SUPPLEMENTARY INFORMATION

XRF analytical techniques

Juvenile pumice clasts of at least 4 cm size were used for individual analyses by XRF from the Paeroa ignimbrite. Samples were washed in deionized water to remove attached matrix or foreign material, and dried in an oven at 100°C for several days before crushing. Clasts were crushed and altered material was removed. Samples were powdered using a tungsten carbide tema. Five grams of powder from each sample was dried at 110°C for 24 hours to remove meteoric water. Samples were then ignited at 850°C for 12 hours to determine loss on ignition (LOI) by removing volatiles. Two grams of ignited sample was mixed with 6 grams of 12:22 flux ($Li_2B_4O_7$) and fused into glass discs. Major and trace element geochemistry (Table DR1) on glass discs were determined by a Siemens SRS 3000 sequential X-ray spectrometer with a Rh tube at the University of Auckland. All major oxides are recalculated to total 100% anhydrous to account for differences in hydration between samples.

$^{40}Ar/^{39}Ar$ age dating technique

Samples were crushed using a disc mill and plagioclase concentrates prepared by hand picking and using a LB-1 Barrier Frantz magnetic separator. Separates were etched with 0.1 M hydrofluoric acid to remove any adhering glassy material, then washed in acetone and deionized water. Final separates for irradiation were hand picked to remove any crystals containing inclusions or with remaining adhering minerals or glass. Encapsulated packets of ~200 mg of plagioclase were irradiated for 1 hour in the central thimble of the U.S. Geological Survey TRIGA reactor in Denver, Colorado (Dalrymple et al., 1981). Samples were shielded from thermal neutrons and neutron flux was measured using Taylor Creek sanidine (TCR-2) fluence monitors with an assigned age of 27.87 Ma (Dalrymple and Duffield, 1988). The reactor vessel was rotated continuously during irradiation to avoid lateral neutron flux gradients. Fluence monitors were analyzed using a continuous laser system and a MAP 216 mass spectrometer as described by Dalrymple (1989).

Argon was extracted from the plagioclase separates using a Mo-crucible in a Staudacher-type custom resistance furnace attached to the mass spectrometer. Heating temperatures were monitored with an optical fiber thermometer and controlled with an Accufiber Model 10 controller. Gas was purified continuously during extraction using two SAES ST-172 getters operated at 4A and 2.5A.

Detailed step heating experiments were undertaken to yield plateau age spectra and isochron ages with regression intercepts (York, 1969) within error of the atmosphere. Degassing was done to 650°C and steps utilized start at 700°C. Plateau ages and significant ^{39}Ar came off at 1400°C so this was analyzed as a last step. Analytical protocols for determining furnace blanks and mass discrimination followed those detailed in Calvert and Lanphere (2006). All ages are reported with 1σ errors including errors in neutron flux, but not including errors in decay constants or monitor minerals.

With the information available from age dating, a simple analysis was undertaken to determine the probability of the Paeroa Subgroup and other Whakamaru Group ignimbrites having the same age. Treated together, the data have a mean square weighted deviation of 3.21, indicating multiple populations. Geologic relationships show that the Rangitaiki, Te Whaiti, Whakamaru, and Manunui (undated) ignimbrites are coeval (Brown et al., 1998) and those three fractions yield a mean square weighted deviation of 0.18, in excellent agreement. Paeroa Subgroup analyses yield an acceptable mean square weighted deviation of 1.4. We calculated weighted mean ages for the two groups of deposits, using the weighted mean function in Isoplot (Ludwig, 2003). The probability that the difference in the ages exceeds a specified value is then calculated as follows. First, the joint probability distribution of the two sets of combined ages is assumed to be bivariate Gaussian; means and variances are obtained from the sample ages, using weights equal to the reciprocal of the uncertainties. Then the probability of excedance is obtained by numerical integration of the joint density function over the half-space where the younger age is less than the older age minus the specified difference.

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Table DR1. XRF analyses for pumices from Paeroa Subgroup ignimbrites.

