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SI section 1:

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SI section 4:

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Supplementary Table 8: Uranium-series dating of Lida Ajer speleothem: age estimates and supporting data

Sample code /*location* [a]	^{238}U (ppm)	^{232}Th (ppb)	^{230}Th/^{232}Th activity ratio [b]	^{234}U/^{238}U activity ratio	^{230}Th/^{238}U activity ratio	Uncorrected ^{230}Th age (kyr)	Corrected ^{230}Th Age-I (kyr)[c]	Corrected ^{230}Th Age-II (kyr)[d,e]
Flowstones								
LA-F1/*4*[f]	0.407	868	1.206 ± 0.004	1.0290 ± 0.0007	0.849 ± 0.002	187 ± 1	98 ± 62	71 ± 7
LA-F2/*3*	0.134	47.6	1.72 ± 0.08	1.0309 ± 0.0023	0.201 ± 0.009	24 ± 1	13 ± 6	11 ± 2
LA-F3/*2*	0.0116	12.5	2.60 ± 0.04	1.0263 ± 0.0056	0.926 ± 0.016	246 ± 17	211 ± 23	203 ± 17
Soda straw								
LA08-29/*4*	0.0338	3.24	17.9 ± 0.1	1.017 ± 0.002	0.563 ± 0.004	88 ± 1	85 ± 2	84 ± 1

[a] The location refers to one of three areas within the chamber that contain breccia deposits; Areas 1-4 are marked on Fig. 2 with sample depths for F1-3 and LA08 of 1.23, 1.75, 1.60 and 1.23 m, respectively, measured from base of the cave floor to sampling height.

[b] All uncertainties at 95% confidence interval.

[c] Corrected ^{230}Th Age-I calculated using bulk-Earth ^{230}Th/^{232}Th activity ratio of 0.825 ± 50% and the ^{238}U-^{234}U-^{230}Th decay chain in secular equilibrium for non-radiogenic ^{230}Th correction.

[d] Corrected ^{230}Th Age-II calculated using a measured ^{230}Th/^{232}Th activity ratio of 0.969 ± 3.7% and the ^{238}U-^{234}U-^{230}Th decay chain in secular equilibrium for non-radiogenic ^{230}Th correction. The value of 0.969±3.7% was obtained by measuring ^{230}Th/^{232}Th in the nitric-acid insoluble residue (mean of replicate analyses from two separate digestions).

[e] Corrected ^{230}Th age-II is preferred as the ^{230}Th/^{232}Th activity ratio of 0.969 ± 3.7% for non-radiogenic ^{230}Th correction was directly measured from the nitric acid-insoluble residue of the flowstone sample, rather than assumed. As non-radiogenic ^{230}Th was mainly derived from non-carbonate sediments mixed into the speleothem, this non-radiogenic ^{230}Th scheme is more realistic and reliable (see SOM for detailed discussion).

[f] LA-F1/4 was measured by MC-ICP-MS, and the other flowstone and the straw samples by TIMS.

SUPPLEMENTARY INFORMATION - section 6:

Supplementary discussion │ Laser-ablation Uranium-series dating of teeth

The importance of the *Pongo* sp. tooth as a museum specimen from Dubois's original excavation collection (9967/A) meant that we were not able to cut the tooth as per other samples. Instead, we used a small drill to recover dentine from the surface of the specimen. As a comparison, we conducted a similar analysis on sample 7/LA/5/8. While not providing any information regarding U leaching – these analysis were conducted to demonstrate that the material collected by Dubois is roughly of the same antiquity as the material collected and dated from our minor excavations. This agreement is important for establishing a chronology for the modern human teeth discovered by Dubois.

U-series dating of bone and teeth is governed by the fact that the materials may uptake uranium following their burial. A range of models have been developed to account for this uranium uptake and provide a basis for open system dating. The diffusion-adsorption (D-A) model was developed by[143-145], and refined by[146-147]. It is based on laboratory experiments and assumes a continuous diffusion of uranium from the outside of a bone or tooth towards the interior, and that the partitioning between the bone and solution (groundwater) and the U concentration in the solution are constant. The bone is treated as a homogeneous medium with infinite plane geometry. Under constant conditions, the cross sections of bones that conform to the D-A diffusion model are expected to have both u-shaped U-concentration and apparent U-series age profiles, with the apparent ages at the surface being closest to the correct age of the sample. Deviations from such ideal profiles can be explained either by leaching or changes in the U concentration in the solution. A more sophisticated Diffusion-Adsorption-Decay (DAD) model expands the original D-A model for diffusion of ^{234}U and its decay during the diffusion process[148]. For a given volume in a bone, the DAD model postulates that ^{234}U is continually resupplied by diffusion. As a result, ^{234}U/^{238}U ratios change little over time, consequently DAD model ages are somewhat older than comparative D-A results. A fundamental principle of open system U-series dating of bone is that unless a major phase of leaching has taken place, all U-series age estimates on bone/teeth are minimum estimates for the age of the individual. It is important to note that it can be difficult or impossible to estimate by how much the U-series results underestimate the correct age of the sample[147].

It is expected from the diffusion-adsorption model for U-uptake[144-147] that spatially resolved analyses across a homogeneous bone yield U-shaped or constant U-concentration and apparent U-series age profiles. In ideal circumstances, a plot of apparent U-series age versus U-concentration would either be flat or show increasing U-series age estimates with increasing U-concentrations. For a tooth with an enamel barrier on the outside, a one-side diffusion is expected from the interior resulting in a decreasing or flat U-concentration and apparent U-series age profiles.

For the four fossil samples, D-A modelling of U-series age estimates was performed using both 1 and 2 dimensional diffusion. The former initially seemed appropriate where the enamel effectively blocked diffusion from the outer surface, but the model could not account for the steep date gradients at the surface and the shallow U concentration gradients. For most cases this could not be explained by leaching of U from towards the surface, and is therefore probably a result of the non-conformity of the teeth to the ideal infinite plane geometry used by the D-A model. Most of the spot and track data were unsuitable for modelling 2 dimensional diffusion because of their asymmetric U and date profiles, caused by the enamel acing as a barrier to uranium diffusion. However, track 13C is from dentine below the enamel crown and seems to conform to 2 dimensional diffusion-adsorption. By taking spot 3 on the tracks (of track 13C) as the innermost spot (the first two spots seem to run down the inner surface) a reasonable fit to the D-A model was obtained, at around 55 kyr with t'=1 (see Extended Data Fig. 8i) which should be taken as a minimum age for this tooth. This was the only track where a reasonable fit to the DA model was obtained. Clearly, these samples are not universally behaving according to the D-A model, most probably due to the complex geometry of a tooth.

