Preconditioning deep cratonic lithosphere for kimberlite genesis; Evidence from the central Slave Craton

G.M. YAXLEY*[1], A.J. BERRY[1], A. ROSENTHAL[2] & A.B. WOODLAND[3]

[1]Research School of Earth Sciences, The Australian National University (*correspondence: greg.yaxley@anu.edu.au; andrew.berry@anu.edu.au)
2Bayerisches Geoinstitut, Universität Bayreuth, Germany (anja.rosenthal@uni-bayreuth.de)
3Institut für Geowissenschaften, Goethe Universität, Germany (woodland@em.uni-frankfurt.de)

We present the first oxygen fugacity (fO_2) profile through the cratonic lithospheric mantle under the Ekati kimberlite field near Lac de Gras, central Slave Craton. Oxygen fugacity values for a suite of garnet peridotite xenoliths were calculated by combining conventional thermobarometry with Fe XANES and Mössbauer garnet $Fe^{3+}/\sum Fe$ measurements [1] using the oxybarometer calibration of Stagno *et al.* [2]. Combining these data with new and existing data [3] from garnet peridotite xenoliths from an almost coeval kimberlite at the nearby Diavik diamond mine demonstrates that the fO_2 of the Slave cratonic mantle varies by several orders of magnitude as a function of depth and over short lateral distances. The lower part of the diamond-bearing Slave lithosphere (>120-130 km deep) has been oxidized by up to 4 log fO_2 units. This is clearly linked to metasomatic enrichment recorded by elevated trace element contents in garnet and clinopyroxene and by garnet REE patterns. However, despite this deep, oxidising enrichment event, fO_2 levels in the lower half of the Slave Cratonic lithopshere are generally too reduced for carbonatite melts to exist. These are unlikely therefore to be the metasomatic agents. The coupled enrichment and oxidation was likely caused by infiltrating carbonate-bearing, hydrous, silicate melts in the presence of diamond. Such a process may be critical for "pre-conditioning" deep lithospheric mantle and rendering it suitable for generation of kimberlites, which are likely to form by partial melting of magnesite garnet peridotite near the base of the cratonic lithosphere [4].

[1] Berry, Yaxley, Woodland, & Foran (2010), *Chemical Geology* 278, 31-37. [2] Stagno, Ojwang, McCammon & Frost (2013), *Nature* 493, 84-88. [3] Creighton, Stachel, Eichenberg & Luth (2010), *Contributions to Mineralogy and Petrology* 159, 645-657.

[4] Girnis, Bulatov & Brey (2011) *Lithos* 127, 401-413.