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Preliminary zoning for risk assessment and remediation purposes in Portman Bay.

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Portman bay is a singular point of mining impact in the Mediterranean area. The site is located in the province of Murcia, south-eastern Spain, and was completely inundated with more than 63 million tonnes of mining waste discharged through a huge washing plant. Wastes from mining activities mainly consisted of ore materials (galena, pyrite and sphalerite), phyllosilicates, in addition to siderite, iron oxides and sometimes alteration products such as jarosite, alunite, kaolinite and greenalite. These materials were submitted to a concentration process by floatation with sea water and as a result of the discharge, the whole of the bay was filled up with wastes which also extended into the Mediterranean Sea. In the last years of activity, wastes were even poured alternatively in the sea or over the sediments filling the bay. These actions have produced a very high heterogeneity in the sediments. Although after the end of the discharges it has been possible to reach a certain degree of balance, the sediments, especially those closest to the sea, are subjected to marine dynamics and the effects of rainfall and runoffs.
In 2007, a recuperation pilot project was developed and financed by the Spanish Government.
In the first step of this project, the complete physical, chemical and mineralogical characterization of sediments, both in surface and at depth was carried out. Twenty surface samples were collected (<1 m) and twelve sediment cores were also collected at the same time.
To determine the total trace element content, zinc and iron levels were determined by flame atomic absorption spectrometry, while lead, cadmium and copper levels were determined by electrothermal atomization atomic absorption spectrometry. The arsenic content was measured by atomic fluorescence spectrometry using an automated continuous flow hydride generation spectrometer. The reliability of the results was verified by analyzing standard reference materials. The mineralogical composition was determined using Cu-Kα radiation with an X-ray Diffractometer and appropriate software. Data for metal leached, Acid-volatile sulphide (AVS) and simultaneously extracted metals (SEM) were also obtained.
The results allowed two types of materials to be differentiated. The first one with a fine particle size, is related with the direct discharge of wastes and contains jarosite and other minerals resulting of supergenic alteration. The pH is low and both the level of heavy metals and chemical reactivity are high.
The second, different material is black sand, a sediment of coarse texture in which stable minerals, phylosilicates, iron oxides and hydroxides, siderite, pyrite and quartz predominate. The pH is close to neutrality and despite a high heavy metals level, the chemical reactivity is low.
The data allowed a preliminary zoning of the risk in the area to be established, and this was the starting point to outline the remediation project.