On the limit of U-uptake modelling for ESR/U-Th dating of teeth with leaching issues: the case of Sainte-Anne I site

Maïlys Richard*†[1,2], Christophe Falguères[3], Jean-Jacques Bahain[3], Bassam Ghaleb[4], Edwige Pons-Branchu[5], and Jean-Paul Raynal[6,7]

[1]Institut de Recherches sur les Archéomatériaux - Centre de Recherche en Physique Appliquée à l'Archéologie (IRAMAT-CRP2A) – université Bordeaux Montaigne, CNRS : UMR5060 – Maison de l'Archéologie, Esplanade des Antilles, 33607 Pessac, France

[2]Histoire naturelle de l'Homme préhistorique (HNHP) – Muséum National d'Histoire Naturelle (MNHN), CNRS : UMR7194 – Institut de Paléontologie Humaine, 1 rue René Panhard, 75013 Paris, France

[3]Histoire naturelle de l'Homme préhistorique (HNHP) – CNRS : UMR7194, Muséum National d'Histoire Naturelle (MNHN) – Institut de Paléontologie Humaine 1, rue René Panhard 75013 Paris, France

[4]GEOTOP – Université du Québec à Montréal, CP 8888, succ. Centre-Ville, Montréal, Canada

[5]Laboratoire des Sciences du Climat et de l'Environnement (LSCE) – Université de Versailles Saint-Quentin-en-Yvelines (UVSQ), CEA, CNRS : UMR8212 – Bât. 12, Avenue de la Terrasse, 91190 Gif-sur-Yvette, France

[6]De la Préhistoire à l'Actuel : Culture, Environnement et Anthropologie (PACEA) – Université de Bordeaux, CNRS : UMR5199 – Bâtiment B8, CS 50023, Allée Geoffroy Saint Hilaire, 33615 Pessac, France

[7]Department of Human Evolution, Max Planck Institute – Deutscher Platz 6, 04103 Leipzig, Allemagne

Résumé

The reconstruction of the unknown U-uptake history in the dental tissues has always been a source of uncertainty for ESR/U-Th dating and thus for dose rates reconstruction. Since the introduction of the US-ESR model by Grun et al. (1988), which takes into account 234U/238U and 230Th/234U activity ratios for the determination of an uptake parameter (the "p-value"), the accuracy of the age estimates was improved. However, the limit of the US-ESR model is reached when uranium leaching is evidenced in at least one of the dental tissues. In order to overcome this limit, Shao et al. (2012) proposed a new model, called Accelerating Uptake (AU-ESR), which allows to model the evolution of U-uptake as a function of time in tissues which underwent leaching processes.

We present ESR/U-Th age results obtained on *Equus* teeth from the Middle Palaeolithic cave site of Sainte-Anne I (Polignac, Haute-Loire, France) (Raynal, 2007). Results suggest that the dental tissues from five out of six teeth underwent U-leaching during burial, preventing the calculation of US-ESR ages. Minimum ages (Early Uptake, EU-ESR) were thus

*Intervenant

†Auteur correspondant: mailys.richard@u-bordeaux-montaigne.fr

calculated and compared to AU-ESR modelled ages. The difference between mean EU and AU ages ranges from 2 to 22%, indicating that U-loss in some of the dental tissues can have a significant impact on the age estimates. Available biochronological and climatochronological data point out a MIS6 chronology. However, previous ESR ages (Rhodes, 2007) and all of the EU, US and AU ages obtained in this study fall within MIS5. ESR/U-Th ages range from 118 ± 14 ka (AU) to 80 ± 7 ka (US), spanning the entirety of MIS5, and allow to attribute the sequence to the beginning of the Upper Pleistocene.

References

Gr$^{\acute{}}$un, R., Schwarcz, H.P., Chadam, J., 1988. ESR dating of tooth enamel: Coupled correction for U-uptake and U-series disequilibrium. International Journal of Radiation Applications and Instrumentation. Part D. Nuclear Tracks and Radiation Measurements 14, 237-241.

Raynal, J.-P. (dir), 2007. *Sainte-Anne I, Sinzelles, Polignac, Haute-Loire. Le Paléolithique moyen de l'unité J1*, CDERAD ed., Les dossiers de l'Archéo-Logis, 3, Goudet, 265 p.

Rhodes, E.J., 2007. Initial Electron Spin Resonance dating results, in: Raynal, J.P. (dir), *Sainte-Anne 1, Sinzelles, Polignac, Haute-Loire. Le Paléolithique moyen de l'unité J1*. CDERAD ed., Les dossiers de l'Archéo-Logis, 3, Goudet, pp. 43-46.

Shao, Q., Bahain, J.-J., Falguères, C., Dolo, J.-M., Garcia, T., 2012. A new U-uptake model for combined ESR/U-series dating of tooth enamel. Quaternary Geochronology 10, 406-411.

Mots-Clés: Chronology, ESR/UTh, Neanderthal, Middle Palaeolithic, Western Europe