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Distribution and speciation of metals in soils of the former mining district of Touiref (Northwest Tunisia)

M.A. Othmani (1), F. Soussi (1), E. Ferreira da Silva (2), A. Moussi (3), W. Oueslati (4), and R. Jebali (1)

(1) Laboratoire des Matériaux Utiles, INRAP-Technopole de SidiThabet, 2026, TUNISIA, (2) Departamento de Geociencias, Universidad de Aveiro, P-3810-193 Aveiro, Portugal, (3) Laboratoire dynamiques des bassins sédimentaires, paléoenvironnements et structures géologiques, Faculté des Sciences de Tunis, Université de Tunis El Manar, 2092 Tunis, TUNISIA., (4) Laboratoire Ressources Minérales et Environnement, Faculté des Sciences de Tunis, Université de Tunis El Manar, 2092 Tunis. TUNISIA.

The former mining district of Touiref (1901-1958), located North-West of Tunisia, and where the activities have stopped 50 years ago, gave rise to large volumes of mine (extraction, flotation) tailings containing sulphides (galena, sphalerite, jordanite, pyrite, marcasite) associated with a carbonate gangue. Analysis of a hundred samples of soil has been used to develop isoconcentration maps of Pb, Zn, Cd and As across the study area, beyond the local geochemical background (LGB). The drawing of these maps has allowed the delineation of the contaminated areas using Geographic Information Systems (GIS). In addition, the soils of the study area were characterized in terms physico-chemical (pH and Corg), grain size, mineralogical and chemical means. Their neutral to slightly alkaline pH is (7.91 to 8.81), and their clay (32 and 57%)-silt (26 and 42%) texture, are characteristic of soils developed on carbonate bedrocks. The percentages in organic carbon (Corg) are between 0.71 and 5.6%. From a mineralogical point of view, mainly Pb-Fe sulphides associated with their alteration products have been observed within these soils. The levels of Pb, Zn, Cd and As, may go up 0.99%, 1.99%, 140 ppm and 409 ppm, respectively. These high concentrations were recorded around the extraction, processing and storage sites on the one hand and through the flood zones and the prevailing wind direction (NW-SSE) on the other. These soils have also been subjected to sequential extraction tests in order to characterize the metal-bearing phases and assess the mobility and bioavailability of heavy metals. The results have shown that Pb is mainly associated with the acid-soluble fraction (carbonates) and to a lesser extent with the Fe-(oxy)hydroxides, whereas Zn and Cd are mainly associated with Fe-(oxy)hydroxides and to a lesser degree with sulphides. Metals associated with these phases can be easily mobilized in response to physico-chemical changes and become phytoaccessible.