To summarise, the age estimates on the fossil teeth have been analysed using the D-A model and, with one exception that gives a minimum D-A model age of 55 kyr, do not conform to scenarios of constant geochemistry and infinite planar geometry. Thus, the U-series age estimates have been provided as supporting evidence for the time of breccia deposition. However, the teeth have a consistent pattern of U-Th ratios at the surface, which are similar to those from the samples in the museum. This provides another connection between our material and Dubois's original excavations and fossils.

In this study, all profiles are from the interior to the exterior of the tooth (Supplementary Table 7). The enamel was too low in U concentration to calculate ages so only dentine measurements are mentioned. Except when explicitly stated, the elemental $^{238}U/^{232}Th$ ratios are all well in excess of 1000, which correspond to activity ratios of >3000. We cannot explicitly quantify the $^{230}Th/^{232}Th$ activity ratios, as we do not have a matrix matched ^{232}Th standard. However, the very high $^{238}U/^{232}Th$ ratios imply that any corrections for detrital ^{232}Th are not necessary. The measurements are all characterized by a decreasing or flat U-concentration and apparent U-series age profile except for some samples where the first two points are relatively lower. The assumption of the U-uptake model presented by [129], that the $^{234}U/^{238}U$ ratio in the vicinity of the bones' surfaces are constant over time, would have a negligible effect on any age calculations as all measured $^{234}U/^{238}U$ ratios are very close to 1 (except for sample 7/LA/5/8 profile A, B and C with a $^{234}U/^{238}U$ activity ratios of ~1.3).

Sample 7/LA/5/8

The analyses were carried out along four profiles (A-D). In the first profile (A), the uranium concentration decreases from about 5 ppm to 3 ppm in the first 4 spots and is relatively stable thereafter (Supplementary Table 7). The first spot has a relatively lower elemental $^{238}U/^{232}Th$ ratio of 183 corresponding to an apparent age of 94.9 +23.6/-19.7 kyr. The second spot has an apparent age of 33.5 ± 3.3 kyr while the other spots show a slightly reverse u-shaped age profile with apparent ages between about 15 and 25 ka. The last two spots are into the enamel and the uranium concentration is too low to calculate age estimates.

In the second profile (B), the uranium concentration is relativity stable at about 3 ppm except for spot #1, 3 (~4 ppm), and 5 (~8 ppm). For these three spots, the elemental $^{238}U/^{232}Th$ ratio is relatively lower at about 500. The age of spot #3 seems overestimated with an apparent age of 162 + 20.9/-17.9 kyr while spot # 5 is beyond the rage of U-series dating. These 2 spots have a $^{230}Th/^{238}U$ activity of 1.12 and 2.48 and are thus possibly affected by uranium leaching. The apparent ages for the other spots varies between about 15 and 30 ka. The last two spots are into the enamel and the uranium concentration is too low to calculate age estimates.

The third profile (C) shows a slightly decreasing uranium concentration from spot #3 (from 3.72 to 2.41 ppm). The first 2 spots have lower uranium concentrations at 2.67 and 3.13 ppm and are associated with lower elemental $^{232}Th/^{238}U$ of 103 and 176 and apparent older ages of 84 +3.9/-3.8 and 61 +2.7/-2.6 kyr. From spot #3, the apparent age drops from about 40 kyr to stabilize at about 30. They all have high elemental $^{230}Th/^{238}U$ except perhaps for spot 3 at 647. The last spot is into the enamel and the uranium concentration is too low to calculate an age estimate.

The fourth profile (D) is characterized by stable U concentration from spot #3 at about 3 ppm. The first two spots have higher U concentration but are not affected by lower elemental $^{232}Th/^{238}U$. Indeed, the elemental $^{230}Th/^{238}U$ is relatively high for all spots and the apparent ages are all relatively constant at about 14-17 kyr except for the last spot, which has an apparent age of 27.5 ± 0.7 kyr.

The results of these four profiles indicate apparent U-series minimum ages of 80-75 kyr close to the root canal and about 40-30 kyr further into the dentine.

Sample 12/LA/5/8
The two profiles (A, B) have similar characteristics with decreasing uranium concentration from the interior to the exterior of the tooth from about 7 to 4 ppm. The elemental $^{232}Th/^{238}U$ is high and the apparent age constant at about 30 kyr except for spot #1 in the first profile and spot #2 in the second profiles with a 25 kyr apparent age. The minimum age estimate for this sample is 30 kyr. The last two spots are into the enamel while the third spot contains a mixture of dentine and enamel. The uranium concentration is too low to calculate ages.

Sample 13/LA/5/8
In the first two profiles (A, B), the uranium concentration is relatively stable at about 7 ppm. The elemental $^{232}Th/^{238}U$ is high and apparent ages are higher in the first 2 spots at 44.2 ± 1 kyr and 33.8 ± 1 kyr (profile A) and 41.2 ± 1 and 35.2 ± 1.1 kyr (profile B). The apparent ages are relatively constant thereafter at about 28-30 kyr. The last four spots are into the enamel and the uranium concentration is too low to calculate age estimates.

In the third profile, the uranium concentration is higher in the first two spots at about 10 ppm. It then gradually decreases from about 8 to 6.5 ppm. The elemental $^{232}Th/^{238}U$ is high except for the first two spots at 21 and 221 ppm corresponding to apparent ages of 66.4 ± 1.4 and 65.4 ± 1.2 kyr. The first two spots (1 and 2) are possibly affected by detrital contamination resulting in age over-estimation. Post sampling photos reveal that these spots had not left any craters, so they probably were sampling the inner surface of the tooth, hence we have rejected them for the D-A modelling. The remaining apparent age profile shows a u-shaped profile with ages varying from about 50 and 40 kyr on the outside to about 35 kyr on the inside on the profile. The minimum age estimate for this sample is about 55 kyr.

Sample 21/LA/5/8
In the two profiles the U concentration is relatively stable at about 4.5 ppm except for the first two spots at about 3.5 ppm. The elemental $^{232}Th/^{238}U$ is high and the age decreases from about 40 kyr in the first two spots to about 30 kyr. It is possible that the first two spots could be affected by leaching of uranium. The last spot is into the enamel and the uranium concentration is too low to calculate age estimates.

Sample Dubois 9967/A surface drilling
Three spots were drilled into the dentine at the base of the enamel crown (Supplementary Table 8). The first 500 cycles were divided into 10 aliquots of 50 cycles each. The results are essentially only from the top surface of the dentine. It is also impossible to calculate U and Th concentrations from this type of analysis. The results seem to indicate a minimum age of 70-60 kyr.

Sample 7/LA/5/8 surface drilling
The sample was analysed using a similar process to previous sample (Supplementary Table 8) and the results seem to indicate a minimum age of 80-70 ka.

