MACHINE-LEARNING CLASSIFICATION OF PROXIMAL CONVENTIONAL AND HYPER-SPECTRAL IMAGERY

Agustin Lobo[1], Emma Garcia[2], Gisela Barroso[3], David Martí[2], Jose-Luis Fernandez-Turiel[1], Jordi Ibáñez[1]*

[1]Geosciences Barcelona GEO3BCN-CSIC, Spain.
[2]Lithica (SCCL), Spain.
[3]Ms. Sc. program on Remote Sensing and GIS, Universitat Autònoma de Barcelona, Spain.

*Agustin.Lobo@geo3bcn.csic.es

ABSTRACT

We have assessed the feasibility of delineating and identifying mineral ores from images of mine excavation faces, taking samples from a gallery mine in Sn – W *pegmatitic vein* deposits for a case of study. This study consisted on:

1. Analysis of laboratory hyper-spectral images (450 – 1780 nm) of the different minerals of interest from samples collected in the mine to evaluate spectral separability and machine-learning classification under close-to-optimal conditions.
2. Analysis and spectral classification of a hyper-spectral image (950 – 1780 nm) of a panel of samples in the vertical position, acquired under room conditions from a distance of 2.5 m, as a previous test of (i) the deployment of the hyper-spectral equipment in the mine and (ii) the analysis of images acquired in sub-optimal conditions, closer to those expected to be present in gallery mines.
3. Automatic segmentation of conventional digital photos of the mine excavation front to delineate patches of mineral ores and estimate ore grade.

The analysis of laboratory hyper-spectral images indicated that all spectral signatures are statistically separable although care has to be taken with quartz forms including numerous impurities. Classification (Linear Discriminant Analysis, Singular Vector Machines and Random Forest) of laboratory spectra had a very high accuracy rate (up to 98%). In the case of the panel, classification accuracy was highest using Random Forests (93.2%). Segmentation of a conventional image of the mine excavation face successfully delimited ore patches and provided area measurements, thus facilitating area-based ore grade estimates. Our results show the interest and feasibility of the combined use of conventional and hyper-spectral imagery to assess and map mineral ores in mine excavation faces objectively.