

Supplementary Table 1. Analytical fission-track results for Ocoña canyon, Peru

Sample name	Mineral	Location		Elev. (m)	No. of crystals	Track densities						Age dispersion		Central age (Ma±1σ)	Mean track length (μm)	S.D. (μm)	No. of tracks
		Lat. S (UTM Zone 18)	Long. W			Central age		Mean track length		S.D.		Pχ ²	RE				
						ρ _d	N _d	ρ _s	N _s	ρ _i	N _i						
OCO 05 I	Apatite	0712032	8268974	1800	14	1.272	5290	0.236	109	0.544	280	16.2	19.7	84.5±10.6	none		
COTA 01	Apatite	0739753	8328002	2770	10	1.298	3597	0.328	89	1.043	281	62.3	0.1	69.3±8.5	none		
OCO 02	Apatite	0726433	8254464	2790	18	1.272	5290	0.867	405	1.827	872	59.7	0.7	99.4±6.1	none		
OCO 03	Apatite	0715850	8252013	1800	20	1.272	5290	1.299	658	3.474	1785	0.11	22.0	79.4±5.5	11.89±0.16	1.21	56
OCO 04	Apatite	0715850	8252013	1740	20	1.272	5290	0.704	664	1.993	1874	0.17	21.4	76.5±5.2	13.45±0.13	1.01	75
OCO 05	Apatite	0718865	8251918	2200	19	1.272	5290	0.056	372	1.696	1073	19.7	14.6	74.6±5.3	none		
OCO 06	Apatite	0724149	8273472	3700	20	1.298	3597	0.054	390	1.586	1162	72.8	0.7	73.4±4.5	none		
OCO 07	Apatite	0723531	8272655	3280	10	1.298	3597	0.682	186	1.929	546	21.6	10.8	75.9±7.1	14.17±0.18	1.16	41
OCO 08	Apatite	0724478	8273181	3800	7	1.272	5290	0.823	139	2.651	395	33.5	41.6	68.3±13.1	14.79±0.26	0.91	12
OCO 09	Apatite	0718732	8273505	3600	17	1.298	3597	1.178	527	3.145	1413	25.7	0.04	87.1±7.4	14.49±0.17	1.08	39
OCO 10	Apatite	0708069	8253850	1300	10	1.298	3597	2.221	355	6.505	1018	80.7	0.0	76.3±4.9	13.52±0.10	0.99	100
OCO 11	Apatite	0705175	8254271	600	20	1.272	5290	1.207	814	4.234	2834	12.3	10.3	61.6±3.0	12.82±0.13	1.28	101
OCO 12	Apatite	0706528	8254518	700	15	1.272	5290	2.043	699	6.690	2307	77.6	0.0	65.0±2.9	13.29±0.10	0.98	105
OCO 16	Apatite	0704116	8254322	1290	16	1.272	5290	0.628	455	2.705	1976	3.9	16.1	49.7±3.4	13.35±0.34	1.50	20
OCO 17	Apatite	0702020	8278995	1010	16	1.272	5290	0.065	56	0.951	804	4.5	48.6	16.6±3.1	none		
OCO 18	Apatite	0703237	8280060	1020	11	1.298	3597	0.133	46	2.358	852	54.9	0.3	11.9±1.8	none		
OCO 19	Apatite	0705231	8270936	1050	15	1.272	5290	0.252	144	1.115	612	5.4	26.9	54.3±26.9	none		
OCO 23	Apatite	0690198	8260556	2590	21	1.298	3597	0.368	256	1.102	793	69.7	1.1	70.6±5.2	14.65±0.16	1.16	52
OCO 24	Apatite	0693442	8242161	1930	20	1.272	5290	1.368	1936	3.596	5290	19.4	11.5	79.2±4.2	13.49±0.19	1.30	48
OCO 25	Apatite	0691617	8234000	1110	20	1.272	5290	1.031	664	2.208	5290	32.9	6.6	97.4±5.0	14.84±0.21	1.34	40
OCO 26	Apatite	0692604	8234861	1280	20	1.272	5290	1.137	2068	2.782	5290	1.0	16.6	89.0±5.1	13.81±0.10	1.01	103
OCO-04-01	Apatite	0719120	8550500	2400	21	1.106	6131	0.666	633	1.413	1343	40.9	7.4	87.7±4.6	13.43±0.10	1.04	101
	Zircon			2400	15	0.457	3450	10.08	2278	3.076	695	9.0	7.9	98.5±5.0			
OCO-04-04	Apatite	0713050	8243530	1000	22	1.106	6131	0.376	453	0.781	939	3.1	17.6	90.6±6.5	12.71±0.11	0.96	75
	Zircon			1000	20	0.474	3450	9.089	4321	2.247	1068	2.4	10.6	119.5±5.5			
OCO-04-06	Apatite	0701732	8237747	500	20	1.106	6131	0.569	774	1.158	1575	10.0	3.6	91.3±4.2	13.45±0.10	0.97	100
	Zircon			500	20	0.472	3450	9.563	3844	2.32	933	0.6	14.4	120.6±6.5			

