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Quantifying and Visualizing Biomineral preservation.

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Geochemical signatures obtained from fossil apatite play a significant role in reconstructing paleoenvironmental and palaeoecological conditions. The reliability of these signals is dependent on the preservation of primary elementary composition, which is often lost due to alteration by diagenetic processes. In this study, we attempt to visualize and quantify fossil vertebrate dental tissue geochemistry and infer the state of apatite preservation by combining analysis of in-situ major, trace and rare earth element (REE) compositions in plesiosaur and lungfish dental remains from the Lower Cretaceous Wonthaggi and Eumeralla formations of south eastern Australia.Tissue-selective REE values were obtained using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MP), indicating areas of potential REE enrichment. In conjunction, optical Cathodoluminescence (CL) imaging was performed to illustrate any compositional changes in the specimen. Energy Dispersive X-ray Spectroscopy (EDS) mapping was used to identify major elemental components and identify areas of contamination or diagenetic replacement. The REE profiles we present are indicative of limited diagenetic alteration, overlap with the secondary element distributions seen in the CL imaging and EDS maps, and the degree of preservation in some analysed tissues is such that the geochemical signature produced by the sample can be interpreted as primary. The spatial distribution of REE and trace elements revealed by mapping highlights the influence of histology in determining the likelihood of primary preservation in dental remains.