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Heterogenite vs asbolane: a mineralogical study of cobalt oxides from the DRC (Democratic Republic of the Congo)

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The largest cobalt ore reserves are located in DRC, the Democratic Republic of Congo. Most of cobalt is observed as black cobaltic oxide minerals: heterogenite [$HCoO_2$] and asbolane [(Ni,Co)2-xMn(O,OH)4.nH2O] which are hardly differentiable since they exhibit similar macroscopic habit and textures. These minerals are frequently observed in similar environment (oxidized horizon of ore deposits) and they are commonly poorly-crystallized limiting their study with XRD. Their chemical composition is also not very well-constrained since they exhibit significant chemical substitutions with cations as Cu, Co, Ni, Mn.

Our observations on a set of heterogenite and asbolane samples from DRC combined with samples from other localities shows that each phase, even under an amorphous form, can be readily distinguished by Raman microspectrometry. This technique is therefore attractive during ore deposit characterization campaigns or during the follow-up extraction operations where it is important to distinguish the main constituting Co-phase(s). The main advantage of this technique is its speed since no sample preparation is required during the collection Raman spectra that usually last few tens of seconds. The method provides information at a μm-scale and several points are thus required to fully characterize ore batches composed of different mineralogical phases.

Our petrographical observations show also that asbolane and heterogenite mineralogical phases can coexist at a μm-scale as two distinct phases into 'heterogenite' ore.

The distinction between heterogenite and asbolane from our sample set can also be conducted on a chemical base showing that heterogenite represents the richer Co-phase with variable Cu concentrations. By contrast, only Mn traces are usually observed in heterogenite minerals from DRC except in few samples, but always in lower concentration than in asbolane. The latter shows variable Mn/(Mn+Co) ratio between 0.85 and 0.3 and the decrease of this value is related to enrichment into Cu.

Figure 1. Example of coexisting heterogenite (Het) and asbolane (Asb), with their respective EDS spectrum.[1]

0.0.1 [1]**Vanbrabant, Y., Burlet, C. and Louis, P., Mineralogical Characterization of Cobaltic Oxides from the Democratic Republic of Congo, in Ni-Co 2013, John Wiley & Sons, Inc., Hoboken, NJ, USA., Pages: 241–254, 2013**