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Supplemental Material

Table S1. Results of apatite (u-th-sm)/he dating.

Table S2. Results of zircon (u-th)/he dating.

Figure S1. Plot of the inferred expected single grain predicted raw ages vs observed raw ages for the north (a) and south (b) transects. The apatite raw ages are shown as upward pointing triangles and the zircon raw ages as downward pointing triangles (from over 250,000 accepted thermal histories).

Figure S2. Plot of inferred weighted mean expected model predicted raw ages vs observed raw ages for the north (a) and south (b) transects. The apatite raw ages are shown as upward pointing triangles and the zircon raw ages as downward pointing triangles (from 250,000 accepted thermal histories).

Figure S3. Plot of the inferred expected single grain raw ages predictions and observations with elevation for the north (a) and south (b) transects. The observed raw ages are shown as upward pointing triangles, and the predicted raw ages as downward pointing triangles. The closure time is shown as (grey filled, light or dark green borders) downward pointing triangle without error bar. See the legend for the appropriate symbols.

Figure S4. Plot of the weighted mean expected model predictions and observations with elevation for the north (a) and south (b) transects. In this plot, the raw ages observed are shown as upward pointing triangles, and the raw ages predicted and closure time as downward pointing triangles.

TABLE S1. RESULTS OF APATITE (U-Th-Sm)/He DATING

Sample No.	U (ppm)	Th (ppm)	Th/U	Sm (ppm)	eU* (ppm)	[⁴ He] (nmol/g)	Radius (μm)	Ft†	Raw Age (Ma)	Corr. Age (Ma)	Error (Ma ± 1σ)	Mean Age § (Ma ± 2σ)
<u>South Transect[#]</u>												
YN4192-1	44.6	34.1	0.76	108.1	52.6	4.1	53.88	0.72	14.1	19.6	1.2	19.6 ± 2.4
YN4193-1	130.4	9.0	0.07	79.8	132.5	8.3	62.74	0.77	11.5	15.0	0.9	
YN4193-2	148.0	17.4	0.12	83.9	152.1	10.5	74.20	0.80	12.7	15.8	1.0	15.5 ± 1.1
YN4193-3	169.5	20.0	0.12	90.8	174.2	10.8	52.44	0.72	11.5	15.8	0.9	
YN4194-1	209.6	22.4	0.11	92.7	214.9	15.5	61.95	0.76	13.3	17.4	1.0	
YN4194-2	201.9	24.0	0.12	105.6	207.5	16.1	63.74	0.77	14.4	18.6	1.1	16.9 ± 1.1
YN4194-3	173.6	16.1	0.09	77.3	177.3	10.9	55.38	0.74	11.4	15.4	0.9	
YN4197-1	199.9	17.6	0.09	92.7	204.0	13.2	39.02	0.64	11.9	18.6	1.1	
YN4197-2	119.8	8.6	0.07	73.0	121.8	7.8	32.99	0.59	11.8	20.1	1.2	19.6 ± 1.3
YN4197-3	87.5	6.4	0.07	49.9	89.0	7.3	57.02	0.75	15.2	20.4	1.2	
YN41910-1	387.2	38.2	0.10	125.1	396.2	56.0	34.31	0.60	26.1	43.6	2.6	
YN41910-2	312.7	37.0	0.12	110.4	321.4	35.8	32.65	0.58	20.6	35.5	2.1	37.9 ± 2.6
YN41910-3	252.9	23.1	0.09	92.5	258.3	30.2	33.80	0.59	21.6	36.4	2.2	
YN41911-1	164.2	8.1	0.05	77.7	166.1	14.7	40.34	0.65	16.3	24.9	1.5	26.9 ± 2.3
YN41911-2	46.2	2.6	0.06	50.2	46.9	5.2	45.43	0.69	20.5	29.8	1.8	
<u>North Transect</u>												
YN4201-1	47.9	46.3	0.96	111.1	58.8	7.9	33.25	0.57	24.4	43.0	2.6	43.0 ± 5.2
YN4202-1	263.6	23.8	0.09	114.2	269.2	35.9	35.61	0.61	24.6	40.2	2.4	40.2 ± 4.8
YN4203-1	215.6	18.6	0.09	88.9	220.0	24.9	50.01	0.71	20.9	29.2	1.8	
YN4203-2	153.4	8.9	0.06	65.8	155.5	18.8	43.72	0.68	22.4	33.0	2.0	31.0 ± 2.2
YN4203-3	387.8	33.2	0.09	108.9	395.6	47.7	49.86	0.71	22.3	31.3	1.9	
YN4208-1	41.4	24.5	0.59	87.8	47.2	7.7	54.91	0.73	29.6	40.7	2.4	35.8 ± 2.5