Sample:	254a	254b	254c	254d	266a	266b	266c	R1a	R1b	R1c	R1d	R1e	R1f	R1g	R1h	R1i	R1j	R1k	R1l	R1m	R1n	R1o
wt%																						
SiO_2	74.74	74.93	74.31	74.91	72.63	73.89	72.50	75.19	76.62	76.49	76.09	76.08	76.33	75.76	75.95	76.30	75.91	75.82	76.09	76.11	76.02	75.93
TiO_2	0.26	0.23	0.26	0.25	0.30	0.28	0.31	0.24	0.16	0.20	0.21	0.20	0.20	0.21	0.21	0.21	0.21	0.20	0.21	0.21	0.20	0.20
Al_2O_3	13.66	13.84	13.83	13.63	14.71	14.05	15.17	14.00	12.85	12.73	12.92	12.93	12.75	13.00	12.96	12.72	12.95	13.08	12.90	12.86	12.96	12.99
Fe_2O_3	1.90	1.78	2.03	1.88	2.12	1.81	2.18	1.69	1.26	1.49	1.54	1.53	1.55	1.58	1.55	1.59	1.57	1.55	1.55	1.56	1.54	1.55
MnO	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.03	0.03	0.06	0.06	0.06	0.06	0.07	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.06
MgO	0.42	0.39	0.44	0.41	0.49	0.44	0.49	0.32	0.23	0.31	0.31	0.35	0.36	0.36	0.36	0.37	0.36	0.36	0.36	0.36	0.35	0.35
CaO	1.76	1.49	1.79	1.73	2.20	2.14	2.20	1.37	1.15	1.28	1.34	1.33	1.25	1.39	1.36	1.28	1.36	1.37	1.33	1.32	1.34	1.34
Na_2O	4.24	3.55	4.18	4.24	3.47	3.58	3.75	3.31	3.31	4.19	4.25	4.28	4.22	4.33	4.30	4.20	4.28	4.32	4.27	4.28	4.29	4.31
K_2O	2.95	3.72	3.09	2.88	3.95	3.69	3.29	3.82	4.37	3.21	3.23	3.20	3.23	3.27	3.20	3.22	3.25	3.19	3.18	3.20	3.19	3.22
P_2O_5	0.02	0.01	0.01	0.01	0.06	0.05	0.04	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
(LOI)	1.47	2.31	1.52	1.59	1.67	1.71	2.16	2.38	1.99	0.89	1.13	1.04	0.40	0.25	0.24	0.58	0.57	1.97	1.03	1.08	0.85	1.13
(Total)	99.86	99.86	99.87	99.87	99.88	99.88	99.86	99.84	99.83	99.86	99.86	99.87	99.86	99.85	99.88	99.86	99.86	99.87	99.87	99.87	99.87	99.85
ppm																						
Zn	28	41	27	26	28	26	31	25	18	33	34	35	34	35	33	34	34	32	32	34	36	35
Rb	141	138	129	121	117	122	106	166	166	108	108	104	107	108	105	105	107	106	105	105	105	105
Sr	145	129	144	142	176	170	181	120	98	110	115	115	107	120	117	109	117	118	112	114	115	116
Y	19	17	19	18	18	19	18	19	21	24	26	25	25	25	25	26	25	25	25	25	25	26
Zr	158	145	156	151	174	169	179	166	123	145	149	144	145	152	147	149	151	148	149	151	148	146
Nb	7	6	8	7	6	7	7	8	7	8	9	9	8	8	8	8	8	8	9	9	9	9
Ba	712	701	730	713	766	763	741	1039	1160	813	825	814	811	843	817	812	837	810	809	814	798	808
La	24	21	23	21	23	21	21	26	24	26	24	22	26	26	25	24	22	28	22	26	28	28
Ce	38	34	36	49	35	38	35	38	39	48	39	33	34	38	42	44	40	37	28	28	30	39
Pb	16	24	18	16	16	14	14	14	10	16	15	14	16	14	15	14	16	14	13	15	13	14
Th	13	15	12	9	16	13	12	9	13	12	9	6	11	9	11	9	10	15	14	6	8	9

Values for major oxides are summed to 100%, but the original analytical totals and loss on ignition (LOI) values are given for reference.
Samples are all from individual pumice clasts collected from the Paeroa ignimbrite.

