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Triple Stable Oxygen Isotopes in Bioapatite as Paleo-pCO_2-Proxy

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The $\Delta'^{17}O_{atmosphere}$ of tropospheric O_2 is related to atmospheric CO_2 concentration and gross primary production (GPP) [1,2,3,4]. Atmospheric oxygen is respired by animals, hence $\Delta'^{17}O_{atmosphere}$ can be approximated from the oxygen isotope composition of tooth enamel [4,5]. Assuming a given GPP, such analyses can aid in the reconstruction of paleo-pCO_2.

In order to reconstruct the atmospheric $\Delta'^{17}O_{atmosphere}$ from bioapatite, accurate phosphate-water triple oxygen isotope fractionation factors ($\alpha_{PO4\text{-}H2O}$, $\theta_{PO4\text{-}H2O}$) are required. We performed enzymatic assay experiments in order to empirically calibrate the triple oxygen isotope equilibrium curve for phosphates. The enzyme pyrophosphatase is used to achieve oxygen isotope equilibrium between water and dissolved phosphate under controlled laboratory conditions [6]. A refined method was developed to precipitate the dissolved phosphate as pure Ag_3PO_4, which is to be analyzed for $\Delta'^{17}O$.

The paleo-pCO_2-proxy depends on knowledge of a variety of physiological and environmental parameters. In order to minimize uncertainties related to environmental and physiological factors, different taxa from the same location and age and thus from the same environmental setting are analyzed. This allows directly comparing taxon-specific body water models using the same environmental parameters. In particular, enamel from fossil teeth of crocodiles, the dwarf sauropod *Europasaurus holgeri* [7] as well as fish from the Upper Jurassic fauna of the Langenberg Quarry in Oker, Germany, was analyzed for its triple oxygen isotope composition ($\Delta'^{17}O_{PO4}$). By combining the respective animal body water models, we aim to reconstruct the $\Delta'^{17}O_{atmosphere}$ from these $\Delta'^{17}O_{PO4}$ values and subsequently paleo-pCO_2 of the Late Jurassic atmosphere.

Our aim is to improve all aspects of the model to allow for accurate pCO_2 reconstructions and to explore further applications, such as the reconstruction of GPP and the physiology of dinosaurs, including the dwarf sauropod *Europasaurus*.

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