P and Fe cycling in deep saprolite, Luquillo Mountains, Puerto Rico

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Rapid weathering and erosion rates in mountainous tropical watersheds lead to highly variable soil and saprolite thicknesses which in turn impact nutrient fluxes and biological populations. In the Luquillo Mountains of Puerto Rico, a 5 meter-thick saprolite contains high microorganism densities at the surface and at depth overlying bedrock. We test the hypotheses that these organisms are limited by the availability of P and Fe. Many tropical soils are P limited, rather than N limited, and dissolution of apatite is a primary source of P. We document patterns of apatite weathering and of bioavailable Fe derived from the weathering of primary minerals hornblende and biotite in cores augered to 7.5 m on a ridgetop as compared to spheroidally weathering bedrock sampled in a nearby roadcut.

Iron isotopic compositions of 0.5 N HCl extracts of soil and saprolite range from about δ^{56}Fe = 0 to -0.1‰ throughout the saprolite except at the surface and at 5 m depth where δ^{56}Fe = -0.26 to -0.64‰. The enrichment of light isotopes in HCl-extractable Fe in the soil and at the saprolite-bedrock interface is consistent both with active Fe cycling and with the locations of high cell densities and Fe(II)-oxidizing bacteria, identified previously. To evaluate the potential P-limitation of Fe-cycling bacteria in the profile, bulk P was measured as a function of depth and weathering apatite crystals were examined in thin sections and an apatite dissolution rate of 5.5×10^{-15} mol $m^{-2}s^{-1}$ was calculated. While surface communities depend on recycled nutrients and atmospheric inputs, deep communities survive primarily on nutrients released by the weathering bedrock and thus are tightly coupled to processes related to saprolite formation. While low available P may limit microbial activity within the middle saprolite, fluxes of P from apatite weathering should be sufficient to support robust growth of microorganisms in the deep saprolite.

An Andean-type arc on the western margin of Rodinia – Evidence from Neoproterozoic ultramafic rocks in the Andriamena region, Madagascar

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The ultramafic-mafic complexes intruding into Archaean ortho- and paragneisses in the Andriamena region of north-central Madagascar fall within the domain of a ~900-km-long belt consisting of gabbroic and granitoid plutons that has been interpreted as the roots of a Neoproterozoic (700-800 Ma) continental arc [1, 2]. This Andean-type arc is reported to extend from north-central Madagascar through the Seychelles into India [3, 4]. The ultramafic bodies are crudely zoned, with dunite forming the cores surrounded by harzburgite, lherzolite, pyroxenite, pegmatoidal pyroxenite and marginal fine-grained gabbroic rocks. One sampled contact between an ultramafic body and the basement is chilled and sharp, indicating an intrusive rather than a sheared contact; this argues against allochthonous emplacement as in ophiolite suites. The composition of this chilled basaltic margin is similar to volcanic lithologies from well-known continental arcs. PGE data from the Lavatrafo body show enrichment in the Pd-group PGEs and prominent negative Ru anomalies. $[Ru/Ru^*]_N$ ranges from 0.037 to 0.31 with average $[Ru/Ir]_N = 0.17$. Zoned Alaskan-Uralian-type complexes, which generally form the roots of continental arcs, characteristically display such features where $[Ru/Ru^*]_N$ varies between 0.032 and 0.17 and average $[Ru/Ir]_N = 0.13$ [5]. A U-Pb single zircon step-wise evaporation age of 787 ± 16 Ma was obtained by Guerrot *et al.* [6] for the basic rocks around Andriamena. This age coincides with the reported age range of other proposed continental-arc fragments in the ~900-km-long belt [2–4]. We suggest that the Andriamena complexes represent the roots of an Andean-type arc and provide new evidence, in the form of ultramafic intrusions, for a convergent margin on the western edge of the Rodinian supercontinent where eastward subduction occurred underneath the continental terrains of Madagascar, the Seychelles and NW India.

[1] Goncalves *et al*. (2003) *Precamb. Res.* **123**, 135-157. [2] Handke *et al*. (1999) *Geology* **27**, 351-354. [3] Ashwal *et al*. (2002) *Jour. Petrology* **43**, 45-83. [4] Torsvik *et al*. (2001) *Precamb. Res.* **108**, 319-333. [5] Johan (2002) *CIM Special Volume* **54**, 669-719. [6] Guerrot *et al.* (1993) *Terra Abstracts* **5**, p 387.