(U-Th)/He geochronology and $\delta^{18}O$ values of goethite in weathering profiles

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The application of geochronologic methods to common weathering reaction minerals such as oxyhydroxides has shown the episodic nature of weathering profile development [1]. Deep lateritic weathering profiles have particularly protracted histories that have been found to create some of the most stable landscapes on Earth [1,2]. Goethite cements from highly developed weathering profiles in the Carajas region of Brazil and Hamersley Province, Australia were measured for their $\delta^{18}O$ value in addition to obtaining ages by the (U-Th)/He method. Little exploration of weathering profile minerals by this combination of methods has been done.

Oxygen isotopes from 34 grains of goethite from 24 samples from 5 localities were measured by the laser fluorination method. The $\delta^{18}O_{VSMOW}$ value of goethites from weathering profiles at Roy Hill, Lynn Peak and Yandi in Australia and Igarape Bahia in Brazil range from -2.5‰ to 1.5‰. However, the $\delta^{18}O_{VSMOW}$ value of goethite samples from the weathering profile at Brockman in Australia ranges from 11.3‰ to 11.9‰. This result is higher than any other reported oxygen isotope value for weathering profile goethite. (U-Th)/He dates of 15 grains from 4 samples in one hand specimen collected at Brockman yield precipitation ages ranging from 10.5 ± 0.6 Ma to 6.0 ± 0.4 Ma. The weathering profile at Yandi shows a very similar distribution of ages but without the distinctly heavy $\delta^{18}O$ values.

We hypothesize that the weathering profile at Brockman developed in environment where evaporation of surfice or soil waters led to heavy oxygen isotope enrichment; we will test this possibility using hydrogen isotope measurements. In addition to understanding the weathering profile history at Brockman, the combination of (U-Th)/He geochronology and $\delta^{18}O$ measurements on goethite cement offers access to a wealth of paleoclimate and paleoenvironmental information. The ubiquity of well presered weathering profiles on Earth makes this a particularly attractive pair of methods.

[1] Vasconcelos, Goldschmidt Abstract 2013, p2401 [2] Shuster, D. L. *et al* (2012) *EPSL*, ***329-330*** (2012) p41–50