

Supplemental Item S10 - Detrital volcanic-lithic $^{40}\text{Ar}/^{39}\text{Ar}$ (DARL) step-heat ages from cobbles sampled from modern rivers, Wrangell Arc, Wrangell-St. Elias Mountains, Alaska-Canada

CHISANA-2 WR#L1

Weighted average of J from standards = 1.052e-04 +/- 1.125e-06

Laser Power (mW)	Cumulative 39Ar	40Ar/39Ar meas.	+/-	37Ar/39Ar meas.	+/-	36Ar/39Ar meas.	+/-	% Atm. 40Ar	+/-	Ca/K	+/-	Cl/K	+/-	40*/39K	+/-	Age (Ma)	+/- (Ma)
500	0.0218	3289.61	128.2982	0.66262	0.14439	9.85753	0.3917	88.54765	0.69175	1.21638	0.26518	0.04255	0.00794	376.9106	27.16716	70.07	4.95
1000	0.1156	517.2004	9.13909	0.45878	0.04697	1.3312	0.0281	76.05468	0.89899	0.84207	0.08624	0.04598	0.00269	123.8783	5.17126	23.33	0.97
1500	0.2417	332.7015	4.34645	0.5422	0.03502	0.71635	0.01473	63.61729	1.02134	0.99524	0.06431	0.0583	0.00136	121.0814	3.76731	22.81	0.71
2000	0.4207	193.7595	1.65613	0.59695	0.02989	0.26228	0.00753	39.9811	1.10169	1.09578	0.05488	0.01913	0.00089	116.3235	2.36984	21.92	0.44
2500	0.5722	169.4783	1.674	0.67761	0.02947	0.16279	0.00768	28.3553	1.3123	1.24391	0.05412	0.01236	0.00109	121.4591	2.53849	22.88	0.48
3000	0.6683	157.3317	1.83576	0.97841	0.06022	0.11325	0.00991	21.22239	1.84623	1.79649	0.11065	0.00948	0.00132	124.0044	3.25238	23.36	0.61
4000	0.7738	176.3053	3.23225	0.66402	0.03507	0.17204	0.0094	28.80928	1.48805	1.21896	0.06441	0.00786	0.00131	125.5508	3.50176	23.65	0.66
9000	1	309.7258	3.94155	0.9974	0.03302	0.5209	0.00908	49.67586	0.60522	1.83138	0.06067	0.01596	0.00112	155.9617	2.75923	29.33	0.51
Integrated		326.2613	1.59582	0.72508	0.01408	0.64838	0.00485	58.71197	0.33738	1.33111	0.02587	0.02324	0.00052	134.7636	1.29228	25.37	0.36

CHISANA-11 WR#L1

Weighted average of J from standards = 1.054e-04 +/- 3.042e-07

Laser Power (mW)	Cumulative 39Ar	40Ar/39Ar meas.	+/-	37Ar/39Ar meas.	+/-	36Ar/39Ar meas.	+/-	% Atm. 40Ar	+/-	Ca/K	+/-	Cl/K	+/-	40*/39K	+/-	Age (Ma)	+/- (Ma)
500	0.0354	8256.331	375.7581	0.4529	0.37822	26.35721	1.20799	94.33423	0.5464	0.83127	0.69442	0.06461	0.01712	467.933	50.06073	86.79	9.07
1000	0.0999	1662.558	77.41123	0.94251	0.16215	5.04955	0.24534	89.74663	1.25867	1.73053	0.29792	0.1998	0.0106	170.5787	22.42093	32.12	4.19
1500	0.2611	484.2326	6.95155	0.62873	0.05984	1.28044	0.0246	78.13215	1.01739	1.15414	0.1099	0.0404	0.00262	105.9318	5.1827	20.02	0.97
2000	0.4468	176.8403	1.76284	0.21334	0.06131	0.22742	0.01185	37.99813	1.94536	0.3915	0.11253	0.01258	0.00158	109.6424	3.61194	20.71	0.68
2500	0.5572	166.2595	4.51128	0.20783	0.10023	0.18927	0.01612	33.63536	2.718	0.38139	0.18397	0.00748	0.00242	110.334	5.42809	20.84	1.02
3000	0.6217	164.4032	4.54122	0.28247	0.18112	0.15948	0.02633	28.65649	4.66724	0.5184	0.33246	0.00689	0.00418	117.2932	8.3336	22.15	1.56
4000	0.7107	207.4621	4.04187	1.20253	0.13386	0.34201	0.02559	48.67308	3.52058	2.20835	0.24604	0.02032	0.00359	106.5592	7.6022	20.14	1.43
9000	1	636.2241	7.91432	1.08262	0.045	1.53819	0.02476	71.43189	0.73988	1.98798	0.08269	0.02044	0.00181	181.8878	5.24872	34.23	0.98
Integrated		741.9036	5.17423	0.67929	0.03276	2.01403	0.01692	80.21431	0.38463	1.24701	0.06016	0.03302	0.00113	146.8553	3.04783	27.69	0.58