Overall, the four fossil teeth analysed provide a minimum age range of >80-75 ka. In addition, the Dubois tooth (9967/A) provided a rough estimate of 70-60 ka based only on surface drilling. We do not place too much emphasis on this later result (hence we have not presented the data on SI section 5 Table 8) and it has not been used in the Bayesian modelling, as we have no knowledge of the how leaching has affected this tooth. Instead, we use it to demonstrate that the tooth from the Dubois excavation is of a similar antiquity to the fossil teeth analysed using the profiling techniques.

7/LA/5/8 profile 1

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10	Spot-11
Start	1528	1619	1710	1801	1892	1983	2074	2165	2256	2347	2438
End	1586	1677	1768	1859	1950	2041	2132	2223	2314	2405	2496
Top Start	1534	1625	1716	1807	1898	1989	2080	2171	2262	2353	2444
Top End	1574	1665	1756	1847	1938	2029	2120	2211	2302	2393	2484
Th-230	38	15	6	6	9	7	7	7	6	1	0
U-234	422	376	323	239	294	249	255	268	250	6	1
R85	141.1	141	142.1	143	142.1	143.5	140.5	142.6	142.8	276.8	-19.2
U (ppm)	4.99	4.52	3.97	2.88	3.59	2.99	3.1	3.24	3.01	0.08	0.01
Th (ppb)	27.29	3.1	0.55	0.97	0.31	-0.17	0.4	0.45	0.58	0.47	1
U/Th	183	1457	7232	2962	11464	-17078	7804	7214	5180	175	8
R08	0.7919	0.3475	0.1653	0.2166	0.2472	0.2287	0.2424	0.2322	0.1972	0.789	3.8425
R08-error	0.1165	0.0294	0.0131	0.0148	0.0118	0.0132	0.0169	0.0149	0.0135	46.7464	5.0854
R48	1.3222	1.2989	1.2706	1.2955	1.278	1.3038	1.2833	1.2921	1.2978	1.1903	1.4539
R48-error	0.0116	0.0112	0.0093	0.0108	0.008	0.0121	0.0117	0.0089	0.0117	6.258	0.8936
R04	0.5988	0.2675	0.1301	0.1672	0.1934	0.1754	0.1889	0.1797	0.1519	0.6628	2.6427
R04-error	0.0796	0.0217	0.0104	0.0119	0.009	0.0106	0.0132	0.012	0.0106	0.7143	1.682
R04	0.5989	0.2675	0.1301	0.1672	0.1934	0.1754	0.1889	0.1797	0.1519	0.6629	2.6429
R04-error	0.0883	0.0227	0.0104	0.0115	0.0093	0.0103	0.0133	0.0116	0.0105	39.4259	3.8565
CS age	94.9	33.5	15.1	19.8	23.3	20.9	22.7	21.4	17.9	113.7	0
Err+	23.6	3.3	1.3	1.5	1.2	1.3	1.8	1.5	1.3	0	0
Err-	19.7	3.3	1.3	1.5	1.2	1.3	1.7	1.5	1.3	0	0

7/LA/5/8 profile 2

Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9
2529	2620	2711	2802	2894	2985	3076	3167	3258
2587	2678	2769	2860	2952	3043	3134	3225	3316
2535	2626	2717	2808	2900	2991	3082	3173	3264
2575	2666	2757	2848	2940	3031	3122	3213	3304
11	5	42	7	189	7	6	4	1
337	228	342	211	759	255	222	183	3
141	141	139.8	138.2	140	140.9	142.6	139	43.8
4.13	2.74	3.88	2.57	7.95	3.09	2.73	2.25	0.01
7.78	0.67	8.28	0.22	15.9	0.81	0.32	0.42	0.62
531	4060	469	11622	500	3816	8637	5343	22
0.2835	0.19	1.1229	0.2919	2.4765	0.2453	0.2375	0.1966	5.3941
0.0141	0.0173	0.0631	0.0206	0.159	0.0155	0.0158	0.0168	1.915
1.2739	1.3022	1.3763	1.2817	1.4922	1.286	1.2703	1.2685	2.9505
0.0104	0.0116	0.0099	0.0114	0.0194	0.0124	0.0124	0.0152	0.3501
0.2226	0.1459	0.8159	0.2277	1.6595	0.1907	0.1869	0.1549	1.828
0.0111	0.0138	0.0438	0.0169	0.1015	0.0114	0.0128	0.0144	0.9156
0.2226	0.1459	0.8159	0.2277	1.6596	0.1907	0.187	0.1549	1.8282
0.0112	0.0133	0.0462	0.0162	0.1087	0.0122	0.0125	0.0133	0.6843
27.2	17.1	162	27.9	0	22.9	22.4	18.3	0
1.6	1.7	20.9	2.3	0	1.6	1.7	1.7	0
1.5	1.7	17.9	2.2	0	1.6	1.6	1.7	353.2

7/LA/5/8 profile 3

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10
Start	3349	3440	3531	3622	3713	3804	3895	3986	4077	4168
End	3407	3498	3589	3680	3771	3862	3953	4044	4135	4226
Top Start	3355	3446	3537	3628	3719	3810	3901	3992	4083	4174
Top End	3395	3486	3577	3668	3759	3850	3941	4032	4123	4214
Th-230	19	17	15	11	9	8	8	7	7	1
U-234	227	265	314	273	261	231	222	219	195	2
R85	140.6	141.1	140.1	138.8	141.7	139.3	141.1	141	139.9	150.3
U (ppm)	2.67	3.13	3.72	3.31	3.15	2.84	2.7	2.65	2.41	0.02
Th (ppb)	25.87	17.76	5.75	0.58	1.15	0.8	0.55	0.69	0.76	0.5
U/Th	103	176	647	5687	2728	3539	4961	3845	3183	34
R08	0.7323	0.5784	0.4141	0.3442	0.3011	0.2779	0.3118	0.2768	0.2928	3.8381
R08-error	0.0212	0.0187	0.0145	0.0171	0.0224	0.0207	0.0192	0.0187	0.0194	115.886
R48	1.3272	1.3237	1.318	1.2877	1.293	1.2709	1.2809	1.2949	1.2653	1.5883
R48-error	0.0147	0.0114	0.0112	0.012	0.016	0.0121	0.0159	0.0133	0.014	3.7871
R04	0.5517	0.4369	0.3142	0.2673	0.2329	0.2186	0.2434	0.2137	0.2314	2.4164
R04-error	0.017	0.0144	0.0112	0.0132	0.0206	0.0175	0.0157	0.016	0.0171	1.3201
R04	0.5518	0.437	0.3142	0.2673	0.2329	0.2186	0.2434	0.2137	0.2314	2.4165
R04-error	0.0171	0.0146	0.0113	0.0135	0.0175	0.0164	0.0153	0.0146	0.0155	73.191
Age	84	61	40.5	33.5	28.6	26.7	30.1	26	28.4	0
Err+	3.9	2.7	1.8	2	2.5	2.3	2.2	2	2.2	0
Err-	3.8	2.6	1.7	1.9	2.4	2.2	2.1	2	2.1	0

