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Development of oxy-symplectites in a slow-spreading lower oceanic crust: Insights from the Atlantis Bank Gabbro Massif, Southwest Indian Ridge

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Abstract

Igneous microtextures are significant tracers of magmatic processes as these provide important information about magma evolution. Oxy-symplectite intergrowth of orthopyroxene (host) with Fe-Ti oxide (lamellae) is described from the Atlantis Bank, an Oceanic Core Complex (OCC) along the ultraslow spreading Southwest Indian Ridge (SWIR). This texture is widespread in the oxide-rich lithologies recovered from the lower crustal section of the Atlantis Bank. There exists a long-standing debate on the magmatic vs. metamorphic origin of the oxy-symplectites. The symplectitic intergrowth is usually noted wherever the olivine grain is in intimate proximity to the magmatic magnetite and is developed at the expense of the olivine. Comparative oxybarometric results between the ilmenite-magnetite pairs close to the symplectites and those away from the symplectites reveal relatively higher f_{O_2} range for the former group. These observations along with phase equilibria modeling suggest that oxidation of olivine primocrysts may lead to the development of oxy-symplectite in the studied gabbros (sensu lato). Furthermore, the compositional variabilities between the symplectitic phases and the discrete magmatic phases away from the symplectite indicate that the origin of the oxy-symplectite took place under subsolidus conditions. Additionally, phase equilibria modeling reveals that for the observed range of olivine compositions, higher oxidizing conditions are required for symplectite formation at higher temperatures. Synthesizing all the results, we suggest that the formation of the oxy-symplectite in this lower crustal section is a subsolidus process, where the oxide phases (especially magnetite) aided the oxidation of olivine.

Keywords: Oxy-symplectite, phase equilibria modeling, subsolidus cooling, Atlantis Bank, Southwest Indian Ridge