Hyperspectral analysis of drillcores from Kedonojankulma Cu-Au deposit

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Introduction

Hyperspectral analysis of drillcores involves measuring and studying of electromagnetic radiation reflected or emitted from a target at varying visible to infrared wavelengths. The variety of absorption processes and their wavelength dependence allows us to get information about the mineral composition of samples. The wavelength areas relevant to hyperspectral mapping of minerals are:

- In visible and near infrared (VNIR) 400 - 1000 nm (electronic processes): Ferric and ferrous oxides and REEs
- In shortwave infrared (SWIR) 1100 – 2500 nm (vibrational processes): OH-bearing minerals i.e. clays, micas, chlorites, talc, epidote and amphiboles, sulphates and carbonates
- In thermal infrared (TIR) 8000 – 12000 nm: quartz, K-feldspar, garnet, pyroxenes and oxides

Instruments

SisuROCK, the hyperspectral imaging instrument developed by Specim, is a fully automated equipment for the high speed scanning of drill cores. Depending on application, SisuROCK contains one or more of the following spectral imaging modes: VNIR (400 – 1000 nm), SWIR (970 – 2500 nm), combined VNIR+SWIR (380 – 2500 nm), TIR (8 – 12 µm) and high resolution RGB camera. SisuROCK collect spectral and spatial information about the drill cores as the core box is automatically moved through the system.

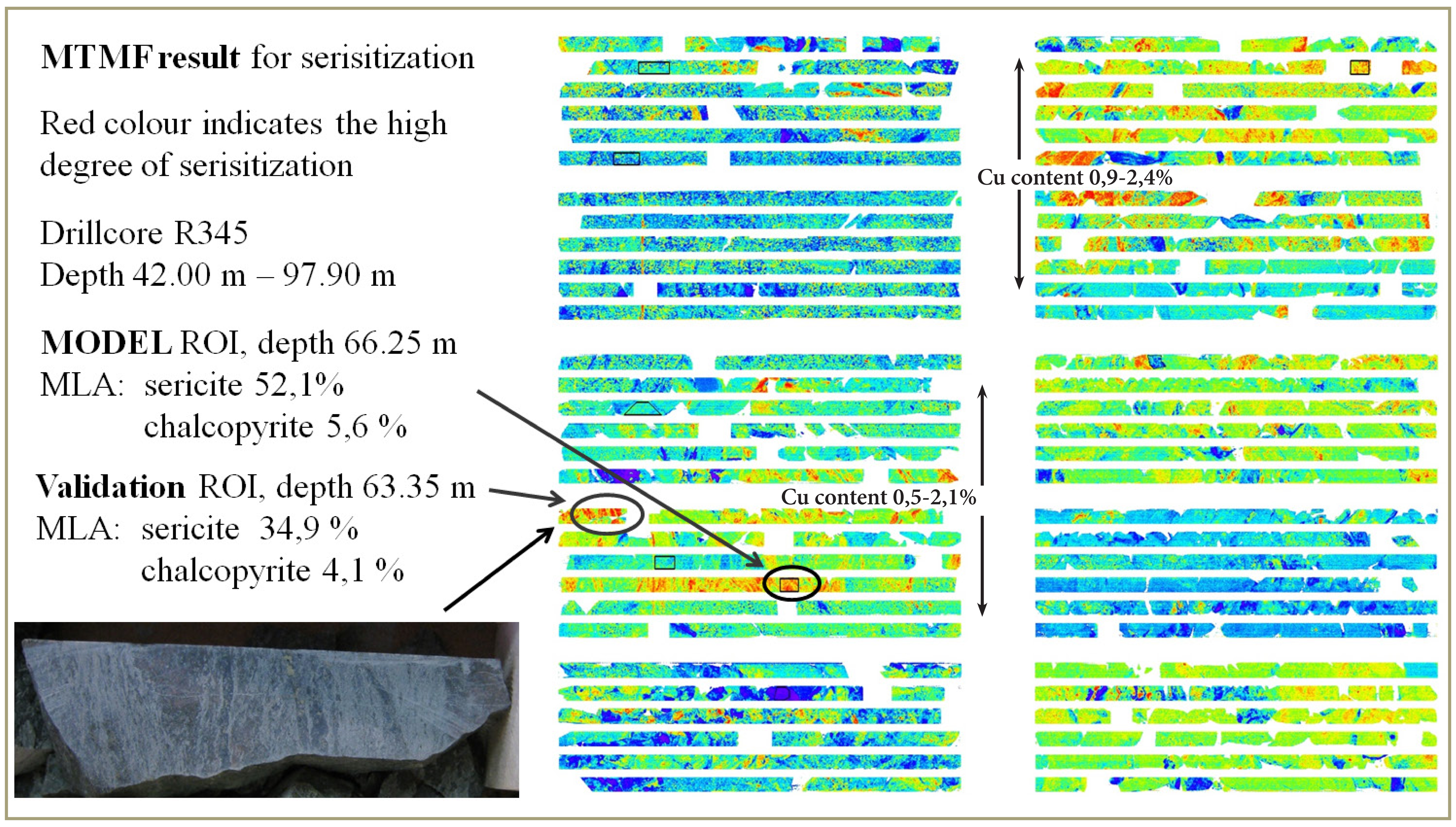
FieldSpecFR portable spectroradiometer is instrument which rapidly measures single spectra via its fiber optic cable input in spectral range 350 – 2500 nm.

