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Anomalously high Fe contents in rehomogenized olivine-hosted melt inclusions from oxidized magmas

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ABSTRACT

Iron concentrations in rehomogenized (remelted) melt inclusions hosted in forsterite-rich olivine ($Fo_{88–92}$) from an alkalic lava have significantly higher Fe contents (FeO* up to 21 wt%) than found in naturally quenched inclusions, matrix glasses, and bulk lava compositions (6.21–6.66 wt% FeO*). The main objectives of this study were to: (1) determine the source of the anomalous Fe concentrations, and (2) evaluate the significance of this signature with respect to rehomogenization of melt inclusions. Heating experiments conducted from 1125 to 1225 °C on crystallized inclusions show that Fe and Mg contents in rehomogenized inclusions increase with homogenization temperature, consistent with dissolution of olivine + magnetite in a 1:1 atomic ratio. The dissolution of magnetite contributes significant excess Fe to the homogenized inclusions, and thus the high FeO* contents of the glasses do not reflect the original composition of the trapped melt. The addition of excess Fe also dilutes the concentrations of other major elements, especially evident in SiO_2, Al_2O_3, and CaO wt%.

Although the cause of magnetite formation in the inclusions is unresolved, two models (H^+ diffusion and co-entrapment of magnetite) for the formation of significant volumes of magnetite are considered. One of the most significant conclusions for this study is that magnetite formation occurred prior to rehomogenization and that the magnetite did not result from post-entrapment fractional crystallization of the inclusion. For these inclusions, a correction must be made for the dissolution of magnetite (± pyroxene) and olivine to the silicate melt to accurately reconstruct the original Fe content of the melt.

Keywords: Experimental petrology, rehomogenization, major and minor elements, Fe in glass, electron microscopy, melt inclusions, phase equalibria, olivine, magnetite