7/LA/5/8

Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8
1445	1536	1626	1717	1808	1899	1989	2080
1503	1594	1684	1775	1866	1957	2047	2138
1451	1542	1632	1723	1814	1905	1995	2086
1491	1582	1672	1763	1854	1945	2035	2126
30	22	15	17	17	15	16	27
908	670	451	458	437	410	415	457
140.4	140.3	141.2	140.6	140.1	140.1	139.7	139.4
6.39	4.72	3.19	3.18	3.06	2.86	2.92	3.11
2.72	0.56	0.49	0.4	0.19	0.31	0.43	1.35
2347	8494	6495	8020	16158	9227	6818	2304
0.1336	0.1288	0.1338	0.1481	0.1563	0.1441	0.1546	0.2427
0.004	0.0045	0.005	0.0057	0.004	0.0066	0.0055	0.0055
1.051	1.0512	1.0461	1.0667	1.0578	1.0613	1.0497	1.0848
0.0044	0.0056	0.0083	0.0057	0.0068	0.0072	0.0076	0.0071
0.1271	0.1226	0.1279	0.1388	0.1477	0.1358	0.1473	0.2237
0.0039	0.0044	0.0048	0.0056	0.004	0.0059	0.0056	0.0056
0.1271	0.1226	0.1279	0.1388	0.1478	0.1358	0.1473	0.2237
0.0038	0.0043	0.0049	0.0054	0.0039	0.0063	0.0053	0.0053
14.8	14.2	14.9	16.3	17.4	15.9	17.4	27.5
0.5	0.5	0.6	0.7	0.5	0.8	0.7	0.7
0.5	0.5	0.6	0.7	0.5	0.8	0.7	0.7

13/LA/5/8 profile 1

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10	Spot-11	Spot-12	Spot-13	Spot-14	Spot-15
Start	884	976	1068	1160	1252	1344	1436	1528	1619	1711	1803	1895	1987	2079	2171
End	942	1034	1126	1218	1310	1402	1494	1586	1677	1769	1861	1953	2045	2137	2229
Top Start	890	982	1074	1166	1258	1350	1442	1534	1625	1717	1809	1901	1993	2085	2177
Top End	930	1022	1114	1206	1298	1390	1482	1574	1665	1757	1849	1941	2033	2125	2217
Th-230	91	77	70	60	58	61	61	59	56	52	54	1	0	1	1
U-234	1012	1077	1074	979	967	1007	1026	1013	964	922	961	35	5	1	0
R85	140.2	139.8	140	139.6	140.4	140.3	139.9	140.2	140.3	139.4	139.3	117.5	106.4	39	16.3
U (ppm)	6.93	7.42	7.4	6.85	6.73	6.99	7.06	7.01	6.67	6.38	6.67	0.23	0.03	0	0
Th (ppb)	6.65	0.98	0.24	0.3	0	0.01	-0.15	-0.42	-0.29	-0.03	-0.13	-0.16	-0.14	-0.48	-0.02
U/Th	1042	7556	30694	22723	2455974	712408	-47489	-16596	-23226	-244263	-50198	-1386	-215	-7	-84
R08	0.3581	0.2845	0.2583	0.238	0.2381	0.2397	0.2351	0.2285	0.2301	0.2248	0.221	0.1721	0.3422	4.054	12.5503
R08-error	0.0067	0.0067	0.0053	0.0053	0.0057	0.0053	0.0047	0.0053	0.0052	0.005	0.0048	0.0267	0.5075	2.1324	54.985
R48	1.0693	1.0632	1.064	1.0466	1.0534	1.0563	1.0648	1.0586	1.0594	1.0587	1.0559	1.1365	1.1335	1.1502	0.8291
R48-error	0.0044	0.0049	0.0047	0.0042	0.0055	0.0047	0.005	0.0046	0.0053	0.0063	0.0051	0.0387	0.1205	0.5499	10.7217
R04	0.3347	0.2675	0.2427	0.2273	0.2259	0.2269	0.2207	0.2158	0.2171	0.2123	0.2092	0.1513	0.3018	3.5235	15.1322
R04-error	0.0061	0.0062	0.005	0.005	0.0057	0.0049	0.0047	0.005	0.0048	0.0048	0.0048	0.0256	0.5772	0.716	0.814
R04	0.3348	0.2676	0.2428	0.2274	0.226	0.227	0.2208	0.2159	0.2172	0.2123	0.2093	0.1514	0.3019	3.5247	15.1375
R04-error	0.0064	0.0064	0.0051	0.0052	0.0056	0.0051	0.0046	0.0051	0.005	0.0049	0.0047	0.024	0.4488	2.5054	206.688
Age	44.2	33.8	30.2	28.1	27.9	28	27.1	26.5	26.6	26	25.6	17.8	38.9	0	0
Err+	1	1	0.7	0.7	0.8	0.7	0.6	0.7	0.7	0.7	0.6	3.1	105.7	0	0
Err-	1	0.9	0.7	0.7	0.8	0.7	0.6	0.7	0.7	0.7	0.6	3	0	0	0

