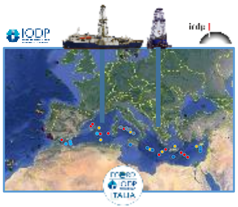

Workshop IODP-Italia "Lo stato delle proposte di perforazione nell'area mediterranea"
Scientific Drilling in the Mediterranean Sea
Roma, 15-16 gennaio 2018

Abstract
I giovani ricercatori italiani nell'ambito dei programmi internazionali di perforazione scientifica

Amphibole and felsic veins from Atlantis Bank gabbros (Southwest Indian Ridge, IODP Hole U1473A): do the fluids meet the melts?

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Key words:

Oceanic core complex, gabbro, amphibole vein, felsic vein, seawater-derived fluids

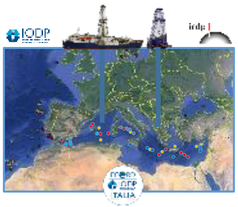
Argomento della ricerca nella perforazione scientifica

The main research topic is the poorly known interplay among hydrothermalism, magmatism and tectonics during the early exhumation of the lower oceanic crust at slow spreading ridges. We also expect to shed light on the debate dealing with the maximum depth reached by hydrothermal circulation at slow-spreading ridges.

Abstract

We present a petrological and geochemical investigation of brown amphibole and felsic veins drilled during IODP 360 expedition at Atlantis Bank, a gabbroic oceanic core complex from Southwest Indian Ridge. The main purpose of this study is to unravel the role of seawater and magmatic components in the origin of these veins. Brown amphibole veins were collected at 90-170 mbsf. These veins typically include minor modal amounts of plagioclase and are associated with alteration halos made up of brown amphibole and milky plagioclase in host gabbros. Two sets of late magmatic felsic veins, which mostly consist of plagioclase and minor brown amphibole, were selected. The first set of felsic veins was collected at 210-260 mbsf and is characterized by sharp planar boundaries against host gabbros. Similar to the brown amphibole veins, these felsic veins locally crosscut the crystal-plastic foliation of host gabbros at a high angle. The second set of felsic veins was sampled at 350-390 mbsf and is characterized by diffuse boundaries and frequent incorporation of gabbro material.

Geothermometric evaluations for the crystallization of the felsic veins gave a wide temperature interval of 880-680 °C. This temperature interval most likely reflects a magmatic fractional crystallization process controlled by separation of plagioclase and minor amphibole. Cl concentrations in amphibole from the felsic veins are low, thereby documenting that the melts feeding these veins had low or no seawater component.



Abstract
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We envisage a process of extreme fractional crystallization starting from MORB (after crystallization of gabbros rich Fe-Ti-oxide phases) for the origin of the parental melts of the felsic veins. Crystallization of the brown amphibole veins occurred at 790 ± 20 °C. Amphibole from the brown amphibole veins has 0.2-0.3 wt% Cl, which shows the involvement of a seawater component in the amphibole-veining event. The ductile to brittle transition in the exhuming gabbro was therefore associated with hydration by seawater-derived fluids of the highest section of the footwall of the detachment fault.

With respect to host gabbros and included clinopyroxene, amphibole from the brown amphibole veins exhibits substantially higher concentrations of FeO, TiO_2 and MnO, and of incompatible trace elements, such as Nb, Zr, Y and Rare Earth Elements. These chemical characteristics indicate that the amphibole veining cannot be related to interaction of the gabbros with seawater-derived fluids alone. Conversely, they are consistent with involvement of the melts feeding the felsic veins in the amphibole-veining event. We conclude that the onset of the brittle tectonic regime in the exhuming gabbros most likely formed a fracture network that allowed interaction between seawater-derived fluids migrating downward, and late-stage residual melts rising through the gabbroic sequence.