Mineral Deposit Research Unit
The University of British Columbia

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GEOCHRONOMETRY OF THE ISKUT RIVER AREA – AN UPDATE (104A and B)

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INTRODUCTION

The Mineral Deposit Research Unit's (MDRU) project "Metallogeny of the Iskut River Area, Northwestern British Columbia" (Macdonald *et al.*, 1991) is employing high-precision, U-Pb zircon geochronometry to augment the understanding of the relative and absolute timing of intrusive and extrusive events associated spatially with base and precious metal mineralization. Researchers are working together with geologists from the federal and provincial Geological Surveys, and with mining and exploration company geologists active in the area. Data gathered during this study will be integrated with paleontological studies in progress (*e.g.*, Nadaraju and Smith, 1992) to further refine our understanding of stratigraphic relationships and timing. In this contribution, we report four new U-Pb results for zircons from plutons in the Iskut River area; three are from the lower Iskut River district, in the vicinity of the Snip mine and Johnny Mountain and Inel properties; one is from the Eskay Creek area.

EXISTING DATABASE

Alldrick *et al.* (1986, 1987), Anderson (1989), Anderson and Bevier (1990), Anderson *et al.* (1991), Anderson and Thorkelson (1990) and Bevier and Anderson (1991) have summarized the K-Ar and U-Pb isotopic data available for the Iskut River and adjacent areas (*e.g.*, Stewart) comprising northwest Stikinia (Wheeler and McFeely, 1987). In brief, these data indicate four principal plutonic events (Table 6-1-1); Anderson and Bevier (1990) suggest that at least the first three of these have associated extrusive equivalents.

TABLE 6-1-1
PLUTONIC EVENTS, SUITES AND RELATED EXTRUSIVE EQUIVALENTS (ANDERSON AND BEVIER, 1990)

Plutonic Event	Plutonic Suite	Extrusive Equivalent
230-226 Ma (Late Triassic)	Stikine	Stuhini Group
211-187 Ma (Late Triassic to Early Jurassic)	Texas Creek	Hazelton Group
179-172 Ma (Middle Jurassic)	Three Sisters	Salmon River *Formation*
55-51 Ma (Tertiary)	Coast Plutonic Complex	

Anderson and Thorkelson (1990) and Bevier and Anderson (1991) propose a widespread unconformity in northwestern Stikinia separating Toarcian (Harland *et al.*, 1989) and younger (Middle Jurassic) rocks from underlying Early Jurassic strata, attributed to late Early Jurassic contractional deformation.

SAMPLE DESCRIPTIONS – PETROLOGY AND GEOCHEMISTRY

Four samples collected during the MDRU 1990 field program from the Iskut area were analyzed in 1991:

(1) Iskut River (Bronson) stock, on the Iskut Joint Venture property.
(2) Red Bluff porphyry, collected from the Snip property.
(3) Inel stock, on the Inel property.
(4) Eskay porphyry, on the Eskay Creek/GNC properties.

Refer to Figure 6-1-1 for property locations.

ISKUT RIVER (BRONSON) STOCK

Britton *et al.* (1990b) describe the Iskut River stock as follows:

"Phaneritic intrusions of probable early Jurassic age include ... the Iskut River stock. ... A common feature of these intrusions is the presence of coarse (up to 5 cm) potassium feldspar phenocrysts."

The sample of the Iskut River stock collected in 1990 by A.J.M. (AJM-ISK90-333) from the Iskut Joint Venture property (Prime Resources Group Inc., American Ore Ltd., Golden Band Resources Inc.; Figure 6-1-1) is a plagioclase-phyric, locally alkali feldspar phyric, monzodiorite, based upon thin section estimates (plagioclase 60%, poikilitic potassium feldspar 25%, quartz 10% and biotite 5%). The chemical composition of the rock given in Table 6-1-2 yielded a low An:[An+Or] ratio (<10) and a quartz - alkali feldspar syenite classification (Streckeisen and LeMaitre, 1979). Plagioclase euhedra are zoned, with sericitized cores and rims of less altered feldspar, and are locally contained within poikilitic potassium feldspar.

