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The Devonian and Carboniferous arcs of the Oyu Tolgoi porphyry Cu-Au district; South Gobi region, Mongolia

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U-PB ANALYTICAL METHODS AND DATA

Fifteen samples dated using the Sensitive High-Resolution Ion Microprobe; Reverse-Geometry (SHRIMP-RG) U-Pb geochronologic method (reported herein) coupled with other ages reported by Wainwright (2008) establish the chronologic framework for the Devonian and Carboniferous magmatism in the Oyu Tolgoi region. Two additional samples were dated by Thermal Ionization Mass Spectrometry (TIMS) U-Pb methods to better constrain the sequence and to provide an internal check on one of the interpreted SHRIMP-RG U-Pb ages.

Five to fifteen kilogram samples for U-Pb dating were processed using standard heavy mineral separation techniques. Individual zircon grains were then handpicked for U-Pb isotopic analysis. SHRIMP-RG U-Pb dating was performed at the USGS – Stanford University lab and reviews of the applied techniques and data interpretation are in Williams (1996) and Ireland and Williams (2003). Zircons were examined under cathodoluminescence and reflected light to select crystals lacking imperfections or obvious inherited zircon cores for SHRIMP-RG U-Pb analysis.

Zircon grains show a variety of size, morphology and color that range from clear to pale yellow or orange. Cathodoluminescence imaging shows oscillatory banding in most grains, sector zoning in some grains, and occasionally inherited cores (Fig. 1). Most spot analyses were performed on grain rims or tips in order to identify the youngest, magmatic ages; a limited number of cores were analyzed. Isotopic ratios were reduced using ISOPLOT and SQUID (Ludwig, 1999). Analytical data for fifteen SHRIMP-RG samples are presented in Table 1. The reported ages are based on histogram plots of the weighted mean ^{207}Pb-corrected ^{206}Pb/^{238}U age plots. The use of weighted mean ^{207}Pb-corrected ^{206}Pb/^{238}U age for interpretation of SHRIMP-RG data is a standard technique in Phanerozoic zircons, particularly those characterized by low U contents (Table 3) as the laboratory analysis of ^{204}Pb, the measure of common Pb used to correct the ages, and of ^{207}Pb produced by the decay of ^{235}U, which represents <1% of the total uranium in Phanerozoic zircons, is imprecise in young zircons using the SHRIMP (Ireland and Williams, 2003). Hence calculated ^{207}Pb/^{235}U and ^{207}Pb/^{206}Pb ages can be imprecise and inaccurate due to the uncertainty in the measurements and the common Pb corrections.

Individual zircon spot ^{206}Pb/^{238}U ages reported herein are stated with 1σ uncertainty, whereas the weighted mean age is reported at the 2σ uncertainty. In addition, 40 and 24 zircons, respectively, were analyzed by SHRIMP-RG from two tuffaceous sandstone samples (AJW-04-245 and AJW-04-354); probability histograms are used to display the age results.

Thermal ionization mass spectrometry (TIMS) and chemical abrasion thermal ionization mass spectrometry (CA-TIMS) U-Pb analytical work was perfomed at the Pacific Centre for Isotopic and Geochemical Research (PCIGR) at The University of British Columbia. All grains were hand-picked under magnification in alcohol and pre-treated using air abrasion (Krogh, 1982) or chemical abrasion techniques. The CA-TIMS employed, modified from procedures outlined in Mundil et al. (2004) and Mattinson (2005) is described by Scoates and Friedman (2008). Unless otherwise noted, all errors are quoted at the 2σ level. Results are reported in Table 2.

One other aspect of the U-Pb isotopic data needs to be addressed. There are many zircons whose calculated ages are younger than the interpreted age of the rock. The difference can be slight to tens of millions of years. In the U-Pb isotopic system in zircons, the interpretation of the younger ages has traditionally been ascribed to Pb loss. However, Cherniak and Watson (2003) have recently proposed, based on thermal experiments in synthetic zircon, that Pb loss from zirc-

