

Geochemical characterization of biosignatures in subseafloor basalts

E. KNOWLES^{1*}, H. STAUDIGEL², N. MCLOUGHLIN³
AND A. TEMPLETON¹

¹Department of Geological Sciences, University of Colorado, Boulder, CO 80309

(*correspondence: knowlese@colorado.edu)

²Scripps Institution of Oceanography, University of California, La Jolla, CA 92093

³Centre for Geobiology & Department of Earth Science, University of Bergen, Bergen 5007, Norway

The discoveries of intriguing tubular and granular alteration features in subseafloor basalt glasses, ophiolites, and ancient greenstones [1, 2] has exciting implications for increasing our understanding of global geochemical cycling and the evolution of life on Earth, as well as for exploring other planets for signs of life. The suggestion that these features could represent some of the oldest signs of life on Earth [3] has sparked debate about their putative biogenicity. We have been working to constrain the physical and chemical conditions within the basalts at the time of alteration in order to put together a model of the mechanisms of alteration and preservation of the features.

Using a number of synchrotron-based X-ray microprobe and microspectroscopy techniques we have been able to geochemically characterize these alteration features at the sub-micron scale. We have mapped both major and trace element distributions in numerous tubular and granular alteration features, which shows intriguing patterns of mineral dissolution and authigenic precipitation. In addition, we have collected micro-diffraction patterns and analyzed the oxidation and coordination states of major and trace elements in potential biominerals, which may have formed as a result of microbial metabolic processes. We have been able to show that the mechanism of formation of the tubules clearly involves initial dissolution of the glass, followed by precipitation of authigenic minerals, with concomitant partial to complete oxidation of the reduced metals, such as Fe and sometimes Mn. XANES analyses have also revealed the coordination chemistries of these metals, leading to the identification of target phases that are potential biominerals.

[1] Furnes *et al.* (2004) *Science* **304**, 578–581. [2] Staudigel *et al.* (2008) *Earth Sci. Rev.* **89**, 156–176. [3] Banerjee *et al.* (2006) *EPSL* **241**, 707–722.

The study on arsenic stabilization using recycled mine sludge

M.S. KO¹, J.Y. KIM¹, J.S. LEE², J.I. KO² AND
K.W. KIM^{1*}

¹School of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju 500-712, Republic of Korea

²Technology Research Center, Mine Reclamation Corporation (MIRECO), Seoul, 110-727, Republic of Korea

Materials and methods

The stabilization efficiencies of arsenic (As) in contaminated soil were evaluated using mine sludge collected from an acid mine drainage (AMD) treatment system. The soil samples were collected from the Chungyang area, where abandoned Au-Ag mines are located in South Korea. As (V) and As (III) sorption properties were investigated to evaluate the As sorption capacity of mine sludge. The stabilization experiments of As in soil carried out various ratio of mine sludge.

Results and discussion

The pH of the soil samples was 5.07, and the soil texture was silt loam (sand 33%, silt 63%, clay 4%). The CEC value and LOI were 19.8 meq/100 g and 25.6%, respectively. From the results of the SPLP and TCLP tests, the arsenic concentrations in the studied soil were 0.23 and 1.14 mg/kg, respectively. These results show a lower value for the TCLP than that proposed by the USEPA (5 mg/kg). The total arsenic concentration via aqua regia digestion of the soil was 145 mg/kg.

In the kinetic experiments, 99% of As (V) was removed within 3 min and 20% of As (III) was removed from the solution after 20 min and 98% within 12 hours. As (V) and As (III) adsorption process is not pH dependent, and the adsorption isotherm of As (V) and As (III) followed Langmuir isotherm model.

The pH variation depends on the mine sludge ratio (0, 0.5, 3 and 5 wt%) to total soil weight in As stabilization experiments. The extracted arsenic concentrations increased in the control experimental set. The average As concentration was 2.8 µg/L at the 0.5 wt% mine sludge mixed set, and 1.3 µg/L of As was extracted from both 3 and 5 wt% experimental sets. These results suggested that mine sludge influenced on As stabilization and 3 wt% of mine sludge suitable for stabilization of As in soil.