13/LA/5/8 profile 2

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10	Spot-11	Spot-12	Spot-13	Spot-14	Spot-15
Start	2263	2355	2447	2539	2631	2723	2815	2906	2998	3090	3182	3274	3366	3458	3550
End	2321	2413	2505	2597	2689	2781	2873	2964	3056	3148	3240	3332	3424	3516	3608
Top Start	2269	2361	2453	2545	2637	2729	2821	2912	3004	3096	3188	3280	3372	3464	3556
Top End	2309	2401	2493	2585	2677	2769	2861	2952	3044	3136	3228	3320	3412	3504	3596
Th-230	88	67	64	64	66	59	70	68	63	59	63	1	1	0	0
U-234	1037	904	1029	1025	1071	1023	1117	1101	1019	1022	1061	30	5	1	0
R85	140.1	140.1	140.1	140.1	139.9	139.3	140	140	139.8	140.2	139.8	136.5	96.9	286	3.8
U (ppm)	7.02	6.27	7.08	7.09	7.38	7.14	7.74	7.61	7.12	7.05	7.33	0.21	0.04	0.01	0
Th (ppb)	5.23	1.5	0.68	0.62	0.37	-0.16	0.17	-0.04	-0.13	0.07	-0.19	-0.02	-0.64	0.03	-0.21
U/Th	1341	4176	10439	11448	19791	-44892	45718	-205074	-56149	96157	-38379	-8506	-58	214	-4
R08	0.3422	0.292	0.2467	0.248	0.2458	0.2269	0.2486	0.2433	0.2415	0.2283	0.2361	0.1635	0.4259	0.5622	9.6301
R08-error	0.0063	0.0073	0.0061	0.0052	0.0041	0.0053	0.0045	0.0067	0.0055	0.0044	0.0051	0.0356	0.6224	2.2718	217.02
R48	1.0828	1.0562	1.064	1.059	1.0644	1.0502	1.0576	1.0607	1.0484	1.0616	1.0603	1.0564	1.037	0.7909	0.7247
R48-error	0.0051	0.0046	0.0051	0.0052	0.0051	0.0056	0.0053	0.0046	0.0036	0.0055	0.0072	0.0402	0.2083	0.4709	26.9153
R04	0.3159	0.2764	0.2318	0.2341	0.2308	0.216	0.235	0.2293	0.2302	0.2149	0.2226	0.1547	0.4106	0.7106	13.2836
R04-error	0.0064	0.0072	0.0055	0.0049	0.0041	0.0055	0.0046	0.0064	0.0057	0.0043	0.0049	0.0323	0.7382	0.5759	0.8233
R04	0.316	0.2765	0.2319	0.2342	0.2309	0.2161	0.235	0.2293	0.2303	0.215	0.2227	0.1547	0.4108	0.7108	13.2882
R04-error	0.006	0.0071	0.0058	0.005	0.004	0.0052	0.0044	0.0064	0.0053	0.0043	0.0051	0.0342	0.6058	2.9036	577.265
Age	41.2	35.2	28.7	29	28.6	26.5	29.1	28.3	28.5	26.3	27.4	18.3	57.5	150.3	0
Err+	1	1.1	0.8	0.7	0.6	0.7	0.6	0.9	0.8	0.6	0.7	4.5	547.1	212.5	0
Err-	1	1.1	0.8	0.7	0.6	0.7	0.6	0.9	0.7	0.6	0.7	4.3	0	0	0

13.LA/5/8 profile 3

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10
Start	2364	2455	2546	2637	2728	2819	2910	3001	3092	3183
End	2422	2513	2604	2695	2786	2877	2968	3059	3150	3241
Top Start	2370	2461	2552	2643	2734	2825	2916	3007	3098	3189
Top End	2410	2501	2592	2683	2774	2865	2956	3047	3138	3229
Th-230	170	176	111	98	84	73	76	73	81	75
U-234	1482	1555	1196	1253	1195	1107	1110	1072	1046	987
R85	139.5	139.8	140.2	139.8	140.4	140.1	140.1	139.9	139.2	140
U (ppm)	9.81	10.3	8.03	8.45	8.02	7.47	7.45	7.23	7.07	6.61
Th (ppb)	474.92	46.49	2.98	1.04	0.61	0.31	0.89	1.31	1.68	5.25
U/Th	21	221	2694	8130	13209	23983	8417	5505	4211	1258
R08	0.4974	0.4919	0.3963	0.3341	0.3009	0.2796	0.2925	0.2878	0.3307	0.3277
R08-error	0.0073	0.0061	0.0078	0.0049	0.0069	0.0061	0.0064	0.0053	0.0068	0.0071
R48	1.0835	1.0831	1.0691	1.0639	1.0693	1.0635	1.0682	1.0636	1.0616	1.0715
R48-error	0.0048	0.0042	0.0048	0.0045	0.0033	0.0053	0.0049	0.0054	0.0044	0.0051
R04	0.4591	0.4542	0.3707	0.3141	0.2814	0.2629	0.2739	0.2706	0.3115	0.3058
R04-error	0.0072	0.0055	0.0078	0.0049	0.0066	0.0058	0.0058	0.0055	0.0065	0.0068
R04	0.4591	0.4541	0.3707	0.3141	0.2814	0.2629	0.2739	0.2706	0.3115	0.3058

R04-error	0.0071	0.0059	0.0075	0.0048	0.0065	0.0059	0.0061	0.0052	0.0065	0.0068
Age	66.4	65.4	50.2	40.9	35.9	33.2	34.8	34.3	40.5	39.6
Err+	1.4	1.2	1.3	0.8	1	0.9	0.9	0.8	1	1.1
Err-	1.4	1.2	1.3	0.8	1	0.9	0.9	0.8	1	1.1

21/LA/5/8 profile 1

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8
Start	907	998	1089	1180	1271	1362	1453	1544
End	965	1056	1147	1238	1329	1420	1511	1602
Top Start	913	1004	1095	1186	1277	1368	1459	1550
Top End	953	1044	1135	1226	1317	1408	1499	1590
Th-230	44	43	45	44	45	39	27	1
U-234	547	605	680	661	654	625	483	4
R85	139.1	139.6	140.4	140.7	140.1	140.1	141	87.3
U (ppm)	3.66	4.06	4.61	4.51	4.47	4.24	3.28	0.03
Th (ppb)	0.51	0.85	0.13	0.34	0.32	0.48	0.67	0.4
U/Th	7195	4808	35761	13080	14085	8772	4879	79
R08	0.3438	0.3049	0.2823	0.281	0.2897	0.2625	0.2347	0.5736
R08-error	0.007	0.0065	0.0065	0.0069	0.0071	0.0083	0.0073	2.3266
R48	1.0713	1.0668	1.0578	1.0525	1.0503	1.0559	1.0552	1.0044
R48-error	0.0053	0.0071	0.0046	0.0061	0.0064	0.0056	0.0065	0.3304
R04	0.3209	0.2859	0.2669	0.267	0.2758	0.2486	0.2224	0.5711
R04-error	0.0067	0.0067	0.0065	0.0065	0.0066	0.008	0.0072	0.723
R04	0.3209	0.2858	0.2669	0.267	0.2758	0.2486	0.2224	0.5711
R04-error	0.0067	0.0064	0.0063	0.0067	0.0069	0.008	0.007	2.3241
CS age	42	36.6	33.8	33.8	35.1	31.1	27.4	92.2
Err+	1.1	1	0.9	1	1	1.2	1	130.4
Err-	1.1	1	0.9	1	1	1.2	1	0

