Triple oxygen isotopes of modern terrestrial mammalian tooth enamel—new implications for paleoenvironmental and physiological research

DINGSU FENG¹, NIKLAS LÖFFLER¹, FABIAN ZAHNOW², JAKUB SURMA², DANIEL HERWARTZ³ AND ANDREAS PACK⁴

¹Abteilung Geochemie & Isotopengeologie
²Georg-August-Universität Göttingen
³University of Cologne
⁴University of Göttingen

Presenting Author: dfeng@gwdg.de

Atmospheric O₂ is consumed by mammals for metabolic oxidation. The low triple oxygen isotope (Δ¹⁷O) composition of air O₂ serves as a natural tracer for identifying metabolic oxygen in body water [1]. Bioapatite precipitates in isotopic equilibrium with its parental body water and consequently records information on the air O₂. The Δ¹⁷O of atmospheric O₂ is directly linked to pCO₂ and gross primary production, hence fossil teeth can be used for paleo-pCO₂ reconstructions.

To provide a modern baseline for this approach, we measured 128 individual mammal teeth for their bioapatite Δ¹⁷O by automatic BrF₅ laser fluorination. The sample set includes diverse body size and physiology from different habitats. Taxon-specific oxygen mass balance models are developed for resolving principal dependencies and relationships.

The results show that Δ¹⁷O not only correlates with body mass, but also with initial oxygen anomalies of inhaled air O₂, which allows for pCO₂ reconstruction on terrestrial mammalian tooth enamel. This documents the potential of tooth enamel Δ¹⁷O analysis for metabolic rates of extinct vertebrates and paleoclimate reconstructions, especially for small mammals (Mb < 1 kg).