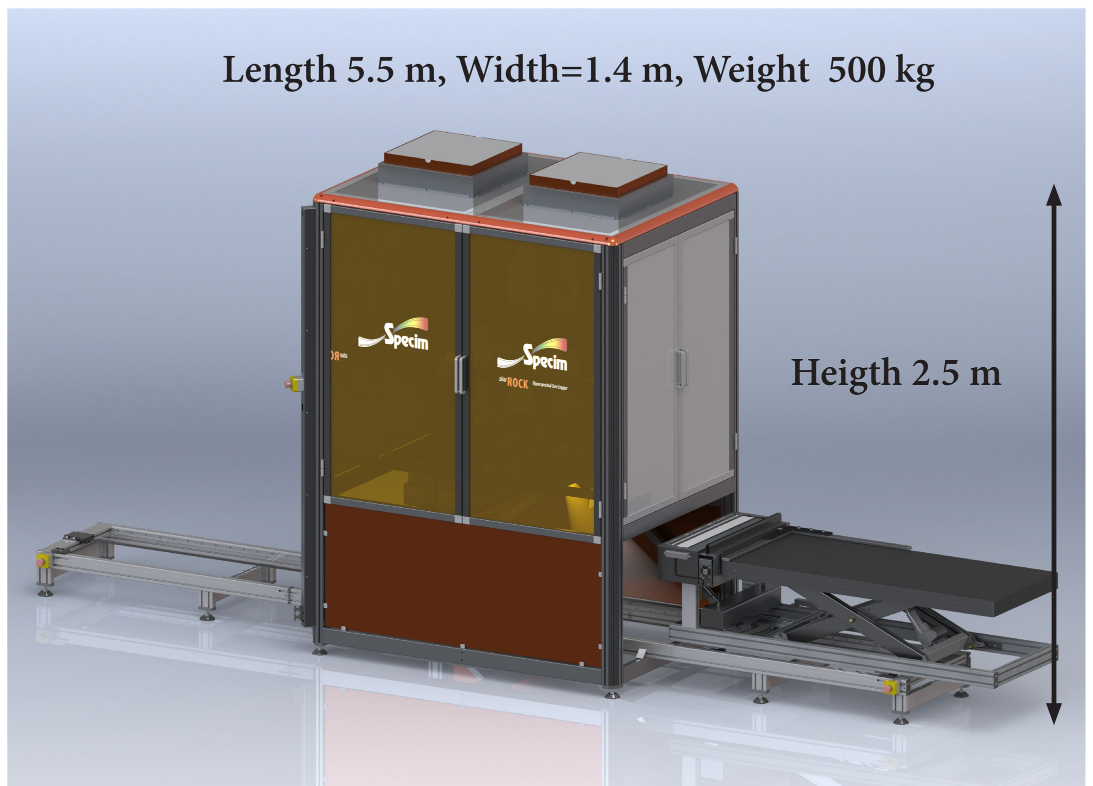
Interpretation of the SisuROCK and FieldSpec data

By using so-called unmixing methods it's possible to determine the relative abundances of different materials in the measured spectrum. If not all end members (materials) are known or if we want to map a few endmembers we can use the so-called partial unmixing methods like Matched filtering (MT) and Mixture Turned Matched Filtering (MTMF).