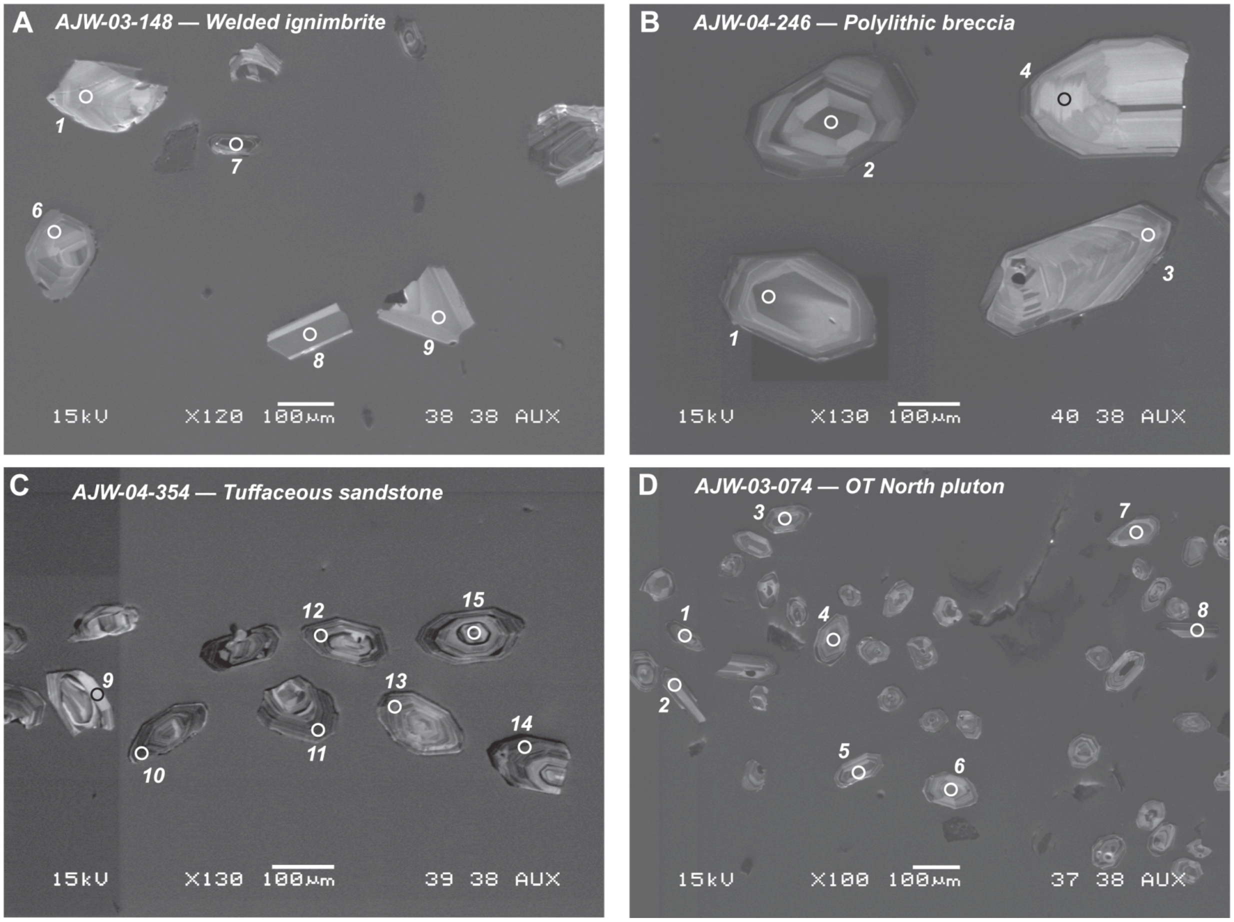

Figure 1. Cathodoluminescence images of zircon grains from **A**) Welded ignimbrite (AJW-03-148); **B**) Polylithic breccia (AJW-04-246); **C**) Tuffaceous sandstone (AJW-04-354); and **D**) OT North pluton (AJW-03-074) dated by U-Pb SHRIMP-RG. Circles represent the spot locations of the analyses and numbers correspond to results in Table 3. Complete images available in Wainwright (2008).

on is geologically too slow. In this case, the calculated ages of younger zircons may have geologic significance. Conversely, examples of zircons that are too young for their host rock are numerous in the literature, and other mechanisms such as recrystallization, fluid interaction, and physical deformation have been proposed (Sinha et al., 1992; Pidgeon et al., 1998) to explain the apparent Pb loss and younger ages in the zircons. In the case of this study, we consider that zircons that are significantly too young were subjected to Pb loss, particularly in view of the significant post-mineral deformation and evidence for fluid flow. However, zircons with ages slightly too young encountered in this study are difficult to interpret as these may also reflect Pb loss or simply be the result of analytical and counting uncertainties inherent in the SHRIMP-RG technique (Ireland and Williams, 2003).

REFERENCES CITED

Cherniak, D.J., and Watson, E.B., 2003, Diffusion in zircon, *in* Hanchar, J.M., and Hoskin, P.W.O., eds., Zircon: Reviews in Mineralogy and Geochemistry, v. 53, p. 113-143.

Ireland, T.R., and Williams, I.S., 2003, Consideration in zircon geochronology by SIMS, *in* Hanchar, J.M., and Hoskin, P.W.O., eds., Zircon: Reviews in Mineralogy and Geochemistry, v. 53, p. 215-241.

Ludwig, K.R., 1999, Isoplot/Ex version 2.01—geochronological toolkit for Microsoft Excel: Berkley Geochronology Center Special Publication 1a, 47 p.

Mundil, R., Ludwig, K.R., Metcalfe, I. and Renne, P.R., 2004, Age and timing of the Permian mass extinctions: U/Pb dating of closed-system zircons: Science, v. 305, p. 1760-1763.

Pidgeon, R.T., Nemchin, A.A., and Hitchen, G.J., 1998, Internal structures of zircons from Archean granites from the Darling Range batholith: implications for zircon stability and the interpretation of zircon U-Pb ages: Contributions to Mineralogy and Petrology, v. 132, p. 288-299.

Scoates, J.S. and Friedman, R.M., 2008, Precise age determination of the platiniferous Merensky Reef, Bushveld Complex, South Africa, by the U-Pb zircon chemical-abrasion ID-TIMS technique: Economic Geology, v. 103, no. 3, p. 465-471.

Sinha, A.K., Wayn, D.M., and Hewitt, D.A., 1992, The hydrothermal stability of zircon: preliminary experimental and isotopic studies: Geochemica et Comochimia Acta, v. 56, p. 3551-3560.

Stacey, J.S. and Kramer, J.D., 1975, Approximation of terrestrial lead isotope evolution by a two-stage model: Earth and Planetary Science Letters, v. 26, p. 207-221.

Williams, I.S., 1996, U-Th-Pb geochronology by ion microprobe: Reviews in Economic Geology, v. 7, p. 1–36.

Table 1. U-Pb SHRIMP-RG analytical data for Devonian and Carboniferous magmatic rocks in the Oyu Tolgoi area, southern Mongolia.

