.50	39.70
TiO2	2.00	1.15	2.30	1.44	0.73	1.51	1.48	1.59	1.56	1.28	1.77	1.65	1.75	1.91	1.08	1.35
Al2O3	13.50	16.00	13.60	17.60	13.20	15.30	14.30	15.50	15.50	16.00	15.00	15.40	13.30	16.80	13.20	12.90
Fe2O3	2.06	1.53	2.27	1.12	1.56	1.74	1.83	1.97	1.71	1.07	2.01	1.63	1.60	2.13	1.52	1.30
FeO	10.48	7.80	11.55	5.73	7.95	8.87	9.33	10.02	8.72	5.48	10.25	9.33	9.16	10.86	7.72	6.62
MnO	0.21	0.17	0.22	0.17	0.24	0.17	0.22	0.18	0.18	0.12	0.21	0.19	0.17	0.22	0.22	0.24
MgO	6.70	7.02	6.30	5.93	10.50	6.26	9.72	8.37	5.92	3.24	6.92	3.33	5.14	6.19	2.43	2.70
CaO	9.40	10.70	9.28	8.65	10.60	10.80	8.53	10.40	10.90	4.01	6.18	7.24	5.01	3.76	4.40	16.00
Na2O	2.50	2.66	2.30	3.71	1.08	2.59	2.16	2.64	2.37	6.16	1.66	3.39	3.01	3.31	3.01	0.77
K2O	0.11	0.62	0.02	1.03	0.97	0.43	0.58	0.23	0.23	0.59	0.32	0.37	0.70	0.53	1.50	2.11
P2O5	0.16	0.11	0.20	0.36	0.11	0.23	0.22	0.21	0.15	0.83	0.23	0.23	0.26	0.28	0.48	0.20
LOI	2.54	2.08	3.23	4.39	7.93	3.39	3.93	2.85	3.54	3.82	3.54	2.39	3.54	4.23	5.54	12.80
Sum	97.67	98.94	97.66	97.63	98.48	97.99	98.78	98.65	99.38	98.92	97.49	96.35	95.56	95.14	98.60	96.70
CO2[Wt.%]	1.00	0.80	0.78	2.03	4.47	1.05	0.04	0.47	1.60	1.22	0.87	1.09	2.60	2.12	4.64	12.40
S[ppm]	0	0	155	0	383	0	150	0	54	0	1040	27200	162	154	0	4110
AI	36.40	36.38	35.31	38.02	49.55	33.32	49.02	33.60	31.67	27.32	48.01	25.62	42.14	48.66	34.66	22.61
Au [ppb]	8	0	10	0	0	5	0	0	0	<DL	2	1	0	1	0	0
Nb[ppm]	22	<DL	26	12	<DL	<DL	35	<DL	31	19	11	11	16	21	20	11
Zr[ppm]	108	63	123	122	32	81	75	80	86	164	85	78	81	84	112	75
Ti[ppm]	11990	6894	13789	8633	4368	9052	8753	9532	9352	7674	10611	9892	10491	11450	6475	8093
Y[ppm]	22	15	28	23	11	30	27	34	19	32	31	31	32	34	22	23
Nb/Y	1.00	-	0.93	0.52	-	-	1.30	-	1.63	0.59	0.35	0.35	0.50	0.62	0.91	0.61
Zr/Ti	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01

