Water in the lithospheric mantle beneath a Phanerozoic continental belt: FTIR analyses of Alligator Lake Xenoliths (Yukon, Canada)

Authors: McKensie Gelber, Anne H. Peslier, Alan D. Brandon

Water in the mantle influences melting, metasomatism, viscosity and electrical conductivity. The Alligator Lake mantle xenolith suite is one of three bimodal peridotite suites from the northern Canadian Cordillera brought to the surface by alkali basalts, i.e., it consists of chemically distinct lherzolites and harzburgites [1-2]. The lherzolites have equilibration temperatures about 50 °C lower than the harzburgites and are thought to represent the fertile upper mantle of the region. The harzburgites might have come from slightly deeper in the mantle and/or be the result of a melting event above an asthenospheric upwelling detected as a seismic anomaly at 400-500 km depth [3]. Major and trace element data are best interpreted as the lherzolite mantle having simultaneously experienced 20-25% partial melting and a metasomatic event to create the harzburgites [3]. Well-characterized xenoliths are being analyzed for water by FTIR. Harzburgites contain 29-52 ppm H_2O in orthopyroxene (opx) and ~140 ppm H_2O in clinopyroxene (cpx). The lherzolites have H_2O contents of 27-150 ppm in opx and 46-361 ppm in cpx. Despite correlating with enrichments in LREE, the water contents of the harzburgite pyroxenes are low relative to those of typical peridotite xenoliths [4], suggesting that the metasomatic agents were water-poor, contrarily to what has been suggested before [3]. The water content of cpx is about double that of opx indicating equilibrium. Olivine water contents are low (< 5 ppm H_2O) and out of equilibrium with those of opx and cpx, which may be due to H loss during xenolith ascent. This is consistent with olivines containing more water in their cores than their rims. Olivines exclusively exhibit water bands in the 3400-3000 cm^{-1} range, which may be indicative of a reduced environment [5].

[1] Francis. 1987 JP 28, 569-97.[2] Eiche et al. 1987 CMP 95, 191-201. [3] Shi et al. 1997 CMP 131, 39-53..[4] Peslier et al. 2015 GGG 154, 98-117.[5] Bai et al. 1993 PCM 19, 460-71.