Spot	U (ppm)	Th (ppm)	$^{232}Th/^{238}U$	$^{206}Pb^*$ (ppm)	Total $^{238}U/^{206}Pb$	± (%)	Total $^{207}Pb/^{206}Pb$	± (%)	$^{206}Pb/^{238}U$ Age	1σ
AJW-03-148 Unmineralized Dacite Sequence welded ignimbrite										
AJW-03-148-1	53	24	0.4682	3	16.85	2.1	0.0550	4.7	371	8
AJW-03-148-2	78	58	0.7714	4	17.13	1.9	0.0538	4.0	366	7
AJW-03-148-3	111	59	0.5465	6	16.04	1.8	0.0536	3.2	390	7
AJW-03-148-4	63	28	0.4632	3	17.07	2.0	0.0561	4.3	366	7
AJW-03-148-5	109	29	0.2788	6	14.91	2.2	0.0572	3.9	418	9
AJW-03-148-6	76	29	0.3878	4	17.1	2.1	0.0562	3.9	365	8
AJW-03-148-7	409	251	0.6349	21	16.86	1.9	0.0556	1.8	371	7
AJW-03-148-8	85	64	0.7762	4	16.96	2.2	0.0549	3.7	369	8
AJW-03-148-9	63	25	0.4102	3	16.61	2.2	0.0541	4.6	377	8
AJW-03-148-10	115	87	0.7861	6	17.56	2.0	0.0549	3.1	356	7
AJW-03-148-11	199	84	0.4363	10	16.61	1.9	0.0534	2.4	377	7
AJW-03-148-12	146	77	0.5486	7	17.12	2.0	0.0554	2.8	365	7
AJW-03-148-13	110	70	0.6604	5	17.25	2.0	0.0561	3.4	362	7
AJW-04-246 Polylithic Breccia Sequence andesite tuff										
AJW-04-246-1	102	80	0.8067	5	17.55	2.2	0.0575	4.2	356	8
AJW-04-246-2	137	122	0.9233	7	17.43	1.9	0.0532	2.6	360	7
AJW-04-246-3	80	40	0.5188	4	18.03	2.0	0.0544	3.5	348	7
AJW-04-246-4	39	18	0.4738	2	17.06	2.3	0.0556	5.1	366	9
AJW-04-246-5	101	65	0.6713	5	18.37	2.0	0.0542	3.3	341	7
AJW-04-246-6	181	86	0.4902	9	17.79	1.8	0.0542	2.4	352	6
AJW-04-246-7	96	48	0.5176	5	17.57	2.0	0.0534	3.3	357	7
AJW-04-246-8	58	27	0.4853	3	17.35	2.2	0.0528	4.3	362	8
AJW-04-246-9	65	39	0.6180	3	17.98	2.6	0.0506	4.2	350	9
AJW-04-246-10	104	74	0.7316	5	17.94	2.0	0.0519	3.3	350	7
AJW-04-246-11	53	37	0.7249	3	17.59	2.2	0.0574	4.4	355	8
AJW-04-246-12	61	44	0.7455	3	17.73	2.6	0.0519	4.6	355	9
AJW-04-246-13	75	46	0.6315	4	18.05	2.1	0.0548	3.8	347	7
AJW-04-246-14	471	572	1.2562	23	17.69	1.7	0.0550	1.5	354	6

AJW-04-246-15	73	42	0.5915	4	17.21	2.1	0.0586	3.8	362	8
AJW-04-246-16	226	119	0.5442	11	17.44	1.8	0.0551	2.9	359	6
AJW-04-246-17	64	43	0.6949	3	18.42	2.1	0.0502	4.5	342	7
AJW-04-354 Sedimentary Sequence tuffaceous sandstone										
AJW-04-354-1	106	65	0.6374	5	16.99	1.9	0.0546	2.9	368	7
AJW-04-354-2	160	132	0.8519	8	17.23	1.8	0.0535	2.4	364	7
AJW-04-354-3	145	112	0.7999	7	17.34	1.9	0.0562	2.6	360	7
AJW-04-354-4	224	164	0.7592	11	17.66	1.8	0.0551	2.1	355	6
AJW-04-354-5	452	495	1.1311	23	16.66	2.0	0.0542	1.5	376	7
AJW-04-354-6	120	91	0.7804	6	16.8	2.0	0.0588	3.1	371	7
AJW-04-354-7	305	186	0.6291	13	19.83	1.8	0.0583	2.2	315	6
AJW-04-354-8	210	165	0.8124	11	16.63	1.8	0.0541	2.2	377	7
AJW-04-354-9	97	39	0.4194	5	16.8	2.1	0.0558	3.7	372	8
AJW-04-354-10	421	350	0.8591	21	17.61	2.0	0.0544	1.9	356	7
AJW-04-354-11	352	227	0.6663	17	17.43	1.8	0.0548	2.0	359	6
AJW-04-354-12	320	191	0.6166	15	17.81	1.8	0.0531	2.3	352	6
AJW-04-354-13	218	109	0.5168	11	17.01	1.9	0.0532	2.8	369	7
AJW-04-354-14	452	237	0.5406	22	17.4	1.8	0.0544	2.0	360	6
AJW-04-354-15	315	266	0.8724	16	16.95	1.9	0.0521	2.5	370	7
AJW-04-354-16	209	169	0.8367	10	17.71	2.0	0.0533	3.3	354	7
AJW-04-354-17	314	215	0.7084	17	16.25	1.8	0.0544	1.8	385	7
AJW-04-354-18	242	118	0.5039	12	17.39	1.8	0.0555	2.2	360	6
AJW-04-354-19	276	152	0.5693	14	17.51	1.8	0.0550	2.2	358	6
AJW-04-354-20	223	90	0.4174	12	16.08	1.8	0.0533	2.4	390	7
AJW-04-354-21	330	175	0.5481	17	17.05	1.8	0.0528	1.8	368	6
AJW-04-354-22	271	181	0.6915	14	16.9	1.8	0.0525	2.0	371	7
AJW-04-354-23	766	776	1.0471	33	20.14	1.7	0.0557	1.2	311	5
AJW-04-354-24	311	164	0.5448	15	17.98	1.9	0.0529	2.6	349	7
AJW-04-245 Sedimentary Sequence tuffaceous sandstone										
AJW-04-245-1	205	177	0.8933	10	18.42	1.8	0.0536	2.7	341	6
AJW-04-245-2	114	104	0.9477	5	17.93	2.0	0.0559	3.5	349	7
AJW-04-245-3	165	111	0.6942	9	15.23	1.8	0.1432	1.9	366	9
AJW-04-245-4	122	68	0.5743	6	17.37	2.2	0.0529	3.4	361	8
AJW-04-245-5	263	259	1.0183	13	17.54	1.7	0.0538	2.3	357	6

