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Why Automated Mineralogy needed an upgrade

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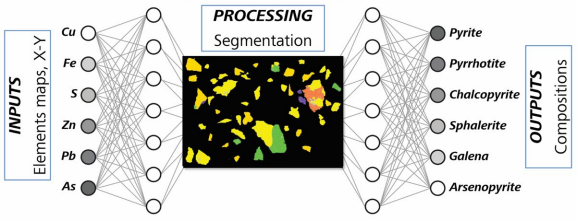

Automated Mineralogy – the past

The automated classification of mineral phases in rocks has been a mainstay of the Geoscience analytical community for over 40 years. The automated capabilities for the SEM have progressed and changed very little in decades.

The technology come with several significant problems moving forward, including excessive hardware-software dependencies, complex mineral libraries and classifications, inconsistent user experience, and difficult workflows outside their intended use.

Recent technological advances

There are two broad shifts that are taking place across a number of microscopy and microanalysis techniques – the acquisition of more quantitative data, and the application of deep learning neural networks (DLNN). As a general trend this can be thought of as building better, and bigger, datasets.

As an analytical technique EDS is commonly applied qualitatively, or as an image based method for distinguishing regions based on chemical maps. In recent years it has become easier than ever before to calibrate systems and detectors for concentration data, meaning the SEM can generate more robust datasets without having to fall back on other techniques.

Deep Learning is a topic that covers a broad range of mathematical applications across almost all sciences, from data acquisition to processing and interpretation. Whilst DLNN are inherently hard to track exactly how they operate, but at their best should be easy to use, and easy to understand how they've been applied to a scientific problem.

Automated Mineralogy – the future

The introduction of both quantitative mineral chemistry and DLNN to automated mineral classification is a huge leap forward, solving many of the problems of traditional software. Detaching data acquisition from processing removes software dependencies and frees users to build their ideal system. An DLNN-driven, unsupervised data processing approach can be data led rather than user led, making it more robust and consistent across instruments and facilities. Quantitative analysis can build on the DLNN approach by allowing a "best fit" classification, removing the need for constant modification of mineral libraries, and simply allowing "textbook" globally consistent mineral compositions to drive the labelling of segmented data.