RED BLUFF PORPHYRY

Britton *et al.* (1990b) described the Red Bluff porphyry (which outcrops on both Cominco Ltd. and Prime Resources Group Inc.'s Snip property and Skyline Gold Corporation's Johnny Mountain holdings, Figure 6-1-1) as a potassium feldpar phyric, Early Jurassic intrusion (*see* description of Iskut River stock). The sample collected by A.J.M. (AJM-ISK91-041) from the 130-metre haulageway in the Snip mine is an altered, sheared, feldspar-megacrystic intrusive rock that is not an ideal candidate for U-Pb geochronometry due to abundant (1 to 5%) pyrite as an alteration product. The Red Bluff porphyry and spatially associated mineralization is the subject of a companion study being conducted by Ettlinger (in preparation). In addition, Rhys and Godwin (1992, this volume) are investigating the structural geology of the Snip mine, including the Red Bluff porphyry, as part of an M.Sc. thesis by Rhys in progress at The University of British Columbia.

TABLE 6-1-2
LITHOGEOCHEMICAL DATA [Wt. %]

	AJM-ISK90-333 Iskut River Stock	AJM-ISK90-162 Inel Stock	AJM-ISK90-111 Eskay Porphyry	DJA-90-PZ1 Eskay Porphyry
SiO_2	62.7	69.8	67.8	64.1
TiO_2	0.42	0.29	0.48	0.58
Al_2O_3	17.4	16.5	14.7	16.4
Fe_2O_3	4.09	2.62	3.53	3.69
MgO	1.39	0.69	0.26	0.25
MnO	0.05	0.09	0.05	0.07
CaO	4.45	0.19	0.12	0.14
Na_2O	3.97	2.96	1.82	2.40
K_2O	3.86	5.48	8.8	9.86
P_2O_5	0.17	0.08	0.15	0.17
H_2O	0.8	1.8	1.6	1.1
CO_2	[dl]	0.04	[dl]	[dl]
TOTAL	99.3	100.54	99.31	98.76

Note: 1. [dl] = below detection limit
2. Total iron as Fe_2O_3
3. Analyses by X-Ray Assay Laboratories, Don Mills, Ontario

Inel Stock

Britton *et al.* (1990b) describe the Inel felsite stock (property location, Figure 6-1-1) as follows:

"Synvolcanic intrusions are thought to be comagmatic and coeval with extrusive rocks. Examples include felsite stocks on the ... Inel property. These are leucocratic to holofelsic, cream to tan, porphyritc rocks with fine feldspar and quartz phenocrysts set in an aphanitic groundmass. Contacts are altered and sheared, but the stocks appear to form sill-like bodies that are crudely conformable with enclosing strata. On the Inel property the felsite stock is associated with a small felsite dike swarm."

