Multidisciplinary characterisation of heterogenite – oxidized cobalt ore deposits (Katanga Province, Democratic Republic of Congo)

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The Lufilian fold-and-thrust belt (Katanga Province, Democratic Republic of Congo) is estimated to hold between a third and half of the world's known cobalt reserves. This non-renewable resource is mainly extracted as secondary ore deposits, the heterogenite (CoO.OH) resulting from the oxidation of Cobalt sulphide primary bodies.

The characterisation of ore materials requires identifying the mineralogical assemblages, to classify the textural and structural features and to analyze the precise chemical composition of the various mineral phases. Such characterisation of heterogenite ore material was conducted in the frame of the activities of the **GECO** research centre ("Geology for an ECOnomic sustainable development") funded by the Belgian Federal Foreign Affairs Ministry and also during the **TRACE** project ("TRACeability of hEterogenite") financed by the Belgian Federal Science Policy Ministry. Heterogenite samples from the collections of the Royal Museum for Central Africa and from the Royal Belgian Institute for Natural Sciences were studied using microprobe and EDS instruments, Raman microspectrometer and EBSD textural tool. This study was completed by traditional optical microscope and SEM observations, as well as macroscopic examination and classification of samples. The bulk of the Lufilian arc is covered by around 100 samples from 16 different mining sites.

The results of the analyses were gathered into an internet-oriented database accessible through the following address: www.gecoproject.org/trace . Amongst the observations one can point out the significance of chemical substitutions in the heterogenite phase, which contents with various amounts of Cu, Al, Ni, Fe and Mn. Copper represents the main substituting element in the majority of studied sites with concentration up to 14 wt% (CuO). The presence of significant amount of Ni was also recorded in the Likasi area (<6 wt% of NiO) and in the Shinkolobwe mine (between 7 and 13wt%). Heterogenite from other sites seem devoid of significant amount of Ni.

A significant additional work was also conducted on heterogenite samples using Raman microspectrometry. This research aims firstly to clarify the correct Raman signature of heterogenite and secondly, to correlate its spectrometric response with the chemical composition. Results show a clear relationship between the recorded Raman spectra and the substitution degree of cations (Cu, Fe, Mn, Al) replacing Co in the heterogenite structure. In parallel, the Raman spectrometry offers the advantage to work on raw samples that is to conduct measurements on ore fragments without any preparation work. The combination of tests on raw samples and the correlation between Raman response and chemistry represents an effective tool for a rapid evaluation of ore batches or mine site evaluation. This methodology was tested for several mines and shows the high-level of chemical variability that can be found within a single site.

The results of our researches provide a first global overview of the chemical composition and variability of heterogenite through the Lufilian fold-and-thrust belt. This study should be completed in the future with a geostatistical representative sampling and by taking into account the architecture of ore bodies.