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The 18O/16O ratio in vertebrate biogenic apatite as a proxy to Palaeozoic seawater temperatures

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Stable oxygen isotope ratios in vertebrate microfossils, conodonts as well as early fish dermal scales, have been used as proxies to palaeoseawater temperatures, and Palaeozoic climate. The compact tissues of conodont elements and fish scales, such as albite (Trotter et al. 2006, 2007) or enamel (Žigaitė et al. 2010) are supposed to have a high potential in preserving the primary oxygen isotope signal, which may correspond to the ambient palaeoseawater. However, application of analythical methods has not always been taken into consideration, particularly obtaining the 18O/16O values by a wet chemistry phosphatic remnant separation from bioapatite (Joachimski et al. 2002, 2004, 2006, 2009; Žigaitė et al. 2010) versus an ion microprobe bulk tissue-selective microsampling (e.g. Wheeley et al. 2010), which are not comparable. Recently, a new phosphate-water paleothermometer equation (Pucéat et al. 2010) based on advanced analytical techniques has yielded an offset of about +2‰ , producing the paleotemperatures for the Early Palaeozoic up to 8°C higher than previously considered (e.g. Trotter et al. 2008). Multiple reasons, ranging from diagenetic alteration of isotopic signal to circular change of palaeoseawater isotopic composition, may cause the final variations of isotopic signal. The acid preparation of fossil biominerals and other chemical processing play an important role affecting the 18O/16O ratio as well. Results of our study reveal that the enrichment in heavy 18O isotopes in the Early Palaeozoic fish bioapatite may be directly correlated with a poor preservation of fossil biominerals. Additionally, the δ18O ratios appear to be strongly species-dependent, which may refer either to specific susceptibility to diagenesis, or to specific palaeobiological isotope assimilation in vertebrate biominerals.

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