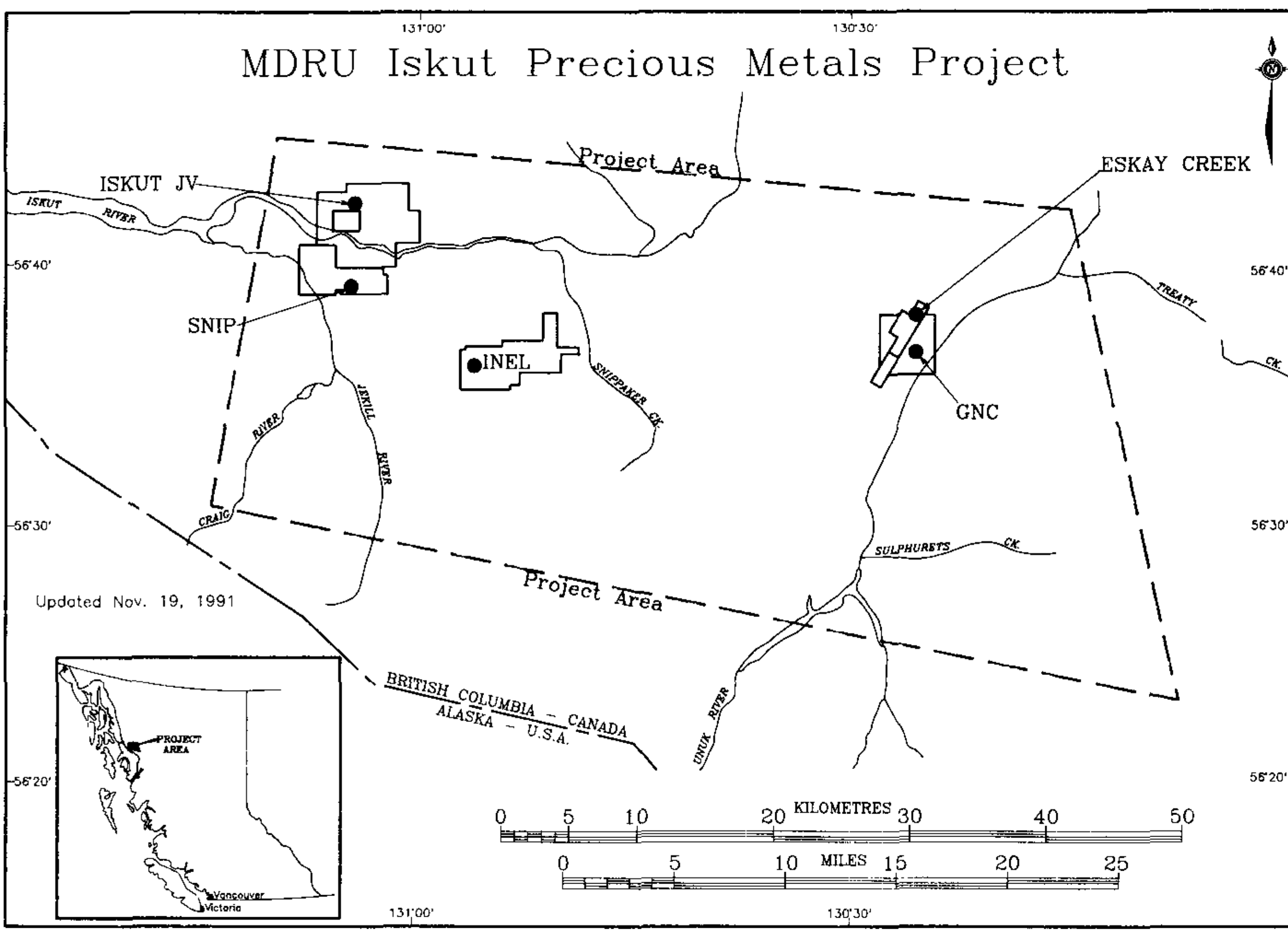

Figure 6-1-1. Location map of the Iskut River Project area, showing properties from which samples described in this report were collected.

The Inel stock is also spatially associated with diatreme-like, igneofragmental breccia dikes that cut overlying strata, indicative of vigorous devolatilization of a magma body, which may have consolidated to form the Inel stock, or a related, blind intrusion.

Sample AJM-ISK90-162 was collected from the Gulf International Minerals Ltd. exploration campsite (1990) on the Inel property and contains altered feldspar (15%) and *quartz (5%) phenocrysts in a fine-grained quartz-feldspar* groundmass. A quartz monzodiorite composition is indicated (Streckeisen and LeMaitre, 1979) from the chemical composition (Table 6-1-2).

Eskay Porphyry

A sill-like body (C. Edmunds, International Corona Corporation, personal communication, 1991) of feldspar porphyry crops out approximately 1 kilometre east of the 22 zone at Eskay Creek, and straddles the claim boundary between the Eskay Creek and GNC properties (both properties operated by International Corona Corporation; Figure 6-1-1). Britton *et al.* (1990a), relying also on Donnelly (1976), described the body thus:

"... granodiorite porphyry ... [with] subhedral phenocrysts of oligoclase, up to 1 millimetre long, (36%), anhedral quartz, 0.3 millimetre diameter, (11%) and 1 millimetre, subhedral grains of orthoclase (8%), ... are set in a fine-grained quartz-feldspar matrix. Plagioclase is extensively replaced with chlorite and sericite. Its bulk composition is similar to dacitic pyroclastics seen higher in the section. It may represent a synvolcanic plug or a thick dacitic flow."

Exploration diamond drilling conducted in 1990 by Prime Resources Group Inc. demonstrated the local presence of potassium feldspar megacrysts, up to 2 centimetres in long dimension (V.P. Van Damme, Project Geologist, personal communication, 1990). Along the northern and western margins inclusions, rafts and complex interfingering of porphyry and hornfelsed argillite country rock occurs within the "Porphyry zone".

