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Lateral and depth evolution of the geochemistry and clay mineralogy in Portman Bay, Spain

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Portman Bay is one of the greatest points of mining-metallurgical contamination of the Mediterranean Sea. After an intense mining exploitation, from Roman times to 1991, with more than 60 MT of steriles filling the bay. The effect of currents on the dumped materials resulted in the washings spreading along the marine platform and inside the bay itself, totally blocking it, filling it up from the west. Although a degree of equilibrium has been reached since dumping stopped, the sediments are subject to marine dynamics, especially those nearer the sea line.
The objective of this study is the geochemical and mineralogical in-depth characterization of waste materials from Portman Bay, with special attention to the clay mineralogy. A total of twelve cores were made, aligned in three rows with respect to the coastline. The samples were obtained every meter depth.
The studied materials mostly have a sandy texture and neutral to slightly basic pH values. However, it is necessary to highlight the influence of the direct discharge to the bay, as can be seen in samples collected in cores located in the internal area, where the texture is finer and lower pH values.
The total heavy metal(oid) content is very high, corresponding to materials affected by mining activities. The highest values for Fe have been found in cores located close to the coast line, where a grain selection process, carried out by marine currents, has produced enrichment in magnetite and other iron phases. The Zn content, with a background value of 8134 mg kg-1, has a variable distribution with depth. Lead has a background value (median) of 1219 mg kg-1, and the maximum values have been found in cores with high clay percentage, suggesting a higher content in reactive particles. The arsenic content has a background value of 274 mg kg-1 in the Bay, and its content is lower in cores located in the coastline, increasing as we move away from the shore. The highest concentrations of each core appear in the surface samples. The total Cu content has a background value of 50 mg kg-1, with anomalous values of this element being observed at intermediate depths (5-8 meters). Finally, the highest Cd content has been quantified in cores located in the inner part of the Bay.
The mineralogical composition of cores close to the coast line suggests that materials have undergone a grain selection process, with quartz, iron bearing minerals (e.g. siderite) and phyllosilicates (chlorite, kaolinite, micas and possibly greenalite) as the most abundant phases. Pyrite is present as a residual mineral of the beneficiated ore. Hematite and siderite are partly inherited and partly neoformed as a result of alteration processes. Jarosite has its origin in the oxidation process of pyrites and other sulphides, which have been partially carried out on surface in supergene conditions.
The obtained results have a great importance in the restoration project, which recently has been started, including the dredging of about 2,700,000 m3 of tailings, moving the shoreline some 250 m inland.