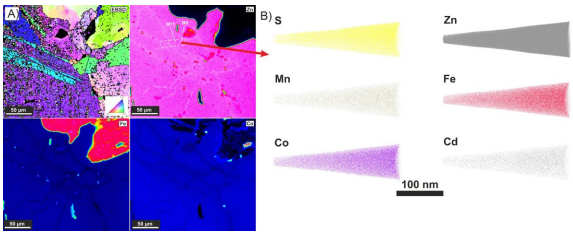
Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17903



Sphalerite as an unconventional cobalt source? Correlative microcopy and atom probe tomography of cobalt-rich sphalerite from the Dolostone Ore Formation deposit, Namibia

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We as geoscientists need to explore new sources of critical metals as demand is rapidly increasing due to their important application in green technology, such as the critical metal Co that is used in large capacity batteries for e.g. electric cars. The Central African Copperbelt (CACB) is currently responsible for the vast majority of global Co production and with such a dominant singular source of Co, additional new alternative sources should be pursued. Our study seeks to understand the occurrence and formation processes behind a new source of Co outside of the CACB. The sediment-hosted Dolostone Ore Formation (DOF) Cu-Co-Zn deposit (northwestern Namibia) is hosted in Neoproterozoic siliciclastics and carbonates that experienced low-grade metamorphism during the Damara orogeny.

Previously published laser ablation inductively coupled mass spectrometry (LA-ICP-MS) data of both sphalerite and pyrite showed Co concentrations above one wt% in both minerals [1]. Although Co-rich pyrite is not unheard of, such high concentrations in sphalerite are new. We combined LA-ICP-MS, electron probe micro analysis (EPMA), electron backscattered diffraction (EBSD), as well as atom probe tomography (APT), to better constrain the means of Co distribution within the DOF as well as the incorporation mechanisms of such high concentrations of Co into sphalerite. EPMA analyses revealed a micron-scale Zn-rich and Co- and Fe-poor network (Fig. 1A). This Co-poor network correlates well with sub-grain boundaries indicated by EBSD that are interpreted to have formed during late-stage metamorphism.

APT data reconstructions of the Co-rich sphalerite show homogenously distributed Co, suggesting that sphalerite can host up to 1.56 wt% (as demonstrated by LA-ICP-MS) Co by simple substitution with Zn rather than as concentrated nano-inclusions (Fig. 1B). Although linnaeite is the major Co-phase in the DOF deposit, this study demonstrated the importance of secondary minerals as possible sources of Co and suggests a focus shift from only considering primary Co-minerals in the pursuit of critical metals.

[1] Bertrandsson Erlandsson et al. (2022), *Journal of Geochemical Exploration 243*, 107105.