Melt inclusion studies of IBM arc magmas

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A. Shaw[1], E. Hauri[2], T. Fischer[3], D. Hilton[4]

[1] Woods Hole Oceanographic Institution; [2] Carnegie Institution of Washington; [3] University of New Mexico; [4] Scripps Institution of Oceanography

Volatile signatures of olivine-hosted melt inclusions in recently-erupted tephras from 9 Mariana arc volcanoes and 4 Izu-Bonin volcanoes show significant variability, with water contents ranging from 0.2 wt% at Maug volcano up to close to 6 wt% at Agrigan and Nijima volcanoes. Our data set shows a strong decoupling between water and slab fluid tracers such as Ba/La, unlike Central American melt inclusion data (Sadofsky et al., 2008)*, where this simple relationship seems to hold. The highest water contents are not found in samples with the highest Ba/La and we suggest that this decoupling is related to how water controls the extent of melting and the incorporation of slab-derived components. The effect of water on the melting process, as recorded by our melt inclusions, is significant. Our result show a negative correlation between TiO_2 (used to track the degree of melting) and water content, implying that higher degrees of melting (lower TiO_2 contents) correspond to higher H_2O content. This trend has already been observed in back-arc systems (Kelley et al., 2006) and Langmuir, et al (2006)*. This study has also produced the first measurements of hydrogen isotopes of melt inclusions from arc volcanoes (Shaw et al., in press). We find that the hydrogen isotope composition of arc-related water ranges from ~ -60 to -10 ‰, significantly higher than typical MORB values (-80 ± 10 ‰). These results have important implications for understanding the exchange of water between the mantle and its exospheric reservoirs.

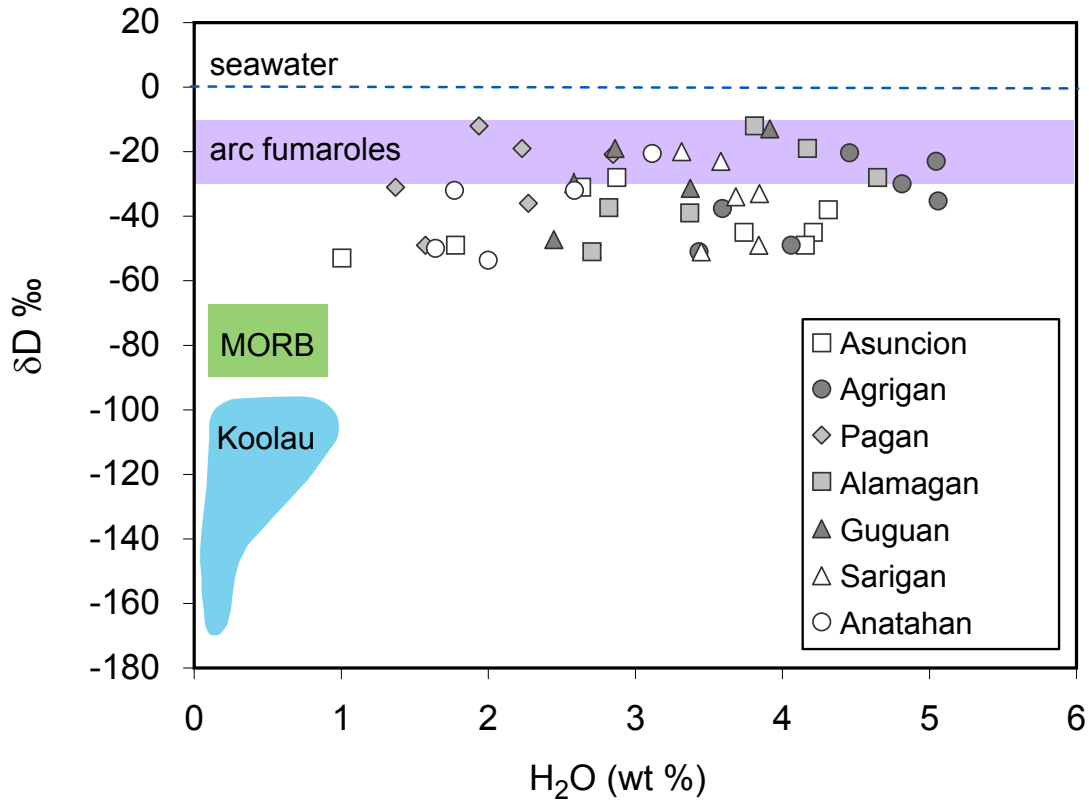

Figure: δD variations as a function of water content in Mariana arc melt inclusions. The shaded boxes show the range proposed for arc fluids based on fumaroles (Giggenbach, 1992), as well as the MORB range. The dashed line indicates modern seawater at 0 ‰. The Koolau melt inclusion field (Hauri, 2002), representing a recycled H isotope signature is included for comparison. Note that Mariana arc melt inclusions have significantly higher water contents and δD values than MORB samples.*

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*References listed in appendix A.