

Please ensure that your abstract fits into one column on one page and complies with the *Instructions to Authors* available from the Abstract Submission web page.

## Evolution of the Oxidation State of the Earth's Mantle

L.R. DANIELSON<sup>1\*</sup>, K. RIGHTER<sup>2</sup>, L. KELLER<sup>2</sup>, R. CHRISTOFFERSEN<sup>1</sup>, Z. RAHMAN<sup>1</sup>

<sup>1</sup> Jacobs Technology, NASA-JSC, Houston, TX  
(lisa.r.danielson@nasa.gov\*, roy.chrisstoffersen-1@nasa.gov, zia.rahman-1@nasa.gov)

<sup>2</sup> NASA-JSC, Houston, TX 77058 (kevin.righter-1@nasa.gov, lindsay.p.keller@nasa.gov)

The oxidation state of the Earth's mantle during formation remains an unresolved question, whether it was constant throughout planetary accretion [1], transitioned from reduced to oxidized [2,3,4], or from oxidized to reduced [1,5]. We investigate the stability of Fe<sup>3+</sup> at depth, in order to constrain processes (water, late accretion, dissociation of FeO) which may reduce or oxidize the Earth's mantle.

In our previous experiments on shergottite compositions, variable fO<sub>2</sub>, T, and P <4 GPa, Fe<sup>3+</sup>/ΣFe decreased slightly with increasing P, similar to terrestrial basalt [6,7,8]. For oxidizing experiments < 7GPa, Fe<sup>3+</sup>/ΣFe decreased as well [9], but it's unclear from previous modelling whether the deeper mantle could retain significant Fe<sup>3+</sup> [1,10]. Our current experiments expand our pressure range deeper into the Earth's mantle and focus on compositions and conditions relevant to the early Earth. Preliminary multi-anvil experiments with Knippa basalt as the starting composition were conducted at 5-7 GPa and 1800 °C, using a molybdenum capsule to set the fO<sub>2</sub> near IW, by buffering with Mo-MoO<sub>3</sub>. TEM and EELS analyses revealed the run products quenched to polycrystalline phases, with the major phase pyroxene containing ≅ Fe<sup>3+/2+</sup>. Experiments are underway to produce glassy samples that can be measured by EELS and XANES, and are conducted at higher pressures.

[1]Righter and Ghiorso, 2012; [2]Rubie et al., 2011; [3]Wood et al., 2006; [4]Wänke and Dreibus, 1988; [5]Siebert et al., 2013; [6] Righter et al., 2013; [7] O'Neill, et al., 2006; [8] Kress and Carmichael, 1991; [9] Zhang et al., 2013; [10] Hirschmann, 2012