Cosmogenic ^{3}He in Goethite

D. L. SHUSTER[1], K. A. FARLEY[2], P. M. VASCONCELOS[3]

[1]California Institute of Technology, Division of Geological and Planetary Sciences, Pasadena, CA 91125-2500, USA [1](dshuster@caltech.edu), [2](farley@gps.caltech.edu)
[3]University of Queensland, Department of Earth Sciences, Brisbane, Queensland 4072, Australia (paulo@sol.earthsciences.uq.edu.au)

Materials composed of Fe and O and exposed to cosmic ray secondary neutrons at earth's surface should experience appreciable spallogenic ^{3}He production (Masarik and Reedy, 1996). Our ongoing work to (U-Th)/He date supergene goethite (FeOOH) suggests that this mineral retains He at low temperatures (<40 ºC). To test our hypothesis that goethite may be a suitable phase for surface exposure studies, we measured ^{3}He concentrations in high- to moderate-purity goethites collected along a recently excavated, 2-meter depth profile at the top of a laterite in Carajas, Brazil (6º S, 720m elev.). Whereas several goethites from greater depths (100m) at nearby sites do not contain significant amounts of ^{3}He (_ $5x10^5$ atoms/gm), the near-surface samples contain ^{3}He concentrations ranging from ~$2.2x10^7$ to ~$3.9x10^8$ atoms/gm. The depth profile (Fig. 1) reveals a maximum ^{3}He concentration at the surface and systematic decrease with depth that we believe is consistent with in-situ cosmogenic production. Aliquots of the uppermost sample, however, reveal a complicated pattern (Fig. 1, zero depth). The (U-Th)/He-ages of these aliquots strongly correlate [^{3}He]. We believe this indicates varying exposure due to dissolution/precipitation taking place at the laterite surface, resulting in multiple generations of goethite.

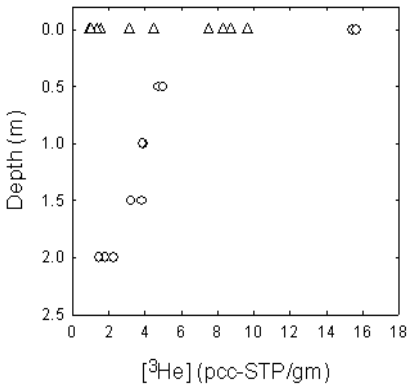

Figure 1: [^{3}He] Vs. Depth

Due to its ubiquity as a weathering product, goethite offers great potential for the study of surface processes. The ability to determine a precipitation age and exposure age on a single phase would allow one to explore the full dimensional space of the classic depth-age-erosion rate problem.

Reference

Masarik J., Reedy R.C., (1996) *Radiocarbon* **38**, p. 163.

Silver, Osmium and Iridium profiles in the Massignano Eocene-Oligo C and O isotopes in early Paleoproterozoic carbonate rocks from the Minas Supergroup, Minas Gerais, Brazil

A.N. SIAL[1], V.P. FERREIRA[1], A.W. ROMANO[2] AND M.M. PIMENTEL[3]

[1] NEG-LABISE, Dept. Geology, UFPE, Recife, Brazil, 50732-970 (ans@npd.ufpe.br)
[2] Inst. of Geosc., UFMG, B. Horizonte, Brazil, 30430
[3] Inst. of Geosc., UnB, Brasilia, D.F., Brazil, 70910

The Paleoproterozoic δ^{13}Ccarb positive excursion (2.25-2.05Ga, Lomagundi phenomenon) has global character, but its occurrence in South America has never been reported. To investigating this anomaly in Brazil, C and O isotopes were analyzed in early Paleoproterozoic shallow water, marine carbonates of the Minas Supergroup (Gandarela, Cercadinho and Fecho do Funil Fms.).

The 2.42-old Gandarela Fm. consists of red carbonate BIF at the base of the sequence, gradually replaced upwards by buff dolomites, and limestones in light and dark-gray alternating bands on a cm scale that, locally, exhibit stromatolitic structure. Carbonates display δ^{13}Ccarb from –1.6 to +0.4‰$_{PDB}$ (n=58), the most negative values found in red dolomites that overlie the finely-laminated Cauê banded iron formations. At the Heargraves quarry, Gandarela carbonates yielded δ^{13}Ccarb from –1.4 to +0.6‰$_{PDB}$ (n=28). In the Cercadinho Fm., at the base of the Piracicaba Group, δ^{13}Ccarb varies from +3.3 to +4.2‰$_{PDB}$ (n=10), values decreasing erraticaly with depth.

The Fecho do Funil dolomites (2.11±0.11Ga, deformation/metamorphic age) were deposited, probably, within the time span for the Lomagundi positive excursion age of the Kaapval craton, Africa. The sampled section of this Formation consists of fine-grained, stromatolite-rich white dolostone at the base, followed upsection by a stromatolite-rich pink dolostone and then by fine-grained white marble. This carbonate sequence is separated from an upper one, by a 15 m thick sequence of black slates. The upper carbonate sequence is characterized by an alternation of dark, micritic calcilutite and white to pink dolostone, in a zebra-like pattern.

Stratigraphically collected samples show δ^{13}Ccarb remarkably homogeneous (+6 to +6.5‰$_{PDB}$, n=47). The δ^{18}O also fairly constant (-9.7 to –10.8‰$_{PDB}$) show a trend which is rather antipathetic to the variation in C isotopes. These high δ^{13}Ccarb carbonates show little scatter, relatively shallow trend on δ^{13}Ccarb vs δ^{18}O diagram and are consistent with low-grade metamorphic decarbonation. The elevated C-isotope values were least reset and probably reflect their protolith composition, rather than subsequent diagenetic or metamorphic processes and this Formation is a proxy, in South America, for the global Lomagundi phenomenon.