Combined mineralogy and chemistry on drill cores: challenging for on-line-real-time analyses

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Abstract. In order to evaluate the instrumental parameters for the combined on-line-on-mine-real-time expert system SOLSA (http://www.solsa-mining.eu), portable and laboratory analyses were carried out on coarse granite, sandstone, serpentinized harzburgite and siliceous breccia. Each sample was studied at 5 different surface roughnesses (sonic or diamond drilled, cut, polished at 6 μm and 0.25 μm, sample powders). X-ray diffraction (XRD), portable Infra-Red (pIR) and X-ray-fluorescence (pXRF), and laboratory micro-Raman spectroscopy gave complementary and corroborating results. No major effect on the analyses was noted for the selected surface states. pXRF gave variable results except for the homogeneously serpentinized harzburgite, related to coarse or contrasting grain sizes or pores, small spot size (8 mm) and needs close-to-surface analyses. Portable IR (spot size 1.76 cm^2) is carried out close to surfaces while Raman spectroscopy (1-2 μm) is performed at distance. Sampling strategies have to be defined for each lithology. Major challenges for a combined on-line analysis are to adapt the specificities of the techniques to (1) analyse similar surface areas (from ~2 cm^2 (pIR) to < μm (Raman)), (2) smartly combine all the techniques into a single instrument, and (3) develop appropriate databases to reach a reliable "real-time" outcome results, which can be used for more precise geomodeling, and to rapidly define exploration and beneficiation parameters.

1 Introduction

Combined mineralogical and chemical analyses on drill cores are highly demanded by mining and metallurgical companies to speed up exploration, mining and define geometallurgical parameters for beneficiation. At present, analyses are done by exploiting only a single technique, such as hyperspectral imaging, XRF or LIBS. The coupling of different analytical instruments is still a technological challenge. The SOLSA project, sponsored by the EU-H2020 Raw Material program, targets to construct an expert system coupling sonic drilling with XRF, XRD, hyperspectral imaging and Raman spectroscopy. In order to define optimal instrumental parameters for combined on-line-real-time-on-mine analyses, we probed sonic and diamond drill core materials from sedimentary, magmatic and hydrothermally altered rock as well as sample powders (Fig. 1 a-e) by a cross-method approach.