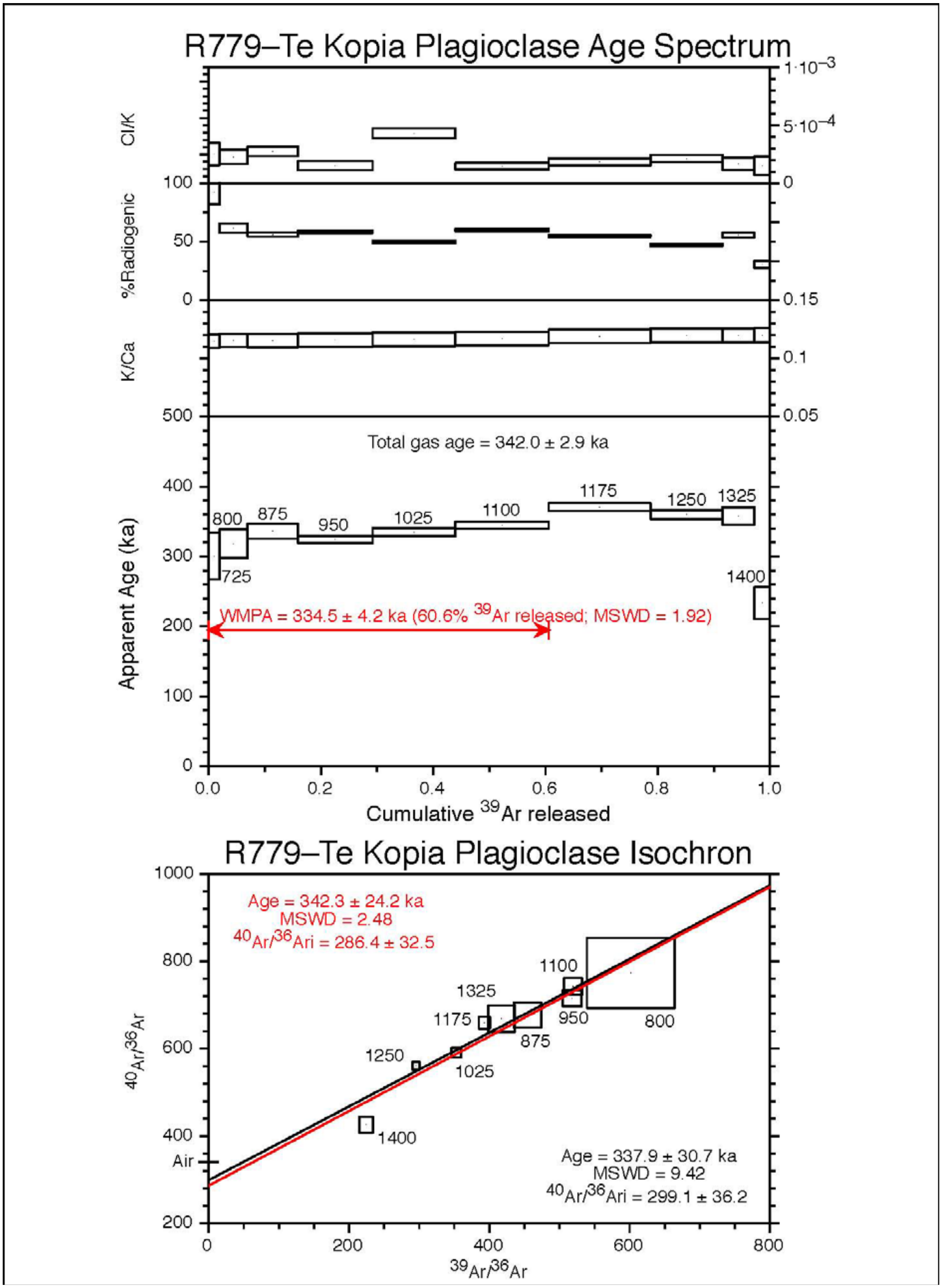

Figure DR1. Age data for sample R779: Te Kopia ignimbrite.

