Possible carbonated melts from a mantle plume; a study of Raivavae

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HIMU geochemical signatures observed in ocean island basalts are believed to be a manifestation of the recycled slab caused by the mantle-scale convection. However, a debate exists on the melting process of the recycled materials in the mantle plume. We present new geochemical data from the basalts on Raivavae in the Austral island chain in the South Pacific. Subaerial lavas are classified into radiogenic (HIMU) and less-radiogenic Pb groups, providing an opportunity to better understand the melting process by comparing geochemical characteristics of the two basalt groups.

Our data and those from previous studies [1, 2] display clear differences in the chemical compositions between the two groups. The radiogenic Pb group shows lower Rb/Nb and K/Th than the less-radiogenic Pb group, consistent with recycling of a dehydrated slab in the source. Relatively high incompatible element concentrations, La/Yb, and Nb/Zr in the radiogenic Pb group indicate that the HIMU signature appears more robust in the low degree melt. These basalts are also low in SiO_2 down to 42 wt%, high in CaO, and have fractionated Nd/Hf (REE/HFSE). These suggest that the HIMU melts were produced by a low-degree partial melting of carbonated fertile peridotite or pyroxenite. As traces of carbonated melts have been recognized in the mantle xenoliths on the neighboring Tubuai [3], such melts would play a significant role in transferring the HIMU geochemical signature to the basalts. Carbonation of the source mantle cannot be a recent process occurred in the upwelling mantle plume, because Hf and Os are insoluble in a carbonated melt and thus the unradiogenic Hf and radiogenic Os typical of HIMU basalts cannot be overprinted in the source by recent carbonation. We propose that the source carbonation was ascribed to hybridization of the peridotitic mantle with the subducted carbonated slab material several billion years ago.

[1] Lassiter et al. (2003) *Chem. Geol.* **202**, 115-138. [2] Maury et al. (2013) *Bull. Soc. Geol. Fr.* **184**, 557-567. [3] Hauri et al. (1993) *Nature* **365**, 221-227.