EGU21-2356
https://doi.org/10.5194/egusphere-egu21-2356
EGU General Assembly 2021

IODP Hole 1473A (Atlantis Bank, SWIR) - Formation of felsic veins in gabbros: reactions at the contact between felsic melt and host rock

Artur Engelhardt, Jürgen Koepke, and François Holtz
Institute for Mineralogy, Leibniz University Hannover, Germany (a.engelhardt@mineralogie.uni-hannover.de)

Hole U1473 (32° 42.3622’ S; 57° 16.6880’ E), located on the summit of Atlantis Bank at the ultra-slow spreading Southwest Indian Ridge was drilled to 789.7 m below seafloor (mbsf) during IODP Expedition 360. It consists of massive gabbros cut by nearly 400 felsic veins, which are evolved, SiO_2- enriched lithologies comprising ~1.5 vol% of the drill core. They vary in composition from diorite to trondhjemite. For their formation, 3 endmember models are discussed: (1) fractional crystallization; (2) hydrous anatexis of mafic rocks; (3) liquid immiscibility in an evolved MORB system.

Mineral assemblages in the felsic veins include mainly plagioclase, amphibole, Fe-Ti oxides ± quartz and minor zircon, apatite, ± titanite, ± biotite, ± K-feldspar.

Vein minerals often show strong zoning, which is especially expressed in amphiboles clearly visible by their variation in color ranging from brown to green corresponding to compositions from pargasite via pargasitic amphiboles, magnesiohornblendes to tremolite/actinolite. Moreover, zoning patterns can be observed in plagioclases from the veins, in which their An contents vary from An_{34} down to An_5. This is distinctly lower than in the plagioclases of the host gabbros, which are virtually unzoned.

Clinopyroxenes at the contact between felsic vein and host gabbro show reactions either towards orthopyroxene or amphibole. TiO_2 in brown pargasites in the host rock at the contact is enriched (up to ~4.6 wt%), whereas counterparts of the same crystals in the felsic veins are distinctly lower in TiO_2 varying from ~2.5 wt% down to 0.1 wt% TiO_2, associated with variation in color from brown to green. Calculated equilibrium temperatures based on Ti-content in amphibole (Ernst & Liu, 1998), consequently lead to higher formation temperatures for amphiboles in the host gabbro (up to ~1000 °C) compared to their counterparts in the veins, ranging from ~890 °C to ~500 °C.

Amphiboles contain ~0.2 wt% F and distinctively lower contents in Cl (with one exception found). Most amphiboles at the contact show a core-rim evolution trend with decreasing F and increasing Cl content, implying a magmatic formation with increasing influence of processes involving a hydrothermal fluid. Only one out of twenty-two investigated samples shows a trend vice versa.

The record of eutectic crystallization expressed by granophyric structures of quartz and plagioclase indicates that the felsic veins crystallized from a melt.

Ernst, W. G., & Liu, J. (1998). Experimental phase-equilibrium study of Al-and Ti-contents of calcic amphibole in MORB—A semiquantitative thermobarometer. American mineralogist, 83(9-10), 952-969.