AJW-04-245-6	203	122	0.6193	10	17.66	1.7	0.0552	2.7	354	6
AJW-04-245-7	218	276	1.3066	11	17.47	1.7	0.0572	2.5	357	6
AJW-04-245-8	138	121	0.9052	7	17.56	1.8	0.0554	3.1	356	6
AJW-04-245-9	216	120	0.5747	11	16.71	1.7	0.0545	2.6	375	6
AJW-04-245-10	209	163	0.8060	11	17.13	1.7	0.0561	2.6	365	6
AJW-04-245-11	148	100	0.6993	7	17.73	1.8	0.0580	3.0	352	6
AJW-04-245-12	216	128	0.6101	11	17.44	1.7	0.0523	2.6	360	6
AJW-04-245-13	159	51	0.3295	8	17.62	1.8	0.0509	3.0	357	7
AJW-04-245-14	165	105	0.6541	8	17.84	1.8	0.0573	2.9	350	6
AJW-04-245-15	136	77	0.5840	7	17.25	1.8	0.0533	3.2	364	7
AJW-04-245-16	197	114	0.5985	10	17.41	1.7	0.0534	2.6	360	6
AJW-04-245-17	440	278	0.6535	22	17.13	1.6	0.0546	1.8	365	6
AJW-04-245-18	204	169	0.8558	10	17.34	1.7	0.0564	2.6	360	6
AJW-04-245-19	132	81	0.6358	7	17.28	1.8	0.0556	3.2	362	7
AJW-04-245-20	140	94	0.6975	7	17.38	1.8	0.0561	3.1	360	7
AJW-04-245-21	383	199	0.5359	19	17.32	1.7	0.0533	1.9	362	6
AJW-04-245-22	140	84	0.6193	7	17.51	1.8	0.0535	3.2	358	6
AJW-04-245-23	167	135	0.8382	8	17.87	1.8	0.0570	2.8	350	6
AJW-04-245-24	170	119	0.7225	8	17.33	1.8	0.0530	2.9	362	6
AJW-04-245-25	129	76	0.6100	6	17.4	1.8	0.0561	3.2	359	7
AJW-04-245-26	194	179	0.9536	9	17.71	1.7	0.0535	2.7	354	6
AJW-04-245-27	144	100	0.7224	7	17.4	1.8	0.0551	3.0	360	6
AJW-04-245-28	150	87	0.5983	7	17.41	1.8	0.0548	3.0	360	6
AJW-04-245-29	155	114	0.7620	8	17.09	1.8	0.0556	3.0	366	7
AJW-04-245-30	614	907	1.5261	32	16.62	1.6	0.0555	1.5	376	6
AJW-04-245-31	196	187	0.9868	10	17.47	1.7	0.0520	2.7	360	6
AJW-04-245-32	219	161	0.7587	11	17.18	1.7	0.0523	2.6	365	6
AJW-04-245-33	160	87	0.5574	8	17.14	1.8	0.0528	3.0	366	7
AJW-04-245-34	126	63	0.5193	6	16.81	1.8	0.0580	3.2	371	7
AJW-04-245-35	146	133	0.9383	7	17.41	1.9	0.0562	3.4	359	7
AJW-04-245-36	156	135	0.8923	8	17.49	1.8	0.0603	2.8	356	6
AJW-04-245-37	158	123	0.8061	8	17.19	1.8	0.0532	2.9	365	6
AJW-04-245-38	219	112	0.5295	11	17.09	1.7	0.0539	2.5	367	6
AJW-04-245-39	156	86	0.5732	8	16.98	1.8	0.0545	2.9	369	7
AJW-04-245-40	316	158	0.5173	16	17.32	1.7	0.0535	2.1	362	6

