XRF Spectroscopy in Analytical Multi-sensor Drill Core-scanning: Evaluating the potential of Qualitative and Quantitative Analysis for Aguas Teñidas, Magdalena, Sotiel and Majada deposits, Iberian Pyrite Belt, Spain (Université de Liège)

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Summary:

During exploration of mineral resources, extensive drilling campaigns are conducted involving a considerable amount of expenses and time. Drill core logging is then carried out by geologists to evaluate the resource. However, this methodology is often subjective, non-standardized and time-consuming. As novel sensors are released into the market, automated logging technologies are set to solve this constraint by developing drill core scanning prototypes.

This master thesis is part of ANCORELOG project (Analytical Core Logger); EIT Raw Materials supported project that aims to develop and commercialize a multi-sensor automated drill core logging system with state-of-art technology. ANCORELOG have, so far, successfully implemented Short-Wave Infrared (SWIR) camera for supervised classification of drillcore segments into geological domains using machine learning algorithms. However, the integration of new sensors to the system such as XRF, RAMAN or LIBS will enhance the capability of ANCORELOG by providing real-time qualitative and quantitative elemental analysis.

This study focuses mainly on the spectral analysis and calibration of the X-Ray Fluorescence (XRF) sensor for evaluating the potential of qualitative and quantitative elemental analysis of drillcore samples from Iberian Pyrite Belt (IPB), Spain, where the Aguas Teñidas, Magdalena and Sotiel mines of Cu-Pb-Zn are explored by Minas de Aguas Teñidas S.A. (MATSA).

The raw XRF spectra generated were analyzed and processed with the combined use of classical visual interpretation and algorithms to estimate and remove background noise as well as Gaussian method for peak-fitting. The resulting spectra showed well defined peaks that were assigned to their respective elements. Therefore, the study showed that the ANCORELOG mounted XRF sensor was successful in identifying all elements within the sensor detection limit range.

Furthermore, attempt was made to provide a means of calibrating the sensor in order to convert the measured fluorescent x-ray intensity to the actual chemical composition of the sample. Linear-regression models have shown sufficient predictive power.

The generated XRF spectra were only effective in identifying and semi-quantitatively determining sample compositions but was also able to discriminate between rock types (both mineralized and barren) with good level of accuracy with the aid of machine learning (supervised) algorithms.