

OH in peridotitic olivines entrained in kimberlitic magma

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FTIR spectra were measured on olivine grains from the peridotitic xenoliths collected from the Boshof dump (Kimberley, South Africa), the Finsch kimberlite (South Africa) and the Diavik A154 kimberlite (Canada). Each sample was fairly homogeneous in terms of intensity and frequency of OH IR-absorption bands. For large xenoliths such homogeneity implies that the system had approached some state of equilibrium and that the FTIR spectra are representative of the hydrogenation conditions. All samples could be divided into two major groups: peridotites containing olivines rich in hydroxyl (>100 ppm H₂O) and peridotites with olivines containing very low hydroxyl concentrations (<20 ppm). The majority of the measured peridotites belong to the hydroxyl-rich group. However, it is the hydroxyl-poor group that includes all of the studied diamondiferous peridotites. So far no significant differences in olivine spectra were observed between the Kaapvaal and Slave samples.

In the water-rich olivines hydroxyl produces strong IR absorption bands in the wavenumber range between 3420 and 3650 cm⁻¹ commonly referred to as to Group 1 bands. Such FTIR spectra suggest that the source peridotite approached equilibrium with a low aSiO₂ hydrous melt, e.g. a kimberlite. A comparison of measured hydroxyl concentrations with experimentally determined OH solubilities [1] provides minimum equilibration pressures 0.5 - 1GPa. At the same time pressures of chemical equilibration calculated for the studied peridotites are in the range between 3 and 4GPa. The latter allows to suggest that peridotites in the lithospheric mantle equilibrated with a melt with aH₂O ~ 0.1 - 0.2.

OH IR-absorption in the hydroxyl-poor olivines occurs mainly at lower frequencies in the wavenumber range between 3280 and 3370 cm⁻¹, these bands are commonly called Group 2 bands. Such spectra are characteristic of depleted (naturally anhydrous, low-Ti) peridotite in which crystalchemical equilibrium between olivine and orthopyroxene was not significantly affected by metasomatic reactions [1, 2]. In contrast to samples with hydroxyl-rich olivines, interaction with a hydrous melt was probably limited to the short time span of kimberlite ascent. This relatively brief interaction with melts may explain better diamond preservation in these samples.

References

- [1] Matveev et al., (2001) *J.Petrol.*, 42, 721-729.
- [2] Berry et al., (2005) *Geology*, 33, 869-872.