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Meso- and microscale vein structures in fore-arc basalts and boninites related to post-magmatic tectonic deformation in the outer Izu-Bonin-Mariana fore arc system: preliminary results from IODP Expedition 352

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The International Ocean Discovery Program (IODP) Expedition 352 aimed to drill through the entire volcanic sequence of the Izu-Bonin-Mariana fore arc. Two drill sites are situated on the outer fore arc composed of fore arc basalts (FAB) whereas two more sites are located on the upper trench slope penetrating the younger boninites. First results from IODP Expedition 352 and preliminary post-cruise data suggest that FAB were generated by decompression melting during near-trench sea-floor spreading, and that fluids from the subducting slab were not involved in their genesis. Subduction zone fluids involved in boninite genesis appear to have been derived from progressively higher temperatures and pressures over time as the subducting slab thermally matured.

Structures within the drill cores combined with borehole and site survey seismic data indicate that tectonic deformation in the outer Izu-Bonin-Mariana fore arc is mainly post-magmatic associated with the development of syn-tectonic sedimentary basins. Within the magmatic basement deformation was accommodated by shear along cataclastic fault zones and the formation of tension fractures, shear fractures and hybrid (tension and shear) fractures. Veins form by mineral filling of tension or hybrid fractures and show no or limited observable macroscale displacement along the fracture plane. (Low Mg-) Calcite and/or various types of zeolite are the major vein constituents, where the latter are considered to be alteration products of basaltic glass. Micrite contents vary significantly and are related to neptunian dikes. In boninites calcite develops mainly blocky shapes but veins with fibrous and stretched crystals also occur in places indicating antitaxial as well as ataxial growth, respectively. In FAB calcite forms consistently blocky crystals without any microscopic identifiable growth direction suggesting precipitation from a highly supersaturated fluid under dropping fluid pressure conditions. However, fluid pressure must have been high before calcite precipitation in order to fracture the host rock and to place host rock fragments within the vein. Cross-cutting relationships of veins and zonation consisting of blocky calcite and micritic calcite indicate multiple and probably chaotic fracturing and repeated mineral precipitation or emplacement of micrite, respectively. Hydrothermal fluids affected significantly the vein walls by forming selvages of asbestiform mineral bands and alteration halos along the vein-wall rock contact. Rock fragments show the same selvages as the vein walls. Moreover, volcanic glass can be completely altered to zeolite and/or palagonite. This hydrothermal activity took place shortly after magma cooling since vein frequency varies with depth but does not seem to correlate with the proximity to faults. With increasing depth, calcite grains in both sequences exhibit deformation microstructures more frequently than at shallower core intervals. These microstructures include thin twinning (type I twins), increasing in width with depth (type I and type II twins), slightly curved twins, and subgrain boundaries indicative of incipient plastic deformation. The differential stresses ($\geq$ 50 MPa) that triggered vein deformation were presumably related to IBM forearc extension due to the retreating Pacific lower plate.