Reactive transport analysis of mineralogical controls affecting metal release from polymetallic carbonate waste rock

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Mineral weathering and metal leaching from mine waste is of worldwide environmental concern. Specific challenges exist under neutral drainage conditions in waste rock with a high carbonate mineral content. Such rock types are present at the Antamina mine site in Peru. Mining of the polymetallic skarn deposit produces waste rock containing multiple sulfide minerals that potentially liberate metals including Cu, Mo, Pb, and Zn. Prediction of the release of these metals from mine waste is difficult and depends on a number of hydrogeological and geochemical processes and parameters. In this study, we use reactive transport modelling to conceptually investigate the effect of thermodynamic and kinetic parameters on metal concentrations in drainage water with a specific focus on Mo. Parameters considered in the analysis include the mineralogical composition of the waste rock, which shows great variability at the site, and the rate of oxidation of the various sulphide minerals in relation to each other. In addition, the formation of secondary minerals including oxides, carbonates and hydroxides is considered. However, it is also possible that metal release is affected by the formation of molybdates, which further limits predictability of metal release. The effect of thermodynamic constants and rates for secondary mineral formation are also evaluated. Model results are compared with experimental data from field cells and laboratory experiments.

The rate of AMD and environmental affects of heavy metals (Cu, Pb, Zn, As, Hg, Cd and Fe) at Taknar Polymetal Mine, Bardaskan, Iran

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The Taknar polymetal (Cu, Zn, Au, Pb) massive sulfide deposit was formed within the Taknar formation (Ordivician). The Taknar zone is a wedge shape block situated between two fauls, Darouneh to the south and Rivash to the north. Paeozoic, Mesozoic and Tertiary intrusive rocks are exposed within the Taknar zone. The Taknar Mine area is divided into four Taks: I, II, III and IV. Waste dumps from Tak's tunnels, which have been left unmanaged at the main river limits, created many problems related to the chemicals in stream water, stream sediments, layers of surface soil and ground water. These problems are responsible for increasing the rate of AMD and the transportation of waste dumps material by surface water and wind. Therefore the total waste dumps not only have increased the heavy metal concentrations in downstream sediments, but also a large volume of sediments have precipitated far from spoil heaps.

Based on EEC and EPA standards, the total concentration of trace elements (Pb, Zn, Cd, As, Hg) in the main river bed sediments close to minning activities is much higher than standard. Minning activities have been causing considerable amounts of minning wastes, especially at the vicinity of Taks I, II, III tunnels. The source of water contamination seems to be the northern tunnel of Tak III. This tunnel is also responsible for AMD generation as well as high pollution of the main river sediments. The structure of tunnel, high oxidation of sulfide minerals and its close distance to the river are the main reasons for the pollution. Water samples from this tunnel and some other localities confirm the high content of copper, hydrochemical parameters SO^4 and TDS. This water indicated a high acidity and high salty condition.

Water contamination has also influenced the groundwater and Qanats of downstream villages in this area. Acceptable standard limits in drinking water (WHO, EPA and Iran National Standard) for heavy metals have also been used in order to compare the samples results. Having these type of pollution a special pollution source management must be arranged for the future.