Water and metasomatism in the Slave cratonic lithosphere (Canada): an FTIR study

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Water in the mantle influences melting, viscosity, seismic velocity, and electrical conductivity. The role played by water in the long-term stabilization of cratonic roots is currently being debated [1]. This study focuses on water contents of mantle minerals (olivine, pyroxene and garnet) from xenoliths found in kimberlites of the Archean Slave craton. 19 mantle xenoliths from central Lac de Gras, and 10 from northern Jericho were analyzed by FTIR for water, and their equilibration depths span the several compositional layers identified beneath the region [2]. At both locations, the shallow peridotites have lower water contents in their olivines (11-30 ppm H_2O) than those from the deeper layers (28-300 ppm H_2O). The driest olivines, however, are not at the base of the cratonic lithosphere (>6 GPa) as in the Kaapvaal craton [1]. Instead, the deepest olivines are hydrous (31-72 ppm H_2O at Lac de Gras and 275 ppm H_2O at Jericho). Correlations of water in clinopyroxene and garnet with their other trace element contents are consistent with water being added by metasomatism by melts resembling kimberlite precursors in the mantle ~0.35 Ga ago beneath Lac de Gras [1]. The northern Jericho xenoliths are derived from a region of the Slave craton that is even more chemically stratified, and was affected at depth by the 1.27 Ga Mackenzie igneous events [3,4]. Metasomatism at Jericho may be responsible for the particularly high olivine water contents (up to 300 ppm H_2O) compared to those at Lac de Gras, which will be investigated by acquiring trace-element data on these xenoliths. These data indicate that several episodes of metasomatic rehydration occurred in the deep part of the Slave craton mantle lithosphere, with the process being more intense in the northern part beneath Jericho, likely related to a translithospheric suture serving as a channel to introduce fluids and/or melts in the northern region [5]. Consequently, rehydration of the lithosphere does not necessarily cause cratonic root delamination and these peridotites may represent localized metasomatic zones – the wall rocks to kimberlite magma passage.

[1] Peslier et al. 2010 Nature 467, p78; [2] Aulbach et al. 2013 CG 352, p153; [3] Heaman et al. 2010 CJES 47, p369; [4] Kopylova et al. 2000 EPSL 181, p71; [5] Poudjom Djomani et al. 2005 GGG 6, n10.