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REPLY

MEBUS A GEYH AND G J HENNIG

STRATIGRAPHY

Grün and Schwarcz claim that the numbering of the flowstone profile conflicts with that published by Grün (1985). Due to the complex sequence of non-continuous sedimentologic and crystallographic strata first brought to attention in our study, all profiles from different sampling projects have somewhat differing numbers. However, our numbers for Layers 1–11 (Fig 1, above) are identical to the labels (black dots in Fig 1, above) of the first paleomagnetically analyzed profile.

We did not assign the Bruhnes/Matuyama boundary between Layers HA 17 and HA 18 but noted that "from layer 18 downwards, the magnetic orientation is reversed." The depth scale in Figure 1 conflicts with the mean thickness of the layers in Table 1.

ESR DATING

The purpose of our Figure 2 (data from Grün, 1985) was to demonstrate that three stratigraphically related vertical profiles in the same flowstone being only a few decimeters apart from each other, yielded completely different AD/depth relationships. This is independent of using either the original depth data (Grün, 1985), or our normalized ones. In any case, only one of the three profiles (shown as a bold line, Fig 2, our paper) shows a linear trend with depth (restricted to 40cm below the top).

It is well-known that additional parameters have to be taken into account for the transformation of AD values to ESR ages. However, the main parameter is the uranium content of the speleothem, which is rather uniformly distributed (250 ± 60ppm) in the upper part of the vertical flowstone profile. But, as seen from Figure 2, above, the ESR ages for the same layers scatter by up to a factor of three. Therefore, the question should be raised if deletion of the other results (without age/depth trends) is permitted without additional arguments.

We are convinced that ESR analyses can yield very reliable dates if the suitability of the samples is proven or disproven, eg, by independent crystallographic, sedimentologic, mineralogic, or trace element analysis. Obviously, in the case of very slowly growing flowstone, zones containing suitable and unsuitable material follow so closely that samples a few centimeters thick (as used for ESR by Grün) most probably contain some unsuitable material. Moreover, Grün had only broken samples, which made stratified sampling difficult. These and other reasons already mentioned may be responsible for the Holocene samples yielding ESR ages of ca 40,000 BP ± 30% (Grün & Schwarcz).

U/TH DATING

A complete data list could not be published due to the restriction in the length of the paper. Grün and Schwarcz stated "we do not know whether Geyh and Hennig in fact used the same samples for their measurements" of ^{14}C and U/Th. But this was clearly mentioned in the section on $^{234}U/^{230}Th$ data. The data of Peters (1981) cannot be compared to ours as he used thick layers of up to 10cm for U/Th dating.

Indeed, the ^{232}Th content of the samples is increased in samples with obviously too large U/Th ages. However, there is no radiometric method to ascertain whether ^{232}Th was diagenetically moved by recrystallization or remained *in situ*.

STABLE ISOTOPE ANALYSES

The problems and presuppositions inherent in the transformation of stable isotope data in paleotemperature were first discussed by Fanditis and Ehhalt (1970). Hendy worked as a postgraduate student under Ehhalt and published his identical results one year later. Hence, our citation is correct. As we proved analytically, conditions of isotope equilibrium were not fulfilled for the investigated flowstone (there is a strong correlation between $\delta^{13}C$ and $\delta^{18}O$). Therefore, δ values were applied only stratigraphically, correlated to sedimentologic findings and the raw time scale, and any paleoclimatic interpretation was avoided based only on $\delta^{18}O$ values.

RATE OF SPELEOTHEM GROWTH

Speleothem growth is at least one order of magnitude larger during interglacial periods than during glacial periods (Geyh & Franke, 1970). Geyh, Franke and Dreybroth (1982) discussed this problem in more detail and initiated a theoretical study (Dreybroth, 1980). He confirmed quantitatively the theoretical approach by Franke (1971) who evaluated the parameters determining the growth rate and the shape of stalagmites. The qualitative statements by Grün and Schwarcz were already quantified (Dreybroth, 1980, 1982). In flowstones that have grown during glacial periods, the sedimentation rate (if not zero) seems to be smaller than the erosion rate. This may be different for stalagmites which have sedimentation rates one order of magnitude higher.

CONCLUSION

^{14}C, U/Th, and paleomagnetic data are in fairly good agreement for a long flowstone profile. However, the age resolution achieved is smaller than methodologically expected. Diagenetic processes modify the specific activities of ^{14}C, U, and Th isotopes, as well as the number of trapped electrons used for ESR dating. Hence, an exact fixation of the sediment boundaries between glacial and interglacial periods is not possible.

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