Preliminary U-series results and dating of faunal remains from Castel di Guido, Italy

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SUMMARY: The first U-Th data measured from five *Bos* teeth (enamel, dentine, cement) and seven bone samples from Castel di Guido (units 4 and 5) are presented in this study. The uranium content measured from tooth and bone samples is particularly high. The U-Th apparent ages of bone and cement samples are more scattered than for enamel and dentine samples. The dates of the teeth (enamel, dentine) are the most coherent, ranging from 250 to 170 ka. This range of date is in agreement with the fact that the Castel di Guido palaeosurface is younger than the "Tufo rosso a scorie nere" eruptive event of the Sabatini Volcanic District. The U-Th data obtained there are preliminary and ESR method will be applied for comparison.

1. Introduction

The Castel di Guido open site is located in central Italy (Latium), an area with complex stratigraphic correlations. The site is characterized by the presence of a Lower Palaeolithic industry and of a rich vertebrate fauna (Radmilli & Boschian 1996). Artefacts like choppers, chopping-tools and handaxes have been made either on stone or on bone which is a great particularity of the site. The sediments consist of interbedded fluviatil, lacustrine and volcanic deposits with the main characteristic of a reworking. The main faunal species discovered in the palaeosurface (units 4 and 5) of the site are *Bos primigenius, Elephas antiquus, Equus caballus, Cervus elaphus*. Recently, Caloi *et al.* (1998) suggested that the faunal association there belongs to OIS 9 (0.303-0.339 Ma, SPECMAP, Imbrie *et al.* 1984). The units 4 and 5 have succeeded the Sabatino explosive products "Tufo rosso a scorie nere" (TRSN). The data of K-Ar method applied on volcanic rocks from the TRSN appear to date the eruptive event at 442 ± 7 ka (Evernden & Curtis 1965; Fornaseri 1985). Then, this unit should be correlated to OIS 12 (Imbrie *et al.* 1984). The purpose of the present paper is to present new radiometric data in order to contribute to the dating of the Castel di Guido palaeosurface. U-Th results are presented for four kinds of tissues (bone, enamel, dentine and cement) of mammalian remains excavated from the units 4 and 5. Our ESR analyses will be presented in a future paper.

2. Sample and Method

The enamel, dentine and cement were separated using a dentist drill from the M3 teeth of five *Bos* individuals (N°11479, 405, 3436, 6155, 7599). Only one tooth, N°11479, has no remaining cement on the outer surface of the enamel, the other ones had small quantities. Samples of bone were extracted from the most compact part of two mandibles and of five fragments (Fig. 1). Samples were reduced to powder in an agate mortar for analyses.

The U-Th method is based on the measurement of the activity ratio $^{230}Th/^{234}U$ using the

exponential function of ^{230}Th ingrowth. The disequilibrium between ^{234}U and ^{238}U is measured and taken into account for calculation. An early uranium uptake (EU) is assumed with no initial ^{230}Th. We have measured the activity ratios of samples by alpha spectrometry (IPH, MNHN) using the same procedure as described in another paper (Michel *et al.* 2000).

Results and Discussion

All activity ratios (^{234}U/^{238}U, ^{230}Th/^{234}U) and the U-Th corresponding apparent ages of faunal samples from the units 4 and 5, are presented in Table 1 and Figure 1. These first analyses revealed that the uranium content within samples is very high. The U content range is between 9 and 49 ppm for compact enamel samples and between 195 - 863 ppm for porous tissues as dentine, bone and cement. U contents in bone and cement are the highest (Fig.1). This degree of content is rarely reached in fossil apatites. Only, few papers related very high U content in these types of samples; as for example, the U contents of the fossil bones from Olduvai Gorge between about 4 and 820 ppm (Williams & Marlow 1987). The authors concluded that U can be taken up very early in the fossilization process and the amount of U depends on the redox potential of the depositional environment. At Notarchirico site, Rhodes & Grün (1999) found high uranium content for teeth (1.5-6.5 ppm for enamel; 132-271 ppm for dentine). At Castel di Guido, the U content range in dentine is about 10 to 30 times higher than in enamel as Grün & Taylor (1996) observed or as others studies shown. The uranium content of the surrounding sediment (units 4 and 5) measured by gamma spectrometry, is relatively high: about 4-8 ppm. The U-Th apparent ages are more scattered for bones than for other types of material (Tab. 1 and Fig. 1). The apparent dates range from about 200 to 350 ka. The U-Th age of dentine and enamel samples are the most interesting data for dating. As a matter of fact, the data are more consistent, ranging between 170 and 250 ka.

Tab.1 - U-Th data of bone and tooth samples from Castel di Guido palaeosurface (units 4 and 5).

