

The Atlantic Iberian and Macaronesian margins: A promising context in critical raw materials exploration

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The Atlantic Iberian margins and European Macaronesia (Canary, Madeira and Azores Archipelagos) cover a vast area in the NE Atlantic Ocean, comprising the seabed and subsoil of the juridical Continental Shelves of Spain and Portugal. Estuaries, seamounts, submarine banks, abyssal plains, spreading ridges, hot-spot volcanoes and undercurrent channels, are prominent geomorphic features in the studied area that have become an important target for minerals research and exploration, with the goal to determine their potential for future exploitation.

Based on extensive studies, carried out during the last four decades, which include swath bathymetry, backscatter, multi-channel and very high-resolution seismic reflection profiles, gravimetry, magnetism, heat flow probes, dredging and CTD stations, underwater photography and ROV surveys, several mineral occurrences and deposits have been discovered along the Atlantic Spanish and Portuguese continental margins and the Macaronesia Region. The European projects: EMODnet-Geology (<http://www.emodnet-geology.eu/>) and GeoERA-MINDeSEA (<http://geoera.eu/projects/mindesea/>) address mapping and integrative metallogenic studies of these seabed mineral deposits.

Placer deposits of chemically resistant and durable minerals have been discovered on shallow water favorable settings (<50 m water depth on estuaries, deltas and beaches) linked to the weathering of onshore lithologies and ore deposits from the Variscan Belt. Ilmenite and rutile concentrations on beaches and estuaries are abundant in the Algarve and Andalucía regions. In the West and North Portugal and Galicia Rias (Spain) accumulations of heavy minerals that include monazite, zircon, garnet, gold, cassiterite and magnetite have been discovered. Some eolian placers could be important in the East side of the Canary Islands, on seashores where the Sahara winds act as the concentrating agent.

Ferromanganese crusts deposits, up to 25 cm of thickness, occur throughout seamounts and banks, from 1000 to 4000 m water depths, especially abundant (>60 deposits) and extensive in the Macaronesia region, where they show potential for strategic and critical metals such as Co, V, Ni, Te, Nb, Ti and REEs. In many places, Fe-Mn crust mineralisations are accompanied by phosphorites on the seafloor of continental shelves and slopes along the western continental margins of Portugal and Spain, Lion and Ampère seamounts and the Canary Island Seamount Province. These marine phosphorites concentrate REEs and Y. In addition, ferromanganese nodule fields have been discovered in the Canary seamounts and Galicia Bank (Spain) and the Cadiz Contourite Channel in Gulf of Cadiz (South Portugal).

Seafloor polymetallic sulphides and metalliferous sediments precipitating from hot hydrothermal solutions and plumes are forming today in the vicinity of the Azores Islands (Portugal), along the Mid-Atlantic Ridge, and hot-spot underwater volcanoes in the Canary Archipelago (Spain). Polymetallic sulphides are among the most important marine resources in this geological context for a number of commodities, including Cu, Zn, Ag and Au. In addition, they may contain economic grades of Co, Sn, Ba, In, Bi, Te, Ga and Ge. More than 20 seafloor occurrences have been reported in the studied area.