Detail and context: using core-scale μXRF imaging to understand ore deposits

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Microanalysis is a powerful tool to understand mineral deposits, but studying rocks in detail does not always result in samples being representitive. We have developed a lab-scale micro X-ray fluorescence (μXRF) instrument to map trace element distributions in 50 cm lengths of drill core at a spatial resolution of 30 μm. This new instrument, the Maia Mapper, couples the Maia detector, commonly used on synchrotron X-ray fluorescence beamlines, with an ultra-bright Excillum X-ray source to produce ~12 megapixel images in 17 hours with ppm analytical sensitivity. The high X-ray flux and detection efficiency produces datasets that maintain the spatial context for detailed subsampling but that overlap in analytical and spatatial resolution with more typical microanaltyical techniques such as EDS or laser ablation.

Samples from a range of mineral deposit styles show some of the many uses for our unique datasets:

1) Multiple mineral and microstructural hosts for zinc in a polymetallic base metal deposit
2) Variability in trace element content in pyrite at the core-scale to target laser ablation subsamples
3) Location of rare phases (e.g. gold grains in 3 g/t ore samples)
4) Trace element distribution in altered pillow lavas

The datasets, complemented by the increasing range of core-scale analysis techniques and micro-to-nanoscale analyses for geological materials, promise to rapidly increase our understanding of mineralisation processes, deleterious element deportment and geometallurgical performance. Future developments aim to increase the spatial resolution to sub-10 μm and to develop textural analysis techniques that take advantage of these novel, spatially referenced multielement datasets.