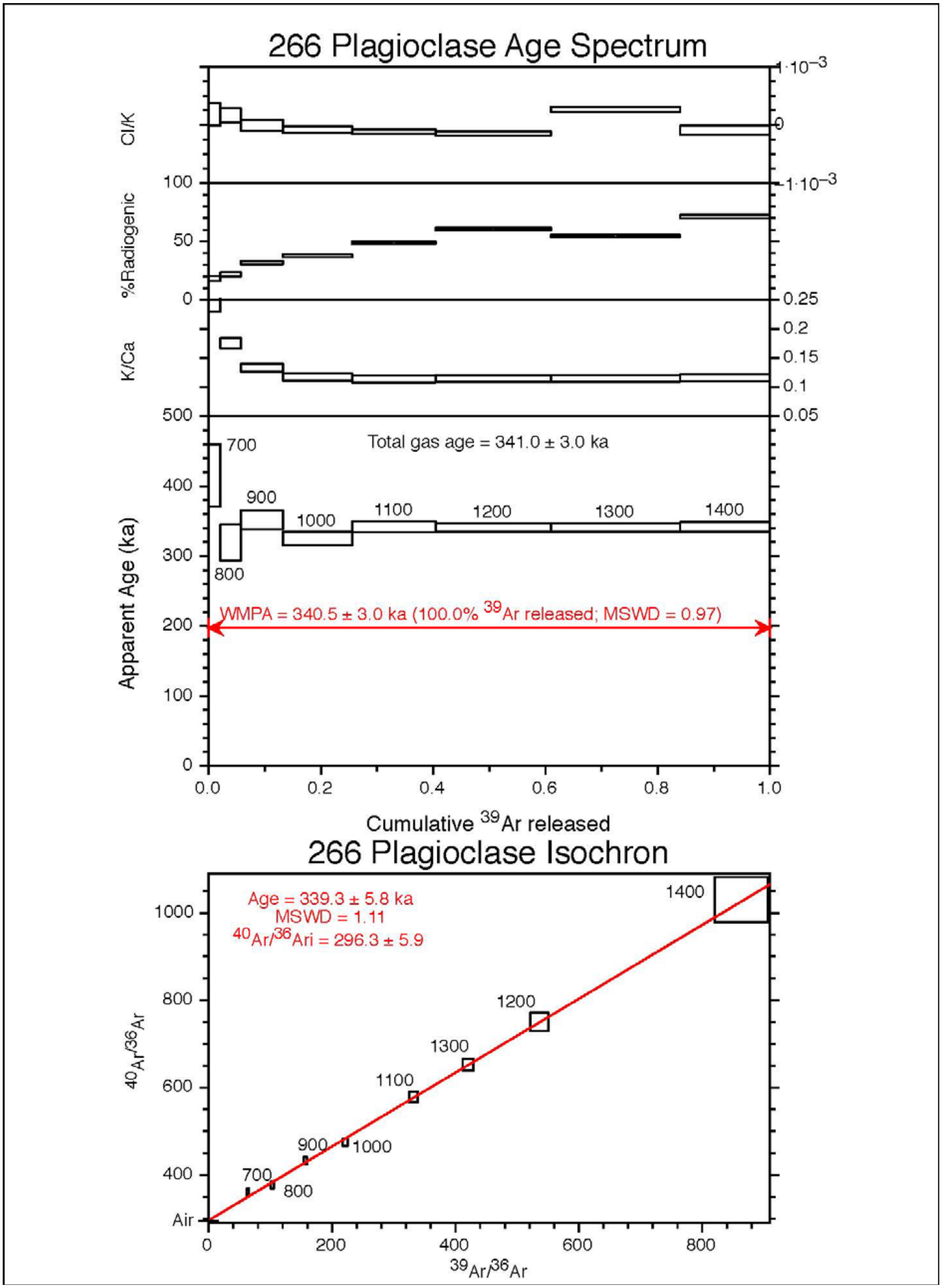

Figure DR2. Age data for sample 266: Paeroa ignimbrite.

