Copper attenuation in a river confluence receiving acid drainage in Central Chile: Coupling of physical and chemical processes

M. MONTECINOS[1], M. BRETIER[2], A. DABRIN[2], M. ALSINA[3], M. COQUERY[2], P.PASTÉN[1,4]

[1]Pontificia Universidad Catolica de Chile, Santiago, Macul 6904411, Chile (*correspondence: ppasten@ing.puc.cl)
[2]IRSTEA, U.R. MALY, 5 Rue de la Doua, CS70077-69626 Villeurbanne Cedex, France
[3]Department of Civil and Environmental Engineering, Northwestern University, Evanston, IL 60201, USA
[4]CEDEUS, El Comendador 1916, Providencia, Santiago, Chile

The dynamics of neutralization of acid drainage in river confluences plays a key role in the attenuation of metals. In this work, we address the natural attenuation of Cu in a river confluence in the upper Mapocho watershed. This watershed hosts one of the largest known copper reserves and it is also a source of drinking water for Santiago, Chile.

The chemistry controlling the formation of precipitates has been addressed previously. However, properties determining the physical fate of particles, like particle size distribution (PSD), have seldom been addressed concurrently with metal speciation. We studied the confluence between the Yerba Loca River, an acidic river with high Cu concentrations (pH=3.5–4.9; Cu=4.5–9.4 mg/L; Al=4.5–34 mg/L; Fe=0–56 mg/L) and the San Francisco River (pH= 6.7–7.8; Cu=0–0.2 mg/L; Al=0.1 1.1 mg/L; Fe=0.1–1 mg/L;). We used laser in-situ scatter transmissometry along with hydrochemical measurements to study particle assemblages formed at the confluence. A geochemical thermodynamic model was used in combination with an estimation of floc settling velocities to contrast the theoretical Cu removal by sorption, precipitation and settling, with the observed Cu attenuation for different hydrological scenarios.

Our results highlight key interactions between hydrological, hydrochemical and hydrodynamic processes controlling metal mobility in river confluences receiving acid drainage. This knowledge is relevant to evaluate future scenarios of metal mobility in copper-enriched Andean watersheds with urban development and mining activity in a context of climate change.

Acknowledgements: FONDECYT-CONICYT 1161337, CONICYT-PCHA Doctorado Nacional 2015-21151580, FONDAP-CONICYT 15110020, ECOS-CONICYT C15U03.