NABESNA-2 WR#L1

Weighted average of J from standards = 9.377e-05 +/- 4.498e-07

Laser Power (mW)	Cumulative 39Ar	40Ar/39Ar meas.	+/-	37Ar/39Ar meas.	+/-	36Ar/39Ar meas.	+/-	% Atm. 40Ar	+/-	Ca/K	+/-	Cl/K	+/-	40*/39K	+/-	Age (Ma)	+/- (Ma)
500	0.0247	7694.829	431.9206	1.13509	0.21062	23.56779	1.32453	90.50513	0.29603	2.0844	0.38708	0.50977	0.03273	731.1976	47.13537	119.5	7.45
1000	0.1061	1969.957	25.39195	1.92541	0.06952	5.74191	0.09042	86.12381	0.79278	3.53767	0.12791	0.12108	0.00553	273.7231	16.07452	45.67	2.65
1500	0.264	415.5837	5.11483	0.66703	0.03572	0.91572	0.01615	65.10388	0.8262	1.22448	0.06561	0.01146	0.00171	145.0806	3.87973	24.35	0.65
2000	0.3893	441.0091	4.16157	0.62046	0.0404	1.00929	0.01615	67.62055	0.8821	1.13895	0.0742	0.01608	0.00151	142.8493	4.13538	23.98	0.69
2500	0.4956	403.0614	4.67511	0.53164	0.0591	0.88478	0.0158	64.86066	0.88689	0.97585	0.10852	0.01598	0.00149	141.6759	3.9468	23.78	0.66
3000	0.56	363.126	4.54206	0.87659	0.08347	0.76288	0.01826	62.06551	1.27322	1.60943	0.15334	0.02471	0.00293	137.8241	4.94995	23.14	0.83
5000	0.8018	440.4755	4.03862	1.02196	0.02535	0.9486	0.0134	63.62377	0.68932	1.87651	0.04659	0.03671	0.00098	160.3333	3.38837	26.89	0.56
9000	1	595.4461	4.74293	2.3909	0.04166	1.3846	0.01647	68.68337	0.62709	4.3944	0.07671	0.07874	0.00146	186.7797	4.07551	31.29	0.68

Integrated	762.2992	3.21604	1.20204	0.01696	1.96831	0.0105	76.2902	0.25481	2.20745	0.03117	0.05406	0.00082	180.8861	2.10146	30.31	0.38
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NABESNA-13 WR#L1

Weighted average of J from standards = 9.377e-05 +/- 4.498e-07

Laser Power (mW)	Cumulative 39Ar	40Ar/39Ar meas.	+/-	37Ar/39Ar meas.	+/-	36Ar/39Ar meas.	+/-	% Atm. 40Ar	+/-	Ca/K	+/-	Cl/K	+/-	40*/39K	+/-	Age (Ma)	+/- (Ma)
500	0.0469	275.2904	4.47181	0.12483	0.04853	0.60182	0.02286	64.60302	2.22177	0.22906	0.08907	0.00578	0.00222	97.44255	6.32358	16.39	1.06
1000	0.2191	177.1136	2.25546	0.25519	0.01497	0.07985	0.00362	13.31234	0.57979	0.46833	0.02749	0.00099	0.00058	153.5376	2.21207	25.76	0.37
1500	0.3964	187.0151	1.53264	0.22473	0.01526	0.07977	0.00398	12.59634	0.62017	0.41241	0.02801	0.00151	0.00104	163.4581	1.77526	27.41	0.3
2000	0.5592	169.7794	1.67722	0.24257	0.01305	0.0105	0.00495	1.8152	0.86216	0.44517	0.02395	0.00054	0.00075	166.697	2.20414	27.95	0.37
2500	0.6659	174.2413	1.84596	0.29827	0.01726	0.01663	0.0058	2.80632	0.98412	0.5474	0.03169	0.00173	0.0009	169.3583	2.48371	28.39	0.41
3000	0.7287	168.2396	3.32122	0.3521	0.04946	0.01851	0.00755	3.23483	1.32555	0.64622	0.09079	0.00494	0.00129	162.8091	3.91367	27.3	0.65
5000	0.901	175.0628	1.49967	0.54407	0.01726	0.03262	0.00433	5.482	0.73023	0.99868	0.0317	0.00806	0.00068	165.5013	1.91128	27.75	0.32
9000	1	200.8332	2.95483	1.15045	0.03246	0.12857	0.00702	18.87356	0.99499	2.11263	0.05965	0.03546	0.00182	163.0372	3.12849	27.34	0.52

Integrated	183.4116	0.76044	0.39078	0.00736	0.07911	0.00204	12.73033	0.32407	0.71723	0.01351	0.00619	0.00036	160.0809	0.89234	26.85	0.2
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WHITE-5 WR#L1