21/LA/5/8 profile 2

Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8
1635	1726	1817	1908	1999	2091	2182	2273
1693	1784	1875	1966	2057	2149	2240	2331
1641	1732	1823	1914	2005	2097	2188	2279
1681	1772	1863	1954	2045	2137	2228	2319
43	39	49	45	49	44	37	2
553	546	703	666	691	679	648	28
140.3	140.4	139.7	139.2	140.5	138.7	139.7	124.3
3.72	3.67	4.8	4.54	4.68	4.64	4.38	0.19
1.26	0.62	0.29	-0.05	0.28	0.04	-0.1	-0.05
2942	5929	16552	-93460	16534	111586	-44968	-3616
0.3292	0.3053	0.2928	0.2833	0.298	0.2718	0.2409	0.3009
0.0081	0.0073	0.0078	0.0074	0.0073	0.0072	0.0066	0.0364
1.0667	1.0658	1.0502	1.0541	1.0587	1.0506	1.0605	1.0737
0.0061	0.0055	0.0056	0.0058	0.0067	0.0068	0.0069	0.0336
0.3086	0.2865	0.2788	0.2688	0.2815	0.2587	0.2272	0.2802
0.0078	0.0067	0.0077	0.0071	0.0064	0.0071	0.0062	0.0335
0.3086	0.2865	0.2788	0.2687	0.2815	0.2587	0.2272	0.2802
0.0078	0.007	0.0076	0.0071	0.0071	0.0071	0.0064	0.035
40.1	36.7	35.5	34	35.9	32.6	28	35.7
1.1	1	0.9	1	1	1.2	1	130.4
1.1	1	0.9	1	1	1.2	1	0

12/LA/5/8 profile 1

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10	Spot-11	Spot-12	Spot-13	Spot-14	Spot-15
Start	906	998	1089	1181	1272	1364	1455	1547	1638	1730	1822	1913	2005	2096	2188
End	964	1056	1147	1239	1330	1422	1513	1605	1696	1788	1880	1971	2063	2154	2246
Top Start	912	1004	1095	1187	1278	1370	1461	1553	1644	1736	1828	1919	2011	2102	2194
Top End	952	1044	1135	1227	1318	1410	1501	1593	1684	1776	1868	1959	2051	2142	2234
Th-230	53	57	56	54	55	49	43	45	40	46	43	38	17	0	0
U-234	988	926	880	859	833	806	702	744	619	720	686	627	274	1	6
R85	140	140.4	140.1	140.5	139.7	140.3	140	139.7	140.7	139.6	140.2	138.9	140.3	62.5	169.4
U (ppm)	6.82	6.41	6.11	5.96	5.77	5.56	4.89	5.14	4.26	4.99	4.79	4.34	1.91	0.01	0.06
Th (ppb)	0.02	-0.04	0.01	-0.27	0.04	-0.39	-0.24	-0.26	-0.16	-0.07	0.28	-0.03	0.2	0.07	0.79
U/Th	279474	-153649	1092164	-22048	134132	-14363	-20098	-19977	-26386	-76637	17203	-136510	9496	111	76
R08	0.2169	0.25	0.2549	0.2519	0.2661	0.2479	0.2468	0.2441	0.2632	0.2582	0.2504	0.2462	0.2447	1.2024	0.1913
R08-error	0.0051	0.0061	0.0063	0.0053	0.0058	0.0049	0.0068	0.0067	0.0057	0.0057	0.005	0.0056	0.009	0.688	2.3633
R48	1.0601	1.0571	1.054	1.0556	1.0567	1.0606	1.0511	1.0591	1.0646	1.0556	1.0469	1.0573	1.0484	0.782	0.7438
R48-error	0.0052	0.005	0.0054	0.006	0.0052	0.0055	0.0063	0.0049	0.0057	0.0054	0.0067	0.0053	0.0093	0.2038	0.726
R04	0.2046	0.2365	0.2419	0.2386	0.2518	0.2337	0.2348	0.2304	0.2472	0.2446	0.2392	0.2329	0.2334	1.5376	0.2571
R04-error	0.0048	0.0057	0.0058	0.005	0.0054	0.0052	0.0062	0.0062	0.0054	0.0057	0.0049	0.0055	0.0087	0.583	0.5885
R04	0.2046	0.2365	0.2419	0.2386	0.2518	0.2337	0.2348	0.2304	0.2472	0.2447	0.2392	0.2329	0.2334	1.5376	0.2571
R04-error	0.0049	0.0058	0.0061	0.0052	0.0056	0.0048	0.0066	0.0064	0.0055	0.0056	0.005	0.0054	0.0088	0.9667	3.187
Age	24.9	29.4	30.1	29.6	31.6	29	29.1	28.5	30.9	30.5	29.7	28.8	28.9	0	33
Err+	0.7	0.8	0.9	0.7	0.8	0.7	0.9	0.9	0.8	0.8	0.7	0.8	1.3	0	46.7
Err-	0.7	0.8	0.9	0.7	0.8	0.7	0.9	0.9	0.8	0.8	0.7	0.8	1.2	127.4	0

12/LA/5/8 profile 2

	Spot-1	Spot-2	Spot-3	Spot-4	Spot-5	Spot-6	Spot-7	Spot-8	Spot-9	Spot-10	Spot-11	Spot-12	Spot-13	Spot-14	Spot-15
Start	2279	2371	2462	2554	2645	2737	2829	2920	3012	3103	3195	3286	3378	3469	3561
End	2337	2429	2520	2612	2703	2795	2887	2978	3070	3161	3253	3344	3436	3527	3619
Top Start	2285	2377	2468	2560	2651	2743	2835	2926	3018	3109	3201	3292	3384	3475	3567
Top End	2325	2417	2508	2600	2691	2783	2875	2966	3058	3149	3241	3332	3424	3515	3607
Th-230	65	50	63	58	63	52	48	44	46	40	39	44	34	0	0
U-234	1068	944	998	951	979	848	776	705	726	651	599	698	545	8	2
R85	139.3	139.2	139.7	139.2	139.8	140	139.9	140.1	141.1	141	140.1	139.7	140.1	124	293.9
U (ppm)	7.42	6.56	6.89	6.6	6.8	5.84	5.41	4.89	5.03	4.48	4.12	4.87	3.76	0.06	0.02
Th (ppb)	0.62	0.31	0.51	-0.07	0.02	0.09	0.21	0.14	-0.02	-0.15	0.25	0	0.11	0.07	0.21
U/Th	11937	20960	13628	-98060	434695	68195	25313	34076	-230223	-29258	16592	-5E+06	35494	855	78
R08	0.2446	0.2156	0.2579	0.247	0.2585	0.2482	0.2485	0.2536	0.255	0.2507	0.2672	0.2555	0.2538	0.2438	0.7679
R08-error	0.0064	0.0056	0.005	0.0044	0.0039	0.0047	0.0053	0.0056	0.0068	0.0068	0.0066	0.0059	0.0063	0.4264	0.9207
R48	1.0532	1.0536	1.06	1.0536	1.0537	1.0628	1.0502	1.0543	1.0571	1.0618	1.0626	1.0493	1.0612	0.9942	0.9525
R48-error	0.0048	0.0055	0.0037	0.0047	0.0047	0.0047	0.0053	0.0078	0.0064	0.007	0.0066	0.0066	0.0057	0.0914	0.1855
R04	0.2322	0.2047	0.2433	0.2344	0.2453	0.2335	0.2366	0.2405	0.2412	0.2361	0.2515	0.2435	0.2391	0.2452	0.8062
R04-error	0.0062	0.0054	0.0046	0.0041	0.0037	0.0043	0.0052	0.0055	0.0069	0.0066	0.0068	0.006	0.0061	0.3693	0.4351
R04	0.2322	0.2047	0.2433	0.2344	0.2453	0.2335	0.2366	0.2405	0.2412	0.2361	0.2515	0.2435	0.2391	0.2452	0.8062
R04-error	0.0062	0.0055	0.0048	0.0043	0.0039	0.0045	0.0052	0.0056	0.0066	0.0066	0.0064	0.0058	0.0061	0.4294	0.9792
Age	28.7	24.9	30.3	29.1	30.6	28.9	29.4	29.9	30	29.3	31.5	30.4	29.7	30.7	184.1
Err+	0.9	0.7	0.7	0.6	0.6	0.6	0.7	0.8	1	0.9	0.9	0.8	0.9	91.8	260.4
Err-	0.9	0.7	0.7	0.6	0.6	0.6	0.7	0.8	0.9	0.9	0.9	0.8	0.9	0	0

