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The infidelity of H_2O/Ce in alkalic melts—a result of low-degree melting and CO_2-rich primary melts

OLIVIA E ANDERSON[1,2], MATTHEW G. JACKSON[1], JAMES W DOTTIN III[2], SUNNA HARÐARDÓTTIR[1], KENNETH T. KOGA[3], GARETH SEWARD[1], JOHN M. COTTLE[4], DR. ESTELLE F. ROSE-KOGA[5] AND NATÁLIA GAUER PASQUALON[6]

[1]University of California Santa Barbara
[2]Brown University
[3]Université d'Orléans
[4]Department of Earth Sciences, University of California, Santa Barbara, CA, USA
[5]ISTO, CNRS
[6]University of Hawai‘i at Mānoa

We analyzed O‘ahu rejuvenated olivine-hosted ($Fo_{80–83}$) melt inclusions from the Honolulu Volcanic Series for major elements (by EPMA), trace elements (by LA-ICP-MS), and volatiles (H_2O, CO_2, and Cl by NanoSIMS, and F and S by EPMA). These melt inclusions, which are foiditic in composition, are highly alkalic (7.9–11.3 wt.% Na_2O+K_2O) and silica-undersaturated (37.42–39.33 wt.% SiO_2). The O‘ahu rejuvenated melt inclusions have H_2O/Ce ratios of 12 to 63, which is low compared to other submarine glasses and melt inclusions from MORB (~100–300[1–2]) and OIB localities (non-enriched mantle on average 209±92 (2SD)[3 and references therein]). The melt inclusions in this study have low H_2O/Ce because they were shallowly entrapped (2–29 MPa) and highly degassed due to closed-system degassing starting at great pressure (~2.9 GPa). Closed-system degassing that initiates deep will lead to the loss of both CO_2 and H_2O, as seen in the O‘ahu rejuvenated melt inclusions. However, due to the higher solubility of CO_2 in alkalic melts, one of the bubble-free melt inclusions has 1.7 wt.% CO_2, which is comparable to other measured values[4–6] of CO_2-rich, alkalic melt inclusions. We found that, at a given pressure, CO_2-rich, alkalic melts degas more H_2O compared to CO_2-poor tholeiitic melts via closed-system degassing. This relationship is established, in part, by the degree of melting because CO_2 is relatively incompatible. Alkalic melts most often derive from lower degrees of melting and, since degree of melting controls the amount of CO_2 in primary melts, the degree of melting has an indirect influence on the H_2O/Ce of melts at shallow pressures. At 50 MPa, a highly alkalic, CO_2-rich melt will have lost ~61% H_2O through closed-system degassing whereas a tholeiitic, CO_2-poor melt will have lost only ~6% H_2O. Therefore, at a given pressure, the more alkalic a melt, the more degassed in H_2O and CO_2, and thus the lower the H_2O/Ce.

[1] Dixon et al. (2002) *Nature*, [2] Michael (1995) *EPSL*, [3] Anderson et al. (2024) *Chem. Geol.*, [4] DeVitre et al. (2023) *PNAS,* [5] Lo Forte et al. (2024) *GCA,* [6] Moore et al. (2021) *JVGR*.