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Correlated Raman and SEM Measurements of Mineral Sections

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Modern laboratories often have a range of different microscopes such as optical, fluorescence, confocal, scanning electron, infra-red and Raman. These, often complementary, imaging techniques are often used in isolation but, by combining the power of these techniques, more information, and a better interpretation of the sample, can be obtained. We have used correlated Raman and SEM analysis to investigate the composition of mineral samples. The combined results reveal more details on the minerals than the individual techniques provide alone. SEMs provide highly detailed, magnified images and information about the surface composition of the samples including elemental concentrations. Raman microscopy, with a spatial resolution of typically 1 μm or less, provides chemical and structural information of each mineral.

The correlation is achieved by calibrating and transforming coordinates between Raman and SEM systems and using an image overlay tool. Measurements were automated in the Raman system to analyse all positions of interest without any intervention.

We illustrate the power of this technique with data that includes analysis of a mineral section containing a dissolution layer. Backscattered SEM images of the mineral section were initially obtained, showing contrast based on atomic number. The same areas were then located and analysed in a Raman microscope. Minerals were identified from the Raman analysis and images of their distributions were generated. These images were overlaid with the SEM images to complement the information from the two techniques.

The correlated results showed that, for example, areas of apatite in the Raman images correlated to both bright and dark areas in the SEM image. This may be indicative of apatite with heavier or lighter endmembers. A larger scale white light image was also acquired, to understand the SEM and Raman results in the context of the visible structure of the mineral section. Compositional differences were observed between the bulk and the dissolution layer in the sample, with more calcite observed in the bulk and more quartz and carbon observed in the dissolution layer.