Supplementary Table 9 - Raw U-series data

Dubois 9967A Drill hole A

	Aliquot-1	Aliquot-2	Aliquot-3	Aliquot-4	Aliquot-5	Aliquot-6	Aliquot-7	Aliquot-8	Aliquot-9	Aliquot-10
R08	0.5295	0.509	0.5	0.5999	0.5472	0.5222	0.6064	0.6463	0.5741	0.5159
R08-error	0.0241	0.0218	0.0254	0.0288	0.0289	0.0359	0.0458	0.0472	0.0681	0.0664
R48	1.2845	1.2787	1.2896	1.2661	1.2865	1.249	1.2398	1.2423	1.2191	1.2149
R48-error	0.0129	0.0134	0.0161	0.0159	0.0178	0.0214	0.0216	0.0213	0.0254	0.0248
R04	0.4122	0.3981	0.3877	0.4739	0.4254	0.4181	0.4891	0.5203	0.471	0.4246
R04-error	0.02	0.0179	0.0207	0.0253	0.0228	0.0337	0.0402	0.0425	0.0578	0.0612
CS age	56.7	54.2	52.4	68.2	59	57.8	71.4	77.8	67.9	59.2
Err+	3.5	3.1	3.5	4.7	4.3	5.4	7.9	8.6	11.7	10.5
Err-	3.4	3	3.4	4.5	4.1	5.2	7.4	8	10.6	9.7

Dubois 9967A Drill hole B

	Aliquot-1	Aliquot-2	Aliquot-3	Aliquot-4	Aliquot-5	Aliquot-6	Aliquot-7	Aliquot-8	Aliquot-9	Aliquot-10
R08	0.502	0.4903	0.556	0.5429	0.578	0.584	0.5846	0.5949	0.4821	0.5639
R08-error	0.0227	0.0268	0.0282	0.0307	0.0353	0.0406	0.0387	0.0504	0.0455	0.0863
R48	1.2819	1.2628	1.2777	1.285	1.2991	1.2617	1.2695	1.2474	1.243	1.1783
R48-error	0.0115	0.0135	0.0154	0.016	0.0198	0.0198	0.0218	0.0219	0.0277	0.0305
R04	0.3916	0.3883	0.4352	0.4225	0.4449	0.4629	0.4605	0.4769	0.3879	0.4786
R04-error	0.0178	0.0213	0.0231	0.024	0.0276	0.0352	0.0289	0.0403	0.0346	0.0697
CS age	53.1	52.6	60.8	58.5	62.5	66.1	65.6	68.9	52.6	69.6
Err+	3.1	3.8	4.2	4.5	5.3	6.5	6.2	8.4	6.6	15.9
Err-	3.1	3.6	4.1	4.3	5.1	6.2	5.9	7.9	6.3	14

Dubois 9967A Drill hole C

	Aliquot-1	Aliquot-2	Aliquot-3	Aliquot-4	Aliquot-5	Aliquot-6	Aliquot-7	Aliquot-8	Aliquot-9	Aliquot-10
R08	0.5224	0.5034	0.5719	0.5845	0.6271	0.6262	0.5964	0.6324	0.7138	0.501
R08-error	0.0249	0.0217	0.0274	0.0315	0.0494	0.0372	0.0483	0.0478	0.0645	0.0555
R48	1.2787	1.2807	1.2785	1.2673	1.2639	1.2834	1.297	1.3065	1.294	1.3164
R48-error	0.0098	0.0118	0.0146	0.0157	0.0157	0.0222	0.0245	0.0241	0.0288	0.0288
R04	0.4086	0.3931	0.4474	0.4613	0.4962	0.4879	0.4599	0.4841	0.5517	0.3806
R04-error	0.0209	0.0168	0.0224	0.024	0.0377	0.0316	0.0452	0.0375	0.0512	0.0441
CS age	56	53.3	63.1	65.7	72.6	70.9	65.3	70	84.2	51.1
Err+	3.5	3	4.2	5	8.3	6.2	7.5	7.7	12	7.5
Err-	3.4	2.9	4.1	4.8	7.8	5.9	7.1	7.2	11	7

7/LA/08 Drill hole A

	Aliquot-1	Aliquot-2	Aliquot-3	Aliquot-4	Aliquot-5	Aliquot-6	Aliquot-7	Aliquot-8	Aliquot-9	Aliquot-10
R08	0.4435	0.4796	0.6113	0.5977	0.632	0.6077	0.6431	0.6039	0.6372	0.6174
R08-error	0.0141	0.0196	0.0251	0.026	0.0251	0.0396	0.0485	0.0433	0.0423	0.0516
R48	1.2942	1.3016	1.2948	1.3026	1.3022	1.3016	1.2867	1.3071	1.3174	1.2846
R48-error	0.0088	0.0133	0.0124	0.0118	0.0161	0.0192	0.0209	0.0225	0.0218	0.0233
CS age	45	49.2	67.7	65.1	70.2	66.7	73.2	65.7	69.8	69.4
Err+	1.8	2.6	3.9	3.9	4.1	6.1	8.1	6.7	6.7	8.4
Err-	1.8	2.6	3.8	3.8	4	5.9	7.6	6.3	6.4	7.8

