Supplementary Material

^{40}Ar/^{39}Ar step-heating analysis and data

Adularia grains in the sub-vertical late-stage tensile veins of the Hoping structural complex were mechanically separated and sieved; grain sizes between 140–250μm were ultrasonically cleaned with acetone and deionized water then dried. The washed grains were handpicked to remove visible contamination to obtain pure separates. Weighted sample separates were wrapped in aluminum packets and packed with LP-6 Biotite standard for irradiation. After irradiation, the LP-6 biotite standard and samples were measured with step-heating technique, incrementally heated from 500 to 1500◦C using a double-vacuum resistance furnace, with a 30-min step schedule. Purified gas analyzed by a VG1200 mass spectrometer at the Argon geochronology laboratory, National Taiwan University.

^{40}Ar/^{39}Ar date was calculated from the argon composition released from the LP-6 biotite monitor (Odin et al., 1982) with a calibrated ^{40}Ar/^{39}Ar age of 128.48 ± 0.64 Ma based on Fish Canyon Sanidine (28.294 ± 0.036 Ma; Renne et al., 2010; 2011) with R value of 4.669 ± 0.023. Details of the analytical procedure are given in Lo et al. (2002). Plateau ages are calculated on adjacent steps with similar ages which together comprise more than 50% of $^{39}Ar_K$ released. The results are presented in Fig. 1d and Table S1.

References cited

Lo, C.-H., Chung, S.-L., Lee, T.-Y., and Wu, G.-Y., 2002. Age of the Emeishan flood magmatism and relations to Permian-Triassic boundary events. *Earth Planetary Science Letters*, **198**, 449-458.

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Table. 2. Analytical results of $^{40}Ar/^{39}Ar$ dating

Step*	cum.$^{39}Ar_K$	Atmos.(%)	$^{36}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{38}Ar/^{39}Ar$	$^{40}Ar/^{39}Ar$	$^{40}Ar/^{36}Ar$	Age (Ma) ± 1SD
Sample: HPa1								
400	0.004	79.118	6.87E-01	9.57E-03	1.82E-01	2.57E+02	3.74E+02	87.98±8.27
450	0.011	74.666	1.60E-01	1.27E-02	5.50E-02	6.32E+01	3.96E+02	26.72±2.47
500	0.029	80.031	6.14E-02	1.20E-03	3.11E-02	2.27E+01	3.70E+02	7.6±0.95
550	0.059	81.139	3.30E-02	3.13E-03	2.29E-02	1.21E+01	3.65E+02	3.81±0.58
600	0.107	77.224	1.94E-02	2.88E-03	1.37E-02	7.44E+00	3.84E+02	2.84±0.24
650	0.171	75.021	1.33E-02	4.30E-04	1.48E-02	5.28E+00	3.96E+02	2.21±0.38
700	0.245	71.396	1.09E-02	2.03E-04	1.50E-02	4.52E+00	4.17E+02	2.16±0.39
750	0.32	68.508	1.02E-02	4.77E-04	1.50E-02	4.41E+00	4.34E+02	2.32±0.33
800	0.39	73.342	1.14E-02	7.64E-04	1.59E-02	4.61E+00	4.05E+02	2.05±0.53
850	0.457	74.701	1.27E-02	3.17E-04	1.66E-02	5.05E+00	3.98E+02	2.14±0.41
900	0.524	70.116	1.30E-02	4.76E-04	1.54E-02	5.49E+00	4.24E+02	2.74±0.33
950	0.59	67.772	1.37E-02	0.00E+00	1.47E-02	6.00E+00	4.38E+02	3.23±0.22
1000	0.66	66.45	1.46E-02	4.04E-04	1.61E-02	6.54E+00	4.47E+02	3.67±1.26
1050	0.736	67.828	1.68E-02	1.04E-03	1.75E-02	7.35E+00	4.37E+02	3.96±1.57
1100	0.816	66.663	1.86E-02	2.41E-05	1.72E-02	8.27E+00	4.45E+02	4.62±1.37
1150	0.903	62.911	2.03E-02	0.00E+00	1.71E-02	9.55E+00	4.71E+02	5.93±1.29
1200	1	66.073	2.51E-02	4.97E-04	1.85E-02	1.13E+01	4.48E+02	6.41±1.25