Sample	Unit, Zone, N$_i$	*Sample N$_i$	U (ppm)	^{234}U/^{238}U	^{230}Th/^{232}Th	^{230}Th/^{234}U	U-Th age (ka)
Bone fragment	5, - , 10877	cast10877b	253.0	1.142 ± 0.007	> 1000	0.878 ± 0.011	208^{+9}_{-8}
Bone fragment	5, - , 10879	cast10879b	862.6	1.015 ± 0.004	> 1000	0.940 ± 0.014	297^{+30}_{-23}
Bone fragment	5, - , 10881	cast10881b	249.2	1.081 ± 0.006	> 1000	0.942 ± 0.012	276^{+18}_{-16}
Bos mandible	5, - , 11479	cast11479e	9.3	1.098 ± 0.027	> 1000	0.831 ± 0.021	183^{+15}_{-13}
with M_3		cast11479d	286.4	1.175 ± 0.009	> 1000	0.824 ± 0.013	174 ± 7
		cast11479b	422.5	1.048 ± 0.007	> 1000	0.868 ± 0.014	212^{+12}_{-11}
Bos M_3	4, N14, 405	cast405e	15.7	1.118 ± 0.018	> 1000	0.811 ± 0.019	171^{+11}_{-10}
		cast405d	239.2	1.186 ± 0.016	> 1000	0.912 ± 0.019	227^{+19}_{-16}
		cast405c	282.3	1.131 ± 0.010	> 1000	0.892 ± 0.015	219^{+13}_{-11}
Bone fragment	4, T17, 1679	cast1679b	606.1	1.043 ± 0.007	> 1000	0.974 ± 0.016	351^{+62}_{-39}
Bone fragment	4, Q11 , 2392	cast2392b	526.0	1.050 ± 0.004	> 1000	0.853 ± 0.010	201^{+8}_{-7}
Bos M^3	4, U36, 3436	cast3436e	12.1	1.099 ± 0.018	> 1000	0.883 ± 0.019	217^{+18}_{-15}
		cast3436d	251.4	1.195 ± 0.009	> 1000	0.819 ± 0.015	171^{+8}_{-7}
		cast3436c	281.5	1.172 ± 0.008	> 1000	0.917 ± 0.014	233^{+14}_{-12}
Bos mandible	4, ZS21, 6155	cast6155e	14.9	1.127 ± 0.015	> 1000	0.826 ± 0.017	178^{+10}_{-9}
with M_3		cast6155d	195.2	1.146 ± 0.011	> 1000	0.873 ± 0.018	196^{+12}_{-11}
		cast6155c	265.9	1.180 ± 0.012	> 1000	0.905 ± 0.017	223^{+15}_{-13}
		cast6155b	265.8	1.048 ± 0.007	> 1000	0.870 ± 0.013	214^{+12}_{-11}
Bos M_3	4, ZZ122, 7599	cast7599e	49.0	1.146 ± 0.011	> 1000	0.911 ± 0.016	232^{+16}_{-14}
		cast7599d	427.3	1.095 ± 0.006	> 1000	0.920 ± 0.012	248^{+14}_{-13}
		cast7599c	549.5	1.043 ± 0.005	> 1000	0.928 ± 0.014	271^{+21}_{-18}

Counting error : 1 σ uncertainies due to counting statistics.

*b= bone, e = enamel, d = dentine, c = cement.

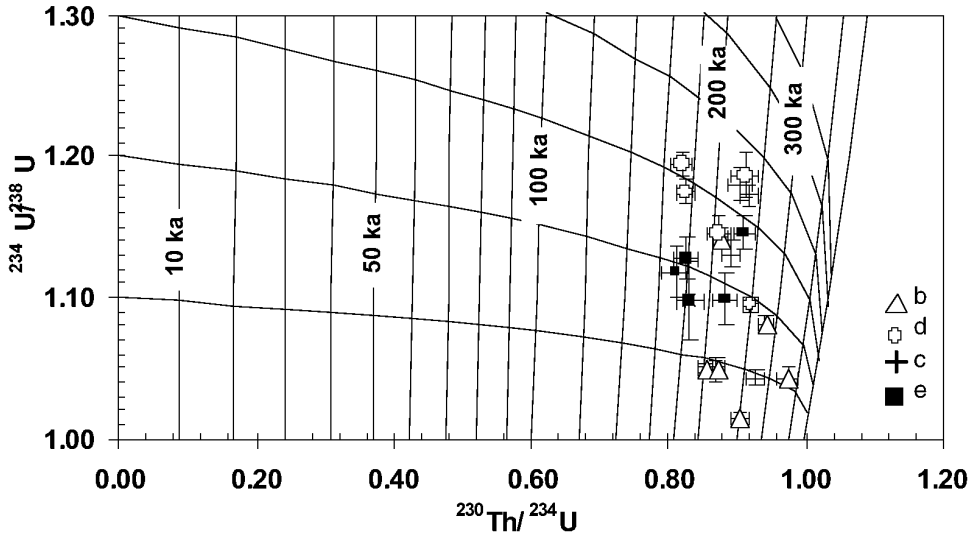

Fig.1 - The graphical solution of the U-Th age equation with variation of $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ activity ratios of bone (b), dentine (d), cement (c) and enamel (e) samples from Castel di Guido site.

These first U-Th results will be compared with ESR data, by knowing by advance that the annual dose will be very different between the usual EU (early uptake) and LU (linear uptake) modes because of the high U content within the samples.

4. Conclusion

The first U-Th data of *Bos* teeth showed high uranium content and gave apparent U-Th ages ranging from 250 to 170 ka. These data are preliminary and will be compared to the ESR dating of the same teeth. Presently, the U-Th age range obtained on teeth is coherent with the fact that the age of the CDG palaeosurface is younger than the eruptive event (TRSN) of the Sabatini Volcanic District.

5. Acknowledgements

Authors are thankful to Professor C. Tozzi (Università degli Studi di Pisa) for supplying the fossil remains and to Professor H. de Lumley (IPH, MNHN, Paris) for the proposition of this study.

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