Pre-mining environmental geochemical survey of a mineralised watershed in North Greece

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Pre-mining baseline characterization studies of unmined mineralised areas may be useful in serving the purposes of sustainable mining by providing a basis for detecting future environmental change and setting realistic remediation standards. This study defines the pre-mining signatures in soil, sediment and water of the mineralised watershed of Piavitsa Creek, adjoining to the porphyry copper deposit of Skouries at Kassandra mining district, north Greece. The study area of approximately 2 km^2 is densely forested and characterised by rough topography and high slopes. Local geology comprises metamorphic rocks of mica schist and gneiss. Parts of the creek are planned as mine tailing disposal areas and will be receiving waste originating from the future open pit mine at Skouries. Sixty five soil samples (0-25 cm depth) were collected on a 200m x 200m regular grid covering the slopes of the creek. Nine water and stream sediment samples were also collected along the main stream of the catchment and at tributaries. Results of total analysis of soils indicated elevated mean concentrations of Pb (526mg kg^{-1}), Zn (350mg kg^{-1}), As (165mg kg^{-1}), Sb (13mg kg^{-1}) Cd (16mg kg^{-1}), and Mn (1774 mg kg^{-1}). Acid base accounting indicated that at present there is a positive net neutralization capacity of soil. Elevated levels of Pb (39-1812mg kg^{-1}), Zn (73-2090mg kg^{-1}), As (43-1136 mg kg^{-1}), Mn (680- >10000mg kg^{-1}) and Sb (3- 40mg kg^{-1}) in stream sediment samples signified that sediments are a favourable sink for elements, which are introduced to the aquatic environment of the drainage system following chemical weathering of the existing sulphide mineralization. Mobility of selected heavy metals in stream sediment samples was investigated through the application of a 5-step sequential extraction procedure. Results showed that, despite the high total metal content, the majority of analyzed elements are mainly bound to relative immobile operationally defined geochemical phases of amorphous to poorly crystalline Fe and Mn oxides and the residual fraction. Surface waters were predominantly near neutral to mildly alkaline and Eh data indicated moderate reducing conditions. Electrical Conductivity (EC) varied widely from 328 to 1669 µS cm^{-1}, indicating significant differences between the stream water ion content. The highest metal/ metalloid concentrations in water samples were measured for Pb (2-45 µg l^{-1}), Mn (5-106 µg l^{-1}) and As (4-141 µg l^{-1}). The collected data were used for evaluating alternative scenarios with respect to metal transport under possible future chance in flow and other physicochemical characteristics of stream water and sediment.

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