YN4208-2	27.5	10.6	0.39	83.7	30.0	4.1	65.53	0.77	24.5	31.8	1.9	
YN4208-3	34.4	7.5	0.22	67.6	36.2	5.9	73.46	0.80	29.6	37.2	2.2	
YN4204-1	63.9	26.9	0.42	114.6	70.2	6.3	27.34	0.50	16.3	32.5	1.9	32.5 ± 3.8
YN4205-1	49.1	7.2	0.15	80.0	50.8	4.9	46.78	0.69	17.7	25.5	1.5	25.5 ± 3.0
YN4206-1	150.7	11.3	0.08	67.1	153.4	22.3	42.41	0.67	26.8	40.2	2.4	
YN4206-2	104.8	6.6	0.06	52.4	106.4	19.2	67.16	0.78	33.3	42.6	2.6	41.9 ± 2.9
YN4206-3	173.5	14.7	0.08	70.8	177.0	30.2	53.24	0.73	31.5	43.1	2.6	
YN4207-1	182.6	30.0	0.16	102.3	189.7	29.1	28.89	0.53	28.3	53.2	3.2	
YN4207-2	544.2	237.6	0.44	184.9	600.0	104.3	34.07	0.59	32.1	54.8	3.3	54.0 ± 4.6

Note: The samples of apatite were analyzed in the Thermochronology Lab at the University of Texas at Austin.

*Effective uranium concentration, $eU = U + 0.235 \times Th$.

[†] α -ejection correction (Farley et al., 1996).

[§]The mean age calculation using the Isoplot of Ludwig (Ludwig, 1991).

[#]The south transect data have been published by Nie et al. (2018).

