

Metallogenesis in Sardinia: the Critical Raw Materials (CRM) perspective

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Critical Raw Materials (CRM) future supply is a matter of major concern for the EU, so that in several European old and mature districts new studies have begun to evaluate their potential in terms of CRM resources. Sardinia represents one of these areas: despite the technical exhaustion of its main districts the island still retains a metallogenic potential, not only as secondary resources (old mine wastes), but also as primary, still unexploited ores. A further increase in the list of the potentially economic orebodies comes from recent studies that have substantially improved the past knowledges of the Sardinian metallogenesis suggesting new exploration themes, particularly in the CRM's field. Sardinian mineral deposits include a large variety of types, resulting from a multi-stage metallogenesis that mirrors the complex geological history of the island. Since 1960's, ore geology studies recognized in Sardinia different metallogenic periods, from early Paleozoic to Quaternary. Periods of relative metallogenic stasis alternated with metallogenic peaks characterized by massive mobilization, migration and concentration of elements in the Sardinian crust. The main metallogenic peaks are related with: 1) large MVT deposits in Iglesias district (Cambrian: Pre-sardic phase peak); 2) a huge variety of late Variscan hydrothermal deposits hosted in the metamorphic basement or in granitoids (Carboniferous-Permian: Variscan peak); 3) porphyry to epithermal deposits related to the Cenozoic calcalkaline volcanism (Oligocene-Miocene: Cenozoic peak). From CRM's perspective, the hydrothermal deposits and occurrences related to the Variscan peak emerge now as the most promising in different districts. In detail, major themes of recent investigations include: a) the "five elements-type" veins of Southern Arburès district (SW Sardinia), hosting Ni-Co-Bi-Ag and REE minerals; b) the Mo-W-Sn (Re, In, Ga, Ge, REE) vein, greisen and skarn deposits related to ilmenite-series, F-bearing ferroan granites of southern Sardinia (Linis, Sulcis, Sarrabus); c) the structurally-controlled Au-W-Sb veins of eastern and northwestern Sardinia (Gerrei, Nurra), related to early Permian extensional tectonics; d) REE minerals in granite-related fluorite-barite vein deposits (southern Sardinia) and in shear zone-related skarns (central Sardinia). Interestingly, these latter may be a striking example of metallogenic inheritance, as a major source for REE in Sardinian crust has been identified in late Ordovician sedimentary sequences that host extended heavy mineral (zircon, rutile, monazite) paleoplacers. New evidences from eastern Sardinia basement suggest that this first important REE metallogenic event was highly remobilized during multiphase deformation and granite emplacement in Variscan times.