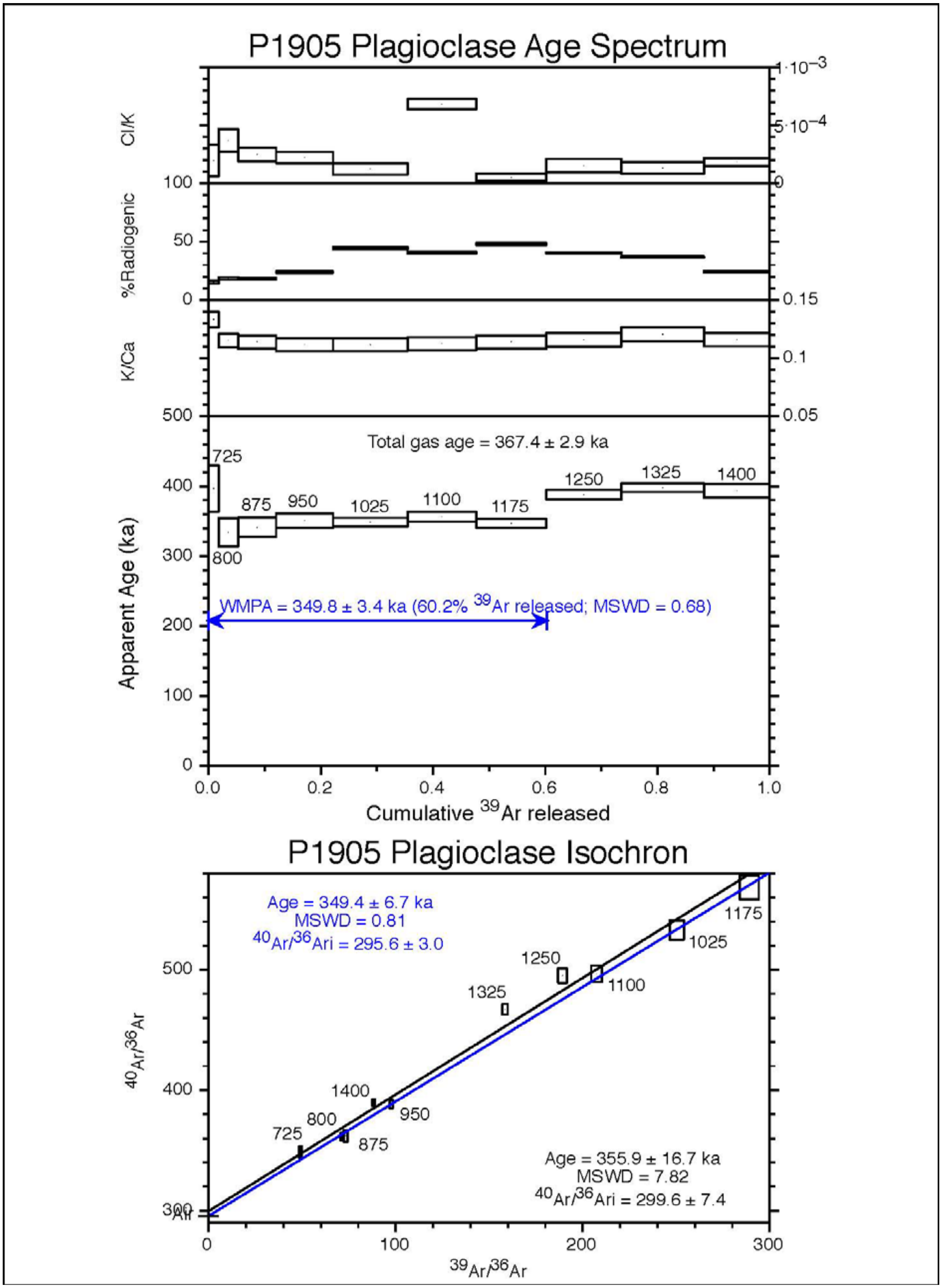

Figure DR3. Age data for sample P1905: Rangitaiki ignimbrite.