TABLE S2. RESULTS OF ZIRCON (U-Th)/He DATING

Sample No.	U (ppm)	Th (ppm)	Th/U	eU* (ppm)	[⁴ He] (ncc)	Radius (μm)	Ft [†]	Raw Age (Ma)	Corr. Age (Ma)	Error (Ma ± 1σ)	Mean Age [§] (Ma ± 2σ)
<u>South Transect</u>											
YN4192-1	1303.2	202.2	0.16	1350.8	10.708	63.90	0.79	26.7	34.0	0.6	36.5 ± 0.9
YN4192-2	1151.4	174.9	0.15	1192.5	27.068	78.10	0.82	31.4	38.3	1.7	
YN4192-3	1075.5	244.3	0.23	1132.9	17.403	60.49	0.77	31.7	41.2	0.9	
YN4192-4	1250.3	361.3	0.29	1335.2	12.994	59.85	0.77	28.2	36.6	0.8	
YN4193-1	501.0	147.2	0.29	539.2	26.518	87.37	0.85	28.3	33.1	1.8	37.8 ± 1.7
YN4193-2	927.1	257.4	0.28	994.3	57.542	98.93	0.87	27.4	31.4	1.7	
YN4193-3	730.3	209.7	0.29	784.9	58.711	89.27	0.86	37.5	43.7	2.4	
YN4193-4	571.5	178.9	0.31	617.7	87.456	67.92	0.81	37.4	46.0	2.5	
YN4193-5	564.3	135.7	0.24	600.3	84.213	86.22	0.85	36.8	43.2	2.3	
YN4193-6	441.4	72.5	0.16	461.7	44.499	74.21	0.83	32.6	39.3	2.1	41.0 ± 2.6
YN4194-1	290.0	49.1	0.17	303.6	13.492	55.76	0.77	33.7	43.6	2.4	
YN4194-2	2084.4	166.1	0.08	2138.6	73.573	70.38	0.82	30.3	37.0	2.0	
YN4194-3	671.2	153.3	0.23	712.1	21.303	72.64	0.83	36.6	44.3	2.5	36.0 ± 0.9
YN4195-1	1912.5	152.8	0.08	1948.4	38.221	77.63	0.82	30.1	36.7	0.8	
YN4195-2	1284.9	169.8	0.13	1324.8	54.238	97.15	0.85	31.2	36.6	1.6	
YN4195-3	1839.9	301.7	0.16	1910.8	77.070	92.09	0.85	34.5	40.7	0.9	
YN4195-4	1636.7	237.5	0.15	1692.5	26.939	72.71	0.81	22.9	28.4	1.8	
YN4195-5	1245.6	208.0	0.17	1294.5	17.600	75.37	0.82	26.4	32.4	0.8	38.4 ± 0.8
YN4196-1 [#]	649.7	138.2	0.21	682.1	45.551	105.00	0.86	43.0	49.7	1.0	
YN4196-2	1088.3	134.9	0.12	1120.0	54.256	105.53	0.87	33.5	38.6	0.7	
YN4196-3	655.3	154.3	0.24	691.6	42.957	108.69	0.87	34.7	40.0	0.8	

YN4196-4	361.5	71.2	0.20	378.2	12.209	88.61	0.84	32.6	38.8	0.7	
YN4196-5	641.7	102.4	0.16	665.8	14.158	77.14	0.82	29.3	35.8	0.8	
YN4197-1	1260.8	168.4	0.13	1309.5	40.031	66.71	0.81	35.9	44.3	2.4	
YN4197-2	970.1	107.5	0.11	1002.4	27.887	73.68	0.83	33.5	40.4	2.2	
YN4197-3	1574.8	93.8	0.06	1608.3	46.683	68.60	0.82	32.9	40.4	2.2	37.2 ± 1.8
YN4197-4	852.8	77.7	0.09	877.2	17.026	57.63	0.78	26.7	34.2	1.8	
YN4197-5	592.1	170.6	0.29	636.5	16.180	73.65	0.83	26.9	32.5	1.7	
YN4199-1	856.9	229.6	0.27	910.9	21.594	76.42	0.82	40.1	49.1	1.8	
YN4199-2	801.6	103.1	0.13	825.8	26.545	81.90	0.83	32.4	39.2	0.8	
YN4199-3	1058.1	291.8	0.28	1126.7	28.384	68.09	0.79	39.6	49.9	1.1	41.9 ± 0.9
YN4199-4	564.1	668.6	1.19	721.2	16.968	72.27	0.80	33.7	42.1	0.7	
YN4199-5	1068.7	104.2	0.10	1093.1	15.885	65.97	0.79	28.6	36.3	1.1	
YN41910-1	626.0	94.4	0.15	648.2	17.071	68.14	0.79	45.8	57.6	2.5	
YN41910-2	568.9	93.8	0.16	590.9	70.984	113.66	0.87	54.1	61.9	1.2	
YN41910-3	585.3	76.9	0.13	603.4	36.143	80.76	0.82	47.2	57.3	1.3	60.4 ± 1.4
YN41910-4	447.9	65.3	0.15	463.2	17.599	83.16	0.83	47.8	57.6	2.4	
YN41910-5	739.4	60.0	0.08	753.5	38.027	92.86	0.85	55.2	65.0	1.7	
YN41911-1	894.6	135.9	0.15	933.0	20.068	53.66	0.76	38.4	50.4	2.8	
YN41911-2	505.0	142.6	0.28	542.2	6.008	50.79	0.75	36.1	48.2	2.6	
YN41911-3	353.2	162.1	0.46	393.8	5.673	49.81	0.74	40.2	54.0	2.9	52.7 ± 2.9
YN41911-4	437.8	298.6	0.68	511	8.088	54.44	0.77	47.5	62.0	3.4	
YN41912-1	386.7	112.6	0.29	413.1	11.863	72.41	0.80	37.0	46.0	2.0	
YN41912-2 [#]	854.5	257.9	0.30	915.1	32.106	64.86	0.78	58.1	74.2	1.9	
YN41912-3	243.4	22.9	0.09	248.7	6.426	77.42	0.82	40.1	48.9	2.1	49.4 ± 1.4
YN41912-4	316.7	78.0	0.25	335.0	19.659	89.79	0.84	42.5	50.6	1.1	
YN41912-5	780.2	118.8	0.15	808.1	17.192	72.51	0.81	40.0	49.4	1.2	

