Emphasizing the importance of the expert user and a case-specific mineral database in automated quantitative mineralogy techniques – An inter-lab comparative study using QEMSCAN

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With the development of QEM*SEM, the first automated scanning electron microscopy (ASEM) system, by CSIRO in the 1970s, mineral and texture quantification in the extraction industries was revolutionised. Since then, several systems have emerged (QEMSCAN, MLA, Mineralogic, TIMA, AMICS, INCA-mineral) that now find widespread application not only in the industry but also in science. The popularity of these systems is owed to their ability to rapidly and reliably quantify the mineralogy and textures in a variety of sample types including polished rock samples, thin sections and epoxy mounts of both whole and particulate samples. However, despite their apparent automatization, to guarantee high quality data and reliable results, a key role falls to the operator. It is through a mineral database that the raw data collected by EDS-detectors is converted into quantitative mineralogical data, and the database is adjusted by the operator on a case by case basis.

In this study we qualitatively compare analyses of the same sample at two different QEMSCAN labs, Camborne School of Mines (CSM) in the UK and Boliden AB in Sweden, to highlight differences in their approach towards analysis and set-up of the database, and the consequences this has for the results. Furthermore, through modification of the database used at Boliden AB, several methods of how the results can be influenced are demonstrated.

The selected sample is a polished thin section of mineralised vein from a drill core from the Liikavaara East Cu-(W-Au) deposit in northern Sweden. The sample contains massive pyrite and pyrrhotite associated with quartz, silicates, and fine-grained clusters of carbonates and Fe-oxides. Chalcopyrite fills cracks in pyrite. Some sphalerite and scheelite are observed as well as traces of cassiterite, molybdenite, and Au-, Ag-, Bi-, and Te-minerals.

Compared to the analysis at CSM, the analysis at Boliden AB showed an overestimation of the chalcopyrite content, limited differentiation of gangue phases, and problems with identification of phases at scan resolution (~5 µm). These differences could subsequently be reduced through
editing of the database.

Application of a software-tool called the ‘boundary-phase processor’ was used to correct erroneous mineral classifications resulting from mixed signals at grain boundaries, which had caused pyrite grains to show a false coating of chalcopyrite. Gangue phases were differentiated through subdivision of phase-categories, although for higher accuracy comparison with standards and fine-tuning of mineral-entries in the database would be necessary. Element-filters in the database allowed identification of phases of specific elements, e.g. Au, at or below scan resolution despite mixed signals with the surrounding phases.

While data from both analyses was generally similar, the inter-lab comparison clearly demonstrated that more detailed information could be attained with ASEM systems through optimisation of the database. In the mining industry, a loss in the level of detail is often accepted in favour of time spent on data processing. However, particularly the characterisation and quantification of complex ores and critical metals, which often occur only in traces and fine grain sizes in ore deposits, require a high level of detail to allow efficient processing of the ore.