Supplementary Table 2. Apatite (U-Th)/He results

Sample name	Aliquot name	*n*	He (nmol/g)	U (ppm)	Th (ppm)	Ft	Age (Ma)	Abs. error	Std dev.
OCO 04-01	Ap1	2	2.27	32.12	44.94	0.65	15.1	0.9	
	Ap2	2	1.39	13.20	20.98	0.68	20.6	1.2	
	Ap3	2	4.32	35.20	53.04	0.68	24.6	1.5	
	Ap4	2	2.22	24.63	39.19	0.71	16.9	1.0	
Mean	*1&4*	*2*	*2.24*	*28.37*	*42.07*	*0.68*	*16.0*	*0.8*	*1.3*
	2&3		*2.85*	*24.20*	*37.01*	*0.68*	*22.6*	*0.5*	*2.9*
OCO 04-04	Ap1	3	0.48	7.85	15.86	0.76	10.1	0.6	
	Ap2	3	1.00	9.80	23.69	0.79	15.1	0.9	
	Ap3	4	0.38	7.09	14.70	0.76	8.8	0.5	
Mean			*0.62*	*8.24*	*18.08*	*0.77*	*11.3*	*0.4*	*3.3*
OCO 04-07	Ap1	3	11.35	32.61	106.51	0.70	51.4	3.1	
	Ap2	3	9.64	32.00	97.99	0.72	44.9	2.7	
	Ap3	3	6.02	16.24	45.56	0.76	54.1	3.2	
Mean			*9.00*	*26.95*	*83.35*	*0.73*	*50.1*	*1.7*	*4.7*
OCO 04-09	Ap1	3	29.89	131.79	241.06	0.71	41.1	2.5	
	Ap2	3	22.99	207.91	311.57	0.66	22.7	1.4	
	Ap3	3	19.37	117.91	164.06	0.68	33.3	2.0	
Mean			*24.09*	*152.54*	*238.90*	*0.69*	*32.3*	*1.2*	*9.2*
OCO 02	Ap1	2	1.88	30.90	45.06	0.72	11.6	0.7	
	Ap2	2	1.97	34.43	48.32	0.68	11.6	0.7	
	Ap3	2	3.21	51.04	57.05	0.69	13.2	0.8	
Mean			*2.35*	*38.79*	*50.15*	*0.70*	*12.1*	*0.4*	*0.9*
OCO 04	Ap1	3	1.00	20.31	19.91	0.73	10.1	0.6	
	Ap2	3	0.89	15.14	14.54	0.74	12.0	0.5	
	Ap3	2	1.19	17.08	19.09	0.76	13.3	0.4	
	Ap4	2	1.90	24.31	27.47	0.78	14.5	0.3	
	Ap5	2	2.22	35.46	37.58	0.77	12.0	0.3	
Mean			*1.44*	*22.46*	*23.72*	*0.76*	*12.4*	*0.2*	*1.3*
OCO 05	Ap1	1	1.67	18.38	22.43	0.78	16.6	1.0	
	Ap2*	2	3.74	21.09	35.08	0.76	30.8	1.8	
	Ap3	2	0.63	10.11	10.18	0.73	12.7	0.8	
Mean			*0.87*	*14.24*	*16.30*	*0.75*	*14.6*	*0.9*	*9.5*
OCO 06	Ap1	2	2.81	12.74	46.54	0.77	28.3	1.7	
	Ap2	2	1.85	8.79	23.60	0.79	29.9	1.8	
	Ap3	2	1.70	12.21	33.77	0.74	20.8	1.2	
Mean			*2.12*	*11.25*	*34.64*	*0.77*	*26.4*	*0.9*	*4.9*
OCO 11	Ap1	2	3.89	81.69	156.84	0.74	8.1	0.5	
	Ap2	3	4.61	74.24	150.23	0.70	11.0	0.7	
	Ap3	2	3.87	44.87	97.98	0.78	13.4	0.8	
Mean			*4.12*	*66.93*	*135.02*	*0.74*	*10.8*	*0.4*	*2.6*
OCO 12	Ap1	2	4.47	62.34	78.83	0.76	13.4	0.8	
	Ap2	2	3.56	49.81	51.37	0.78	13.5	0.8	
	Ap3	2	4.77	75.28	81.50	0.79	11.8	0.7	
Mean			4.27	62.48	70.57	0.78	12.9	0.4	*1.0*