North Transect

YN4201-1	1101.2	150.2	0.14	1136.5	20.364	63.36	0.78	53.7	68.5	1.4	64.3 ± 1.4
YN4201-2	294.0	56.8	0.19	307.4	27.283	107.81	0.87	58.5	67.3	1.3	
YN4201-3	865.3	411.7	0.48	962.1	27.869	75.32	0.81	47.4	58.3	1.2	
YN4201-4	1053.8	211.7	0.20	1103.6	30.307	69.15	0.80	51.7	64.7	1.8	
YN4202-1	758.4	144.6	0.19	792.4	41.863	76.61	0.82	53.8	66.0	1.3	60.9 ± 1.3
YN4202-2	920.7	53.3	0.06	933.2	25.210	73.93	0.81	45.6	56.1	1.1	
YN4202-3	669.8	202.5	0.30	717.4	20.376	70.32	0.80	59.3	73.9	3.1	
YN4202-4	2721.3	922.7	0.34	2938.2	150.722	73.21	0.81	56.1	69.7	1.7	
YN4202-5	796.5	58.4	0.07	810.2	18.849	67.22	0.79	43.9	55.4	1.2	73.1 ± 1.6
YN4203-1	1135.3	138.0	0.12	1167.7	49.135	66.98	0.79	69.4	87.7	1.7	
YN4203-2	583.3	131.6	0.23	614.3	34.277	80.92	0.83	72.1	87.3	2.5	
YN4203-3	1276.5	60.9	0.05	1290.8	28.953	60.45	0.77	50.8	65.9	1.5	
YN4203-4	1203.0	245.4	0.20	1260.6	20.485	65.46	0.79	48.5	61.4	1.5	70.1 ± 1.5
YN4203-5	2495.7	335.5	0.13	2574.5	125.918	74.58	0.81	62.7	77.3	2.2	
YN4204-1	1235.7	106.0	0.09	1260.6	59.999	81.47	0.83	57.2	69.1	1.6	
YN4204-2	1062.1	131.0	0.12	1092.9	34.293	69.03	0.80	45.5	74.4	1.7	
YN4204-3	583.3	118.7	0.20	611.2	22.788	75.53	0.81	59.4	63.7	1.3	81.7 ± 1.3
YN4204-4	636.9	228.1	0.36	690.5	44.522	87.16	0.84	51.8	77.7	1.7	
YN4205-1	1989.6	396.0	0.20	2082.7	115.749	84.60	0.83	66.7	80.0	0.9	
YN4205-2	753.5	265.8	0.35	816.0	65.111	95.12	0.85	70.1	82.4	1.9	
YN4205-3	745.6	210.5	0.28	795.1	77.354	104.14	0.86	70.5	81.7	1.6	92.1 ± 3.5
YN4205-4	638.0	219.8	0.34	689.7	35.004	83.34	0.83	66.9	80.5	2.2	
YN4205-5	973.6	372.4	0.38	1061.2	67.565	85.07	0.83	75.9	91.0	2.1	
YN4207-1 [#]	1526.1	149.3	0.10	1561.1	24.707	60.61	0.77	47.3	61.1	1.2	
YN4207-2	836.0	142.0	0.17	869.4	54.263	87.89	0.84	74.0	88.0	2.5	