Two samples from the Eskay porphyry were selected for lithogeochemical analysis: AJM-ISK90-111, collected from outcrop by A.J.M. and DJA-90-PZ1, collected from talus blocks at the base of a cliff by D.J.A. The latter sample was also selected for U-Pb geochronometry (see below). Sample AJM-ISK90-111 is an amphibole (5%) plagioclase (20%) potassium feldspar (20%) porphyry. Phenocrysts up to 3.2 millimetres occur in an altered groundmass (<0.1 mm) of (?) *quartz and feldspar; amphibole is also completely* altered. Sample DJA-90-PZ1 is similar, with coarser grain size (phenocrysts to 1 cm) and more abundant plagioclase (approximately 30%) compared to potassium feldspar (10%), and with accessory biotite (<5%) and pyrite (1-2%). Both rocks are compositionally similar (Table 6-1-2) and are classified as alkali-feldspar granites (Streckeisen and LeMaitre, 1979).

Early Jurassic potassium feldspar megacrystic plutons (*e.g.*, phases of the Iskut River, Red Bluff and Eskay bodies) are texturally similar to rocks described in the Stewart area ("Premier porphyries", a component of the Texas Creek plutonic suite, Table 6-1-1; *e.g.*, Alldrick, 1987; Brown, 1987), that show a spatial and temporal relationship with the Silbak Premier gold, silver and base metal deposit. Grove (1971) and, more recently, Anderson (1989) and Britten and Alldrick (1990) suggested that there may be a genetic relationship between the Premier-like igneous bodies and precious metal mineralization (with or without base metals) in both the Stewart and Iskut areas. This hypothesis will be tested further as part of MDRU's Iskut project.

U-Pb GEOCHRONOMETRY ANALYTICAL PROCEDURES

All work was carried out in the geochronometry laboratory at the Department of Geological Sciences, The University of British Columbia. Zircon-rich heavy mineral concentrates were recovered using standard crushing, grinding wet shaking (Wilfley table) and heavy liquid separation techniques. Abundant pyrite in the Wilfley concentrate from sample AJM-ISK91-41 (Red Bluff porphyry) was removed from heavy silicates by flotation using warm 7N HNO_3. Pure zircon populations from nonmagnetic size fractions were handpicked in ethanol. Zircons from sample DJA-90-PZ-1 (Eskay porphyry) were separated by hand from abundant pyrite in the heavy fraction and were treated with HNO_3 only during final zircon washing. Abrasion of all zircon fractions was done using the procedure of Krogh (1982), and zircons were handpicked from the abrasion mixture. Zircon dissolution was done in microcapsules using the technique of Parrish (1987), and uranium and lead chemistry procedures were modified from the technique developed by Krogh (1973).

Uranium and lead concentrations were determined using a ^{205}Pb-^{233}U-^{235}U mixed spike (Parrish and Krogh, 1987). Uranium and lead were loaded together on single rhenium filaments using H_3PO_4 and silica gel and analyzed in a VG Isomass 54R solid-source mass spectrometer in single collector mode (Daly photomultiplier). Analytical precision was better than 0.1 per cent for ^{207}Pb:^{206}Pb and ^{208}Pb:^{206}Pb, and better than 0.3 per cent for ^{205}Pb:^{207}Pb. Precisions for ^{204}Pb:^{205}Pb were as much as 1 per cent due to small ^{204}Pb ion beam currents (in the 10-16 A range). Total procedural blanks were approximately 40 picograms lead and 30 picograms uranium, based on repeated analyses of blanks during the period our analyses were carried out.

Lead:uranium and lead:lead errors for individual zircon fractions were obtained by individually propagating all calibration and analytical uncertainties through the date calculation and summing the individual contributions to total variance. Errors on individual U-Pb dates are quoted at the 2 sigma level (95% confidence interval). The U-Pb analytical data are given in Table 6-1-3.

DISCUSSION OF RESULTS

The Iskut River (Bronson) stock is either Early Jurassic or Late Triassic in age. This uncertainty is due to noncolinearity of the error ellipse for the +149-micron fraction relative to the ellipsoids for the other three fractions, all of which clearly show the effects of lead loss (Figure 6-1-2c). A best-fit chord through the three colinear points has an upper intercept of $225^{+100}/_{-40}$ Ma; the lower intercept is 142 Ma, but no significance is attached to this date. A best-fit chord through all four points and 0 Ma intersects concordia at 203±4 Ma. The youngest and oldest $^{207}Pb/^{206}Pb$ dates for the four fractions are 197±8 Ma and 208±2 Ma, respectively. We interpret the age of the Iskut River (Bronson) stock to lie between 197 and 225 Ma, based on the youngest $^{207}Pb/^{206}Pb$ date and the upper intercept for the three colinear points.

