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The volatile content of heterogeneous intraplate mantle source reservoirs: Insights from a global dataset of olivine-hosted melt inclusion compositions

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Understanding the geochemical evolution of Earth's interior has long been an important area of research in the earth sciences, and recycling of the volatile elements (e.g., H and C) via plate tectonics has fundamental implications for mantle rheology and planet habitability. Ocean island basalts (OIB) sample heterogeneous mantle domains at a range of depths that have been variably influenced by subduction recycling. However, the volatile inventory of these heterogeneous intraplate mantle domains remains uncertain, predominantly due to the challenges associated with the measurement of volatiles. Here, we utilize the major, trace element, volatile, and halogen compositions of olivine-hosted melt inclusions from end-member ocean island basalts (OIB) to better quantify the volatile content of intraplate mantle reservoirs. We present data from 38 different samples derived from 9 different ocean island chains that represent the main end-member OIB compositions including: EMI (Pitcairn Islands); EMII (Ra Seamount; Tristan de Cunha Island; Sao Miguel, Azores); HIMU (St. Helena; La Palma, Canary Islands) and FOZO (Fogo, Cape Verde; La Réunion Island; Ascension Island). Importantly, we employ a computational model to restore entrapped CO_2 contents (MIMiC; Rasmussen et al., 2020), and carefully investigate melt inclusion suites to determine maximum H_2O contents for each sample. Through comparisons between corrected H_2O and Ce, corrected CO_2 and Ba, and estimated saturation pressures, we conclude that variability in volatile concentrations between the samples can't be explained by degassing or pre-eruptive storage alone and are likely the result of compositional differences between the mantle domains. We further explore relationships between volatiles (i.e., H_2O/Ce, CO_2/Ba), halogens (i.e., Cl/Nb), light stable isotopes (i.e., $d^{11}B$), and major and trace-element based indicators for mantle melting processes, like silica saturation index (SSI) which varies as a function of depth and degree of mantle melting. Ultimately, we aim to disentangle the complex series of processes – from melting to eruption - that impact the volatile concentrations measured in OIB to better assess the role these elements have played in the long-term evolution of the mantle.