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Evidence of dehydration in peridotites from Eifel volcanic field

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From experimental studies, it is known that a significant part of the water of our planet may be in the form of hydrogen dissolved as point defects in nominally anhydrous minerals of Earth's mantle. Such hydrogen defects embedded in the mineral atomic structures are easily detectable using Fourier transform infrared spectrometry (FTIR) at low concentration levels (ppm). We report water contents in upper mantle minerals from peridotites transported by sodic olivine nephelinite–basanite suite lavas from three volcanoes Rockeskyllerkopf, Dreiser Weiher, and Meerfelder Maar in the Eifel volcanic field (West Germany). The water concentrations, obtained with FTIR, are $\sim$ 6pmm, $\sim$ 210 ppm and $\sim$ 250 ppm for olivine, enstatite and diopside, respectively.
The water concentration in individual olivine grains is very heterogeneous; in constrast to water contents in pyroxenes which are quite homogeneous. In addition, profiles using polarized infrared radiation across crystallographically oriented single-crystals of olivine reveal hydrogen depleted rims. These observations indicate that partial dehydration occurs during the ascent of the xenolith to the surface. Using experimentally obtained diffusion coefficients for hydrogen in olivine at high temperature, we estimate that the duration of the dehydration for the spinel-bearing xenoliths is limited to a few hours. We have also combined hydrogen diffusion profiles with Fe-Mg interdiffusion profiles in both xenolithic and phenocryst olivines to constrain furthermore the ascent duration. Our study suggests that the water content of the upper mantle based on measurements of mantle-derived peridotites is likely to underestimate the true water content of the equilibrated uppermost mantle.