Spatial and compositional effects of intersection zones in the five-element (Ni-Co-As-Bi-Ag) vein system of the Southern Arburèse district (SW Sardinia)

Scano I.*[1], Deidda M.L.[1], Fancello D.[1], Frau F.[1], Moroni M.[2] & Naitza S.[1]

[1] Dipartimento di Scienze Chimiche e Geologiche, Università di Cagliari. [2] Dipartimento di Scienze della Terra "A. Desio", Università di Milano.

Corresponding author e-mail: iscano91@gmail.com

Keywords: five-element veins, intersection zones, SW Sardinia.

The Arburèse district (SW Sardinia) is regarded as potential source of critical raw materials related to the large Montevecchio vein system, mined in the past for Pb and Zn ores. In the > 5 km-long, poorly exploited Southern branch of the system, the ores have been defined as five-element (Ni-Co-As-Bi-Ag) polymetallic veins (Moroni et al., 2019). They are hosted in late-Ordovician metasandstones and Silurian carbonaceous shales between two granitoid intrusions: the Arbus (304 Ma) and Mt. Linas (289 Ma) plutons. Investigations in the Perda S'Oliu, Sa Menga, Acqua Is Prunas and Pira Inferida old mines highlighted a pinch-and-swell attitude, with alternating ore shoots and low-mineralized zones. Prevalence of breccia/cockade textures and complex ore mineralogy indicate multiple hydrothermal mineralizing pulses, resulting in the overall mineral assemblages: i) native Bi; ii) Ni-Co arsenides/antimonides and sulfarsenides/sulfantimonides + quartz; iii) Zn, Pb, Cu, Bi sulfides and Cu-Ag-Sb sulfosalts + siderite; iv) quartz; v) pyrite and calcite. As noted in the recent literature on similar European ore deposits (Markl et al., 2016), mineralization processes were mainly controlled a) by redox environments, and b) by intersections with other mineral systems. Native Bi and arsenide precipitation occurred under rapidly evolving reducing conditions, favored by interaction of hydrothermal fluids with carbon-rich lithologies, well represented in Ordovician and Silurian host rocks. Moreover, field surveys in the studied localities pointed out that relevant ore shoots also correspond to intersection zones (IZs) with earlier hydrothermal systems related to the Monte Linas pluton (Deidda et al., 2021). Brecciated domains of IZs were critical both for fluid circulation and entrapment, but also for ore compositions. Indeed, the high-Bi contents of the five-element ore in the Pira Inferida mine are explained by intersection with a granite-related wolframite-quartz (Bi-Au-Te) vein system, from which abundant Bi (±Au) was remobilized. Similarly, in the Sa Menga mine, skarns and veins rich in Ni-Co-bearing arsenopyrite and Fe sulfides were As and metal sources for the cross-cutting five-element ore. In conclusion, where the low-temperature five-element system is close to the inferred contact with the Mt. Linas granite, or it crosscuts the related high-temperature hydrothermal systems selective leaching and reconcentration of Bi, As and other elements might have occurred. Sb abundance seems more related to host rocks chemistry, with increase of Ni-Co antimonides and sulfantimonides far from main IZs. Numerous, unexplored IZs may be assumed as a key targets for further mineral exploration in the Arburèse district, where undiscovered ore shoots may be present at depth.

Deidda M.L., Fancello D., Moroni M., Naitza S. & Scano I. (2021) - Spatial and metallogenic relationships between different hydrothermal vein systems in the Southern Arburèse district (SW Sardinia). Environ. Sci. Proc., 6, 13.

Markl G., Burisch M. & Neumann U. (2016) - Natural fracking and the genesis of five-element veins. Miner. Deposita, 51, 703-712.

Moroni M., Rossetti P., Naitza S., Magnani L., Ruggieri G., Aquino A., Tartarotti P., Franklin A., Ferrari E., Castelli D., Oggiano G. & Secchi F. (2019) - Factors Controlling Hydrothermal Nickel and Cobalt Mineralization - Some Suggestions from Historical Ore Deposits in Italy. Minerals, 9, 429.