Synchrotron XRF fabric recognition in continental carbonates: elemental incorporation and implication for palaeoclimate reconstructions

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Synchrotron radiation X-ray fluorescence microscopy (SR-XFM) application for high-resolution elemental mapping of continental carbonates has been penalized to date by acquisition times and sample size limitations. Recent advance in detectors technology allows investigate at high resolution (0.5 – 5 μm) and with fast acquisition times (tens of ms per pixel) samples up to several cm long and wide.

Here we present elemental maps from a suite of continental calcites (stalagmites, flowstones, coralloids, subglacial carbonates) obtained at the XFM beamline at the Australian Synchrotron equipped with a Maia 384 detector array, which acquires full spectral X-ray data for each detector.

The combined maps for Sr, Y, U, Br, Fe, Mn and Zn allow identification of laminae and highlight the original fabric of the deposits, providing insight on the processes of their formation. Maps of Ca, Sr and the elastic scattering yield information on growth mechanism, original and actual porosity. Finally, the full spectral acquisition and off-site software elaboration allow obtaining high-resolution quantitative linear and complex traverses by integrating selected areas of variable orientation and pixel width within the map.

The SR-XFM technique provides imaging of trace elements which identify structures otherwise difficult to visualize, with valuable information on original fabric and diagenetic modifications, which are fundamental in our correct interpretation of climate and environmental proxy data extracted from continental carbonates.