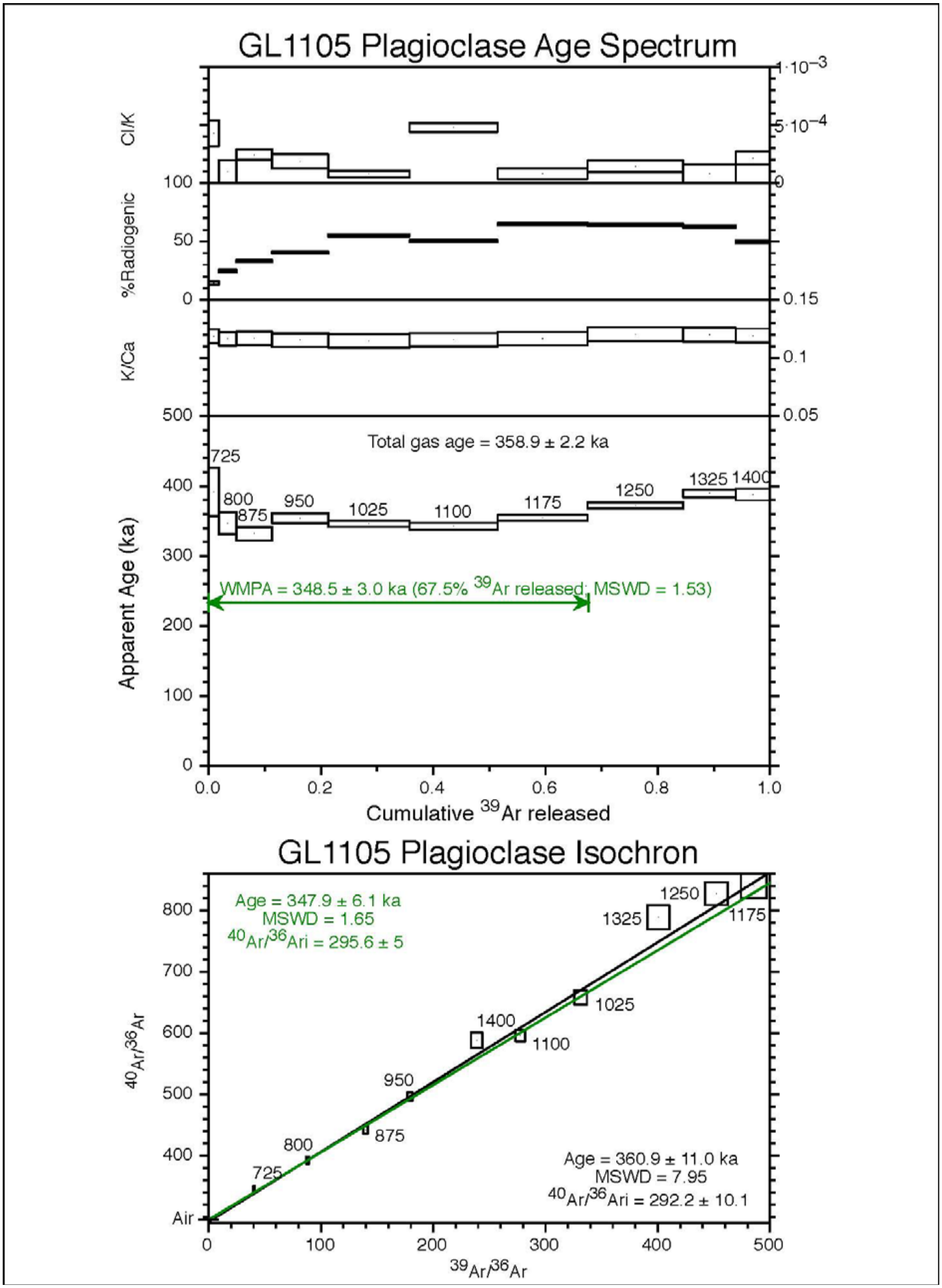

Figure DR4. Age data for sample GL1105: Te Whaiti ignimbrite.