Weighted average of J from standards = 1.052e-04 +/- 1.125e-06

Laser Power (mW)	Cumulative 39Ar	40Ar/39Ar meas.	+/-	37Ar/39Ar meas.	+/-	36Ar/39Ar meas.	+/-	% Atm. 40Ar	+/-	Ca/K	+/-	Cl/K	+/-	40*/39K	+/-	Age (Ma)	+/- (Ma)
500	0.0536	7320.182	295.824	0.4086	0.33415	23.09843	0.96156	93.24333	0.94527	0.74995	0.61347	0.0757	0.01559	494.7413	72.11606	91.43	13
1000	0.15	1103.294	33.74046	1.42803	0.16423	3.16301	0.10812	84.70782	1.30774	2.62288	0.30195	0.02708	0.00651	168.8835	15.36611	31.74	2.86
1500	0.328	286.6835	5.96632	1.20256	0.12439	0.56581	0.01966	58.29214	1.63196	2.2084	0.22863	0.00778	0.00289	119.6588	5.32102	22.54	1
2000	0.4825	218.2201	4.95482	1.15662	0.11887	0.31148	0.01424	42.14017	1.67752	2.12398	0.21847	0.0004	0.00382	126.3478	4.66216	23.8	0.87
2500	0.5793	215.6748	7.1783	0.81032	0.18702	0.28463	0.0223	38.97146	2.76924	1.48768	0.34355	0.00304	0.00538	131.6804	7.41858	24.79	1.39
3000	0.6261	218.207	13.61231	0.74271	0.36153	0.31131	0.08953	42.13635	11.83911	1.36349	0.66405	0.02534	0.01252	126.3116	27.0269	23.79	5.06
4000	0.6925	264.8927	9.11539	2.19163	0.23292	0.47773	0.04187	53.23107	4.30603	4.02758	0.4287	0.04435	0.00951	124.0657	12.21773	23.37	2.29
9000	1	706.5738	7.61539	3.7457	0.08816	1.6638	0.03188	69.54187	1.10847	6.89108	0.16261	0.10272	0.00273	215.7709	8.20907	40.45	1.52

Integrated	849.1751	7.32632	1.96393	0.05503	2.27644	0.02579	79.20037	0.58659	3.60854	0.10125	0.04412	0.00185	176.8644	5.22763	33.22	1.03
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WHITE-15 WR#L1

Weighted average of J from standards = 1.052e-04 +/- 1.125e-06

Laser Power (mW)	Cumulative 39Ar	40Ar/39Ar meas.	+/-	37Ar/39Ar meas.	+/-	36Ar/39Ar meas.	+/-	% Atm. 40Ar	+/-	Ca/K	+/-	Cl/K	+/-	40*/39K	+/-	Age (Ma)	+/- (Ma)
500	0.06	177.4151	5.01745	0.51598	0.10594	0.42502	0.02176	70.7789	3.02476	0.94711	0.19454	0.00316	0.00286	51.85286	5.56684	9.8	1.05
1000	0.2971	82.35259	0.91575	0.36053	0.03237	0.07856	0.00533	28.16189	1.88808	0.66169	0.05943	0.00158	0.00093	59.15428	1.691	11.18	0.32
1500	0.4404	83.22079	1.16632	0.50218	0.03991	0.08966	0.00813	31.79702	2.85612	0.92176	0.07329	0.00029	0.00122	56.75894	2.51068	10.73	0.47
2000	0.613	75.06686	1.06355	0.47509	0.03563	0.06723	0.00674	26.42479	2.62999	0.87201	0.06543	0.00234	0.001	55.22728	2.12629	10.44	0.4
2500	0.7334	78.43881	1.29282	0.58498	0.04559	0.09349	0.01233	35.17261	4.6135	1.0738	0.08372	0.00382	0.00175	50.85159	3.71718	9.61	0.7
3000	0.8041	80.26944	1.2044	0.81809	0.09347	0.10289	0.01379	37.80599	5.04935	1.50196	0.1717	0.00387	0.0026	49.93317	4.12684	9.44	0.78
4000	0.8711	76.67621	1.34421	1.65903	0.08527	0.08395	0.01705	32.18744	6.55046	3.04767	0.15683	0.00513	0.00224	52.03696	5.1139	9.84	0.96
9000	1	112.8218	1.88095	2.88739	0.07673	0.1937	0.01097	50.53515	2.75074	5.30878	0.14137	0.00305	0.00145	55.90648	3.25018	10.57	0.61

Integrated	89.85242	0.49879	0.88253	0.01871	0.1177	0.00347	38.64107	1.12242	1.62033	0.03438	0.00248	0.00052	55.14864	1.05558	10.42	0.23
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Note:

Monitor mineral TCR with an age of 28.619 Ma (Renne et al., 2010) was used to monitor neutron flux and calculate ages.

Reference:

Renne, P.R., Mundil, R., Balco, G., Min, K., and Ludwig, K.R., 2010, Joint determination of ^{40}K decay constants and $^{40}\text{Ar}/^{40}\text{K}$ for the Fish Canyon sanidine standard, and improved accuracy for $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology: *Geochimica et Cosmochimica Acta*, v. 74, p. 5349.