Heterogeneity of water concentrations in the mantle lithosphere beneath Hawaii

M. BIZIMIS[1], A.H. PESLIER[2], AND D. CLAGUE[3]

[1] SEOE, U. of South Carolina, Columbia, SC 29208, USA; mbizimis@geol.sc.edu
[2] Jacobs, NASA Johnson Space Center, Mailcode XI3, Houston, TX 77058, USA; anne.h.peslier@nasa.gov
[3] MBARI, Moss Landing, CA 95039, USA; clague@mbari.org

The amount and distribution of water in the oceanic mantle lithosphere has implications on its strength and of the role of volatiles during plume/lithosphere interaction. The latter plays a role in the Earth's deep water cycle as water-rich plume lavas [e.g., 1] could re-enrich an oceanic lithosphere depleted in water at the ridge, and when this heterogeneous lithosphere gets recycled back into the deep mantle. The main host of water in mantle lithologies are nominally anhydrous minerals like olivine, pyroxene and garnet, where hydrogen (H) is incorporated in mineral defects by bonding to structural oxygen. Here, we report water concentrations by Fourier transform infrared spectrometry (FTIR) on olivine, clino- and orthopyroxenes (Cpx & Opx) from spinel peridotites from the Pali vent and garnet pyroxenite xenoliths from Aliamanu vent, both part of the rejuvenated volcanism at Oahu (Hawaii) [2].

Pyroxenes from the Aliamanu pyroxenites have high water concentrations, similar to the adjacent Salt Lake Crater (SLC) pyroxenites [3] (Cpx ~400-500 ppm H_2O, Opx ~200 ppm H_2O). This confirms that pyroxenite cumulates form water-rich lithologies within the oceanic lithosphere. In contrast, the Pali peridotites have much lower water concentrations than the SLC ones (<25 ppm vs. 50-96 ppm H_2O [4,5] respectively) despite being relatively fertile with >10% modal Cpx and low spinel Cr# (0.09-0.10). The contrast between the two peridotite suites is also evident in their trace elements and radiogenic isotopes. The Pali Cpx are depleted in light REE, consistent with minimal metasomatism. Those of SLC have enriched light REE patterns and Nd and Hf isotopes consistent with metasomatism by alkaline melts [2]. These observations are consistent with heterogeneous water distribution in the oceanic lithosphere that may be related to metasomatism, as well as relatively dry peridotites cross-cut by narrow (?) water-rich melt reaction zones.

[1] Dixon & Clague (2001) *JP* **42**, 627-634.
[2] Bizimis *et al.* (2007) *EPSL* **257**, 259-273.
[3] Bizimis & Peslier (2015) *CG* **397**, 61-75.
[4] Peslier & Bizimis (2015) *GGG* **16**, 1-22.
[5] Peslier *et al.* (2015) *GCA* **154**, 98-117.