YN4207-3	1418.7	235.3	0.17	1474.0	101.849	77.23	0.82	78.3	95.8	2.4
YN4207-4 [#]	3765.9	653.8	0.17	3919.5	54.291	69.69	0.80	23.5	29.5	1.0

Note: The samples of zircon were analyzed in the Thermochronology Lab at the State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration and John de Laeter Centre, Curtin University.

*Effective uranium concentration, $eU=U+0.235\times Th$.

[†] α -ejection correction (Farley et al., 1996).

[§]The mean age calculation using the Isoplot of Ludwig (Ludwig, 1991).

[#]The outlier or unreliable value, not used in the calculation of mean age.

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SUPPLEMENTARY TEXT

It is important to consider the consistency between observed and predicted values when assessing the results of inverse thermal history modeling (Gallagher, 2016). We plotted the summary expected model predictions for the two transects (Figs. S1-S4). The expected model or weighted mean model is preferred model in Bayesian approaches as it captures the tendencies in all accepted models. Furthermore, for the results presented here, individual models such as the maximum likelihood and maximum posterior models contain the same important features as the expected model.

The Fig. S1 shows the observed raw ages and (expected model) predicted raw ages of individual grains. Although there is dispersion in the observed raw ages, the model predictions can explain most of the AHe ages (upward triangles) for the two transects (Figs. S1A and S1B), but slightly underestimate the ZHe ages for the south transect (Fig. S1B). Although the individual grains are not always closely predicted, it is clear that the trends in the mean predicted values for the two transects are generally consistent with observations (Figs. S2).

Fig. S3 presents the predicted and observed raw values of individual grains for all samples in the transects, as a function of elevation. We also show the closure time, which is an estimate for each grain of the last time, for a given thermal history, it was totally degassed (here the given thermal history being the expected model). Variations in the closure time for different grains from a particular sample reflect controls of grain size, and potentially some contribution from radiation damage effects. Given that the samples often have several single crystal ages, a small perturbation is added to the elevation, in order to facilitate visual identification of different data points on the graph. Thus, older observed raw ages for a particular sample are plotted at a slightly higher elevations than the younger observed raw ages. While most of the predictions for the two transects are close to the observed raw values, some raw ages are under or over predicted (Fig. S3), which suggest they are outliers for unknown reasons. However, removing these makes little to no difference to the inferred thermal history. To make the age versus elevation relationship plot less cluttered, we also display the mean observed raw ages versus mean predicted raw ages for the vertical transects (Fig. S4). The trends look similar as we see in the predicted raw ages.

Figure S1. Plot of the inferred expected single grain predicted raw ages vs observed raw ages for the north (A) and south (B) transects. The apatite raw ages are shown as upward pointing triangles and the zircon raw ages as downward pointing triangles (from over 250,000 accepted thermal histories).

Figure S2. Plot of inferred weighted mean expected model predicted raw ages vs observed raw ages for the north (A) and south (B) transects. The apatite raw ages are shown as upward pointing triangles and the zircon raw ages as downward pointing triangles (from 250,000 accepted thermal histories).

Figure S3. Plot of the inferred expected single grain raw ages predictions and observations with elevation for the north (A) and south (B) transects. The observed raw ages are shown as upward pointing triangles, and the predicted raw ages as downward pointing triangles. The closure time is

shown as (gray filled, light or dark green borders) downward pointing triangle without error bar. See the legend for the appropriate symbols.

Figure S4. Plot of the weighted mean expected model predictions and observations with elevation for the north (A) and south (B) transects. In this plot, the raw ages observed are shown as upward pointing triangles, and the raw ages predicted and closure time as downward pointing triangles.

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