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High-speed Micro-XRF Analysis of Rock Samples and Drill Cores

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Micro-X-ray fluorescence (micro-XRF) is a spatially-resolved variant of traditional X-ray fluorescence analysis (XRF). The micro-XRF analytical technique was first described more than 30 years ago [1] and with technological and computing developments over the past decade it is being utilized more frequently across a range of applications, especially in geo-analytical projects for which its capabilities are well-suited. The use of a focused X-ray beam, similar in principle to an electron beam but larger in diameter, allows studies of the compositional variations of inhomogeneous samples. Polycapillary lenses can yield spot sizes < 20 μm and thus the localized measurement position can be used for single point analysis, or in a scanning mode for line or area analysis. For the latter, the full energy intensity spectrum is saved for each measured location (pixel). This position-tagged style of spectroscopy then allows for the creation of element distribution maps, as well as for other complex post-processing procedures, including Automated Mineralogical (AMICS) analyses. Automated Mineralogy has been successfully used in the mining industry since the 1970s, however, it has mostly been based on electron beam (e-beam) systems (e.g. SEM-EDS). Nowadays, a micro-XRF system can be operated using similar parameters as an e-beam system, and thus yield results compatible with traditional Automated Mineralogical analysis, but on samples or scales that would not normally be possible with a SEM.

Based on the aforementioned capabilities, it is important to assess the speed and information performance of micro-XRF, especially as applied to drill core and rock samples, as such information is important in brownfields and greenfields exploration projects to enable an initial understanding of potential mineral processing requirements. Figure 1 is an example of the information obtainable from a single analysis of multiple cores. In the first example seven ¼ cores were laid horizontally in the micro-XRF M4 TORNADO and a 10 cm section scanned across all of them. The information obtained from a single analysis includes the optical image, the total X-ray intensity image, individual (or overlaid) elemental maps, and ultimately, mineralogy. In addition, from these maps it is possible to determine "whole rock" compositions for each sample down to trace element levels, or if required, the composition of selected objects or minerals. Furthermore, depending on the level of information required it is possible to adjust the resolution and time per pixel to yield relevant results in a timeous manner, depending on the user requirements, i.e. commercial throughput or academic research. Understanding the advantages and limitations of changing these conditions is of importance. For example, the analyses of the drill cores in Figure 1 could be completed within 30 min (i.e. 4 min per sample) or analysed overnight. Similar examples will be shown for large rock hand-specimens and drill cores from an exotic Cu deposit in Chile and a Au-Co exploration project in Finland.

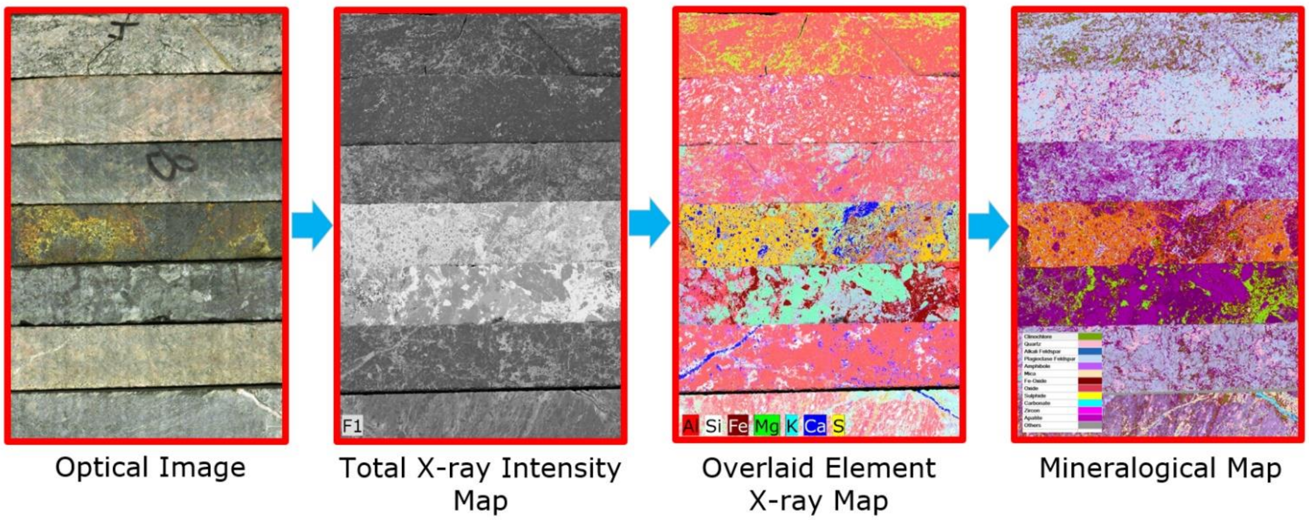

Figure 1. Micro-XRF (M4 TORNADO) analysis of 7 drill cores, showing the various datasets obtainable from a single analysis.

References:

[1] Rindby, A., Engström, P., Larsson, S., Stocklassa, B., Microbeam Technique for Energy-Dispersive X-ray Fluorescence, X-ray Spectrometry (18) 109-112 (1989)

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