Iron enrichment in stalagmites from Java, Indonesia, as an indicator for paleo-floods

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Iron concentrations have been measured in samples extracted every mm along the growth axis of a stalagmite from Bribin Cave, Middle Java, Indonesia, using a 0.6 mm drill bit. The results show numerous peak-like enrichments of Fe of up to several thousand ppm, especially in dark layers. High resolution elemental mappings (10 μm) using synchrotron radiation (μXRF) revealed Fe enrichments of up to 1 wt% in layers of less than 100 μm thickness. Iron covaries with other metals like Mn, Ti or Zn, as well as with P in older parts of the stalagmite. However, no significant correlation with $\delta^{18}O$, $\delta^{13}C$, Sr/Ca or Mg/Ca has been found.

Layers of Fe/Mn rich crusts which have been formed from Fe/Mn-colloidal accumulation under subaquatic conditions, are also present on the walls and ceiling of Bribin cave. As a consequence, we assume that Fe rich layers in stalagmites could be indicative of large floods that have led to phreatic conditions causing colloidal Fe or Fe rich detritus to be deposited on the stalagmite surface. The detrital Fe either originates from Fe rich cave deposits that are physically remobilized during floods or from pedogenic material washed in from the surface via surface runoff.

So far, paleo-hydrology is mainly reconstructed from $\delta^{18}O$ profiles. Floods, however, are not necessarily correlated with an overall change of the hydrological cycle which would be recorded by a shift in the $\delta^{18}O$ signal. In fact, they rather often occur as single short-term events which are not traced by $\delta^{18}O$ variations in speleothems, especially in deep caves where signals are damped. We think that measurements of Fe concentrations in stalagmite records, particularly those at high resolution, will allow detection of single flood events.

This can help to reconstruct the influence of past climate changes on the frequency of extreme floods in densely populated areas in Indonesia.