

Petrogenesis of Cenozoic plateau lavas from the Pali Aike Volcanic Field and Morro Chico Volcano, southern Patagonia in South America

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Geochemical and Sr-Nd-Pb isotopic analyses of late Miocene to Quaternary plateau lavas from the Pali Aike Volcanic Field (PAVF) and Morro Chico Volcano (MCV) (52°S) were undertaken to constrain the melting processes and mantle sources that contributed to magma generation and the geodynamic evolution of southernmost Patagonia, South America. The PAVF and MCV lavas are alkaline (PAVF, 45–49 wt% SiO₂; 4.3–5.9 wt% Na₂O+K₂O) and subalkaline (MCV, 50.5–50.8 wt% SiO₂; 4.0–4.4 wt% Na₂O+K₂O), relatively primitive mafic volcanic rocks that have typical intraplate ocean island basalt-like signatures. Incompatible trace element ratios and isotopic ratios of the PAVF and MCV lavas differ from those of the majority of Neogene southern Patagonian slab window lavas in showing more enriched characteristics and are similar to high-μ (HIMU) end-member basalt. The REE melting model suggests that these lavas were produced by low degrees of partial melting of a garnet lherzolite mantle source. The major systematic variations of Sr-Nd-Pb isotopes in southern Patagonian lavas are related to geographic location. The PAVF and MCV lavas from the southernmost part of Patagonia have lower ⁸⁷Sr/⁸⁶Sr and higher ¹⁴³Nd/¹⁴⁴Nd and ²⁰⁶Pb/²⁰⁴Pb ratios, relative to most of the southern Patagonian lavas erupted north of 49.5°S, pointing to a HIMU-like signature. An isotopically depleted and HIMU-like asthenospheric domain may have been the main source of magmas in the southernmost part of Patagonia, suggesting the presence of a major discontinuity in the isotopic composition of the asthenosphere in southern Patagonia. On the basis of geochemical and isotope data and the available geological and geotectonic reconstructions, a link between the HIMU asthenospheric mantle domain beneath southernmost Patagonia and the HIMU mega-province of the southwestern Pacific Ocean is proposed.

Organic matter effects on xenobiotic sorption at critical zone interfaces

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Processes ranging from rhizosphere exudation to anthropogenic wastewater discharge result in infusion of reduced carbon compounds into the upper critical zone. This drives incongruent (bio)weathering reactions toward products that include neo-formed secondary minerals and their nanoparticulate complexes with natural organic matter. Mobility of these colloids in soil pore water depends on system hydrochemistry and microbial response. Increasingly thrust into the mix are organic micropollutants (OMPs) from human activity. Several research groups have been documenting a widespread distribution of OMPs in watersheds worldwide. These include endocrine disrupting compounds that exhibit biological effect even at trace concentration. We hypothesize that the fate of these micropollutants is coupled to their interfacial reactivity with bio-inorganic products of critical zone weathering.

Since many OMPs released to the environment are polar and/or ionic, their fate is often controlled by interfacial reactions that are highly sensitive to OMP and surface functional group composition and charge, with strong dependence on solution chemistry of contaminant sorptive partitioning. Such reactions are also affected by aqueous phase OMP complexation with solutes including dissolved organic matter (DOM). Ternary OMP-DOM-surface reactions may be particularly important in microbially-active pore waters where DOM enters and exits the aqueous phase, and where mineral surfaces are often masked by biomolecular coatings resulting from DOM sorptive fractionation.

Given the known capability of OM constituents to form aggregated “supramolecular” structures, we postulate that OMPs may enter into DOM aggregates by similar modes of association. Many OMPs possess polar, ionic and/or hydrophobic functional groups like those of DOM components, and so processes such as H-bonding, cation bridging, and hydrophobic interaction that promote DOM aggregation are likely to also sequester OMPs. This should, in turn, affect OMP reactivity toward surfaces and, by extension, environmental transport. For example, we have shown via aqueous infusion experiments that effective separation and quantification of OMPs via LC-MS/MS methodologies are diminished in DOM-containing solutions (Wickramasekara et al., 2012). Additional model systems experiments under controlled laboratory conditions show that various DOM fractions differently affect the partitioning of OMPs in aqueous solutions monitored by LC-MS/MS. To help identify the DOM components involved in OMP interaction, we measured OMP-induced quenching of bulk and DOM fraction fluorescence (Hernandez-Ruiz et al., 2012). Results of several types of experiments indicate a strong role of hydrophilic acid DOM fractions in complexing the target analytes. The effect of DOM on OMP reaction at mineral surfaces is being investigated, to assess its impact on sorptive uptake and release of OMPs in natural systems.

[1] Wickramasekara et al. (2012) *Anal. Chim. Acta*
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[2] Hernandez-Ruiz et al. (2012) *Water Res.* **46**, 943-954.