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Water in the Cratonic Mantle: Insights from FTIR Data on Lac de Gras Xenoliths (Slave Craton, Canada)

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Abstract:
The mantle lithosphere beneath the cratonic part of continents is the deepest (> 200 km) and oldest (>2-3 Ga) on Earth, remaining a conundrum as to how these cratonic roots could have resisted delamination by asthenospheric convection over time. Water, or trace H incorporated in mineral defects, could be a key player in the evolution of continental lithosphere because it influences melting and rheology of the mantle [e.g., 1]. Mantle xenoliths from the Lac de Gras kimberlite in the Slave craton [2] were analyzed by FTIR. The cratonic mantle beneath Lac de Gras is stratified with shallow (<145 km) oxidized ultradepleted peridotites and pyroxenites with evidence for carbonatitic metasomatism, underlain by reduced and less depleted peridotites metasomatized by kimberlite melts [3,4]. Peridotites analyzed so far have H_2O contents in ppm weight of 7-100 in their olivines, 58 to 255 in their orthopyroxenes (opx), 11 to 84 in their garnet, and 139 in one clinopyroxene. A pyroxenite contains 58 ppm H_2O in opx and 5 ppm H_2O in its olivine and garnet. Olivine and garnet from the deep peridotites have a range of water contents extending to higher values than those from the shallow ones. The FTIR spectra of olivines from the shallow samples have more prominent Group II OH bands compared to the olivines from the deep samples, consistent with a more oxidized mantle environment [5]. The range of olivine water content is similar to that observed in Kaapvaal craton peridotites at the same depths (129-184 km [1]) but does not extend to as high values as those from Udachnaya (Siberian craton [6]). The Slave, Kaapvaal and Siberian cratons will be compared in terms of water content distribution, controls and role in cratonic root longevity.
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[2] Aulbach *et al.* 2007 *CMP* **154**, 409-427.
[3] Creighton *et al.* 2009 *CMP* **157**, 491-504.
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Back to: Volatiles and Earth's mantle processes

<< Previous Abstract | Next Abstract >>

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