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Coprecipitation of schwertmannite with oxyanions and its role in the attenuation of these ions in acid mine drainage

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Many different iron minerals can precipitate in acid mine drainage (AMD). Schwertmannite, which is poorly crystalline with a high specific surface area, is one of the main mineral phases found in AMD and easily coprecipitates with oxyanions replacing sulfate in the structure. Therefore, the coprecipitation of schwertmannite with toxic oxyanions can play important role in controlling the behaviors of these elements. To study the effect of coprecipitation of schwertmannite on the concentrations of these elements in drainage, schwertmannite was coprecipitated with three different oxyanions (AsO_4^{3-}, CrO_4^{2-}, MoO_4^{2-}) at different molar ratio of Fe:oxyanions (4, 8, 12, 18, 30). After the precipitation, the solid and solution samples were analyzed using XRD and ICP-OES to identify the mineral phases and to measure the concentrations of oxyanions in the remaining solution after the precipitation.

For arsenate, with decreasing Fe:As ratio, XRD patterns show that schwertmannite structure is maintained until 8. However, when the ratio is 4, it becomes almost amorphous. The effect of molybdate on the precipitation of schwertmannite is similar to arsenate, showing amorphous when Fe:Mo ratio is close to 4. However, for chromate, the schwertmannite structure is maintained at all Fe:Cr ratios used in this study. After the precipitation of schwertmannite, more than 80 and 90 % of arsenate and molybdate are coprecipitated with schwertmannite, respectively, indicating that those two oxyanions can be easily removed from AMD by the precipitation of schwertmannite. However, only less than 40 % of chromate is coprecipitated with schwertmannite, probably leading to the precipitation of schwertmannite at all Fe:Cr ratio used in this study. This results clearly show that precipitation of schwertmannite in AMD can attenuate the toxic oxyanions even at high oxyanion ratios, but the removal efficiency is different for different oxyanion species.