Geophysical Research Abstracts
Vol. 14, EGU2012-13964, 2012
EGU General Assembly 2012

Agricultural land contamination by heavy metals around the former mining site of Bechateur (northern Tunisia)

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The activity of the former Pb-Zn mine of Jebel Ghozlen (Béchateur. extreme northern Tunisia) generated during the last century large quantities of tailings (extraction, flotation, gravimetry) deposited as three heap between the mine site and the shoreline located 700 m away. Areas surrounding the mine site are agricultural and are crossed by two rivers, one of which crosses the main heap. The minerals that make up these wastes are calcite, dolomite, quartz, gypsum, pyrite, barite, smithsonite, cerussite and galena. The amounts of Zn, Cd and Pb in the wastes vary between 1.3 and 9.3%, 1.1% and 5.7 and 185 and 410 mg kg-1, respectively.

Soils in the study area are carbonated and are characterized by a silt-sand texture. The clay fraction is dominated by kaolinite. The chemical analysis of thirty samples collected over an area of 3 km2 shows that the amounts of total organic carbon (TOC) and total sulfur vary from 0.7 % to 2.5 % and 0.08 % to 0.96 %, respectively, while those of Zn, Pb and Cd range from 300 to 22 000 mg kg-1, 85 to 3000 mg kg-1 and 2 to 47 mg kg-1, respectively. The highest concentrations of metals were found in flood plains at 500 m downstream of the mine site.

Extraction tests using deionized water and a 0.1 M CaCl2 solution were performed to assess the mobility of Zn, Pb and Cd in contaminated and reference soil samples collected within the study area. The results of extraction with deionized water showed that the leached amounts of Zn and Cd range between 0.2 and 4 mg kg-1 and 0.02 and 0.2 mg kg-1, respectively; while that of Pb is quite near the detection limit. During the extraction with CaCl2 the leached amounts of Zn, Pb and Cd range from 0.3 to 86 mg kg-1, 2 to 6 mg kg-1 and 0.05 to 0.9 mg kg-1, respectively. Thus, the mobility of Cd, Zn and Pb in CaCl2 solution (0.8 %, 0.4 % and 0.3 %, respectively) is higher compared with the extraction with deionized water (0.2%, 0.1% and 0.02 %, respectively).

Toxicity tests were conducted on these soils using the MetPlate method. The results show a low bioavailability of contaminants.