OCO 14	Ap1	2	4.27	20.06	49.47	0.74	33.3	2.0	
	Ap2	2	9.13	44.31	114.27	0.67	35.1	2.1	
	Ap3	3	7.27	30.69	77.02	0.74	37.2	2.2	
Mean			*6.89*	*31.68*	*80.26*	*0.72*	*35.2*	*1.2*	*1.9*
OCO 16	Ap1*	2	151.58	29.94	70.44	0.74	766.9	46.0	
	Ap2	2	3.44	20.54	49.09	0.76	25.9	1.6	
	Ap3	3	5.19	34.35	80.73	0.70	25.5	1.5	
Mean			*4.31*	*27.45*	*64.91*	*0.73*	*25.7*	*1.1*	*0.3*
OCO 17	Ap1	2	0.30	14.84	18.58	0.77	3.8	0.2	
	Ap2	3	0.37	17.88	22.27	0.77	3.8	0.2	
	Ap3	2	0.22	9.99	17.23	0.79	3.7	0.2	
Mean			*0.30*	*14.23*	*19.36*	*0.77*	*3.77*	*0.1*	*0.1*
OCO 18	Ap1	4	0.39	23.11	53.62	0.74	2.7	0.2	
	Ap2*	4	0.01	33.58	74.70	0.71	0.05	0.003	
	Ap3	4	0.84	91.87	139.08	0.64	1.9	0.1	
Mean			*0.41*	*49.52*	*89.13*	*0.70*	*1.6*	*0.1*	*1.4*
OCO 19	Ap1	3	0.83	9.46	24.78	0.79	12.7	0.8	
	Ap2	3	0.80	12.45	32.39	0.72	10.2	0.6	
	Ap3*	3	0.41	29.59	60.07	0.78	2.2	0.1	
Mean			*0.81*	*10.95*	*28.59*	*0.75*	*11.5*	*0.3*	*1.7*
OCO 21	Ap1	4	10.09	31.25	113.18	0.67	48.0	2.9	
	Ap2	4	6.13	28.03	75.29	0.68	36.2	2.2	
	Ap3*	4	31.43	22.40	81.01	0.72	191.2	11.5	
Mean			*8.11*	*29.64*	*94.23*	*0.67*	*42.1*	*5.8*	
OCO 24	Ap1	2	12.22	31.03	127.64	0.70	52.4	3.1	
	Ap2	2	20.49	45.06	189.93	0.71	59.2	3.5	
	Ap3	2	11.08	29.73	106.97	0.69	53.5	3.2	
Mean			*14.60*	*35.27*	*141.51*	*0.70*	*55.0*	*1.9*	*3.6*
OCO 25	Ap1*	3	19.14	32.37	80.29	0.66	102.9	6.2	
	Ap2	2	8.41	22.18	80.73	0.71	53.2	3.2	
	Ap3	2	5.57	23.49	63.52	0.76	34.9	2.1	
OCO 26	Ap1*	2	4.47	35.72	67.99	0.80	20.0	1.2	
	Ap2*	2	4.60	35.81	63.63	0.77	21.8	1.3	
	Ap3	2	7.15	26.46	70.76	0.71	43.0	2.6	

Notes: Laser extraction of ^4He was carried out at the University of Kansas. Each sample aliquot for ^4He, U and Th determinations typically comprised two to four apatite grains 100–250 µm long and 60–150 µm wide. Evolved helium was spiked with ^3He, cryogenically concentrated and purified, and the $^4He/^3He$ ratio determined by quadrupole mass spectrometry after He degassing of the apatite at 1050 °C for 5 minutes with a Nd-YAG laser (House *et al.*, 2000). Grains were retrieved from the vacuum system, dissolved in HNO_3, spiked with ^{230}Th and ^{235}U, and analysed for U and Th by ICPMS. Reported AHe ages are corrected for alpha ejection effects (Farley *et al.*, 1996) based on measured individual grain size and geometry (Gautheron *et al.*, 2006). Each age determination involves 3–5 replicates, the mean of which is reported in this Table and used for geological interpretation when aliquot ages are closely clustered around that mean. The estimated analytical uncertainty for AHe ages based on age standards is about 7% for Durango apatite (2σ). These are the default uncertainty values used on a sample unless the standard deviation of the sample replicate ages is higher, in which case the latter is used.

In this Table, *n* is number of grains per aliquot. * indicates aliquots not used for the calculation of a mean age. Reasons for this were anomalous aliquot results relating to analytical problems (presence of a fluid inclusion, degassing issues), or the existence of more robust or consistent data provided by geographically adjacent samples with similar characteristics (e.g. AHe ages, AFT signatures, elevation, apatite chemistry). Because there is no sound geological basis for determining a mean AHe age when aliquot age dispersal is large, limited geological mileage was made in this study from samples such as OCO04-09 or OCO26.

References: HOUSE, M.A., FARLEY, K.A. & STOCKLI, D. 2000. Helium chronometry of apatite and titanite using Nd-YAG laser heating. *Earth and Planetary Science Letters*, **183**, 365–368. FARLEY, K.A., WOLF, R.A. & SILVER, L.T. 1996. The effects of long alpha-stopping distances on (U-Th)/He ages. *Geochimica et Cosmochimica Acta*, **60**, 4223–4229. GAUTHERON, C.E., TASSAN-GOT, L. & FARLEY, K.A. 2006. (U–Th)/Ne chronometry. *Earth and Planetary Science Letters*, **243**, 520–535.