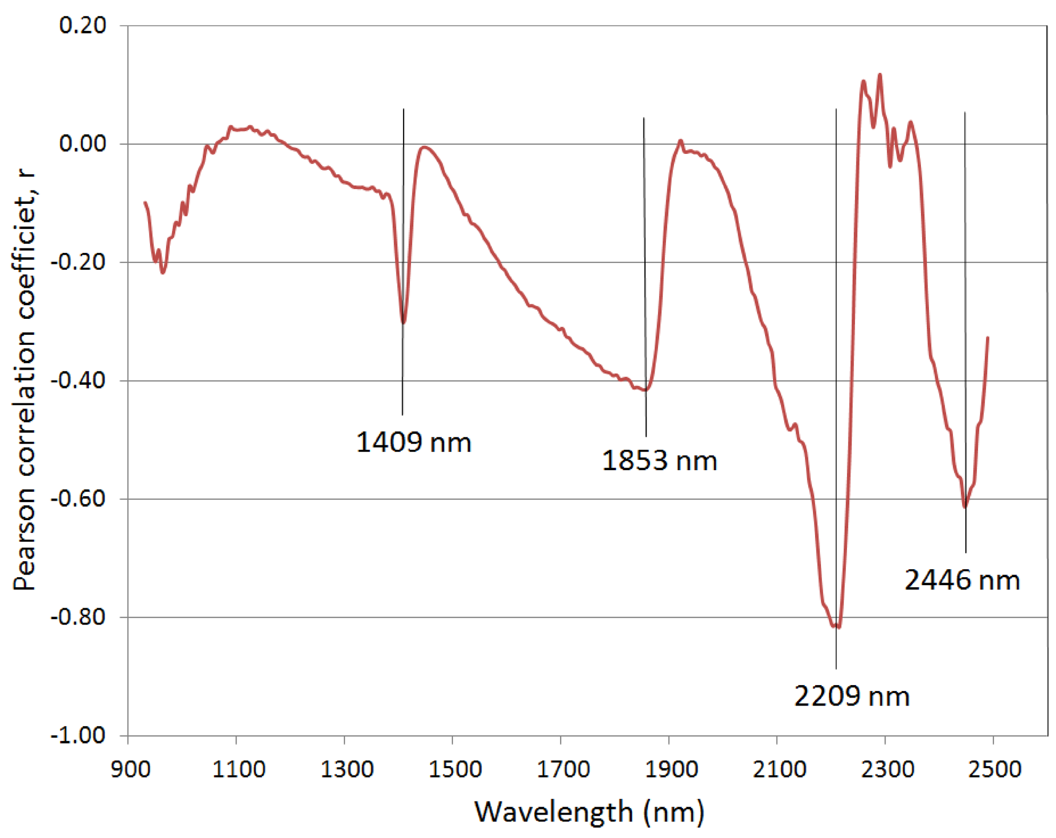
User-defined endmember spectra in the interpretation of SisuROCK data were collected from the mean spectra of model samples chosen by the exploration geologist. The results estimate the relative degree of match to the reference spectrum and approximate subpixel abundance. The mineral composition of the chosen model samples (endmembers) were also determined by MLA (Mineral Liberation Analysis).

The relative abundances of alteration minerals were interpreted from SisuROCK data by MTMF, the values of which highly correlate with the MLA result. Serizitization show up correlating with the increased copper content. Chlorite and carbonate minerals show up promptly and quartz probably due to its characteristic inclusions.