[Wt.%]	AJM-ISK90-056	AJM-ISK90-065	AJM-ISK90-067	AJM-ISK90-068	AJM-ISK90-069	AJM-ISK90-070	AJM-ISK90-081	AJM-ISK90-082	AJM-ISK90-083	AJM-ISK90-086	BDM91-B109	BDM91-B15	BDM91-546	BDM91-P15	BDM91-[illegible]
SiO2	46.90	47.20	49.20	48.00	49.20	48.10	48.90	43.50	48.10	44.20	48.20	51.50	6.80	45.10	51.50
TiO2	1.68	1.65	1.78	1.72	1.85	1.91	1.75	1.95	1.93	1.55	1.02	1.21	1.97	0.42	0.49
Al2O3	14.70	16.60	15.20	15.40	15.60	16.00	15.00	18.30	19.50	16.70	16.90	14.00	5.50	9.15	17.30
Fe2O3	1.85	1.89	1.85	1.74	1.82	1.82	1.97	1.71	1.62	1.20	1.79	1.64	2.28	0.79	0.30
FeO	9.41	9.64	9.41	8.67	9.25	9.25	10.02	8.72	8.26	6.13	9.10	8.34	1.63	4.01	4.10
MnO	0.21	0.23	0.20	0.20	0.22	0.19	0.22	0.06	0.11	0.09	0.21	0.20	0.19	0.26	0.39
MgO	5.69	5.74	5.43	4.64	5.23	5.61	5.21	10.20	7.14	6.56	8.19	6.58	5.76	6.36	2.14
CaO	9.75	6.05	8.14	6.85	6.45	5.78	6.01	0.18	0.57	6.22	6.41	10.90	8.53	13.00	7.73
Na2O	2.61	3.40	2.97	3.50	4.50	4.63	4.05	1.87	2.75	5.41	2.94	2.08	2.63	2.25	6.30
K2O	0.34	1.67	0.91	1.29	0.34	0.15	0.26	3.64	2.22	0.55	1.25	0.22	1.04	0.91	0.35
P2O5	0.26	0.19	0.24	0.23	0.26	0.25	0.24	0.20	0.21	0.46	0.17	0.16	0.19	0.10	0.33
LOI	1.77	4.23	2.47	3.77	2.93	3.47	2.47	8.23	5.54	8.40	5.23	2.47	0.39	17.50	7.36
Sum	97.36	98.49	97.77	98.21	97.65	97.16	98.09	98.58	97.95	97.47	99.41	99.29	99.11	99.64	99.41
CO2[Wt.%]	0.59	1.37	0.61	2.20	0.55	0.33	0.10	0.00	0.02	6.30	0.38	0.94	0.40	15.70	5.40
S[ppm]	0	130	3980	57	15100	150	0	14000	0	0	0	1	0	0	0
AI	33.51	43.95	36.33	32.44	33.72	35.62	31.20	87.10	73.82	37.94	50.24	34.38	17.44	32.28	17.94
Au [ppb]	0	0	0	5	7	0	0	19	0	-2	<DL	<DL	18	4	7
Nb[ppm]	11	<DL	<DL	24	15	23	23	19	<DL	<DL	2	<DL	4	4	3
Zr[ppm]	78	76	86	80	81	90	84	92	91	<DL	59	85	137	62	55
Ti[ppm]	10072	9892	10551	10311	11091	11450	10491	11690	11570	9292	6115	7254	1610	2524	4119
Y[ppm]	32	32	33	33	35	32	32	27	26	37	32	41	31	-999	46
Nb/Y	0.34	-	-	0.73	0.43	0.72	0.72	0.70	-	-	0.06	-	0.13	0.00	0.07
Zr/Ti	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	0.01	0.01	0.01	0.02	0.02

