SASA TAILINGS DAM CHARACTERIZATION (MACEDONIA)

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Purpose

This research is aimed to investigate the mineralogical characteristics and heavy metal contents as also their bioavailability in the Sasa tailings dam material, deposited close to the Sasa Pb-Zn mine in the Osogovo Mountains (eastern Macedonia).

Methods

Mineralogy of the surficial samples was determined at the Department of Geology, Ljubljana (Slovenia) by X-ray powder diffractometry using a Philips PW 3710 diffractometer and Cu*K*α radiation. Diffraction patterns were identified with the Powder Diffraction File (1977) JPDS system. Scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) were carried out on a Jeol JSM 5800 scanning electron microscope, equipped with a Si-Li detector (LINK ISIS 300, Oxford Instruments) at the Jožef Stefan Institute in Ljubljana, Slovenia. Geochemical analysis of the elements Mo, Cu, Pb, Zn, Ni, As, Cd, Sb, Bi, Ag, Al, Fe, Mn and S was obtained in a certified commercial laboratory in Canada (ACME Analytical Laboratories, Ltd.). 0.5 g of each sample was leached in hot (95ºC) Aqua Regia and analysed by ICP Mass Spectrometry, for evaluating the fractionation of metals (Co, Ni, Cr, Cu, As, Cd, Zn and Pb) in Sasa tailings dam material. For sequential extraction procedure, modified BCR scheme was used to evaluate the bioavailability of heavy metals in investigated waste material. During the procedure the metals were extracted into four fractions: acid soluble fraction (B1), reducible fraction (B2), oxidizable fraction (B3) and residual fraction (B4). To check the accuracy of the analytical procedure, the certified reference material BCR-701 was used.

Geology and environmental setting of the study area

The Sasa lead-zinc deposit lies within the Sasa-Toranica mining district in the Osogovo Mountains, eastern Macedonia. The geology of the Toranica-Sasa ore field comprises various rocks of both metamorphic and igneous origin, with the latter of Tertiary age. The most economically valuable mineralization is closely related to quartz-graphite schists, with the ore consisting mainly of galena, sphalerite, chalcopyrite and pyrite.

Results and discussion

According to XRD and SEM/EDS analyses the investigated material was dominated by the following minerals: quartz, calcite, mica, cordierite, epidote, clinochlore, sphalerite and clinopyroxene. Sample three (H-3) include pyrite and sample four (H-4) also contained magnetite, galena, hematite and chlorite. TASEV *et al*. (2005) classified the afore-mentioned minerals as belonging to the Sasa-Toranica zone. Sphalerite and galena, two of the most important minerals in the Sasa ore district, were not found at all in the samples as it was expected. One explanation for this may have been because samples were collected from the upper oxidation zone, where reduction minerals are absent. In addition, SERAFIMOVSKI *et al.* (2006) reported that in the Zletovo ore district, located near the Sasa mine, sphalerite is usually found only in a few generations and it is sometimes interstitially replaced by quartz, galena and other minerals. According to geochemical analyses the average contents of studied toxic metals in Sasa tailings dam material are as follows: Ag 20.49, As 111.3, Cd 151.93, Cu 928.12, Mo 3.04, Pb 6496.22, Sb 5.62, Bi 18.26, Zn 5121.89, Ni 31.2 and Co 24.97 mg/kg. Compared to average concentrations from Barroca Grande tailings dam (ÁVILA *et al.,* 2008), it can be seen that concentrations of almost all toxic metals are much higher in surficial material from Sasa tailings dam. Sequential extraction analysis revealed that Pb is the most mobile metal in Sasa tailings dam material since only 15% of total Pb is associated with residual fraction, while 50% of total Pb found in the acid soluble fraction. Ni, Cd and Zn showed far less mobility according to the first step of BCR scheme, with acid soluble concentration of less than 7%.

Conclusions

XRD and SEM-EDS analyses showed that detected mineral assemblage from Sasa tailing dam consists most of the minerals from the background rocks of the studied mining area. Results shown that due to high contents of metals and high mobility of metals, tailings dam material from Sasa mine represent a serious threat to the surrounding environment. Further research activities are urgent to find a potential remediation strategy to reduce the metal contents and their mobility in Sasa tailings dam.

References

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