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Characterisation and Metallogenesis of Cobalt-bearing Mineralisation in the English Lake District

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Cobalt is a critical metal needed for the production of carbon-neutral technologies, particularly within electric vehicles as part of Co-Li batteries. The key issue society faces is that cobalt along with other designated Energy Critical Elements (ECE), are in short supply.

To successfully explore and develop new, economic grade cobalt deposits we must first understand the genesis of cobalt-bearing mineralisation in its varying styles. In support of this goal, the English Lake District, with numerous and varied Co-bearing occurrences, offers an excellent case study, within an easily accessible region, to build a generalized ore formation (i.e. metallogenetic) model.

The localities of Scar Crags, Dale Head North (DHN), Ulpha and Coniston within the Lake District have been investigated, confirming the presence of As-Co-Ni-bearing minerals at Scar Crags, DHN [1] and Ulpha. Thus far, it has been determined that ECE mineralisation at Scar Crags and DHN was derived from a mix of magmatic and convecting connate / meteoric fluids, with weaker presence of convected fluid at DHN [1]. Preliminary S isotope data indicates that the most likely source of ore metals for Scar Crags, DHN and Coniston is the underlying Skiddaw Slates, supported by existing literature [2]. Further analysis using EDS-SEM, LA-ICP-MS and stable isotopes is ongoing to completely characterise the ore assemblages at all four localities and develop ore emplacement / source models.

Alongside the detailed mineralogical characterisation at the aforementioned localities, a more regional scale study is being conducted, facilitated by the use of the G-BASE stream and soil geochemical database which will be used for two objectives: (1) narrow down areas where further As-Co-Cu-Fe-Ni ore mineralisation may exist across Cumbria; (2) identify regional-scale lithology based on stream geochemistry, providing regional host rock geochemistry to compare ore enrichment to.

By combining regional scale geochemistry and targeted, mineralogical characterisation studies a greater understanding of these ore-forming processes, fluids and sources can be developed. This has global applicability to exploration for cobalt-bearing ore in similar geological settings.

References:

[1] Solferino et al. (2021), *Mineralogical Magazine,* 85 (2), 197-214

[2] Lowry et al. (1991), *Journal of the Geological Society*, 148, 993-1004