Using stable isotopes of Cr to monitor PGE enrichment in lateritic soils developed under cold and humid climates

J. RIVERA[1*], M. REICH[1], R. SCHOENBERG[2], J. M. GONZÁLEZ-JIMÉNEZ[3], ,F. BARRA[1], J. PROENZA[4], T. AIGLSPERGER[4], S. CARRETIER[5]

[1]Dept. of Geology and Andean Geothermal Center of Excellence, FCFM, Universidad de Chile, Santiago
[2]Dept. of Geosciences, University of Tübingen, Germany
[3] Dept. de Mineralogía y Petrología and Instituto Andaluz de Ciencias de la Tierra (Universidad de Granada-CSIC)
[4] Dept. de Mineralogia, Petrologia i Geologia Aplicada, Universitat de Barcelona, Barcelona, Spain
[5]GET, Université de Toulouse, CNRS, IRD, France
Javier.rivera.geo@gmail.com

Weathering of ultramafic rocks, under humid tropical conditions leads to the development of soil profiles of variable thickness with high metal (eg. Fe, Ni, Co) and PGE (Pt, Pd) contents, also known as “laterites”. Although the mobility and secondary accumulation of PGEs under surficial conditions is still debated, geochemical models support the remobilization of, e.g., Pd at neutral pH even under cold and humid climate conditions. It is likely that the progressive enrichment of PGEs during laterization is controlled by incorporation onto secondary phases including Fe-Mn oxyhydroxides, although physical/mechanical dispersion of PGM particles may also play a role during enrichment.

In order to evaluate the geochemical and physical controls on PGE enrichment under cold and humid conditions, we studied five soil profiles developed above serpentinized ultramafic rocks and gabbros at La Cabaña, in southern Chile. Our approach combined major and trace element geochemistry with Cr stable isotope data along soil profiles of variable thickness. The Cr isotope systematics were used here as a soil redox proxy due to well-documented fractionation of Cr(VI) to Cr(III) during reduction, which generates a fractionation towards lighter isotopic signatures. The measured $\delta^{53/52}$Cr values show slight variations among the profiles (- 0.320 to + 0.129 ‰), but most importantly, in Fe-Mn -rich soil horizons, where more negative $\delta^{53/52}$Cr values correlate with both Pd enrichment and the intensity of weathering, defined as an index of Al and Fe retention versus Mg and Si loss. These results point to a strong redox control on the mobility and sequestration of Pd in the surficial environment, most likely modulated by the presence of Fe-Mn oxyhydroxides.