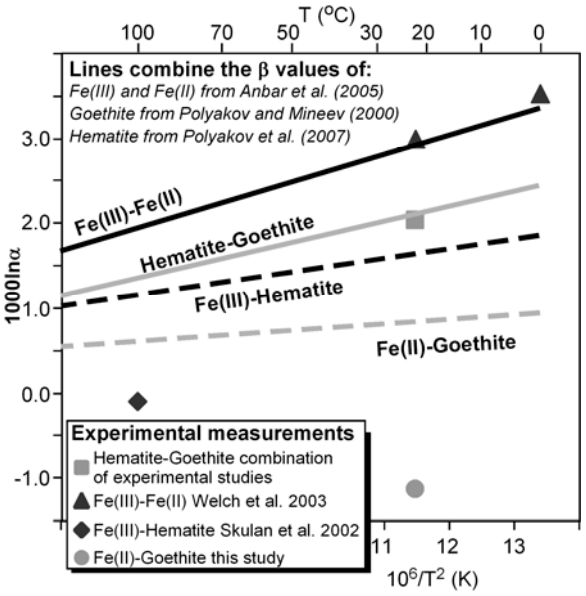
Experimental determination of the Fe isotope fractionation between Fe(II) and goethite

BRIAN L. BEARD[1,2], ROBERT HANDLER[3], CLARK M. JOHNSON[1,2] AND MICHELLE SCHERER[3]

[1]Univ. Wisconsin-Madison (beardb@geology.wisc.edu)
[2]NASA Astrobiology Institute
[3]The University of Iowa

The $^{56}Fe/^{54}Fe$ fractionation between aqueous Fe(II) and goethite was measured using the three isotope method. Six replicate experiments conducted at 25°C and a pH of 7.5 produced a weighted average Fe(II)-goethite equilibrium Fe isotope fractionation factor or -1.13 $\pm$ 0.07 (2-σ) ‰.

The aqueous Fe(II)-Fe(III) and goethite-hematite experimental results from our group agree with calculated fractionation factors based on spectroscopic data for these different species by [1] for Fe(II)-Fe(III) and for hematite and goethite by [2-3] (see figure). However, combining the calculated β values from these studies results in significant differences compared to experimental measurements. These inconsistencies might be reconcilable if scaling factors are applied to the predicted β values, which would allow an internally consistent set of fractionation factors to be defined in the system $Fe(II)_{aq}$-$Fe(III)_{aq}$-hematite-goethite.



[1] Anbar *et al.* (2005) *GCA* **69**, 825-837. [2] Polyakov & Mineev (2000) *GCA* **64**, 849-865. [3] Polyakov *et al.* (2007) *GCA* **71**, 3833-3846.

Continental flood basalts and mantle plumes: A case study of the Northern Ethiopian plateau

L. BECCALUVA[1], G. BIANCHINI[1,2], C. NATALI[1]* AND F. SIENA[1]

[1]Earth Sciences Department , University of Ferrara, 44100 Ferrara, Italy (bcc@unife.it, snr@unife.it) (*correspondence: ntlcld@unife.it)
[2]School of Geology, Geography and the Environment, Kingston University, Penrhyn Road, Kingston upon Thames, Surrey KT1 2EE, UK (G.Bianchini@kingston.co.ac.uk)

New geochemical data integrated in a petrogenetic model indicate that the Northern Ethiopian Continental Flood Basalts (CFB; ca. 30 Ma) preserve a record of magmas generated from the centre to the flanks of a plume head, currently corresponding to the "Afar hot spot". Basaltic lavas appear zonally arranged with Low–Ti tholeiites (LT) in the west, High–Ti tholeiites (HT1) to the east and very High–Ti transitional basalts and picrites (HT2, TiO_2 4–6 wt%) closer to the Afar triple point. Modelling elemental distribution provides estimates of the P–T–X conditions of magma sources showing that Ethiopian CFB could be generated in the pressure range of 1.3–3.0 GPa at an approximate depth of 40–100 km from mantle sources increasingly metasomatised and hotter (1200–1500°C) from west to east, i.e. from the outer zones (LT) to the core of the plume head (HT2 ultra-titaniferous basalts and picrites). Metasomatising agents can be envisaged as alkali–silicate melts which integrate various geochemical components (e.g.: Ti, and related HFSE, LFSE, LREE, H_2O, noble gases etc.) both scavenged and pooled along the plume axis, and derived from heterogeneous mantle materials mixed during the plume's rise. This has significant implications for the current debate on mantle plumes, since the modelled compositionally and thermally zoned plume head (T excess > 300°C with respect to ambient mantle xenoliths) is in accordance with seismic tomography, buoyancy flux, as well as geochemical characteristics, thus supporting a deep provenance of the Afar plume, which possibly originated in the Transition Zone/Lower mantle.