Investigating critical metals Ge and Ga in complex sulphide mineral assemblages using LIBS mapping

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LIBS mapping is a powerful tool for visualizing chemical heterogeneity of geological materials [1, 2 and references therein]. Fast data acquisition, minimal sample preparation, multi-elemental detection and high dynamic range are key advantages of LIBS compared to other techniques. In this contribution we show that LIBS maps can provide geologists and engineers with a wealth of information including identification, characterization and quantitation of the different mineral phases, and detection of trace-elements together with their distribution within their host minerals [e.g., 3].

Several ore samples from Kipushi mine, DRC, were selected from the university collection. These ores are known for their mineral complexity and economic value as they contain critical metals such as Ge and Ga.

Analyzing colocalisation of major elements in the extracted LIBS maps allowed the reconstruction of the mineralogy. Detected minerals include chalcopyrite [$CuFeS_2$], bornite [Cu_5FeS_4], chalcocite [Cu_2S], sphalerite [ZnS], galena [PbS], tennantite-(Zn) [$Cu_6(Cu_4Zn_2)As_4S_{12}S$], germanite [$Cu_{13}Fe_2Ge_2S_{16}$], renierite [$(Cu^{1+},Zn)_{11}Fe_4(Ge^{4+},As^{5+})_2S_{16}$], tungstenite [$WS_2$], betekhtinite [$Pb_2(Cu,Fe)_{22\text{-}24}S_{15}$] and a series of non-sulphide gangue minerals. SEM-EDS analyses are planned to check this LIBS-derived mineralogy. Relative abundance and grain size of the different minerals can be easily evaluated by image analysis of the LIBS maps. These minerals are preferential hosts for trace-elements Ga and Ag, with Ga being preferentially enriched in chalcopyrite and, to a lesser extent, in renierite, and Ag occurring within bornite and tennantite, with some migration in fractures affecting other sulphides.

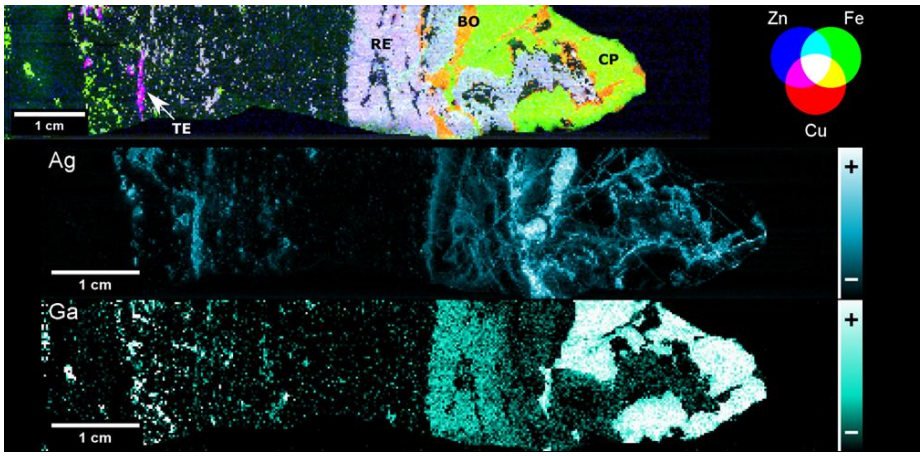

Fig. 1. LIBS maps of a sulphide ore from Kipushi Mine, Democratic Republic of Congo. Upper : RGB composite map for Zn, Fe and Cu. Middle : silver map. Lower : gallium map. BO : bornite, CP : chalcopyrite, RE : renierite, TE : tennantite-(Zn)

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