$^{18}O/^{16}O$ and D/H of Miocene age pedogenic CID goethite

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Channel iron deposits (CIDs) in Western Australia are ore-grade accumulations of pedogenic goethite/hematite ooids that formed during intense chemical weathering in a Miocene climatic extreme. Oolitic goethite/hematite samples from cores drilled in CID on Mesa J in the Robe River area were obtained from the CSIRO. $^{18}O/^{16}O$ and D/H measured in goethite samples that are also analyzed using (U-Th)/He and $^{4}He/^{3}He$ chronometry provide information on temperature, timing of crystallization, and isotopic characteristics of ancient water. Admixed minerals complicate oxygen isotopic analysis of goethite, but the CID samples provide an opportunity to compare (1) results from a method that uses the kinetics of the goethite-hematite phase transition with (2) results obtained using a mass balance approach. The data obtained thus far from the two methods are in reasonable agreement for the test CID material. The goethite $\delta^{18}O$ value is -2.4‰. The δD value is -153‰. For ancient meteoric waters whose δD and $\delta^{18}O$ values plot on, or very near, the modern GMWL, the oolitic goethite isotopic composition implies a temperature of crystallization of about 18 (±3)°C. The corresponding $\delta^{18}O$ value of the ancient GMWL-type water was -9.3‰. If representative, such a negative $\delta^{18}O$ value for the low altitude Miocene meteoric water suggests that local precipitation intensities at that time were substantially higher, on average, than today. Moreover, the inferred temperature for the Miocene subtropics may reflect seasonal crystallization of pedogenic goethite, perhaps at times when cloud cover and intense rainfall had cooled the soil to some extent.