

Impact of an historic mercury mine and Hg processing plant on the surrounding surface soils (Apuseni Mts., Romania)

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The Izvorul Ampoiului mercury mine lies in the Apuseni Mts., Romania. The mineralisation is epithermal, connected with the Neogene volcanism. The ore deposit was exploited between the years 1557 and 1964. Total production of the mine was 110000 tons of ore (360 tons of Hg). A smelter located close to the mine had been in operation since 1964. The waste material from the mine and the smelter was dumped in close vicinity of the mine. Total quantity of the waste has been estimated at 170000 tons.

Thirty soils samples together with thirty rock samples have been collected from the mine dump. Samples were analyzed for V, Cr, Cu, Zn, Zr and Pb by XRF Spectroscopy using pressed powder pellets. A SRS3400 Bruker AXS was used.

In order to estimate the natural or anthropogenic inputs of heavy metals into surface soils, we made a geochemical normalization of data to a reference element. We used Zr as a reference element. The concentrations of V, Cr, Cu, Zn, and Pb don't present a linear relationship with Zr concentration (e.g., $r_{(V-Zr)}=0.63$, $r_{(Cr-Zr)}=0.21$; $r_{(Cu-Zr)}=0.34$; $r_{(Zn-Zr)}=0.24$; $r_{(Pb-Zr)}=0.35$), fact indicates their anthropogenic origins.

Enrichment factor (EF) was used to quantify the percentage gain or loss of a selected metal relative to a refractory metal, and in the soil relative to the parent material. Zr and the rock samples were regarded orderly as reference element and reference environment. From our study all of the selected heavy metals presents an $EF > 1.5$ and may be considered to be dominantly anthropogenic in origins. So, the surface soils show minor enrichment for Cr (i.e., $EF(Cr)=1.54$) and V (i.e., $EF(V)=1.62$), moderate enrichment for Cu (i.e., $EF(Cu)=3.75$), moderate severe enrichment for Zn (i.e., $EF(Zn)=6.29$), and extremely severe enrichment for Pb (i.e., $EF(Pb)=49.18$). The source of selected heavy metals can be entirely attributed to the waste material input in the area.

Besides EF, in the environmental studies is used the cumulative enrichment factor (or the contamination index CI) of the geological materials in order to identify the multi-element contamination, which may increment the toxicity of the metals. In the study area, the $CI=5.48$, indicating that the waste material contain heavy metals at considerable levels that may induce toxicity in the ecosystem.

The above evaluation results indicate that the heavy metals contained in soils at Izvorul Ampoiului mine and Hg factory has moderate to serious potential ecological risks.