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The geochemical behavior of Pb and Zn in waters and stream sediments around a former Pb-Zn mine, central Portugal

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In Portugal, ore mineral exploitation has left millions of tons of mining waste rich in metals in the environment. The former Várzea Pb-Zn mine is located in the Várzea dos Cavaleiros village, about 10 km from Sertã village and 65 km from Castelo Branco county, central Portugal. The Pb-Zn quartz vein with N10ºW; 75º SW orientation, 0.5-1.5 m thick, intruded the Neoproterozoic-Cambrian schist-greywacke complex. About 17576.47 tons of ore minerals were exploited between 1953 and 1967 [1]. There are two main mine dumps, the largest one is 100 m long and 47 m wide. The other dump is mainly composed of fine tailings.

In the Várzea area, seventeen water samples (twelve wells, two springs and three surface waters) were collected in the winter (February 2018) and summer (July 2018), three samples are outside mine influence. Eight stream sediments and ten tailing samples were also collected. Lead and Zn concentrations in tailings are up to 12903 mg/kg and 2216 mg/kg, respectively. The pH of groundwaters and surface waters ranges between 5.45 and 7.35 and 5.89 and 8.05, respectively. In groundwaters, Pb (3.04-13.92 µg/L) and Zn (2.35-2555 µg/L) concentrations are higher than Pb (3.09-5.90 µg/L) and Zn (1.38-52.81 µg/L) concentrations in surface waters. Outside mine influence, Zn water concentration is 10.2 µg/L, while Pb was not detected. However, at about 2 km downstream of the old mining area, in Tamôlha stream, Pb and Zn concentrations are up to 5.09 and 52.81 µg/L, respectively, showing the old mine influence. Water geochemistry is not seasonally trended. Upstream sediments have Pb concentrations up to 30.23 mg/kg and Zn up to 111 mg/kg, while some downstream sediments have Pb and Zn concentrations of 204 mg/kg and 545 mg/kg, respectively. Zinc concentrations in groundwater near mine dumps are greater than the recommended limit for irrigation (2000 µg/L) [2]. Spatial Statistical Analysis will be used to obtain risk maps to support the definition of the most appropriate remediation measures.

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