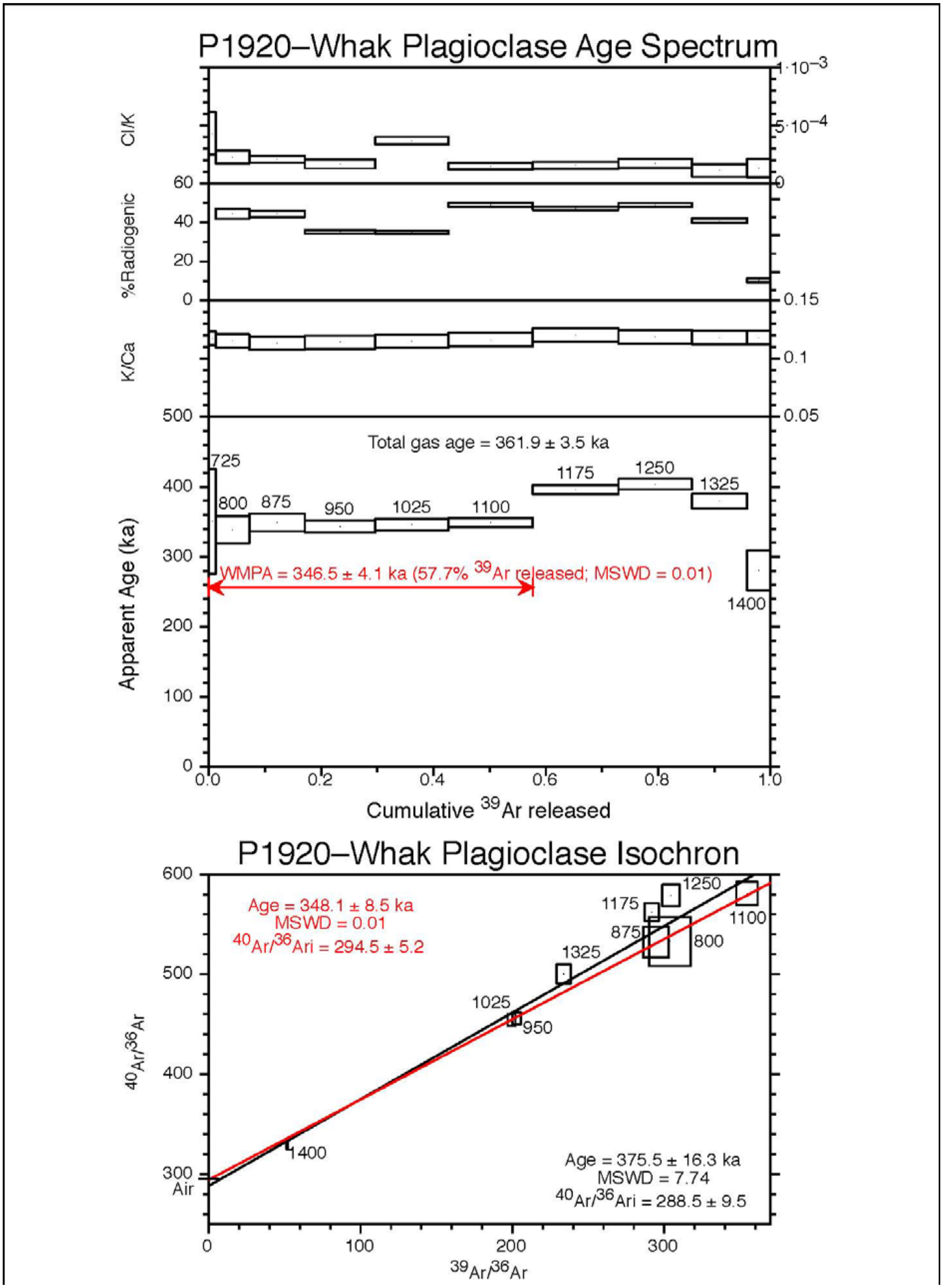

Figure DR5. Age data for sample P1920: Whakamaru ignimbrite.