Zircons from the Red Bluff porphyry have a minimum age of 195±1 Ma, but are not likely to be much older. The effect of lead loss is evident from dispersion of three error ellipsoids along concordia (Figure 6-1-2b). This dispersion may be due to lead loss during a hydrothermal mineralizing event shortly after emplacement and crystallization of the intrusion (note that the sample contained significant pyrite). This interpretation is speculative and the problem of timing of lead loss from Red Bluff zircons will require further investigation. The error ellipse for the coarse, +149-micron fraction plots below concordia, and its errors are relatively large due to low-intensity ion beams (a result of sample loss during column chemistry), but its $^{206}Pb:^{238}U$ date is within error of the oldest concordant fraction. The anomalously high Pb:Pb date for this fraction may reflect minor inheritance of older radiogenic lead.

The Inel stock is 190±3 Ma old, based on the upper intercept with concordia of a best-fit chord through all four points, forced through 0 Ma (Figure 6-1-2d). Forcing the

TABLE 6-1-3
U-Pb ANALYTICAL DATA[1]

Sample Fraction[2]	Wt (mg)	U (ppm)	Pb[3]	Isotopic abundance[4] $^{206}Pb=100$ 208	207	204	6/4[5]	Isotopic ratios[6] ±2σ errors $^{206}Pb^*/^{238}U$	$^{207}Pb^*/^{235}U$	$^{207}Pb^*/^{206}Pb$
								Dates (Ma)[7] ±2σ errors		
AJM-ISK90-333 Iskut River (Bronson Stock)[8]										
−74	0.8	580	16.8	9.18	5.11	0.0074	8199	0.02944±16	0.20310±124	0.05003±16
NM2/2 ABR								**187.0±1.0**	**187.7±1.0**	**196.5±7.8**
−134+74	1.9	470	13.9	8.59	5.25	0.0161	5379	0.03020±14	0.20877±106	0.05013±6
NM2/2 ABR								**191.8±1.0**	**192.5±0.8**	**201.1±3.1**
−149+134	3.5	428	12.6	7.71	5.04	0.0017	31665	0.03038±14	0.21004±94	0.05015±6
NM2/2 ABR								**192.9±0.8**	**193.6±0.8**	**201.7±2.8**
+149	3.8	380	10.9	7.18	5.14	0.0075	11031	0.02976±20	0.20632±142	0.05029±4
NM2/2 ABR								**189.0±1.2**	**190.5±1.2**	**208.4±2.0**
AJM-ISK91-041 Red Bluff porphyry[9]										
−74	1.2	437	13.2	10.60	5.42	0.0290	3001	0.03018±16	0.20788±120	0.04995±10
NM2/2 ABR								**191.7±1.0**	**191.8±1.0**	**192.9±4.3**
−149+134	1.4	341	10.3	7.98	5.21	0.0142	5341	0.03077±16	0.21208±120	0.04999±14
NM2/2 ABR								**195.4±0.6**	**195.3±1.0**	**194.4±6.4**
+149	0.9	317	10.0	10.27	6.37	0.0886	1037	0.03099±30	0.21644±268	0.05066±38
NM2/2 ABR								**196.7±2.0**	**198.9±2.2**	**225.2±17.4**
−134+74	3.1	376	11.4	9.94	5.57	0.0388	2443	0.03040±18	0.20972±140	0.05003±18
NM2/2 ABR								**193.0±1.2**	**193.3±1.2**	**196.6±8.0**
AJM-ISK90-162 Inel stock[10]										
−74	5.3	590	18.4	21.29	5.34	0.0241	4002	0.02843±18	0.19536±132	0.04983±6
NM2/2 ABR								**180.7±1.2**	**181.2±1.2**	**187.3±3.2**
−134+74	2.2	521	17.1	22.52	6.31	0.0896	1084	0.02910±14	0.20054±112	0.04999±14
NM2/2 ABR								**184.9±0.8**	**185.6±1.0**	**194.4±6.4**
−149+134	0.8	487	15.2	17.92	5.51	0.0357	2400	0.02927±14	0.20135±116	0.04989±18
NM2/2 ABR								**186.0±1.0**	**186.3±1.0**	**189.7±8.2**
+149	0.3	484	18.7	28.75	10.98	0.4077	236	0.02956±24	0.20326±308	0.04987±62
NM2/2 ABR								**187.8±1.4**	**187.9±2.6**	**189.1±28.8**
DJA-90-PZ-1 Eskay porphyry[11]										
−74	0.5	489	15.3	21.63	5.21	0.0143	4213	0.02856±14	0.19670±94	0.04997±8
NM2/2 lightly abraded								**181.5±0.8**	**182.3±0.8**	**193.0±2.0**
−134+74	1.5	328	10.1	18.18	5.07	0.0059	9475	0.02909±14	0.19990±98	0.04984±8
NM2/2 ABR								**184.8±0.8**	**185.0±0.8**	**187.6±4.0**
−149+134	2.2	279	8.6	16.66	5.13	0.0102	7214	0.02920±16	0.20035±114	0.04977±10
NM2/2 ABR								**185.5±1.0**	**185.4±1.0**	**184.1±4.4**
+149	5.5	220	6.7	15.03	5.18	0.0131	6648	0.02913±22	0.20024±146	0.04986±10
NM2/2 ABR								**185.1±1.4**	**185.3±1.2**	**188.4±4.2**

