Volatiles in the HIMU mantle component and the efficiency of dehydration during subduction

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Pillow basalts have been collected from the flanks of Rurutu and Tubuai in the Austral Islands, South Pacific by submersible. Whole rock radiogenic isotope and trace element chemistry of these samples suggests that the basalts were generated from a HIMU mantle component derived from recycled ancient subducted oceanic crust that entrained and mixed with depleted asthenospheric mantle. Sixteen glassy rims from the same samples have been analysed for major (electron microprobe), trace (LA-ICP-MS), and volatile elements (H_2O and CO_2 by FTIR spectroscopy, S and Cl by electron microprobe) to constrain the volatiles in the magma sources, the volatiles in HIMU and the efficiency of subduction-related volatile-loss in the HIMU component. H_2O ranges from 0.62 to 2.44 wt%, S 612 to 1889 ppm, Cl 151 to 538 ppm, while CO_2 is below detection (<20 ppm). The highest H_2O contents may reflect late-stage hydration and are oversaturated at the depth of collection, the low H_2O contents (11 samples 0.62-0.96 wt%) are undersaturated, and there is a positive correlation between the H_2O contents of all chips and their incompatible element concentrations. Cl also correlates strongly with incompatible elements, while S correlates positively with FeO and Cu, but not with incompatible elements, suggesting sulfide saturation. Using H_2O/Ce and Cl/Nb the Rurutu source contains 292 ppm H_2O and 7 ppm Cl, and the Tubuai source contains 215 ppm H_2O and 3 ppm Cl. Using the isotopic compositions to estimate the contribution from HIMU in the sources of Rurutu (11% HIMU) and Tubuai (3% HIMU), the H_2O content of the HIMU component is 1,714 ppm in the Rurutu source, and 3,415 ppm in the Tubuai source. Thus, assuming oceanic crust entering a subduction zone contains 20,000-30,000 ppm H_2O, the HIMU component in the Rurutu source has been ~91-94% dehydrated and ~83-89% dehydrated in the Tubuai source.