[Wt.%]	BDM91-S101	BDM91-S105	BDM91-S106	CA89-89-34.3	CA89-89-42.1	CA90-291-15.9	CA90-291-9.2	CA90-291-87.0	CA90-423-29.3	CA90-423-55.5	CA90-423-57.0	D91-196	E91-H17	G91-151	G91-175	GM-92-001	GM-92-002	GM-92-033
SiO2	58.00	43.70	47.70	47.20	39.90	47.00	27.70	45.10	48.70	35.80	35.90	50.50	50.80	51.80	48.10	4.50	47.30	43.30
TiO2	2.10	0.48	0.50	1.52	0.93	1.47	0.67	1.61	1.60	0.87	1.77	1.67	1.67	1.24	1.50	18	1.84	1.54
Al2O3	11.60	17.00	19.70	15.50	9.90	15.30	9.15	15.50	16.00	11.10	16.60	15.40	15.40	16.40	14.70	1.30	14.90	14.30
Fe2O3	1.94	0.98	1.13	1.85	1.31	1.68	1.40	1.83	1.92	1.68	1.53	1.89	1.92	1.28	1.62	08	1.91	1.79
FeO	9.67	5.07	5.77	9.41	6.66	8.57	7.11	9.33	9.79	8.57	7.80	9.64	9.79	6.40	8.26	1.46	9.71	9.10
MnO	0.24	0.12	0.22	0.21	0.24	0.21	0.18	0.16	0.14	0.15	0.14	0.21	0.21	0.14	0.23	19	0.21	0.19
MgO	4.22	4.92	6.73	5.65	3.75	5.31	3.23	11.30	6.70	7.66	16.80	4.22	4.23	4.33	5.08	1.10	4.68	9.33
CaO	5.44	19.60	9.63	9.37	19.60	10.40	28.90	3.01	3.48	9.99	1.85	7.37	7.42	7.52	9.40	72	10.20	8.30
Na2O	3.86	1.23	1.65	3.86	2.38	3.60	0.36	2.89	2.95	0.17	0.48	3.73	3.68	5.06	4.47	24	3.91	1.34
K2O	0.20	0.10	2.45	0.43	0.02	0.50	0.18	0.08	0.58	3.96	2.03	0.27	0.26	0.36	0.14	44	0.25	1.22
P2O5	0.36	0.09	0.06	0.17	0.14	0.19	0.13	0.17	0.18	0.23	0.19	0.23	0.23	0.89	0.18	14	0.24	0.24
LOI	2.93	6.23	3.77	2.70	12.50	3.39	16.50	6.54	3.77	4.77	6.39	3.54	3.54	2.93	4.62	77	4.16	7.38
Sum	98.75	99.53	99.52	97.68	97.32	97.62	95.51	97.32	95.61	84.75	95.48	98.67	98.15	98.35	98.30	9.11	99.11	97.83
CO2[Wt.%]	0.18	2.36	0.13	1.19	13.10	2.72	17.90	2.17	1.16	8.21	1.23	0.88	0.88	0.30	2.96	.15	2.01	3.12
S[ppm]	0	0	0	827	5290	1370	12100	305	-50	47300	11300	17000	19000	960	2500	0	0	0
AI	32.22	19.42	44.43	31.78	14.64	29.33	10.44	66.63	53.10	63.35	89.84	28.60	28.80	27.13	27.34	8.73	25.69	52.32
Au [ppb]	33	<DL	<DL	11	3	<DL	<DL	3	6	780	100	6	3	6	2	1	2	4
Nb[ppm]	4	<DL	<DL	31	15	17	<DL	14	14	18	19	5	5	27	5	<DL	<DL	<DL
Zr[ppm]	156	36	37	78	52	72	49	79	75	65	87	92	94	175	80	57	87	62
Ti[ppm]	12589	2860	3021	9112	5551	8813	4005	9652	9592	5228	10611	10012	10012	7434	8993	374	9632	9232
Y[ppm]	56	<DL	32	32	21	31	17	40	30	22	22	31	24	37	33	<DL	25	27
Nb/Y	0.07	-	-	0.97	0.71	0.55	-	0.35	0.47	0.82	0.86	0.16	0.21	0.73	0.15	-	-	-
Zr/Ti	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01

Analyses by X Ray Assay Laboratories, Don Mills, Ontario. FeO and Fe_2O_3 calculated from Total Iron analysis as Fe_2O_3; TiO2 (ppm) calculated from wt. % TiO_2. AI is an alteration index after the method of Ishikawa et al. *(1976).*

