

Characterization of the white precipitates found in acid mine drainage

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The mobility of heavy metals released from acid mine drainage can be controlled by sorption on the iron and aluminum precipitates. There have been plenty of reports on the iron precipitates found in acid mine drainage. However, the white precipitates, mainly composed of aluminum, have not been thoroughly investigated. Previous study have reported hydrobasaluminite and gibbsite as possible phases. Recently Al_{13} -tridecamer was suggested as a possible aluminum phase in precipitates. We used chemical analysis, XRD, SEM, NMR, and sequential extraction method to characterize the white precipitates collected at three different sites.

XRD and SEM data show that most white precipitates are amorphous with small amount of gypsum. ^{27}Al MAS NMR spectra provide more detailed information on the aluminum species in precipitates, showing that there are 4- and 6-coordinated aluminums in the samples. The aluminum with 4-coordination can be assigned to Al_{13} -tridecamer, which has been known as one of the most toxic aluminum species. The calculations based on chemical and ^{27}Al MAS NMR data, show that the relative amounts of Al_{13} -tridecamer, hydrobasaluminite, gibbsite and gypsum are different for each sample. The results of sequential extraction experiment also show that each sample has different aluminum and heavy metal fractions, indicating that the toxicity caused by aluminum and heavy metals can be different for each sample. Sequential extraction results show that one sample (S-1) has higher water soluble fraction and sorbed and exchangeable fraction of aluminum than other samples. However this sample does not contain Al_{13} -tridecamer based on NMR data, indicating that careful characterization of white precipitates is needed to estimate the toxicity of aluminum of white precipitates found in acid mine drainage.

Sorption Behavior of Mercury (Hg) on Hydroxylapatite

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Hydroxylapatite (HAP) has been known to be ubiquitous in various environments. Mercury (Hg) is notorious in ecosystems including humans due to its toxicity. Nevertheless, Hg interactions with HAP has been barely addressed yet. In this study, systematic batch experiments were conducted to investigate Hg sorption on HAP over a wide range of physicochemical conditions such as pH, ionic strengths, and ligands forming complexes.

Hg sorption increases with increasing pH up to pH 6.0 whereas the sorption decreases with pH at $pH \geq 7.0$. This result is in good agreement with species modeling calculation showing that $Hg(OH)_2^0$ is dominant at neutral and basic pHs. It is found that Hg sorption on HAP increases with increasing Hg concentration. At pH 5.0 and 7.0, Hg uptake by HAP steeply increases up to $[Hg]_{ini} \leq 10 \mu M$, and then gently increases at higher concentration. At pH 9.0, however, the Hg sorption on HAP shows linear slope with increasing Hg concentration.

Upon Hg sorption edges and isotherms, it is shown that the sorption is little influenced by variation of ionic strengths. This result indicates that Hg would form inner-sphere surface complexes at the HAP. In kinetics, Hg sorption on HAP reaches ~70 % of total sorbed Hg within the first 3 hr, indicating that adsorption plays a major role in controlling the initial uptake of Hg by HAP. During desorption, ~90 % of the sorbed Hg is retained by HAP suggesting that the sorbed Hg is bounded tightly to the surface and irreversible. It is also found that Hg sorption on HAP is decreased by Cl whereas Hg desorption is enhanced in the presence of Cl. These results suggest that Hg interactions with HAP are significantly influenced by various physicochemical conditions in ecosystems.