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Hyperspectral Imaging for Lithium Exploration and Mining

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Raw materials from geogenic resources are essential to enable the global shift to renewable energy sources. The global demand for raw materials is, therefore, being intensified. Electrification is an example of this and represents a key part of the energy transition through the decarbonization of the transportation sector. For this purpose, lithium is a critical metal due to its supply risk. However, significant hard rock lithium resources are found worldwide. The higher energy consumption for the extraction and concentration of lithium minerals from hard rock ores requires a thorough understanding of the mineralogical variability. This knowledge can be used for the selection of new technologies for pre-concentration.

Hyperspectral imaging has proven an excellent tool for providing quantitative data on mineralogy and microfabric attributes at a high spatial resolution in a fast, non-destructive and reproducible manner. Most lithium minerals have diagnostic signatures in either the short-wave infrared (SWIR) or long-wave infrared (LWIR) regions of the electromagnetic spectrum making their direct identification possible using hyperspectral imaging techniques. Zinnwaldite is an example of a lithium-bearing mineral present in high contents in the transitional Cínovec-Zinnwald deposit marked by the occurrence of numerous Li (Sn-W) bearing greisen bodies. Although the greisen bodies are mostly oriented sub-horizontally to the contact between the Cínovec-Zinnwald granite stock and its volcanic host rocks, they are irregularly intercalated with albite-granite, which is always Li- and generally Sn-poor. Large scale exploitation of the greisen will thus lead to variable amounts of dilution by albite granite. The fusion of hyperspectral drill-core imaging, automated mineralogy and geochemical data enabled the calibration of lithium grade at high resolution, allowing for the mapping of centimeter thick greisen layers which could be separated from the albite-granite using optical sorting with SWIR sensors.