AJW-04-270 Lower Volcanic Sequence andesite flow										
AJW-04-270-1	121	114	0.9730	6	18.66	1.4	0.0504	4.1	338	5
AJW-04-270-2	349	220	0.6527	16	18.29	1.0	0.0550	2.3	343	4
AJW-04-270-3	1100	974	0.9148	40	23.91	0.9	0.0508	2.0	264	2
AJW-04-270-4	130	76	0.6034	6	19.75	1.4	0.0534	3.9	318	5
AJW-04-270-5	390	192	0.5081	13	25.83	1.1	0.0517	2.7	245	3
AJW-04-270-6	109	96	0.9139	5	17.54	1.4	0.0523	4.2	358	5
AJW-04-270-7	114	58	0.5301	5	18.4	1.4	0.0583	3.9	339	5
AJW-04-270-8.1	84	66	0.8116	4	18.13	1.6	0.0550	4.5	346	6
AJW-04-270-8.2	49	30	0.6369	2	18.15	1.9	0.0534	6.2	346	7
AJW-04-270-9	108	96	0.9183	5	17.4	1.4	0.0561	3.8	359	5
AJW-03-205 Lower Volcanic Sequence dacite flow										
AJW-03-205-1	93	62	0.6864	4	18.12	1.7	0.0555	2.7	345	6
AJW-03-205-2	212	70	0.3422	10	17.94	1.5	0.0528	1.9	350	5
AJW-03-205-3	210	156	0.7673	10	17.84	1.5	0.0543	1.8	351	5
AJW-03-205-4	81	49	0.6336	4	18.01	1.8	0.0566	3.0	347	6
AJW-03-205-5	135	94	0.7167	6	18.01	1.6	0.0529	2.4	349	5
AJW-03-205-6	215	53	0.2547	10	18.28	1.5	0.0523	1.9	344	5
AJW-03-205-7	73	34	0.4856	4	17.83	1.8	0.0523	3.3	352	6
AJW-03-205-8	144	118	0.8431	7	18.19	1.6	0.0545	2.3	345	5
AJW-03-205-9	76	48	0.6604	4	18.01	1.8	0.0510	3.4	349	6
AJW-03-205-10	155	117	0.7795	7	18.39	1.6	0.0527	2.4	342	5
AJW-03-221 Upper Volcanic Sequence unit rhyolite tuff										
AJW-03-221-1	373	221	0.6120	17	18.7	0.6	0.0525	1.8	336	2
AJW-03-221-2	336	162	0.4969	16	18.56	0.6	0.0544	1.9	338	2
AJW-03-221-3	75	58	0.7942	4	17.31	1.2	0.0521	3.9	363	4
AJW-03-221-4	121	55	0.4675	6	18.44	1.0	0.0541	3.4	340	4
AJW-03-221-5	255	220	0.8937	12	19.09	0.6	0.0543	2.1	329	2
AJW-03-221-6	330	317	0.9934	15	18.45	0.6	0.0532	2.0	340	2
AJW-03-221-7	148	125	0.8746	7	17.79	0.9	0.0510	3.1	354	3
AJW-03-221-8	138	71	0.5270	6	18.43	0.9	0.0537	2.8	341	3
AJW-03-221-9	284	117	0.4256	14	17.82	0.8	0.0536	2.0	352	3
AJW-03-221-10	113	56	0.5103	6	17.32	1.1	0.0635	3.6	358	4
AJW-03-221-11	122	53	0.4496	5	19.26	0.9	0.0533	3.2	326	3

AJW-03-221-12	665	353	0.5476	30	18.823	0.5	0.1240	17.0	305	10
AJW-03-221-13	606	383	0.6530	27	19.253	0.5	0.0549	1.5	326	2
AJW-03-192 Upper Volcanic Sequence unit dacite tuff										
AJW-03-192-1	151	117	0.7991	38	3.446	0.7	0.1054	0.9	1634	10
AJW-03-192-2	315	214	0.7000	15	18.36	0.6	0.0544	2.1	341	2
AJW-03-192-3	148	72	0.5033	7	18.83	0.9	0.0544	3.0	333	3
AJW-03-192-4	301	185	0.6352	14	18.21	0.7	0.0536	2.2	345	2
AJW-03-192-5	224	125	0.5790	10	18.66	0.8	0.0528	2.6	337	3
AJW-03-192-6	309	202	0.6734	11	24.77	0.7	0.0549	2.6	254	2
AJW-03-192-7	613	387	0.6516	29	18.434	0.5	0.0545	1.6	340	2
AJW-03-192-8	188	168	0.9214	8	19.04	0.8	0.0535	2.7	330	3
AJW-03-192-9	473	360	0.7859	16	25.18	0.5	0.0517	2.0	251	1
AJW-03-192-10	283	315	1.1488	11	21.9	0.8	0.0549	2.4	287	2
AJW-03-192-11	163	84	0.5294	8	18.59	1.3	0.0519	3.4	338	5
AJW-03-192-12	181	79	0.4536	8	18.62	0.9	0.0564	2.9	336	3
AJW-03-183 Andesite dike										
AJW-03-183-1	320	190	0.6151	15	18.3	1.4	0.0537	1.6	343	5
AJW-03-183-2	119	116	1.0050	8	12.34	1.6	0.0600	2.1	501	8
AJW-03-183-3	150	56	0.3814	7	17.9	1.6	0.0524	2.3	351	5
AJW-03-183-4	171	61	0.3690	8	17.62	1.5	0.0736	1.9	347	5
AJW-03-183-5	124	35	0.2872	6	18.04	1.7	0.0544	2.5	347	6
AJW-03-183-6	210	81	0.3992	10	17.87	1.5	0.0521	2.0	352	5
AJW-03-183-7	155	68	0.4513	7	18.27	1.6	0.0563	2.2	342	5
AJW-03-183-8	181	67	0.3844	9	17.85	1.5	0.0538	2.1	351	5
AJW-03-183-9	293	148	0.5241	14	17.68	1.4	0.0530	1.7	355	5
AJW-03-183-10	231	120	0.5355	11	18.55	1.5	0.0561	1.8	337	5
AJW-03-183-11	228	77	0.3496	12	16.55	1.5	0.0546	1.8	378	5
AJW-03-183-12	85	38	0.4630	4	17.32	1.7	0.0535	2.9	362	6
AJW-03-183-13	160	76	0.4894	7	18.33	1.8	0.0550	2.3	342	6
AJW-03-183-14	71	47	0.6879	3	22.27	1.9	0.0512	3.8	283	5
AJW-03-183-15	578	373	0.6658	19	26.25	1.4	0.0512	1.4	241	3
AJW-03-183-16	165	197	1.2369	6	24.99	1.6	0.0529	2.6	252	4
AJW-03-183-17	87	98	1.1658	3	25.36	1.8	0.0515	3.6	249	5
AJW-03-183-18	274	102	0.3847	18	13.42	1.4	0.0567	1.4	463	6

