

Water contents of the mantle beneath the Rio Grande Rift: FTIR analysis of Kilbourne Hole peridotite xenoliths

Lillian A. Schaffer,

laschaffer@uh.edu

University of Houston, Houston TX 77004, USA

Anne H. Peslier,

Jacobs Tech., JETS and ARES, NASA-Johnson Space Center Houston TX 77058, USA

Alan Brandon,

University of Houston, Houston TX 77004, USA

Although nominally anhydrous mantle minerals contain only trace amounts of water, they are the main reservoir of water in the mantle. Added up at the scale of the Earth's mantle, these trace amounts of water represent oceans worth in mass [1,2]. Mantle xenoliths from Kilbourne Hole in southern New Mexico are ideal to study mantle water distribution in a rift tectonic setting as they come from a recently-erupted maar in the middle of the Rio Grande Rift. Eleven lherzolites, one harzburgite, and one dunite are being analyzed for water contents by FTIR. The xenoliths will also be analyzed for major and trace element composition, $\text{Fe}^{3+}/\Sigma\text{Fe}$ ratios, and characterized petrologically. Olivines exhibit variable water contents with less water at the rims compared to the cores. This is probably due to H loss during decompression and xenolith transport by the host magma. Mantle water contents appear to have been primarily preserved in the core of the olivines, based on diffusion modeling of the typically plateau-shaped water content profiles across these grains. Water concentrations are in equilibrium between clino- and orthopyroxene, but olivine concentrations are typically not in equilibrium with those of either pyroxene. Lherzolites analyzed so far have water contents of 2-12 ppm H_2O in olivines, 125-165 ppm H_2O in orthopyroxenes, and 328-447 ppm H_2O in clinopyroxenes. These water contents are similar to, but with a narrower range, than those for the respective minerals in other continental peridotite xenoliths [3]. The lherzolites have bulk-rock (BR) Al_2O_3 contents that range between 3.17 and 3.78 wt%, indicating similar degrees of partial melting, which could explain the narrow range of their pyroxene water contents. Primitive mantle normalized rare earth element (REE) profiles of the bulk lherzolites vary from light REE depleted to flat, with no significant differences between, nor relation to, their mineral water contents. Consequently, the metasomatic agents that enriched LREEs in these lherzolites were most likely water-poor. The harzburgite and the dunite have lower weight percent Al_2O_3 compared to the lherzolites (2.11% and 0.34% respectively) indicating higher degrees of melting. Their olivine water contents, however, are similar to those of the lherzolites. Moreover, no correlations are observed

between pyroxene water contents and indices of melting or metasomatism between the lherzolite group, the harzburgite, and the dunite, although the latter has the lowest pyroxene water contents. More samples will be analyzed to determine if the water contents are controlled by melting, metasomatism, or a combination of the two in the Kilbourne Hole mantle.

[1] Bell & Rossman, 1992 Science 255, 1391-1397. [2] Smyth, 1994 AM 79, 1021-1024.[3] Peslier, 2010 JVGR 197, 239-258.