Integrated date= 4.16 ± 0.11 Ma

Sample Mass = 0.1522 g

Plateau Date = 2.4 ± 0.5 Ma

J-value = 0.93267E-03 ± 0.7288E-05

Step*	cum.$^{39}Ar_K$	Atmos.(%)	$^{36}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{38}Ar/^{39}Ar$	$^{40}Ar/^{39}Ar$	$^{40}Ar/^{36}Ar$	Age (Ma) ± 1SD
Sample: HPa2								
450	0.013	55.255	2.92E-01	8.66E-02	8.88E-02	1.56E+02	5.35E+02	130.4±1.11
520	0.04	49.574	1.13E-02	4.57E-01	1.24E-02	6.72E+00	5.93E+02	6.52±0.32
580	0.079	40.875	5.04E-03	1.02E+00	1.23E-02	3.49E+00	6.91E+02	3.96±0.29
630	0.129	46.763	4.80E-03	1.85E+00	1.11E-02	2.76E+00	5.76E+02	2.82±0.43
680	0.195	22.277	1.50E-03	6.44E-01	1.24E-02	1.79E+00	1.20E+03	2.66±0.25
730	0.273	0.631	2.99E-05	2.53E-03	1.20E-02	1.40E+00	4.68E+04	2.64±0.22
780	0.352	20.154	8.27E-04	3.47E-03	1.20E-02	1.24E+00	1.50E+03	1.87±0.3
830	0.43	2.303	8.44E-05	1.35E-06	1.16E-02	1.11E+00	1.32E+04	2.05±0.09
880	0.504	13.301	5.55E-04	1.42E-06	1.17E-02	1.26E+00	2.27E+03	2.07±0.15
930	0.576	17.594	8.89E-04	2.23E-03	1.21E-02	1.52E+00	1.71E+03	2.38±0.34
980	0.647	29.598	1.84E-03	1.47E-06	1.23E-02	1.86E+00	1.01E+03	2.5±0.16

1030	0.716	44.93	3.54E-03	1.52E-06	1.27E-02	2.36E+00	6.66E+02	2.48±0.11
1080	0.784	39.759	4.02E-03	7.21E-04	1.21E-02	3.02E+00	7.50E+02	3.48±0.13
1130	0.852	37.108	4.83E-03	1.54E-06	1.38E-02	3.88E+00	8.02E+02	4.68±0.14
1180	0.921	46.654	8.06E-03	1.53E-06	1.37E-02	5.13E+00	6.37E+02	5.26±0.14
1220	1	50.757	1.20E-02	1.33E-06	1.64E-02	7.00E+00	5.85E+02	6.64±0.14

Integrated Date = 5.06 ± 0.06 Ma

Sample Mass = 0.3000 g

Plateau Date = 2.36 ± 0.08 Ma

J-value = 0.10734E-02 ± 0.61540E-05

Note:

Atmos.(%)=[1-$^{40}Ar*/(^{40}Ar*+^{40}Ar_{air})$]*100, *= radiogenic ^{40}Ar

The apparent date is obtained by using the following equations:

Age = $\frac{1}{\lambda}\ln(1+J\frac{^{40}Ar*}{^{39}Ar_K})$, and

$$\frac{^{40}Ar*}{^{39}Ar_K}=\frac{[^{40}\mathrm{Ar}/^{39}\mathrm{Ar}]_m-[^{40}\mathrm{Ar}/^{36}\mathrm{Ar}]_{air}[^{36}\mathrm{Ar}/^{39}\mathrm{Ar}]_\mathrm{m}+[^{40}\mathrm{Ar}/^{36}\mathrm{Ar}]_{air}[^{36}\mathrm{Ar}/^{37}\mathrm{Ar}]_\mathrm{Ca}[^{37}\mathrm{Ar}/^{39}\mathrm{Ar}]_\mathrm{m}}{1-[^{39}\mathrm{Ar}/^{37}\mathrm{Ar}]_\mathrm{Ca}[^{37}\mathrm{Ar}/^{39}\mathrm{Ar}]_\mathrm{m}}-[\frac{^{40}Ar}{^{39}Ar}]_\mathrm{K}$$

where [ ]$_{Ca}$ and [ ]$_K$ = isotope ratios of argon extracted from irradiated calcium and potassium salts), [ ]$_m$ = isotope ratio of argon extracted from irradiated unknown, and [$^{40}Ar/^{36}Ar$]$_{air}$ = 298.65 (Lee et al., 2006)

J-value: Weighted mean of fusions of irradiation standard LP-6 biotite having a $^{40}Ar/^{39}Ar$ age of 128.48 ± 0.64 Ma with R value of 4.669 ± 0.023 relative to the age of FC Sanidine primary standard (28.294 ± 0.036 Ma; Renne et al., 2011).

Age (Ma)=the date calculated using the following decay constants: □□ = (5.757 ± 0.016)*10^{-11} yr $^{-1}$; □□ = (4.9548 ± 0.0134)*10^{-10} yr^{-1}; □ = (5.5305 ± 0.0134)*10^{-10} yr^{-1} (Renne et al., 2011).

The quoted error is one standard deviation and includes the error in the J-value, the standard error, but not for the error in the interference corrections.

Reference:

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