Table 1 Radiometric data of uncorrected and corrected $^{230}Th/^{234}U$ ages of Petralona Cave travertines

Sample no.	Description	$^{230}Th/^{234}U$	$^{234}U/^{238}U$	$^{230}Th/^{232}Th$	U (p.p.m.)	Th (p.p.m.)	Age (kyr)*
P-12	Travertine (smooth and pale reddish brown), from upper part of Mausoleum calcitic floor	0.953 ± 0.045	1.272 ± 0.049	3	0.75	0.91	250^{+49}_{-34}
(U, Th) corr*		0.780 ± 0.042	1.171 ± 0.053	∝	0.59		$154.4^{+19.1}_{-16.4}$
P-13	Thick (1-cm) monocrystalline travertine from the upper part of Mausoleum calcitic floor	0.980 ± 0.046	1.315 ± 0.031	15	2.7	0.73	269^{+58}_{-39}
(U, Th) corr		0.781 ± 0.037	1.297 ± 0.032	∝	2.51		$150.2^{+15.2}_{-13.5}$
P-6		0.540	1.005	8	8.12†	1.70	84^{+46}_{-32} (130 kyr, +1σ)

* (U, Th) corr, mode of correction and corrected ages.
† Severe bone contamination as determined by X-ray diffraction renders an age of at least 150 kyr + 1σ the most probable. Small clay residue plus contaminant bone prevented (U, Th) corrections.

suggest an avergage growth rate of ~ 0.003 cm kyr^{-1}.

The 4-cm travertine beneath (thick, unlaminated sheet of prismatic calcite), ranged in age from at least 750 kyr to 280 kyr (ref. 5).

P-13 gave an uncorrected age of 269^{+58}_{-39} kyr, which, when corrected for its detrital residue isotope ratios, became ~ 150 ± 40 kyr.

Another indicative sample (P-6) presumably from the burial site of the skull, gave an age of 130 kyr (including 1σ; bone contamination noted). The appearance of this sample has many features in common with the material which encrusted the skull. The above age sequence was found to be typical for certain other parts of the cave.

However, any material, for example of prismatic calcite (colourless to pale brownish-grey), still remaining on the skull beneath the red-brown ESR-dated layer, would imply further that the skull is even older than 250 kyr.

From the above, we can see an obvious correlation, within the errors, between the U/Th series dates for the top travertine layer and the ESR dates for the stalagmitic encrustation on the Petralona cranium.

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THE determination of the age of the hominid cranium from Petralona by Hennig *et al.*[1] is remarkable because it is the first to date the carbonate encrust and cranium itself by the ESR method[2]. However, there are uncertainties in their age derivation.

They assumed that the brown calcite encrusted the cranium soon after the death of the hominid. If this carbonate had been growing linearly up to recent time, the age of the cranium must be doubled to 400 kyr using their ESR age for the carbonate. It must be stressed that the carbonate encrust age is just a minimum age of the cranium.

The high external dose rate of 190 ± 20 mrad yr^{-1} on the cave travertine floor is too high and is very close to that in the soil at Petralona. The dose rate in a limestone cave is generally highly affected by the flow-in soils nearby[3]. The high dose rate would be due to the soil mixed up by excavations in 1960–62 or recently.

The response of $CaSO_4$ to low energy γ rays is also high, leading to an apparently high dose rate. Furthermore, the carbonate encrust was presumably about a few centimetres above the cave floor and shielded by the cranium against the floor. Thus, it would not be appropriate to use the dose rate of 190 mrad yr^{-1}. If the external dose rate of 87 mrad yr^{-1} with thermoluminescent dosing of $CaSO_4$(Tm) or the 50–80 mrad yr^{-1} of Liritzis *et al.*[4] with NaI(T1) at Petralona cave were used as the external dose rate, the total dose rate would be ~ 100 mrad yr^{-1}. The average age of the carbonate encrust could then be 420–600 kyr which is close to those obtained for some carbonates and bones at Petralona with ESR[5]. Careful assessment of the radiation environment must be made using ESR dating before a large scale excavation proceeds.

We have used ESR to study Choukoutien bones. The total dose of natural radiation (TD) of Choukoutien bones estimated with ESR ranged from 20 to 40 krad. The TDs for Petralona bones range from ~10 krad for bones embedded in pure calcite to 80 krad in the soil sediment. The latter age would be ~400 kyr considering the high dose rate of 200 mrad yr^{-1}. The TDs of the cranium of 27 krad yr^{-1} obtained by Hennig is very close to that of bones of layer 17 at Petralona (21 krad) where Petralona man was originally located, according to Poulianos. There are some problems of apatite recrystallization in ESR dating of bones[6]. We might obtain a younger age than the real age for bones with ESR. However, these results may have some bearing on the stratigraphy. The bones at Arago, Tautavel fall in nearly the same range of TDs.

Note added in proof: ESR dating of fossil bones are being determined taking ^{238}U-series disequilibrium and a model of constant uranium accumulation rate into account. Tentative ages neglecting the loss of gaseous radon are 810 kyr and 550 kyr (Kabuh and Pucangan Layer, Jawa), 335–480 kyr (Mauer, Heidelberg), 330–440 kyr (Petralona) and 240–200 kyr (Steinheim). Actual ages are older when a 30–50% loss of gaseous radon is taken into account.

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HENNIG *ET AL. REPLY*—With regard to the above comments we will keep our replies to each author distinct.

The statement by Poulianos in his own publications in *Anthropos* and *Current Anthropology* that there exists a skeleton which belongs to the same individual as the hominid cranium, that is said to have been "buried under a stalagmitic cover ~5 cm thick", clearly contradicts what he has published elsewhere[2]; "Unfortunately, the skeleton was not preserved and lost forever for science. Only the skull was preserved due to the fact that it was covered with stalactitic material".

As far as we know, there is no indication that any bone fragments under the 5-cm thick stalagmitic floor are related to hominids, and even less to the hominid skull. Until now no proof for the existence of a hominid skeleton has been presented.

Poulianos furthermore quotes age data of 340 kyr and 670 yr derived by Ikeya (optionally for dose rates of 0.2 rad yr^{-1} and 0.1 rad yr^{-1} respectively[3]). Curiously, there is no detailed description of the colour, texture, thickness and exact sampling location of these samples in Ikeya's paper. Thus, it is almost impossible to