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Hyperspectral remote sensing for mineral mapping of structural related mineralizations around Mount Isa, Queensland, Australia

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Alone or combined with other remote sensing data, hyperspectral mineral mapping can be used to investigate mineralizations and deposits via alteration minerals. Their kind, abundance and spatial distribution can deliver important statements about the occurrence and formation of mineralizations and their relation to structural features. The high spectral and spatial resolution of HyMap data exceeds multispectral data distinctly and makes the recognition of even smaller geological structures possible. The spectral unmixing of single endmembers can be used for the accurate mapping of specific materials or minerals. The support of hyperspectral imaging by spectral data gathered in the field and the analysis of the composition of rock samples can help to determine endmembers and to identify absorption features.

This study demonstrates the possibilities and limitations of remote sensing, especially hyperspectral data, for mineral mapping purposes, using the example of the Mount Isa Inlier. This geological area is situated in Northern Queensland, Australia, and is known for its considerable ore deposits and consequent mining of predominantly copper, zinc, lead, silver and gold. Beside hyperspectral HyMap data, multispectral Landsat 8 and SRTM digital elevation data were analyzed. A three-week field study in 2014 supported the investigations.

After preprocessing and vegetation masking the data were analyzed using Spectral Feature Fitting (SFF) and Mixture Tuned Matched Filtering (MTMF) for alteration mineral mapping. The outcomes were combined with results from decorrelation stretch, band ratioing, topographic indices and automated lineament analysis. Additional information was provided by field spectrometer measurements and the XRF and XRD analysis of rock samples.

Throughout the study, mineral mapping using remote sensing data, especially hyperspectral data, turned out to deliver high qualitative results when it is supported by additional information. In situ investigation of the observed mineralizations for validation is important and can deliver such data, for instance by the investigation of rock samples or spectral measurements. Since mineralizations and alterations are often related to structures, their analysis and consideration can provide crucial hints.

The most significant result throughout the study was the determination of a new site of gossanous, silicified ridges south of the Mount Isa mining complex. Their occurrence was validated through fieldwork observations including rock sampling and spectral measurements. The gathered information additionally supported the accurate mapping of those ridges using HyMap data, which confirmed the connection between the north-south trending ridges and the Mount Isa mine deposits. The observed ridges coincide compositionally and spectrally with the outcrops of mineralized parts of the Urquhart Shale, which form the mined Pb-Zn-Ag deposits and are probably related to structures. In samples of the new site, amounts of Pb, Zn, Ag and other metals could be detected. Contrary to the mineralized outcrops of the Urquhart Shale deposits, those ridges occur outside of the common host rock and are not mentioned as mineralizations in any available map or publication.