Sample name	Mineral	Location		Elev. (m)	No. of crystals	Track densities						Age dispersion		Central age (Ma±1σ)	Mean track length (μm)	S.D. (μm)	No. of tracks
		Lat. S (UTM Zone 18)	Long. W			Central age		Mean track length		S.D.		Pχ ²	RE				
						ρ _d	N _d	ρ _s	N _s	ρ _i	N _i						
OCO-04-07	Apatite	0698800	8243130	1690	21	1.106	6131	0.516	819	1.42	2252	57.6	0.0	68.3±3.0	12.33±0.13	1.33	101
	Zircon			1690	14	0.469	3450	15.72	4406	3.928	1100	9.4	7.1	118.1±5.0			
OCO-04-09	Apatite	0700180	8243200	1200	20	1.106	6131	1.517	1363	3.649	3277	8.2	1.7	78.0±2.9	12.42±0.11	1.17	100
	Zircon			1200	17	0.469	3450	14.44	4513	3.311	1061	0.4	14.6	125.6±6.6			
OCO-04-10	Apatite	0699787	8240343	600	20	1.106	6131	4.325	2446	7.657	4330	0.5	10.6	105.0±3.9	13.53±0.10	1.05	100
	Zircon			600	15	0.465	3450	9.297	2487	2.299	615	1.1	15.6	114.4±7.3			

Notes: AFT and ZFT age determinations were carried out at the UCL–Birkbeck Thermochronometry laboratories, London. Samples for AFT analysis were irradiated at the well-thermalised (Cd ratio for Au >100) Hifar reactor, Lucas Heights, Australia, using the Corning CN5 glass dosimeter. Analyses were carried out on a Zeiss Axioplan microscope at a magnification of x1250, using a dry (x100) objective. Confined track length measurements were made using a digitizing tablet calibrated against a stage micrometer. Single-grain AFT ages were calculated using the external detector method and the zeta calibration approach, as recommended by the I.U.G.S. Subcommittee on Geochronology (Hurford, 1990). Track length measurements were restricted to confined tracks parallel to the crystal polishing plane. (i) Track densities are ($\times 10^6$ tr cm^{-2}) numbers of tracks counted (N) shown in brackets; (ii) analyses by external detector method using 0.5 for the $4\pi/2\pi$ geometry correction factor; (iii) ages calculated using dosimeter glass CN-5 (apatite), $\zeta_{\text{CN5}} = 333 \pm 5$; CN-2 (zircon), $\zeta_{\text{CN5}} = 127 \pm 5$ calibrated by multiple analyses of IUGS apatite and zircon age standards; (iv) $P\chi^2$ is probability for obtaining χ^2 value for n degrees of freedom, where n = no. crystals – 1; (v) Central age is a modal age, weighted for different precisions of individual crystals.

Reference: HURFORD, A.J. 1990. Standardization of Fission track dating calibration: recommendation by the Fission Track Working Group of the I.U.G.S. Subcommittee on Geochronology. *Chemical Geology*, **80**, 171–178.