Mantle melting in the Izu arc and rear arc: insights from melt inclusion studies.

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Mantle melting in subduction zones may be promoted by both mantle decompression and addition of volatile-rich slab components that lower the mantle solidus. Distinguishing between these two modes has important ramifications for models of subduction zone dynamics. We report results of an ongoing study of volatile contents of primitive lavas from the Izu-Bonin rear arc region. Our goal is to constrain mantle melting processes and our study includes both subaerial samples from cross arc chains as well as submarine rear arc material from Latitude 30°30' to 32°30' N. We have studied lavas from the volcanic front, the active rift zone that lies immediately behind the volcanic front, backarc knolls adjacent to the rift, and seamount chains that extend west into the Shikoku basin, and have have concentrated on olivine-hosted melt inclusions, measuring volatile and major element contents by SIMS and EMPA, and trace elements by LA-ICP-MS. In many cases melt inclusions contain appreciable CO_2, which suggests that minimal water has been lost from these melts via low pressure degassing and trapping pressures range up to as high as 5000 bars.

Magmas from each portion of the rift have distinctive water contents. Arc front basalts have the highest water contents, up to greater than 3 wt.%. In contrast, inclusions from the active rift zone have water contents that are typically < 1 wt.%, consistent with a greater degree of decompression and upwelling. Back arc knolls have highly variable water contents, from < 0.5 wt.% up to > 3 wt.% possibly reflecting a diversity of mantle sources. Western and east seamounts have water contents typically between 1-2.5 wt.%. The overall range of water contents we observe is similar to that from the Mariana trough further south, and our results are consistent with existing models that suggest a role for slab-derived fluids across the arc and rear arc region, but suggest that decompression melting may also be locally important. Preliminary calculation suggest that, as expected, degrees of mantle melting are highest beneath the arc front and are generally lower, but more variable within the rear arc. To some degree this variation may also reflect considerable variations in the composition of the mantle source in this region.