7/LA/5/8 Drill hole B

	Aliquot-1	Aliquot-2	Aliquot-3	Aliquot-4	Aliquot-5	Aliquot-6	Aliquot-7	Aliquot-8	Aliquot-9	Aliquot-10
R08	0.3954	0.4171	0.4345	0.5492	0.5491	0.5792	0.6101	0.6424	0.6704	0.622
R08-error	0.0149	0.0152	0.0176	0.0203	0.0393	0.0357	0.0338	0.0512	0.0602	0.0608
R48	1.2974	1.2889	1.2719	1.2856	1.2882	1.2776	1.2766	1.2927	1.3005	1.3214
R48-error	0.0085	0.0119	0.0101	0.0138	0.0152	0.0145	0.0212	0.0211	0.0234	0.0247
CS age	39.1	42	44.8	59.3	59.2	64.2	68.9	72.6	76.4	67.3
Err+	1.8	1.9	2.3	3	5.7	5.5	5.6	8.5	10.3	9.4
Err-	1.8	1.9	2.2	2.9	5.5	5.2	5.3	7.9	9.5	8.7

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7/LA/5/8 Drill hole C

	Aliquot-1	Aliquot-2	Aliquot-3	Aliquot-4	Aliquot-5	Aliquot-6	Aliquot-7	Aliquot-8	Aliquot-9	Aliquot-10
R85	138.6	139.3	137.5	137.9	139.6	138	139.5	137.8	135	144.3
R08	0.3272	0.4294	0.5012	0.5424	0.5207	0.6013	0.5386	0.5133	0.6223	0.5464
R08-error	0.0117	0.017	0.0206	0.0313	0.0256	0.0334	0.036	0.0453	0.048	0.0558
R48	1.294	1.283	1.2973	1.2925	1.3003	1.2746	1.276	1.3293	1.2979	1.2909
R48-error	0.0089	0.0082	0.0132	0.014	0.0164	0.0148	0.0199	0.0214	0.0213	0.0238
CS age	31.4	43.7	52.1	58	54.6	67.7	58.5	52	69.1	58.6
Err+	1.3	2.1	2.8	4.5	3.6	5.3	5.3	6	7.7	8.2
Err-	1.3	2.1	2.8	4.3	3.5	5.1	5.1	5.7	7.2	7.7

Supplementary Table 10 - A comparison of the drill holes from Dubois's tooth (9967A) and LA-5-8

SUPPLEMENTARY INFORMATION - section 7:

Supplementary discussion │ Coupled U-series/ESR dating of teeth

In principle, the combination of ESR and U-series is used to get a better estimation of the age and U-uptake history[67,149]. However, we have experienced problems trying to model U-leaching from dental tissue in these samples, as the variability of the Uranium content was large. To address this issue, we have applied direct ESR dating to three teeth to enable coupled US-ESR analysis[69,70]. The teeth are well-preserved with only very light discoloration patches and very few cracks with slight soil infiltration but no severe alteration marks due to burial. Dentine did not exhibit sediments/soil intrusion. All teeth were complete but showed small cracks at the base were the enamel joined the roots.

The coupled US-ESR age of 13/LA/5/08 and 12/LA/5/08 fragments were estimated to be between 76 ± 7 kyr and 86 ± 13 kyr (Extended Data Fig. 9). The uptake model for 13/LA/5/08 and 12/LA/5/08 gives a p-value close to zero in both enamel and dentine, designating rather a linear uranium uptake in the sample. The calculated U-series minimum ages of 13/LA/5/08 and 12/LA/5/08 in the dentine directly in contact with the enamel fragment range between 48.4 ± 5.3 and 41.2 ± 2.6 kyr, respectively.

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Supplementary Table 11*:* Raw and measured parameters used for the coupled U-series/ESR dating of tooth fragments

SAMPLE	13LA508	12LA508
ENAMEL		
Dose (Gy)[a]	45.60 ± 0.80	55.50 ± 0.70
U (ppm)[b]	0.82 ± 0.07	1.05 ± 0.21
$^{234}U/^{238}U$ [b]	3.86 ± 0.02	3.25 ± 0.05
$^{230}Th/^{234}U$ [b]	0.31 ± 0.03	0.35 ± 0.04
Thickness (m)	1421 ± 215	1553 ± 272
Water (%)	0	0
DENTINE		
U (ppm) [b]	9.25 ± 0.49	6.52 ± 0.97
$^{234}U/^{238}U$ [b]	1.06 ± 0.01	1.07 ± 0.05
$^{230}Th/^{234}U$ [b]	0.28 ± 0.01	0.38 ± 0.01
Water (%)	10 ± 5	10 ± 5
SEDIMENT		
U (ppm) [c]	1.86 ± 0.69	1.86 ± 0.69
Th (ppm) [c]	5.20 ± 1.70	5.20 ± 1.70
K (%) [c]	0.57 ± 0.04	0.57 ± 0.04
Water (%)	16.3 ± 5	16.3 ± 5
EXTERNAL DOSE RATE SEDIMENT		
Beta (μGy a^{-1})	59 ± 11	55 ± 12
Gamma (μGy a^{-1})[c]	189 ± 5	189 ± 5
Cosmic (μGy a^{-1})	88 ± 9	88 ± 9
COMBINED US-ESR AGE		
Internal dose (μGy a^{-1})	236 ± 54	288 ± 96
Beta Dose dentine (μGy a^{-1})	28 ± 6	25 ± 8
P enamel	-0.14	-0.21
P dentine	-0.04	-0.46
Total Dose rate (μGy a^{-1}) [c]	600 ± 56	645 ± 98
AGE (kyr)	**76 ± 7**	**86 ± 13**

[a] Dose equivalent D_e obtained using McDose 2.0, with SSE.
[b] Uranium concentration values were obtained by LA-MC-ICPMS.
[c] In-situ gamma spectrometry measurements. Sediment content was extrapolated from activity values using ^{238}U: 1 Bq/kg = 81 ppb; ^{232}Th=1 Bq/kg = 246 ppb; ^{40}K= 1 Bq/kg = 0.00323%

SUPPLEMENTARY INFORMATION - section 8:

Supplementary discussion │ A modelled chronology

Bayesian modelling incorporating all chronological results was 68 ± 5 ka with an age range of 73-32 ka (Extended Data Fig. 10c). To evaluate depositional age of just the breccia the model was re-run using the red TL and pIR-IRSL dating on the matrix, and U-series on the flowstones and soda straw. This had a minimal effect on the age range (65 ± 5 kyr, 1σ; age range 70-60 ka) (Extended Data Fig 10c -A). To evaluate the age of the fossils, we re-ran the model just using the U-series and coupled US-ESR dating of the teeth (Extended Data Fig 10c -B). This deletion of age estimates increased the modelled age to 75 ± 5 kyr (1σ; age range 80-70 ka). This result indicates that the fossils are slightly older than the timing of breccia in the cave, which is consistent with a colluvial origin.

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