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Trace element analysis on speleothems using micro-XRF scanning

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Non-destructive micro-XRF scanning is a well-established, accurate and efficient method for high-resolution geochemical analyses on finely laminated sediments, e.g. for distinguishing detrital and authigenic layers in lake sediments. To test this method's applicability on speleothems, micro-XRF scanning analyses were performed on finely polished speleothems using the EAGLE-III-XL micro-XRF scanner at GFZ Potsdam. This scanner can perform multi-element analyses over a predefined sampling profile at sampling rates between 20 and 250 micro m trace of samples no larger than 30 x 30 cm. We measured profiles on two late to mid Holocene stalagmites from caves of the Keklik and Uluu Too mountains near Osh (Kyrgyzstan, Central Asia) with a spot size of 53 micro m. We ran each profile at least twice to obtain replicate measurements of the elements Mg, Al, Si, P, S, Cl, K, Ca, Ti, Mn, Fe, and Sr.
The caves are situated in Upper Devonian to Lower Carboniferous limestone formations at the SE rim of the Fergana Basin. Both speleothems are characterized by distinct alternating light and darker colored laminae that also reveal strong variations of trace elements and potentially provide information concerning variations in dust load, soil development, vegetation, precipitation and infiltration. One speleothem shows elevated Cl and S contents during relatively dry periods associated with salt dust input, probably derived from the Aral Sea region. Identification of the dry periods is further supported by stable oxygen and carbon isotope data. The multi-proxy chemical analyses suggest that Holocene humidity variations in this region are linked to variable strength of the North Atlantic westerlies regime. However, further validation of element variations in speleothems based on host rock and soil chemistry, monitored drip water composition and local climatic variations are needed to improve climatic and of environmental interpretations.