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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(MDRU Contribution 004)

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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 palaeontological studies in progress (e.g., Nadaraj 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>
<thead>
<tr>
<th>Plutonic Event</th>
<th>Plutonic Suite</th>
<th>Extrusive Equivalent</th>
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</thead>
<tbody>
<tr>
<td>230-226 Ma (Late Triassic)</td>
<td>Stikine</td>
<td>Stuhini Group</td>
</tr>
<tr>
<td>211-187 Ma (Late Triassic to Early Jurassic)</td>
<td>Texas Creek</td>
<td>Hazelton Group</td>
</tr>
<tr>
<td>179-172 Ma (Middle Jurassic)</td>
<td>Three Sisters</td>
<td>Salmon River Formation</td>
</tr>
<tr>
<td>55-51 Ma (Tertiary)</td>
<td>Coast Plutonic Complex</td>
<td></td>
</tr>
</tbody>
</table>

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

SAMPLE DESCRIPTIONS – PETROLOGY AND GEOCHEMISTRY

Four samples collected during the MDFU 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/GC property.

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

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-ISK00-333) from the Iskut Joint Venture property (Prime Resources Group Inc., American Ore Ltd., Golden Band Resources Inc.; Figure 6-1-1) is a plagioclase-phryic, locally alkali feldspar phryic, 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 quartz + alkali feldspar syenite classification (Streckeisen and LeMaître, 1979). Plagioclase euhedra are included, with scribe with 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 feldspar phryic, Early Jurassic intrusion (see

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 Etlinger (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.

**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, porphyritic 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.”

### Table 6-1-2

<table>
<thead>
<tr>
<th></th>
<th>AJM-ISK90-333</th>
<th>AJM-ISK90-162</th>
<th>AJM-ISK90-111</th>
<th>DJA-90-PZ1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Inel Stock</td>
<td>Inel Stock</td>
<td>Eskay Porphyry</td>
<td>Eskay Porphyry</td>
</tr>
<tr>
<td>SiO₂</td>
<td>62.7</td>
<td>69.8</td>
<td>67.8</td>
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<tr>
<td>TiO₂</td>
<td>0.42</td>
<td>0.29</td>
<td>0.48</td>
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<tr>
<td>Al₂O₃</td>
<td>17.4</td>
<td>16.5</td>
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<tr>
<td>Fe₂O₃</td>
<td>4.09</td>
<td>2.62</td>
<td>3.53</td>
<td>3.69</td>
</tr>
<tr>
<td>MgO</td>
<td>1.39</td>
<td>0.69</td>
<td>0.26</td>
<td>0.25</td>
</tr>
<tr>
<td>MnO</td>
<td>0.05</td>
<td>0.09</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>CaO</td>
<td>4.45</td>
<td>0.19</td>
<td>0.12</td>
<td>0.14</td>
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<tr>
<td>Na₂O</td>
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<td>2.96</td>
<td>1.82</td>
<td>2.40</td>
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<tr>
<td>K₂O</td>
<td>3.86</td>
<td>5.48</td>
<td>8.8</td>
<td>9.86</td>
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<td>P₂O₅</td>
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<td>0.08</td>
<td>0.15</td>
<td>0.17</td>
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<tr>
<td>H₂O</td>
<td>0.8</td>
<td>1.8</td>
<td>1.6</td>
<td>1.1</td>
</tr>
<tr>
<td>CO₂</td>
<td>[dl]</td>
<td>0.04</td>
<td>[dl]</td>
<td>[dl]</td>
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<tr>
<td>TOTAL</td>
<td>99.3</td>
<td>100.54</td>
<td>99.31</td>
<td>98.76</td>
</tr>
</tbody>
</table>

Note: 1. [dl] = below detection limit
2. Total iron as Fe₂O₃
3. Analyses by X-Ray Assay Laboratories, Don Mills, Ontario
The Inel stock is also spatially associated with diatreme-like, igneous fragmental 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 quartzfeldspar 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 quartzfeldspar matrix. Plagioclase is extensively replaced with chlorite and sericite. Its bulk composition is similar to dacite 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 diameter (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 megacryst 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 Britton and Alldrick (1990) suggested that there may be a genetic relationship between the Premier-like igneous bodies and precious metal mineralization within 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) were removed from heavy silicates by flotation using washing with NH4 NO3. Pure zircon populations from nonmagnetic size fractions were handpicked in ethanol. Zircons from sample DIA-90-PZ-1 (Eskay porphyry) were separated by hand from abundant pyrite in the heavy fraction and were treated with HNO3 only during final zircon washing. Fracturing 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 microcapillaries 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 203Pb-232U-235U mixed spike (Parrish and Krogh, 1987). Uranium and lead were loaded together on single rhodium filaments using H2PO4 and silica gel and analyzed in VG Isomass 54R solid-source mass spectrometer single collector mode (Daly photomultiplier). Analytical precision was better than 0.1 per cent for 206Pb:207Pb and 208Pb and 206Pb, and better than 0.3 per cent for 206Pb:207Pb. Precisions for 204Pb:206Pb were as much as 1 per cent due to small 204Pb ion beam currents (in the 1.16 X, 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.

