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Pushing the boundaries of automated mineral analysis in 2D and 3D

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The phrase “automated mineralogy” has been synonymous with electron microscopy in the geosciences for decades. The technique has been at the core of process mineralogy and metallogeny analysis for understanding ore bodies. The use of energy dispersive spectroscopy (EDS) to rapidly map samples and identify phases of interest has gradually seen a shift out of its original industry applications and into the academic research environment. A major issue for academics wishing to take advantage of this powerful tool is the original platforms are rigid in terms of their industry designed outputs, and there has been a lack of development in both the software and hardware capable of providing automated outputs.

However, rather than just looking backwards at what automated mineralogy was originally designed for, there is a more forward looking and important conversation as geoscience projects increase in scope. To think about geoscience in the context of topics such as big data, statistical relevance, and the use of increasingly prevalent machine learning techniques, we need to think about how we collect and store data. This naturally requires a greater integration of the problems geoscientists are trying to address with the solutions that microscopy and microanalysis equipment suppliers provide. Greater access to the data acquired on scientific equipment not only provides greater research flexibility but opens much smarter routes towards a future of correlated datasets with minimal user input.

Here we show the two biggest shifts in automated mineralogy in both 2D and 3D [1] with AI integrated analytical routines. For SEM-based automated mineralogy data much be capable of integrating with geoscience specific tools used by the community. One example is placing large area mapping by quantitative EDS straight into community-driven, 3rd party software such as XMapTools for mineral formula calculations and thermobarometry. For the first time we can now use quantitative µCT on lab-based X-ray instruments to identify mineralogy straight from 3D data with no need to ground truth with chemical methods. This paves the way for true mineral liberation analysis in 3D for routine workflows such as process mineralogy (Figure 1).

