Geochemical and hydrologic controls of copper-rich surface waters in the Yerba Loca-Mapocho system

M. Montecinos, P. Pasten, Marina Coquery, E.G. Pizarro, M. I. Abarca, G. J. Arce

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Mauricio Montecinos[1], *Pablo Pasten*[2], *Marina Coquery*[3], *Gonzalo E Pizarro*[1], *María Ignacia Abarca*[4] *and Guillermo José Arce*[4], *(1)Pontificia Universidad Catolica de Chile, Santiago, Chile, (2)Centro de Desarrollo Urbano Sustentable, Santiago, Chile, (3)IRSTEA, UR MALY (Freshwater Systems Ecology and Pollution), F-69626 Villeurbanne Cedex, France, (4)Pontifical Catholic University of Chile, Santiago, Chile*

Abstract:
Andean watersheds in Northern and Central Chile are naturally enriched with metals, many of them associated to sulfide mineralizations related to copper mining districts. The natural and anthropogenic influx of toxic metals into drinking water sources pose a sustainability challenge for cities that need to provide safe water with the smallest footprint. This work presents our study of the transformations of copper in the Yerba Loca-Mapocho system. Our sampling campaign started from the headwaters at La Paloma Glacier and continues to the inlet of the San Enrique drinking water treatment plant, a system feeding municipalities in the Eastern area of Santiago, Chile. Depending on the season, total copper concentrations go as high as 22 mg/L for the upper sections, which become diluted to <5 mg/L downstream. pH ranged from 3 to 5.6 while suspended solids ranged from <10 to 100 mg/L. We used Geochemist Workbench to assess copper speciation and to evaluate the thermodynamic controls for the formation and dissolution of solid phases. A sediment trap was used to concentrate suspended particulate matter, which was analyzed with ICP-MS, TXRF (total reflection X ray fluorescence) and XRD (X-ray diffraction). Major elements detected in the precipitates were Al (200 g/kg), S (60 g/kg), and Cu (6 g/kg). Likely solid phases include hydrous amorphous phases of aluminum hydroxides and sulfates, and copper hydroxides/carbonates. Efforts are undergoing to find the optimal mixing ratios between the acidic stream and more alkaline streams to maximize attenuation of dissolved copper. The results of this research could be used for enhancing in-stream natural attenuation of copper and reducing treatment needs at the drinking water facility.

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