

The fate of As in the coprecipitated hydrometallurgical solid wastes

YONGFENG JIA*, LIYING XU, SHUHUA YAO
AND XIN WANG

Institute of Applied Ecology, Chinese Academy of Sciences,
Shenyang, China, 110016
(*correspondence: yongfeng.jia@iae.ac.cn)

Arsenic is released into mineral processing solutions during the extraction of base and precious metals in hydrometallurgical industry. It is removed from the effluents to meet the wastewater standard generally using various precipitation technologies, among which lime neutralization and coprecipitation with ferric iron is the choice of many hydrometallurgical operations and designated by USEPA as best demonstrated available technology (BDAT). In this study, we tried to predict the fate of arsenic in hydrometallurgical wastes based on the characterization of the coprecipitated solid produced in lab.

Arsenic is present predominantly in the form of arsenate in mineral processing solutions. The coprecipitated arsenic solids were prepared by neutralization of arsenate-ferric iron solutions using slaked lime as base. Arsenic-bearing coprecipitates were also synthesized by neutralization of arsenate-ferric solution using sodium hydroxide as base but with the addition of gypsum. The produced arsenic-bearing coprecipitates were characterized by XRD and FTIR.

In previous studies, we found that poorly crystalline ferric arsenate was formed in the NaOH neutralized coprecipitate at acidic pH. However, it was found here that the ferric arsenate decomposed with increasing pH. When lime was used or gypsum was added, an association of calcium with arsenate was clearly observed from quantitative analysis. The XRD and FTIR features of the lime neutralized coprecipitates were similar to those of arsenate-ferrihydrate sorption solids. The coprecipitates were treated at 60 °C to induce crystallinity. It was found that yukonite ($\text{Ca}_2\text{Fe}_3(\text{AsO}_4)_4(\text{OH})\cdot 12\text{H}_2\text{O}$) was developed from both the lime neutralized and gypsum added coprecipitates. Hence, it is predicted here that yukonite is likely to be an ultimate arsenic form in the tailings pond after long-term storage. A recent observation of the presence of yukonite in Ketz River Mine tailings partly supports the present prediction.

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Petrogenesis and mantle dynamics of Kalatongke mafic rock bodies, Northwestern China

CHANGYI JIANG*, ZHUANGZHI QIAN, XU YU, JIANGANG
JIAO, HAIQING YAN, RONGHUI LU AND ZHAODE XIA

Department of Earth Sciences, Chang'an University, Xi'an
710054, China

(*correspondence: jiangchangyi001@163.com)

Kalatongke mafic rock bodies are composed of thirteen small intrusions, occurred in early Permian, which lie in the Ertix fold belt, the southern margin of the Altai Mountains, northwestern China. They contain olivine norites, norites, gabbronorites, gabbros, diabase gabbros, gabbro-diorites, diorites, quartz diorites and minor amount harzburgites. Among these rocks, nearly half of the mafic rocks are the leucocratic variations with the pyroxene content only 15% to 30%. These mafic rocks are mainly calc-alkaline series rather than tholeiitic series. The Σ REE contents are 63.91 ppm~206.17 ppm with $(\text{La}/\text{Yb})_N=3.80\sim 10.79$, $(\text{La}/\text{Sm})_N=1.97\sim 3.61$, $(\text{Gd}/\text{Yb})_N=1.28\sim 3.51$, $\delta_{\text{Er}}=0.82\sim 1.35$. All mafic rocks are enriched in LREE (Cs, Rb, Ba, Th, U, Sr) and some HFSE (Zr, Hf), depleted in compatible elements (V, Co, Cr, Ni) and Nb, Ta, Ti. These rocks also exhibit positive $\epsilon_{\text{Nd}}(t)$ values (+6.79 to +13.27), and negative $\epsilon_{\text{Sr}}(t)$ values (-5.22 to -23.02) except two samples with $\epsilon_{\text{Sr}}(t)$ value of +11.21, +2.45 respectively; Pb isotopic are characterized by $^{206}\text{Pb}/^{204}\text{Pb}=17.98\sim 18.31$, $^{207}\text{Pb}/^{204}\text{Pb}=15.42\sim 15.56$, $^{208}\text{Pb}/^{204}\text{Pb}=37.70\sim 37.82$. The Fo molecular (Fo =80) of olivine and whole-rock geochemical compositions show that the primary magma appear to derive from basaltic magma with $\text{MgO}\approx 9.1\%$, which has experienced fractional crystallization of clinopyroxene and olivine in the deep magma chamber. This magma has also experienced further differentiation process with insignificant continental crustal contamination during continued-rising and after entering high magma chamber. The source of this magma contains large amounts of components of residual island arc mantle, and some asthenosphere components. Therefore, the delamination of lithospheric mantle of residual island arc and the upwelling of asthenosphere material are mainly mantle dynamic mechanism of forming the magma.

This work is financially supported by the National Natural Science Foundation of China (Grant No.40534020).