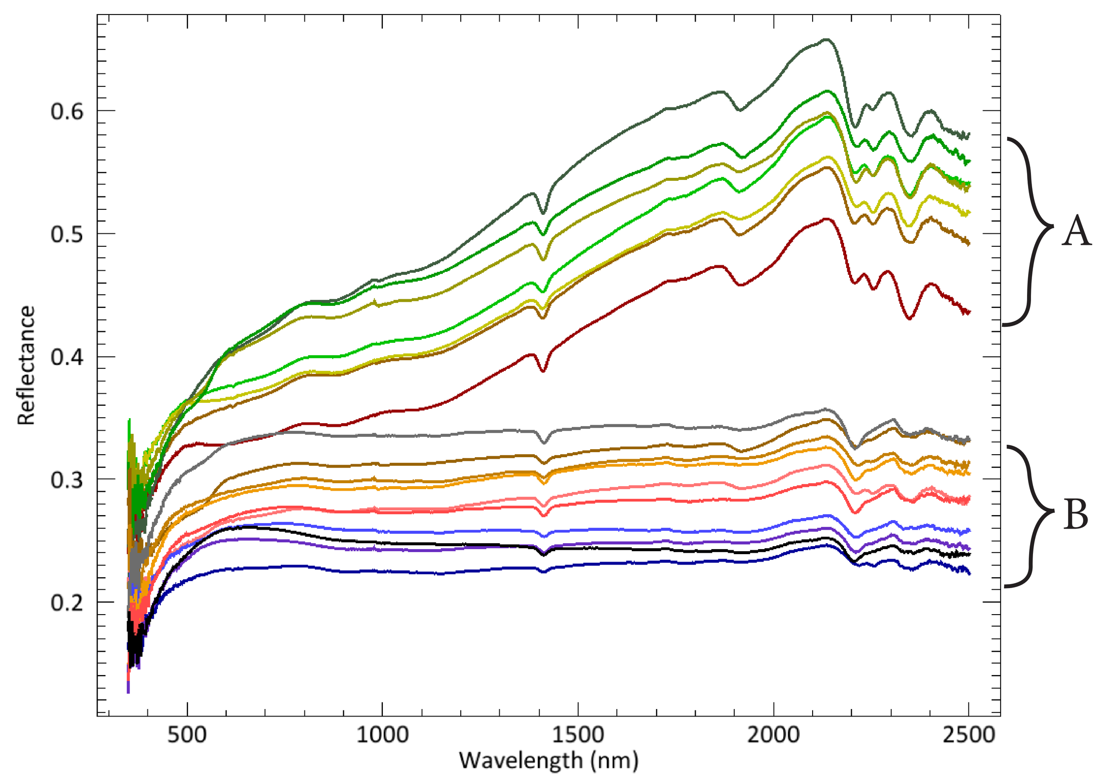




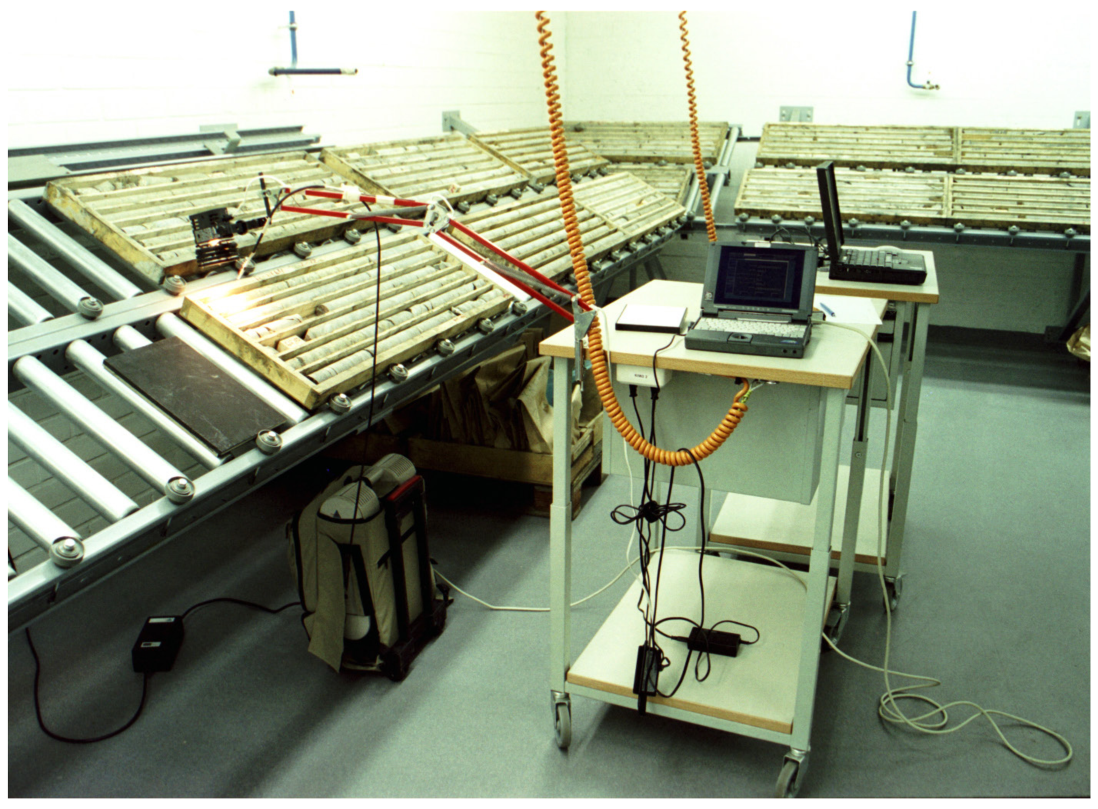
SisuROCK Hyperspectral Core Logger.



The correlation (as a function of wavelength) between determined sericite content by MLA and continuum-removed (normalized) reflectance spectra of SisuROCK data. Note the high correlations in 2209 nm (r = - 0.81) and 2446 nm (r = - 0.61).



The FieldSpec reflectance spectra of the powders (one meter samples) of the drillcore R345 showed also clear differences between host rocks and altered rocks.
A = unaltered or weakly altered rocks
B = sericitized rocks with elevated Cu content (>0.5%)



FieldSpec working in the drillcore store.

Conclusions

The results showed that it is possible to recognize between several mineralogical features, which are crucial for the evaluation or the mineral potential:

- The unaltered rocks can be separated from the altered ones.
- Serisitization show up and it correlates with the increased copper content.
- Chloritization and carbonatization are clearly indicated.
- Abundant quartz is indicated clearly, probably due to inclusions. However, the classification of silicification types needs further studies, preferably using the SisuROCK thermal infrared option.

References

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