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Hydrogeochemistry of the active tailings impoundment Talabre, Chuquicamata, Chile

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A study of the active Talabre tailings impoundment from the Chuquicamata porphyry copper mine, Atacama desert, give indications on the liberation and retention processes of elements as a function of time. The discharge point of the Talabre tailings impoundment (48 km^2) is moved periodically. Before coming back to the same point, the tailings are exposed to oxidation for a known period of time. This gives the possibility to study the kinetics and controlling parameters of sulfide oxidation, element liberation and retention processes in a giant natural laboratory.

Fresh tailings are not oxidized and have pH from the flotation process (pH ~10). After three months of exposure to oxidation (pH ~8), pyrite starts to oxidize, forming Fe(III) hydroxide coating. After one year the pH is neutral. After three years a 10 cm thick low-pH (pH 4) oxidation zone develops, in which the Fe(III) hydroxide coating is dissolved. The high evaporation in the hyper-arid climate at Talabre causes at low pH upwards mobilization of the liberated metals by capillarity. This triggers the precipitation of metal-sulfates chlorides (e.g. atacamite $Cu_2Cl(OH)_3$ and halite) on the tailings surface.

The pore water in fresh tailings have ≈2000 mg/l SO_4 from primary anhydrite and gypsum dissolution. After three years oxidation, up to 3877 mg/l SO_4 are liberated. Increased concentrations of Na, K, Al, Si, and Ca in the pore water reflect neutralization reactions with the carbonate and silicate mineral assemblage. Cu^{2+}, Zn^{2+}, and Ni^{2+} show no liberation to the pore water in the fresh and three months old tailings. After 1 year, up to 122 mg/l Zn and 20 mg/l Ni are liberated to the pore water. After three years of oxidation up to 104 mg/l of Cu are present in the pore water. Mo and As are liberated (up to 9 and 7 mg/l, respectively) at the alkaline pH conditions of fresh tailings. With advanced sulfide oxidation the mobility of Mo and As is limited due to sorption on Fe(III) hydroxides at low pH. The δD vs. $\delta^{18}O$ covariaion of water samples in the tailings impoundment show an evaporative trend and record sediment-water interactions only in the 3 years old tailings.

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Mercury speciation in waters of Wanshan Hg mines in Guizhou, China

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Wanshan mercury mine located in east of Guizhou is the biggest one in China. For a better understanding of the current Hg contamination and its dispersion, speciation of mercury both in surface and ground waters were determined. Simultaneously, transport and accumulation of Hg in aquatic system were discussed in the paper. Reactive, dissolved, particulate and total Hg concentrations were analyzed in water samples by CVAFS following EPA method 1631. The analytic data shown that surface water directly affected by the mining wastes often exhibited high total Hg concentrations (616.0 to 6,226 ngl^{-1}). Whereas, the samples in the downstream isolated from Hg mining area presented lower contents (60.3 to 21.9 ngl^{-1}). In general, high total Hg values always matched high concentrations of particulate form. It may suggest that the suspended particles present as a primarily transport pathway in contaminated aquatic system. Total dissolved Hg in filtered surface waters only if it directly influenced by the leachate from calcines, would show abnormal values (85.8 to 426.5 ngl^{-1}) and be always characterized by a large portion of reactive form reaching up to 94.9%. While other surface waters far away from mine wastes had lower contents. It indicated that the high dissolved Hg contents would be attributed to ignited residues, which contained much more soluble Hg compounds. Unlike the surface water samples, unfiltered samples of groundwater showed abnormal values of reactive Hg ranging from 42.7 to 805.5 ngl^{-1}. The fraction of reactive form constituted 64.3-90.8% of the total Hg concentrations. Highly elevated reactive Hg in groundwater that is the only drinkable water source for residents is of great concern.

The results of the study reflect a high Hg contamination in Wanshan mercury mining area. And the obviously spatial characteristics of Hg distributions in the district are mainly constrained to the old mining activities, geographical conditions and mercuriferous mineralization belt.