NOTES:
1 Complete analytical data, including the measured $^{206}Pb/^{204}Pb$ errors, the mole % blank Pb and the $Pb^*/(Pb^*+Pb_{common})$ ratios in the analyses, the assumed Stacey-Kramers common Pb ages and their errors, and the correlation coefficients for the Pb/U ratios, are recorded on UBC Geochronometry Laboratory data sheets.
2 −149+74 = size range in microns; all fractions are nonmagnetic on Frantz isodynamic separator at 2 A and 2° side tilt; all fractions were abraded to remove outer rims.
3 radiogenic + common Pb.
4 radiogenic + common Pb, corrected for 0.15%/amu fractionation and for 40 pg Pb blank with composition 208:207:206:204=37.30±0.75:15.50±0.34:17.75±0.19:1.
5 $^{206}Pb/^{204}Pb$ measured, corrected for 0.15%/amu fractionation.
6 corrected for fractionation (0.12%/amu for U, 0.15%/amu for Pb), blank Pb (see note 4 above), and for common Pb using the Stacey and Kramers (1975) growth curve; errors are 2 sigma, only last digits are shown.
7 decay constants used in age calculation : $\lambda^{238}U=1.55125\times10^{-10}$, $\lambda^{235}U=9.8485\times10^{-10}$; $^{238}U/^{235}U=137.88$ (Steiger and Jager, 1977). Errors are 2 sigma.
8 collected by AJM, Latitude : 56° 40′ 32″ N, Longitude : 131° 06′ 30″ W; UTM zone 370800 E, 6283270N.
9 collected by AJM, Latitude : 56° 40′ 0″ N, Longitude : 131° 07′ 37″ W; UTM zone 371300 E, 6282340 N.
10 collected by AJM, Latitude : 56° 37′ 45″ N, Longitude : 130° 57′ 18″ W; UTM zone 379800 E, 6275700 N.
11 collected by DJA, Latitude : 56° 38′ 23″ N, Longitude : 130° 26′ 40″ W; UTM zone 411650 E, 6277350 N

chord through 0 Ma is reasonable given the roughly similar Pb:Pb dates of all four fractions, which have clearly suffered some lead loss. The analytical errors for the coarse, +149-micron fraction are somewhat large, due to low-intensity ion beams (small sample load, also reflected in low $^{206}Pb:^{204}Pb$ ratio), but this does not affect the age interpretation for this sample.

Sample DJA-90-PZ-1 of the Eskay porphyry yields an age of 186±2 Ma based on mutual overlap of three error ellipsoids with concordia (Figure 6-1-2a). A fourth, lightly abraded, very fine grained fraction plots below concordia, probably due to minor lead loss. The good analytical quality of the data suggests that the age of the Eskay porphyry is early Toarcian.

SUMMARY

Interpreted ages for the Inel stock and Red Bluff porphyry (190±3 and 195±1Ma, respectively) fall well within the range of Early Jurassic plutonism coeval with Hazleton arc volcanic rocks (205-187 Ma, Table 6-1-1). The interpreted age for the Eskay porphyry (186±2 Ma) is slightly younger than the age range of the Early Jurassic event, although the difference is minimal; at this time, we interpret the Eskay porphyry to be a member of the Early Jurassic Texas Creek suite, thus extending the known time span for this plutonic event in the Iskut River area.