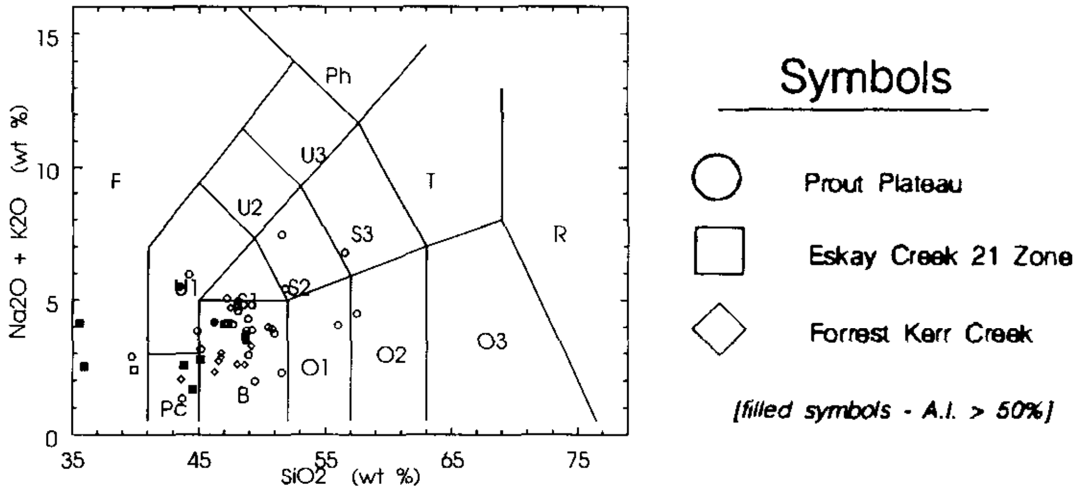

Figure 2-10-2. Total alkali – silica diagram (after LeMaitre, 1989); classification of volcanic rocks (Le Bas *et al.*, 1986). Circles are volcanic rock samples from the Prout Plateau, squares are from diamond-drill core at Eskay Creek, diamonds are from Forest Kerr Creek; filled symbols are those registering with AI>50% (refer to Table 2-10-1).

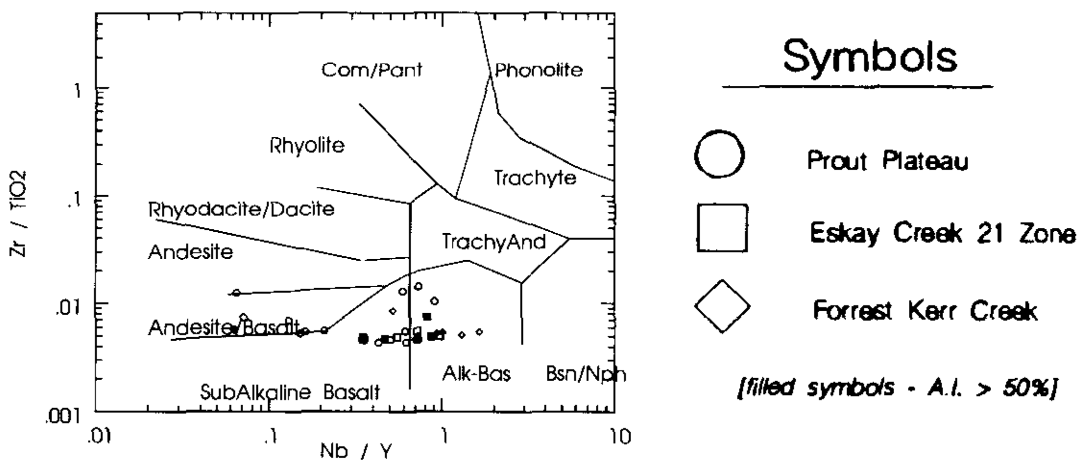

Figure 2-10-3. Zr/TiO_2 vs. Nb/Y diagram (after Winchester and Floyd, 1977), basaltic and intermediate rocks in the Iskut River and Forest Kerr Creek areas. Circles are samples from the Prout Plateau, squares are from diamond-drill core at Eskay Creek, diamonds are from Forest Kerr Creek; filled symbols are those registering with AI>50% (refer to Table 2-10-1).

