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Connecting scales of observation with rapid micro-XRF elemental characterization in the earth and environmental sciences

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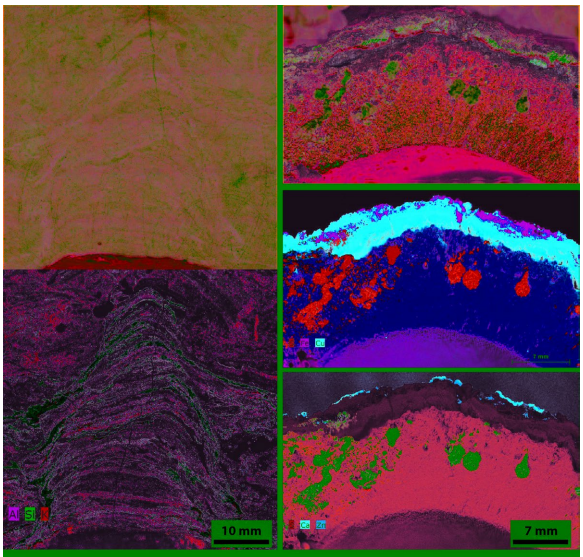

Figure 1: Elemental maps collected using Bruker's M4 TORNADO micro-XRF. ***Left:*** compositional map of non-carbonate components in a stromatolite from the 2.0 Ga Wooly Dolomite. ***Right:*** compositional map of a rough-cut cross-section through a "black smoker" hydrothermal vent.

Among the many challenges in modern geo- and environmental science research is bridging the gap between scales of observation. Advances in technology are driving an ability to obtain high-quality data from smaller and smaller samples with more detail, even down to atomic scales. This drives the critical need to obtain enhanced outcomes for sub-sample selections from micro- and nanoscale analytical techniques, making the most of time constraints and stretched research budgets.

Energy Dispersive Micro X-ray Fluorescence (ED-µXRF) is a technique that enables elemental characterization at ranges from hand sample to thin section effectively bridging micron and sub-micron scales of sampling and measurement. Beam sizes of less than 20 µm are enabled by polycapillary optics, thus minimizing the loss of brilliance caused by collimators. The ED-µXRF technique provides greater sensitivity for detection of trace elements than EDS analysis on scanning electron microscopes. In addition, excitation by primary X-rays allows access to higher energy X-ray lines consequently minimizing peak overlaps common in the low energy part of the X-ray spectrum. High-precision motorized stages on the µXRF allows rapid element mapping of minimally prepared solid samples ranging from rock slabs, thin sections or billets to particulates. The resulting data cube, where each pixel represents a complete energy dispersive spectrum, allows full interrogation of the resulting element maps and extraction of both qualitative and quantitative information at multiple scales.

We will present examples of solid earth material characterization using µXRF that demonstrate the utility of this technique in the analytical workflow, providing stand-alone rapid geochemical context and for further sub-sampling and analysis by other elemental and isotopic techniques.