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Stable isotope distribution in continental Maastrichtian vertebrates from the Haţeg Basin, South Carpathians

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The oxygen isotopic compositions of biogenic apatite from crocodiles, turtles and dinosaurs, and their relationship to climate and physiology have been evidenced by several studies (Barrick and Showers, 1995; Kolodny et al., 1996; Barrick et al., 1999; Fricke and Rogers, 2000; Stoskopf et al., 2001; Straight et al., 2004; Amiot et al., 2007). To date, few attempts have been made to correlate the enamel d13C to dietary resources of dinosaurs (Bocherens et al., 1988; Stanton Thomas and Carlson, 2004; Fricke and Pearson, 2008; Fricke, et al., 2008). One additional complication is that for dinosaurs, the d18O of enamel phosphate depends on both body water and variations in body temperature. Several studies addressed the issue of endothermy vs. ectothermy of fossil vertebrates by studying inter- and intra-bone and enamel isotopic variability (Barrick and Showers, 1994, 1995; Barrick et al., 1996; 1998; Fricke and Rogers, 2000). More recent investigations provided evidence for inter-tooth temporal variations and related them to seasonality and/or changes in physiology (Straight et al., 2004; Stanton Thomas and Carlson, 2004).

The main objectives of this study are to extract palaeoclimatic information considering, beside lithofacial characteristics and the isotopic distribution of carbonates formed in paleosols, the stable isotope composition of vertebrate remains from the Haţeg Basin. We also sampled several teeth along their growth axis in order to get further information about growth rates and the amplitude of isotopic variation. Located in the South Carpathians in Romania, the Haţeg Basin contains a thick sequence of Maastrichtian continental deposits yielding a rich dinosaur and mammalian fauna. Stable isotope analyses of both calcretes and dinosaur, crocodilian and turtle remains from two localities (Tuştea and Sibişel) were integrated in order to reconstruct environmental conditions during the Maastrichtian time and to gain further insights into the metabolism and behaviour of the vertebrates. The large difference observed between the delta 18O and delta 13C of the eggshells and the surrounding mudstones, as well as the preservation of the 9 %■ difference between the oxygen isotope composition of the Telmatosaurus eggshell and tooth enamel, indicate that diagenesis have not significantly altered the primary isotopic signal. Stable isotope compositions of both calcretes and phosphatic remains suggest warmer conditions during the deposition of the Tuştea sequence than during the deposition of the Sibişel sequence. The intra-tooth delta 18O patterns for Zalmoxes and Allodaposuchus show different magnitudes of isotopic variation, with lower values for Tuştea and higher for Sibişel. The calculated delta 18O body water enrichment for Kallokibotion bajazidi is similar to that found in the living turtle taxa. By contrast, in the case of Allodaposuchus, the isotopic enrichment is higher than for recent taxa. This suggests that, for Allodaposuchus, the body water was less buffered by a watery environment, which probably indicates more time spent outside water (i.e. more terrestrial habit). The delta 18O values for the teeth of Telmatosaurus and Zalmoxes are similar to those of Allodaposuchus, suggesting that, at the investigated sites, the body temperature of both dinosaurs was similar to that of the crocodile. The isotopic composition of calcretes, teeth and eggshells indicates a C3 vegetation and diet with delta 13C values between –27 to –29 %■ (PDB) and the absence of large-scale habitat partitioning between the dinosaurs.