Arsenic contaminated streams with circumneutral drainage caused by an old Au-Ag mine, central Portugal

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The old Escádia Grande mine is located 11 km to the south of Góis, Coimbra district and belongs to the Central Iberian Zone. In the area, the Beiras Group dominates, which is a sequence of flyschoid lithologies composed by phyllites and metagreywackes. The mineralized quartz veins cut the Beiras Group, fill N30ºW; 45ºSW faults, are 70 cm thick and up to 300 m long. They have an average of 8 g/ton of Au and 33 g/ton of Ag and consist mainly of quartz, arsenopyrite, pyrite, rare chalcopyrite, galena, sphalerite, gold and argentite. This mine was exploited for Au and Ag until 1952. The relief of the area is vigourous, with the highest altitudes reaching about 800 meters and the lowest 500 meters. A mine dump was deposited in the steep slope at south of the mine gallery and is composed by coarse pieces of quartz with disseminated sulphides and country rocks. A tailings deposit, derived from the ore processing, was deposited at south of the latter. The stream water that crosses the old mine area shows a decrease of SO_4^{2-}, Zn, Ni, Co, Cd, Mg and Mn to the downstream. The circumneutral to alkaline drainage in the most sampling campaigns causes Fe-oxides precipitation that contains high concentrations of As (46234 mg kg^{-1}), Cd (30 mg kg^{-1}), Co (165 mg kg^{-1}), Cr (15 mg kg^{-1}), Cu (128 mg kg^{-1}), Pb (194 mg kg^{-1}), Zn (3043 mg kg^{-1}), Sb (155 mg kg^{-1}), Sn (327 mg kg^{-1}) and W (65 mg kg^{-1}). Stream sediments have higher Sn (49 mg kg^{-1}), Sb (21 mg kg^{-1}) and W (14 mg kg^{-1}) concentrations and lower As (up to 3141 mg kg^{-1}) concentration than those of tailings, where the As concentration is up to 8090 mg kg^{-1}. The As contents increases in the downstream sediments, but As tends to be in solution, because at pH values higher than 5.0 is not adsorbed, as it mainly occurs as oxianions (H_2AsO4^- and $HAsO_4^{2-}$). The waters have As concentrations up to 253 µg L^{-1} higher than the maximum limits allowed for human consumption along 2 km downstream the mine gallery. Arsenic is the main contaminant in surface waters close to the old Au-Ag mine, because is one of the most abundant element in the tailings and the pH values are favourable to its mobilization.