Contrasting biogeochemistry of arsenic in two reservoirs on the Los Angeles Aqueduct, California, USA

JANET G. HERING

California Institute of Technology, Environmental Science & Engineering, Pasadena, CA, USA (jhering@caltech.edu)

Reservoirs as a Laboratory for Lake Processes

Engineering controls imposed on reservoirs for the management of water supply and water quality may (deliberately or not) provide insight into biogeochemical processes in lakes. Reservoirs are subject to altered conditions (e.g., of storage and flow) whose influences on the biogeochemical cycling of elements may be examined. Two examples are provided by Crowley Lake and North Haiwee reservoir on the Los Angeles Aqueduct (LAA), which delivers ca. 1.7×10^9 L per day to serve a population of approximately 3.2 million people. Arsenic concentrations in the LAA water supply are naturally elevated as a result of geothermal inputs above Crowley Lake.

Redox speciation of arsenic in the water column of Crowley Lake

The profiles of manganese and phosphorus in the water column of Crowley Lake under stratified conditions reflect both release from the sediments and the withdrawal and replacement of hypolimnetic water. In contrast, profiles of total arsenic in the water column did not indicate release from the sediments. Arsenic was present as arsenate in the epilimnion and as a mixture of arsenate and arsenite in the hypolimnion. During the period of stratification, the redox speciation of arsenic in the hypolimnion unexpectedly shifted toward the more oxidized arsenate species. This was attributed to the replenishment of the hypolimnion with arsenate-bearing surface waters, driven by reservoir operations.

Mobilization of arsenic in the porewaters of the sediment in N. Haiwee Reservoir

Arsenic is deposited to the sediments of N. Haiwee Reservoir as a consequence of additions of ferric chloride to the Aqueduct above Haiwee. This practice is designed to lower the arsenic concentrations in water supplied to Los Angeles. Mobilization of arsenic, iron, and manganese was observed at depth in the sediment porewaters but diffusion into the overlying water is prevented by an uppermost sediment layer with low porewater concentrations of all three elements. Only a small fraction of the arsenic and iron present in the sediments appears to be remobilized, suggesting a kinetic control over the process of reductive dissolution.

Multiple sources for ultrapotassic arc magmas from Batu Tara Volcano, Indonesia

J.S. HERRIN[1], I.K. NIKOGOSIAN[2], M.J. VAN BERGEN[1], AND P.R.D. MASON[1]

[1]Utrecht University, Netherlands (jherrin@geo.uu.nl)
[2]Vrije Universiteit Amsterdam, Netherlands

Ultrapotassic volcanics in arc settings are a typical expression of post-collisional magmatism, but the exact mechanism of their genesis remains elusive. Batu Tara is an active ultrapotassic volcano in a sector of the eastern Sunda Arc that is colliding with the Australian continental margin. Bulk lavas show a considerable range of chemical and isotopic compositions, which cannot be explained by simple (A)FC processes. The lavas are highly enriched in incompatible elements, yet demonstrate arc-like characteristics such as relative depletion of HFSE. Sr-Nd-Pb-He isotopes provide evidence for involvement of a continental component in variable proportions. However, identification of parental magmas from bulk samples is complicated by considerable petrographic evidence for magma mixing and crystal accumulation. Melt inclusions reveal the genesis of subduction-related ultrapotassic rocks in more detail. LA-ICP-MS analysis of homogenized melt inclusions in olivine and clinopyroxene phenocrysts reveals distinct parental melts with compositional contrasts even greater than those found in bulk rock analysis. Olivine-hosted melt inclusions (<7 wt% MgO, >44 wt% SiO_2, <11 wt% CaO, >4 wt% K_2O) contain 140-400 ppm Zr, 30-120 ppm La, and 900-2230 ppm Ba. They show increasing Zr/Nb (7-19) with increasing Ba/Nb (30-200) and Cl (600-3000ppm), indicating mixing of a melt derived from a relatively 'undepleted' source which experienced a relatively small amount of fluid addition, with a melt derived from a more 'depleted' source having experienced a greater amount of fluid addition. Our melt-inclusion data thus substantiate the coexistence of magmas derived from at least two sources within the Batu Tara system. We speculate that introduction of continental material favors conditions for the simultaneous melting of sub-arc mantle domains with different imprints of slab-derived components, and that this is a common feature in collision settings where ultrapotassic magmas are generated.