**Low-SiO₂ melt inclusions in olivine originate by dehydration of initially H₂O-rich island-arc melts**

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The majority of melt inclusions (MIs) reported in olivine Fo>88 mol% from island-arc rocks have SiO₂-undersaturated compositions, which are distinctive from those of predominantly SiO₂-saturated primitive (Mg#>0.65) island-arc rocks. A number of models has been proposed to explain the origin of these MIs. All the models suggested that low-Si melts existed in nature and were preserved in MIs. In this work we propose an alternative hypothesis implying that these MIs do not represent large volume natural melts but originate by post-entrapment modification of initially SiO₂-saturated MIs.

We show that experimental hydration of SiO₂-undersaturated MIs in olivine Fo₈₅₋₉₀ from Klyuchevskoy volcano in Kamchatka at 300 MPa pressure and 1200 °C causes a concomitant enrichment of melt in H₂O and SiO₂ so that re-hydrated MIs (4-5 wt% H₂O) become as SiO₂-saturated as primitive Klyuchevskoy rocks. A reverse process occurs for experimental dehydration and results in coupled depletion of melt in H₂O and SiO₂. The estimated H diffusivity, FTIR spectra of de- and hydrated olivines and the stoichiometry of coupled Si and H loss/gain suggest hydrogen diffusion in the octahedral metal (Mg, Fe) vacancies in olivine and crystallization of metal-defect olivine (Mg₄H₂SiO₄ and/or FeH₄SiO₄) on MI walls during melt dehydration or reverse process of defect olivine dissolution during melt hydration.

We conclude that the previously reported SiO₂-undersaturated compositions of many MIs from island-arc rocks can originate by dehydration of the initially trapped primitive SiO₂-saturated H₂O-rich melts. Our results show that the initial H₂O content of 5-6 wt% may be typical for island-arc magmas, in contrast to the results based on direct determination of H₂O in potentially dehydrated MIs. The higher H₂O in primary arc melts implies the existence of a ‘crustal filter’ controlling the water content which can be preserved in melt inclusions.