AJW-03-183-19	218	81	0.3847	10	18.36	1.5	0.0546	1.9	341	5
AJW-03-183-20	438	244	0.5769	15	25.06	1.4	0.0516	1.6	252	4
AJW-03-183-21	456	237	0.5365	21	18.57	1.4	0.0535	1.4	338	5
AJW-03-183-22	288	156	0.5587	14	18.15	1.4	0.0549	1.7	345	5
AJW-03-180 Rhyolite dike										
AJW-03-180-1	946	1020	1.1141	28	28.99	0.5	0.0856	4.5	209	2
AJW-03-180-2	229	174	0.7833	10	18.92	0.8	0.0531	2.6	332	3
AJW-03-180-3	175	80	0.4743	8	18.22	0.9	0.0569	3.8	343	3
AJW-03-180-4	151	227	1.5521	7	18.71	0.9	0.0552	3.0	335	3
AJW-03-180-5	262	153	0.6020	12	18.12	0.8	0.0549	2.3	346	3
AJW-03-180-6	144	79	0.5674	7	18.41	1.0	0.0545	3.2	340	3
AJW-03-180-7	400	197	0.5079	21	16.69	0.7	0.0549	1.9	375	3
AJW-03-180-8	326	253	0.8010	15	18.52	0.7	0.0528	2.3	339	2
AJW-03-180-9	117	54	0.4774	5	19.11	1.0	0.0543	3.4	328	3
AJW-03-180-10	188	158	0.8675	8	19.08	0.8	0.0555	2.7	328	3
AJW-03-180-11	212	68	0.3306	10	17.67	0.7	0.0529	2.4	355	3
AJW-03-180-12	458	409	0.9226	21	18.39	0.6	0.0533	1.9	341	2
AJW-03-180-13	322	229	0.7350	15	18.42	0.6	0.0537	2.1	341	2
AJW-03-203 Rhyolite dike										
AJW-03-203-1	372	314	0.8714	17	18.83	1.5	0.0537	1.7	333	5
AJW-03-203-2	124	76	0.6367	6	18.84	1.6	0.0533	3.0	333	5
AJW-03-203-3	233	178	0.7912	11	18.8	1.5	0.0533	2.2	334	5
AJW-03-203-4	785	1249	1.6439	36	18.71	1.5	0.0528	1.2	336	5
AJW-03-203-5	238	192	0.8312	11	18.67	1.5	0.0532	2.2	336	5
AJW-03-203-6	224	151	0.6972	10	18.62	1.6	0.0536	2.2	337	5
AJW-03-203-7	1076	956	0.9175	48	19.1	1.4	0.0540	1.0	329	5
AJW-03-203-8	907	564	0.6423	42	18.7	2.4	0.0543	1.1	335	8
AJW-03-203-9	549	572	1.0762	25	18.83	1.5	0.0533	1.4	333	5
AJW-03-203-10	378	618	1.6902	17	18.9	1.5	0.0542	1.7	332	5
AJW-03-203-11	178	174	1.0065	6	25.23	1.6	0.0564	2.7	249	4
AJW-03-203-12	52	20	0.3974	2	18.58	1.9	0.0536	4.5	338	7
AJW-03-193 Rhyolite sill										
AJW-03-193-1	274	195	0.7358	12	18.94	1.8	0.0538	2.2	331	6