The age of the Iskut River (Bronson) stock is uncertain, due to the highly discordant and variable nature of the data set; it is likely that the stock has an age between 225 and 197 Ma (Late Triassic to Hettangian/Sinemurian). Further work will be required to improve this estimate.

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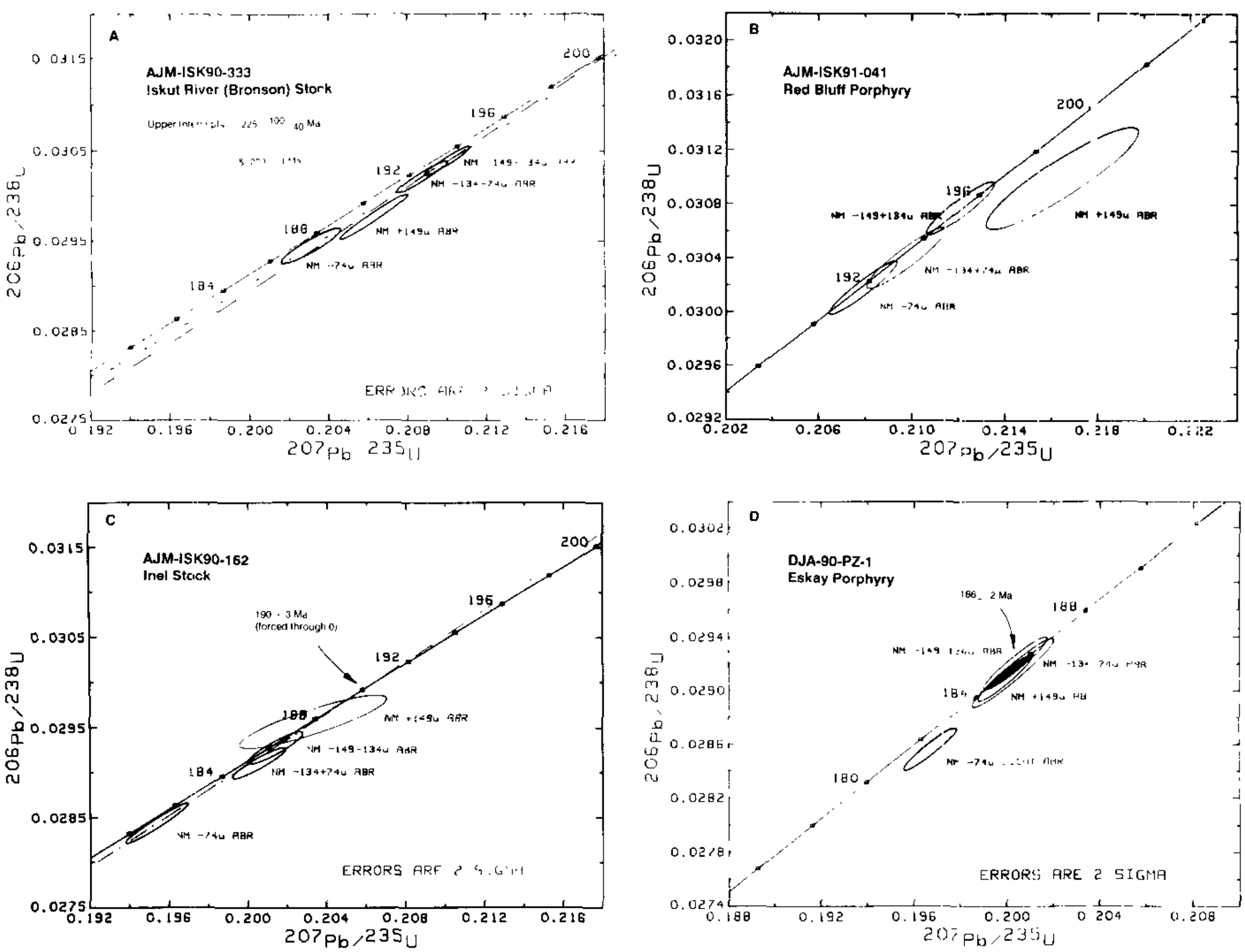

Figure 6-1-2. $^{206}Pb:^{238}U$ Vs. $^{207}Pb:^{235}U$ concordia graphs for (a) Eskay Creek porphyry (b) Red Bluff porphyry (c) Iskut River (Bronson) stock (d) Inel stock.

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