Volatiles in nominally anhydrous mantle olivine from the Auckland Volcanic Field

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Disaggregated olivine crystals from mantle xenoliths found in the the >200 ka basaltic Pupuke tuff ring of the Auckland Volcanic Field were analyzed by synchrotron-sourced Fourier-Transform Infrared (FTIR) microscopy and show the presence of water, carbon dioxide and aliphatic hydrocarbons. Profiles measured across single crystals from core to rim show hydrogen depleted rims that are interpreted to result from partial dehydration by ionic diffusion during the ascent of the xenocrysts to the surface. The main OH absorbance peaks of most samples were located between 3600 to 3450 and 3450 to 3100 cm^{-1}, which are predicted by experimental data and reflect the range of silica activity and iron content. Water contents are highest in the grain centers and show some variability, which may be linked to the increase in water solubility with increasing water fugacity as a function of pressure. Carbon dioxide was also observed in some olivine xenocrysts and, where present, appears to follow similar cross-section diffusion profiles. Aliphatic hydrocarbons (*n*-alkanes) are abiogenic and represent undifferentiated mantle olivine, their presence in these unaltered xenocrystic olivines indicates that they were rapidly transported from the lithispheric mantle by the Pupuke basalt eruption. OH in olivine diffusion profiles reflect rapid transport on the order of a few hours and likely reflect volatile degassing during the last stage of magma rise before eruption. Metasomatism by fluids or melts and the ambient oxygen fugacity of the mantle may have generated the initial incorporation of C-H compounds into these olivines, and the volatile-rich mantle lithosphere observed beneath the Auckland Volcanic Field could help explain the location and longevity of volcanic activity there.