AJW-03-193-2	1294	285	0.2277	42	26.33	1.6	0.0504	1.2	241	4
AJW-03-193-3	849	706	0.8591	28	26.35	1.6	0.0518	1.5	240	4
AJW-03-193-4	244	116	0.4912	10	20.58	1.7	0.0558	2.4	305	5
AJW-03-193-5	273	140	0.5304	12	19.16	1.7	0.0560	2.1	327	6
AJW-03-193-6	176	90	0.5277	8	19	1.7	0.0536	2.7	331	6
AJW-03-193-7	573	307	0.5540	36	13.57	1.6	0.0557	1.3	459	7
AJW-03-193-8	134	73	0.5579	6	18.44	2.0	0.0540	3.1	340	7
AJW-03-193-9	283	176	0.6420	13	18.8	1.7	0.0633	4.1	330	6
AJW-03-193-10	250	172	0.7081	11	19.15	1.7	0.0530	2.3	328	6
AJW-03-193-11	374	239	0.6615	17	19.07	1.7	0.0538	1.9	329	5
AJW-03-193-12	85	36	0.4320	9	7.73	1.8	0.0668	2.2	783	14
AJW-03-193-13	422	366	0.8957	22	16.71	1.7	0.0723	1.6	366	6
AJW-03-193-14	288	178	0.6390	14	18.33	1.7	0.0713	1.9	335	6
AJW-03-193-15	191	126	0.6831	9	19.26	1.7	0.0516	2.7	327	6
AJW-03-193-16	273	134	0.5089	13	18.67	1.7	0.0513	2.2	337	6
AJW-03-193-17	257	172	0.6915	11	19.53	1.7	0.0544	2.2	321	5
AJW-03-193-18	363	306	0.8719	17	18.8	1.7	0.0530	2.3	334	6
AJW-03-193-19	381	285	0.7718	18	18.68	1.6	0.0520	1.9	337	6
AJW-03-193-20	386	315	0.8435	17	19.12	1.9	0.0534	1.9	328	6
AJW-03-193-21	266	113	0.4379	12	18.48	1.8	0.0532	2.7	340	6
AJW-03-193-22	294	131	0.4618	14	18.64	1.8	0.0521	2.6	337	6
AJW-03-193-23	259	192	0.7645	9	23.63	1.7	0.0537	3.0	267	5
AJW-03-193-24	384	260	0.7014	18	18.7	1.7	0.0518	2.1	336	6
AJW-03-193-25	346	239	0.7134	16	18.55	1.7	0.0533	2.3	339	6
AJW-03-193-26	199	95	0.4917	9	18.72	1.8	0.0507	3.1	336	6
AJW-03-193-27	392	276	0.7280	18	19.23	1.7	0.0519	2.2	327	5
AJW-03-193-28	298	203	0.7051	14	18.91	1.8	0.0532	2.5	332	6
AJW-03-193-29	372	234	0.6492	17	19.07	1.6	0.0518	1.9	330	5
AJW-03-074 Oyu Tolgoi North pluton										
AJW-03-074-1	442	487	1.1377	21	18.07	1.6	0.0536	1.8	347	6
AJW-03-074-2	111	64	0.5990	5	17.84	1.8	0.0551	3.3	351	6
AJW-03-074-3	145	85	0.6020	7	17.11	2.2	0.0543	2.9	366	8
AJW-03-074-4	142	107	0.7756	7	17.45	2.1	0.0513	3.0	360	7
AJW-03-074-5	101	69	0.7055	5	17.43	1.9	0.0557	3.4	359	7
AJW-03-074-6	89	61	0.7050	4	17.46	2.3	0.0579	3.4	357	8

AJW-03-074-7	84	49	0.6060	4	18.56	1.9	0.0510	3.9	339	6
AJW-03-074-8	166	115	0.7179	8	17.52	1.7	0.0526	2.7	358	6
AJW-03-074-9	149	101	0.6976	7	17.6	1.8	0.0551	2.7	356	6
AJW-03-074-10	142	78	0.5662	7	17.94	1.8	0.0543	2.8	349	6
AJW-03-074-11	172	128	0.7682	9	17.05	1.9	0.0538	2.6	368	7
AJW-03-074-12	275	311	1.1673	13	18.08	1.7	0.0545	2.2	347	6
AJW-03-132 Javhalant Mountain Pluton										
AJW-03-132-1	402	230	0.5925	16	21.54	0.6	0.0524	2.1	292	2
AJW-03-132-2	539	346	0.6639	23	20.13	3.1	0.0533	1.8	312	9
AJW-03-132-3	347	151	0.4481	14	20.81	0.6	0.0540	2.2	302	2
AJW-03-132-4	426	172	0.4165	18	20.27	0.6	0.0654	1.7	306	2
AJW-03-132-5	624	411	0.6802	25	21.24	0.5	0.0521	1.7	297	2
AJW-03-132-6	422	262	0.6420	18	19.7	0.9	0.0566	2.0	318	3
AJW-03-132-7	520	208	0.4124	23	19.398	0.5	0.0541	1.7	324	2
AJW-03-132-8	288	106	0.3821	13	19.48	0.8	0.0537	2.4	322	3
AJW-03-132-9	201	75	0.3839	9	19.42	1.0	0.0522	3.1	324	3
AJW-03-132-10	489	241	0.5097	20	20.76	0.6	0.0526	2.0	303	2
AJW-03-132-11	482	356	0.7646	22	18.751	0.5	0.0536	1.8	335	2
AJW-03-132-12	576	356	0.6381	26	19.018	0.5	0.0540	1.8	330	2
AJW-03-132-13	449	262	0.6033	20	19.11	0.6	0.0525	2.0	329	2
AJW-03-132-14	159	74	0.4817	7	18.44	1.1	0.0568	3.9	339	4
AJW-03-132-15	253	133	0.5440	11	19.35	0.7	0.0538	2.5	325	2
AJW-03-132-16	340	192	0.5842	15	19.81	0.6	0.0542	2.2	317	2
AJW-03-132-17	269	182	0.6967	12	19.56	0.7	0.0529	2.5	321	2
AJW-03-132-18	1118	1203	1.1118	52	18.474	0.4	0.0530	1.2	340	1
AJW-03-132-19	229	129	0.5849	10	20.07	0.8	0.0528	2.7	313	2
AJW-03-132-20	309	181	0.6049	15	18.05	0.7	0.0530	3.0	348	2
AJW-03-132-21	1029	869	0.8734	41	21.362	0.4	0.0611	1.3	292	1
AJW-03-132-22	162	90	0.5763	7	19.55	0.9	0.0531	3.2	321	3
AJW-03-132-23	363	193	0.5500	17	18.81	0.6	0.0518	2.1	335	2
AJW-03-132-24	113	44	0.4062	5	18.29	1.1	0.0541	3.7	343	4
AJW-03-132-25	274	146	0.5488	12	18.99	0.7	0.0543	2.3	330	2
AJW-03-132-26	133	76	0.5893	6	18.96	1.0	0.0557	3.7	330	3
AJW-03-132-27	193	101	0.5398	9	19.25	0.8	0.0538	2.9	326	3