= 47 300 ppm, or 4.7 %). Caution is required in interpretation of data from samples that contain elevated quantities of elements resulting from alteration.

An "index of alteration" (included in Table 2-10-1) is the percentage ratio $(K_2O + MgO) \times 100/(K_2O + MgO + Na_2O + CaO)$, established originally for felsic rocks by Ishikawa *et al.* (1976). The index is an assessment of alteration phenomena including "addition" of potassium and magnesium, with "removal" of sodium and calcium. This method can only be considered as a first-pass technique as it does not consider conservation of species, nor the effects of closure. Gemmell and Large (1992) demonstrated that the alteration index (AI) is applicable to intermediate and mafic rocks in the Hellyer mine, Tasmania.

Figure 2-10-2 (silica - total alkalis diagram, with rock nomenclature after Le Bas *et al.*, 1986) indicates that most of the rocks are basaltic in composition. Outliers, with silica less than 41 per cent, are samples that have suffered considerable carbonate alteration (Table 2-10-1), most of which are from diamond-drill core in the vicinity of the Eskay Creek deposits. A small number of samples (4) are picrobasaltic, including one from the Forrest Kerr Creek area; the remainder of the Forrest Kerr data cluster tightly within the basaltic field. Prout Plateau rocks, on the other hand, exhibit a range in composition from picrobasalt, through basalt to trachyandesite and andesite. Two samples within the tephrite-basalt field have suffered alkali alteration and are discussed separately below.

Trace element contents suggest alkaline basalt to subalkaline basaltic compositions (Figure 2-10-3; Winchester and Floyd, 1977). Basalts from the Forrest Kerr Creek area again show a restricted composition, whereas Prout Plateau rocks show a range of compositions from basaltic to andesitic. More data are required to assess whether these differences reflect different, time-equivalent volcanic centres; unrelated volcanic events; a natural variation in basalt chemistry; or hydrothermal alteration.

The alteration index data (Table 2-10-1) suggest that the Forrest Kerr Creek sample set comprises a relatively unaltered suite. One sample (BDM91-109) from the Mount Shirley area of the Prout Plateau has an index of 50.24 per cent. Six samples from diamond-drill core in the vicinity of the Eskay Creek 21 zone and also two samples collected from surface in Tom McKay Creek, to the north of the Eskay Creek 21 zone, registered high alteration indices. The two outcrop samples (AJM-ISK90-082, -083; AI = 87.1% and 73.82%, respectively) were collected from the projection to surface of the hangingwall above the Eskay Creek 21 mineralized zone. Gold contents in these two rocks are less than 20 ppb. Another basaltic sample from a nearby exposure in Tom McKay Creek (AJM-ISK90-086, AI = 37.9%) did not register a significant AI using this approach, as the rock has apparently suffered carbonate alteration (CO_2 = 6.3 wt. %) and possible sodium addition (Na_2O = 5.4 wt. %; Table 2-10-1).

SUMMARY

Intermediate to mafic volcanic rocks are a key component of Salmon River Formation hostrocks to the Eskay Creek precious and base metal deposits in the Iskut River area of northwestern British Columbia. An initial appraisal of basalt petrology and geochemistry from the Prout Plateau and Forrest Kerr Creek areas suggests that hydrothermal alteration related spatially and, by inference, genetically to mineralization, may be recorded in the basaltic rocks. The alteration signatures are revealed by a crude measure of alteration involving the oxides of potassium, magnesium, sodium and calcium. These preliminary results encourage us to investigate further the effects of mass transfer that accompanied alteration in the Eskay Creek mineralizing system, through the employment of more rigorous and quantitative analysis, such as that proposed by Pearce (1968).

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