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Revised phosphate/water fractionation equation - implications for existing paleotemperature reconstructions using fish tooth apatite

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Since the work of Longinelli and Nuti (1973), refined by Kolodny et al. (1983), biogenic apatite oxygen isotope composition has provided a valuable mean to reassess anomalous temperatures inferred from ancient biogenic calcite which is more prone to diagenetic alteration (e.g. Pucéat et al., 2007). However, recent developments in analytical techniques and data calibration (Vennemann et al., 2002; Chenery et al., 2009) raise questions on the fractionation equations that have been established over 20 year ago for paleotemperature reconstructions. In addition, because existing fractionation equations have been established from fish recovered from natural environments, they present very large uncertainties due to large data scattering. The uncertainties are mainly due to seasonal variations of both temperature and δ^{18}O of the water from which the analysed fish have been recovered, associated with a short formation time of fish teeth (less than a season). We present here a new apatite-water fractionation equation based on a seabreams (Sparus aurata) raised in aquariums maintained at controlled temperature and water oxygen isotope composition. The new equation presents a similar slope than those previously published, but the data display an offset of about 1.5‰. This work has important implications for paleoclimatic studies based on biogenic apatite oxygen isotope composition, as the reconstructed temperatures in most of the recent works may have been underestimated by several degrees.

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