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Cobalt deportment and supply potential from ore and mine waste of volcanogenic massive sulfide deposits in Europe

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Cobalt is an essential raw material for lithium-ion batteries used in electric vehicles (EVs). Europe aims to become the world leader in battery production while also developing its own integrated value chain for EVs including mine production. However, European mine production of cobalt, accounted for only 1% of the global total in 2019 [1]. There are at least 193 abandoned mines across Europe that are known to contain cobalt [2], showing that historic mine sites can be a potential new source for cobalt exploration in Europe.

In this study, samples from the historic Cu-Zn mine in Løkken, Norway have been analysed to investigate the potential recovery of cobalt from the remaining ore and mine waste. The volcanogenic massive sulfide deposit has a cobalt grade of 0.07%, but it was never extracted during 300 years of intermittent mining history and may reside in mine waste. Whole rock geochemistry, scanning electron microscopy and electron microprobe analysis have been conducted to study the cobalt deportment, including the potential recovery of other metals (e.g. silver and gold), and to identify any deleterious elements such as arsenic, that may have a negative impact on the feasibility of reprocessing these materials. The results are compared with samples from a historic copper mine of the same deposit type in Cyprus (Skouriotissa) to identify common features of cobalt deportment in such deposits. Preliminary results from Løkken show that cobalt is dominantly hosted in pyrite and X-ray maps illustrate that it is particularly enriched in certain pyrite growth zones (Figure 1). Arsenic is also dominantly hosted in pyrite and could make metallurgical processing more difficult. However, discrete silver phases have also been identified in the ore and co-recovery of silver could make reprocessing more profitable.

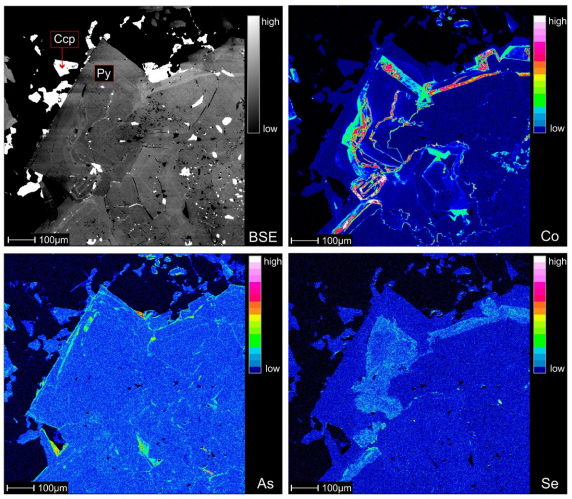

Figure 1. Backscattered image (BSE) and X-ray element maps of a sulfide sample from Løkken, Norway illustrating growth zones of various cobalt, arsenic and selenium concentrations. Py, pyrite; Ccp, chalcopyrite.

[1] Brown, Idoine, Wrighton, Raycraft, Hobbs, Shaw, Everett, Deady, Kresse (2021), World mineral production 2015-2019, British Geological Survey, Keyworth.

[2] Horn, Gunn, Petavratzi, Shaw, Eilu, Törmänen, Bjerkgård, Sandstad, Jonsson, Kountourelis (2021) *Ore Geology Reviews* 130, 103915.