Leaduranium 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 non-colinearity 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 207Pb/206Pb dates for the four fractions are 197 ± 8 Ma and 208 ± 2 Ma, respectively. We interpret the age of the Iskit River (Bronson) stock to lie between 197 and 225 Ma, based on the youngest 207Pb/206Pb 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 6-12b). 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 close, +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 206Pb/238U 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 6-12d). Forcing the

<table>
<thead>
<tr>
<th>Sample Fraction</th>
<th>Wt (mg)</th>
<th>U (ppm)</th>
<th>Pb</th>
<th>Isotopic abundance</th>
<th>6/45</th>
<th>206Pb/207Pb</th>
<th>207Pb/208Pb</th>
<th>206Pb/203Pb</th>
<th>238U/206Pb</th>
<th>208Pb/206Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJM-ISK90-333 Iskit River (Bronson Stock)</td>
<td>0.8</td>
<td>580</td>
<td>16.8</td>
<td>9.18</td>
<td>5.11</td>
<td>0.0074</td>
<td>8199</td>
<td>0.0294±16</td>
<td>0.203±10×124</td>
<td>0.0503±16</td>
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<tr>
<td>NM2/ ABR</td>
<td>1.9</td>
<td>470</td>
<td>13.9</td>
<td>8.59</td>
<td>5.25</td>
<td>0.0161</td>
<td>5379</td>
<td>187.0±1.0</td>
<td>187.7±1.0</td>
<td>196.5±7.8</td>
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<tr>
<td>NM2/ ABR</td>
<td>3.5</td>
<td>428</td>
<td>12.6</td>
<td>7.71</td>
<td>5.04</td>
<td>0.0017</td>
<td>31665</td>
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<td>201.1±3.1</td>
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<td>380</td>
<td>10.9</td>
<td>7.18</td>
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<td>201.7±2.8</td>
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<tr>
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<td>437</td>
<td>13.2</td>
<td>10.60</td>
<td>5.42</td>
<td>0.0290</td>
<td>3001</td>
<td>0.0301±16</td>
<td>0.20788×120</td>
<td>0.04995±10</td>
</tr>
<tr>
<td>NM2/ ABR</td>
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<td>341</td>
<td>10.3</td>
<td>7.98</td>
<td>5.21</td>
<td>0.0142</td>
<td>5341</td>
<td>191.7±1.0</td>
<td>191.8±1.0</td>
<td>192.9±4.3</td>
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<tr>
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<td>0.0886</td>
<td>1037</td>
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<td>195.3±1.0</td>
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<tr>
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<td>5.57</td>
<td>0.0388</td>
<td>2443</td>
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<td>0.20972±140</td>
<td>0.0500±18</td>
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<td>187.8±1.4</td>
<td>187.8±1.2</td>
<td>191.9±28.8</td>
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</table>

Notes:
1. Complete analytical data, including the measured 206Pb/238U errors, the mole % blank Pb and the Pb206Pb/Pb207Pb 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 Franz isodynamic separator at A 2 and 2.5 tone stall; all fractions were abraded to remove outer rims.
3. radiogenic + common Pb.
4. radiogenic + common Pb, corrected for 0.15% sFm fractionation and for 40 pg Pb blank with composition 208:207:206:204=37.30:6.75:15.50:2.34:17.75:0.19:1.
5. 206Pb/238U measured, corrected for 0.15% annihilation.
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 constant used in age calculation: Dk(206U)=1.5512×10^-10, Dk(232U)=9.8483×10^-11, Dk(238U)=1.378. (Steiger and Jager, 1977). Errors are 2 sigma.
8. collected by AJM, Latitude: 56° 40' 32" N, Longitude: 131° 06' 30" W, UTM zone 379800 E, 628709N.
9. collected by AJM, Latitude: 56° 40' 0" N, Longitude: 131° 07' 37" W, UTM zone 379000 E, 628340 N.
10. collected by AJM, Latitude: 56° 37' 45" N, Longitude: 130° 57' 18" W, UTM zone 379000E, 6275700 N.
11. collected by DIA, Latitude: 50° 38' 23" N, Longitude: 130° 26' 40" W, UTM zone 411650 E, 6277350 N.
chord through 0 Ma is reasonable given the roughly similar PbPb 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 \(^{206}\text{Pb} / ^{238}\text{U} \) 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 Jurassic.

**SUMMARY**

Interpreted ages for the Inel stock and Red Bluff porphyry (190±3 and 195±1 Ma, 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/Sinemian). Further work will be required to improve this estimate.

**ACKNOWLEDGMENTS**

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