AJW-03-116 OT18 Pluton										
AJW-03-116-1	138	48	0.3634	6	19.43	1.9	0.0508	3.3	324	6
AJW-03-116-2	135	71	0.5426	6	19.99	1.9	0.0526	3.1	315	6
AJW-03-116-3	146	42	0.2968	5	25.7	2.0	0.0597	3.2	243	5
AJW-03-116-4	130	64	0.5093	6	19.53	1.9	0.0535	3.1	322	6
AJW-03-116-5	188	116	0.6390	8	19.4	1.8	0.0550	2.6	323	6
AJW-03-116-6	193	104	0.5564	9	19.48	1.9	0.0574	2.9	321	6
AJW-03-116-7	176	99	0.5802	8	19.1	1.9	0.0540	2.6	329	6
AJW-03-116-8	152	78	0.5261	7	19.89	1.9	0.0542	2.8	316	6
AJW-03-116-9	126	59	0.4838	5	19.99	2.0	0.0547	3.1	314	6
AJW-03-116-10	116	50	0.4457	5	18.68	1.9	0.0503	3.2	337	7

Table 2. U-Pb TIMS data for Augite Basalt (chemically-abraded grains) and Unmineralized Dacite Sequence (air-abraded grains) units. Sample AJW-03-204 is from diamond drill hole OTD318 at 216 m (Southwest Oyu; WGS84 UTM 649526 4762742; Fig. 3). See Table 4 for sample AJW-03-148 details.

Fraction[1]	Wt (mg)	U^{2} (ppm)	Pb^{*3} (ppm)	$^{206}Pb/^{204}Pb$ [4]	Pb^{5} (pg)	Th/U[6]	Pb^{*}/Pb_c [7]	Isotopic ratios ±1s,% [8] $^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{207}Pb/^{206}Pb$	r[9]	% discordant[10]	Apparent ages ±2s,Ma [8] $^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{207}Pb/^{206}Pb$
AJW-03-148 Unmineralized Dacite Sequence welded ignimbrite															
A	11	131	8.0	507	10.7	0.48	8.3	0.05854 ± 0.17	0.4371 ± 1.69	0.05415 ± 1.61	0.53445	2.9	366.7 ± 1.2	368.2 ± 10.5	377.4 ± 70.8/74.1
B	19	83	5.3	575	10.7	0.51	9.4	0.06101 ± 0.15	0.4559 ± 1.51	0.05420 ± 1.43	0.55051	-0.6	381.7 ± 1.1	381.4 ± 9.6	379.5 ± 63.2/65.8
C	18	98	6.0	613	10.9	0.45	9.9	0.06006 ± 0.13	0.4500 ± 1.35	0.05434 ± 1.28	0.54878	2.4	376.0 ± 1.0	377.3 ± 8.5	385.0 ± 56.4/58.5
D	15	118	7.2	617	10.8	0.46	10.0	0.05905 ± 0.19	0.4401 ± 1.41	0.05405 ± 1.33	0.46687	0.9	369.9 ± 1.4	370.3 ± 8.7	373.2 ± 58.8/61
E	9	58	3.6	846	2.3	0.57	14.2	0.05882 ± 0.18	0.4373 ± 0.55	0.05392 ± 0.49	0.46855	-0.2	368.4 ± 1.3	368.3 ± 3.4	367.7 ± 21.9/22.2
G	9	43	2.6	812	1.8	0.54	13.5	0.05902 ± 0.53	0.4407 ± 0.98	0.05416 ± 0.80	0.57422	2.1	369.6 ± 3.8	370.7 ± 6.1	377.5 ± 35.7/36.6
AJW-03-204 Bulagbayan Fm. Augite Basalt															
CA2	1.0	374	32.2	4509	0.4	0.46	75.3	0.08338 ± 0.12	0.6655 ± 0.22	0.05789 ± 0.18	0.60302	1.8	516.3 ± 1.2	518.0 ± 1.8	525.5 ± 7.8/7.8
CA5	0.6	428	33.1	1221	0.9	0.67	21.2	0.07086 ± 0.12	0.5456 ± 0.41	0.05585 ± 0.37	0.45108	1.2	441.3 ± 1.0	442.1 ± 3.0	446.3 ± 16.5/16.7

[1] All analyzed zircon grains were air abraded or chemically abraded; fraction names: A, B, etc., air abraded; CA1, CA2, etc., chemically abraded.

[2] U blank correction of 0.2-1.0 pg ± 20%; U fractionation corrections were measured for each analysis with a double $^{233-235}U$ spike.

[3] Radiogenic Pb

[4] Measured ratio corrected for spike and Pb fractionation of 0.23-0.35/amu ± 20% (Daly collector), which was determined by repeated analysis of NBS Pb 982 reference material throughout the course of this study.

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

[6] Model Th/U derived from radiogenic ^{208}Pb and the $^{207}Pb/^{206}Pb$ age of fraction.

[7] Ratio of radiogenic to common Pb

[8] Blank and common Pb corrected; blank Pb based on procedural blanks measured throughout the course of the study: amount, 0.4-10 pg; composition, $^{206}Pb/^{204}Pb$ = 18.5 ± 3%, $^{207}Pb/^{204}Pb$ = 15.5 - 15.0 ± 3%, $^{208}Pb/^{204}Pb$ = 36.4 ± 3%. Common Pb compositions are based on Stacey-Kramers model Pb at the $^{207}Pb/^{206}Pb$ age of the fraction or the interpreted age of the rock (Stacey and Kramers, 1975).

[9] Correlation coefficient.

[10] Discordance in % to origin.