Searching mineral resources in ocean domains – the Portuguese case study

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Portugal’s continental shelf comprises most of the seabed physiographic domains: abyssal plains, seamounts and mid-oceanic ridges. These distinct domains are generally related with the potential occurrence of different marine mineral resources, such as polymetallic nodules, ferromanganese crusts and polymetallic sulphides. Polymetallic nodules are potatoes sized concretions formed mostly by hydrogenous and biological processes leading to the precipitation of concentric layers of iron and manganese hydroxides around a core (Morgan, 2012). The nodules lie on the sea-bottom sediment, generally half buried, at depths over 4,000-5,000 m. Ferromanganese crusts are mostly composed by manganese oxides and amorphous iron oxyhydroxides that precipitate directly from cold seawater, forming pavements on hard-rock substrates on the flanks and summit of submarine seamounts (e.g. Hein, 2000). They are found at water depths of about 400-4,000 m, but the thickest crusts (up to 25 cm thick) typically occur at depths between 800 and 2,500 m. Polymetallic sulphides of iron, copper, zinc, and lead precipitate at hydrothermal vents (also called black smokers) when high-temperature fluids (heated beneath the oceanic crust and up to 400 ºC) ascend and mix with the cold surrounding seawater (e.g. Herzig and Petersen, 2000). These deposits are related with ocean spreading centres at water depths generally lower than 3,500 m. Mineral deposits occurring in inactive hydrothermal vents can be oxidized.

Despite the abundance of iron oxides and hydroxides in the mineral composition of the referred marine resources, there are still few studies relying on their magnetic properties. However, as recently shown by Oda et al. (2011) through a fine magnetostratigraphic study on a ferromanganese crust, it is possible to develop new chronological tools with the accuracy promised by the astronomically calibrated magnetostratigraphic time scale (1–40 ky). Further studies are needed in order to develop new tools (for dating, mineral prospection, etc) taking advantage of the abundance of these minerals in vast areas of the seabed.

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