

The effect of Fe(II) on schwertmannite transformation and its interference with As

SUSANTA PAIKARAY AND STEFAN PEIFFER

Department of Hydrology, University of Bayreuth, 95440
Bayreuth, Germany (susanta@uni-bayreuth.de)

Introduction

Schwertmannites (SHM) precipitated from acid mine discharges are often contaminated by arsenic. Under reducing conditions they may be exposed to Fe(II) which was reported to accelerate the transformation rate of SHM to goethite [1]. In this study we have investigated the effect of Fe(II) on the transformation of SHM loaded with As and its subsequent release.

Material and Methods

Ageing experiments were conducted using both arsenic-loaded (9.2 mg/g) and pure SHM at room temperature (22±2°C) for ~ 200 h in the presence of 0.4 and 1.0 mmol L⁻¹ aqueous Fe(II) in oxygen free glove box. pH was maintained at 6 and 7 by using MES and PIPES biological buffers, respectively. Solid phase was studied by infrared (IR) and XRD techniques.

Results and Discussion

Sulphate release was found to be higher at pH 7 compared to pH 6 and increased in the presence of Fe(II) releasing up to ~ 50 % of solid phase sulphate within 8 days. Arsenic desorption was higher at pH 6 releasing ~0.12 ± 0.01% of total solid phase As compared to pH 7 (0.045 ± 0.0005 %).

Both, the presence of Fe(II) and the presence of As in the SHM phase had a significant effect on the transformation process. Arsenic loaded SHM transformed to lepidocrocite after 214 h at pH 6. In contrast, transformation of pure SHM lead to formation of goethite additionally to lepidocrocite already after 154 h under these conditions. Similarly, at pH 7, only lepidocrocite appeared after 200 h in case of As-SHM, and goethite was not formed, while goethite and lepidocrocite were found after 145 h in case of pure SHM. These mineral phases were not observed in the absence of Fe(II).

Conclusion

It appears that transformation of SHM is faster in the presence of Fe(II). However, this effect seems to be counterbalanced if SHM is loaded with As. Absence and presence of As seem also to control product formation. As seems to bound more strongly to the transformation products given its lower release rate at pH 7 compared to that at pH 6.

[1] Burton *et al.* (2008) *Geochim Cosmochim Acta* **72**, 4551-4564.

Characterization of compounds and minerals in the Fe-AsO₄-SO₄ system: Implications for arsenic control in metallurgical wastes

D. PAKTUNC*, J. DUTRIZAC AND G. POIRIER

CANMET, Mining and Mineral Sciences Laboratories, 555
Booth Street, Ottawa, Canada
(*correspondence: dpaktunc@nrcan.gc.ca)

A range of ferric arsenate-sulphate minerals and synthetic compounds were characterized by XRD, XAFS and microanalysis techniques. Hydrothermal synthesis in the temperature range of 150 to 225°C resulted in compounds with the following formulas: Fe(AsO₄)_{0.8-1}(SO₄)_{0-0.2}·2H₂O, FeAsO₄(OH)_{0.2-0.6}, Fe(AsO₄)_{0.3-0.5}(SO₄)_{0.7-0.5}(OH)_{0.5-1.5} and Fe(SO₄)_{0.9-1}(AsO₄)_{0-0.1}(OH), all of which are characterized by 1:1 molar Fe/(AsO₄+SO₄) ratio. Synthetic scorodite accommodates up to 20 mole % SO₄. Substitution of AsO₄ is limited to between 30 and 50 mole % in the ferric sulphate-arsenate compound and 10 mole % in basic ferric sulphate. In comparison, synthetic jarosite can incorporate up to 17 mole % AsO₄/(AsO₄+SO₄). These compounds resemble those that form in the autoclaves during pressure oxidation of refractory gold ores where gold is locked in arsenopyrite and pyrite.

Natural analogs in this system include hydrated ferric arsenate and sulphate minerals such as bukovskyite, sarmientite, zykaite, scorodite, parascorodite, kankite, ferric arsenate, kaatialaite, ferrisymplesite, ferrihydrite, goethite, hematite and schwertmannite. Such occurrences were reported in mine tailings, oxidized portions of gold and base metal mineral deposits and acid mine drainage settings.

Long- and short-range structures of these compounds and their hydrated natural analogs will be presented along with the experimental data, and their implications on arsenic control practices at mine sites will be discussed.