

The effect of Fe cycling on redox-sensitive trace metals in mafic/ultramafic catchments

ADRIANUS DAMANIK¹, MARTIN WILLE¹, QASID AHMAD², SEAN A. CROWE³, KOHEN W BAUER⁴, SRI YUDAWATI CAHYARINI⁵, SATRIA BIJAKSANA⁶, JAMES M. RUSSELL⁷ AND HENDRIK VOGEL¹

¹Institute of Geological Sciences, University of Bern

²Université de Lorraine, CNRS, CRPG

³University of British Columbia

⁴University of Victoria, Ocean Networks Canada

⁵Research Center of Climate and Atmosphere, National Research and Innovation Agency

⁶Faculty of Mining and Petroleum Engineering, Institut Teknologi Bandung

⁷Brown University

A substantial fraction of the Earth surface, particularly in tropical regions, is covered by laterites and associated metal weathering products. High precipitation and erosion rates in these regions transfer laterite derived metal substrates with to aquatic environments, causing downstream ecological effects including potential toxicity. In particular, tropical soils that develop on mafic/ultramafic bedrock contain high concentrations of Fe oxyhydroxide minerals, which often exert the primary control on the mobility of redox sensitive trace metals, such as Mo, Cr and V, during soil formation.

Within the East Sulawesi Ophiolite complex, thick lateritic weathering profiles developed on ultramafic mantle rocks form the catchment of the Malili Lake system, including Lake Towuti. Intensive weathering supplies the lake with a strong influx of Fe (hydr-)oxides but little sulfate, leading to sulfate-poor lake water and anoxic ferruginous conditions below the lakes oxycline. The covariation between Mo concentration and clay content of lake surface sediment suggests hydrodynamic sorting as one possible process driving spatial variations in $\delta^{98}\text{Mo}$. However, while the concentration weighted average $\delta^{98}\text{Mo}$ the soils is indistinguishable from to that of the ultramafic bedrock implying a small dissolved Mo output from the soil horizons, the concentration weighted average $\delta^{98}\text{Mo}$ of lake surface sediments is lower. This indicates that limnological processes mobilize and isotopically fractionate Mo- These processes are likely coupled to active Fe-reduction below the oxycline in the water column and/or early diagenetic processes within the upper sediment column that partly transforms crystalline Fe to amorphous Fe phases. By implicating Fe redox reactions in the cycling of Mo this study connects multiple multiple elemental and isotopic proxies to macronutrient availability and its close coupling to the turnover of organic C.