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Do fossil vertebrate biominerals hold the key to the Palaeozoic climate?

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Fossil vertebrate hard tissues - teeth and dermoskeleton - are considered among the most geochemically stable biominerals, and therefore are widely used for palaeoenvironmental and palaeoclimatic reconstructions. Elemental and isotopic compositions of fossil dental tissues may provide unique palaeoenvironmental information, ranging from the diet and trophic positions on a food chain, to the palaeosalinity and water temperatures of ancient seas. However, the post-mortem alteration and re-crystallisation of fossil hard tissues may hamper these interpretations. Chemical composition and isotopic equilibrium of the biomineral change readily at any time from the earliest diagenesis to the final laboratory acid treatment during the fossil preparation. This is why particular attention shall be given to the preservation of fossil tissues, evaluating carefully the level of possible alteration in the primary geochemical composition. Pre-evaluation of fossil preservation can be made by semi-quantitative spot geochemistry analyses on fine polished teeth and scale thin sections using Energy Dispersive X-ray Spectroscopy (EDS), and help to preview the chemical composition of biomineral. The Electron Backscatter Diffractometry (EBSD) is useful to examine the cristallinity and possible structural alterations. In addition, rare earth element (REE) abundances can be measured in situ within the fine fossil tissues (such as enamel) using Laser Ablation Inductively Coupled Plasma Mass-spectrometry (LA-ICP-MS), giving evidence on the selective geochemical resilience between separate vertebrate hard tissues. Therefore, in order to decipher the geochemical signal correctly, the evaluation of preservation is a necessary starting point to any further studies of fossil biomineral geochemistry.