

Re-examination of the crystallization process of clinopyroxene oikocrysts in layered gabbros at Hess Deep Rift, EPR

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In the Hess Deep Rift, located about 60km east of the East Pacific Rise, the lower crustal gabbros which have been formed at the fast-spreading ridge are exposed. In the IODP Exp. 345, primitive layered gabbros were collected from the lower crust as mainly three drill cores (U1415 I, J, P; Gillis et al., 2014). From the U1415J, unique gabbroic rocks (troctolites) with poikilitic clinopyroxenes (oikocrysts) including many small plagioclase laths have been found (Maeda and Kaise, 2015, Abstracts of the Geological Society of Japan).

Recently, on the origins of clinopyroxene-oikocryst-bearing gabbroic rocks, the different hypotheses have been proposed by Leuthold et al. (2018) and Maeda and Kaise (2015).

Leuthold et al. (2018) proposed that initial olivine gabbros had been partially molten by the intrusion of a primitive melt and then clinopyroxene oikocrysts had crystallized from clinopyroxene-rich basaltic melts formed by the mixing between the partial melt and the primitive magma.

On the other hands, Maeda and Kaise (2015) proposed that clinopyroxenes have first crystallized from a primitive magma and after molten by the encounter with another primitive magma they have continued to grow further and then, the clinopyroxene rim has simultaneously crystallized with matrix olivine and plagioclase. Several hypotheses other than those above (e.g., Tegner et al., 1995; Nicolas and Boudier., 2011) have been also proposed for the origin of the clinopyroxene oikocrysts in gabbroic rocks. The question is still open to discussion.

Therefore, I re-examine the process of clinopyroxene-oikocryst formation through the textural observation and chemical analysis of the constituent minerals for 8 samples of clinopyroxene-oikocryst-bearing gabbros from 3R, 5R, 7G, 8R and 15G of the U1415J core collected at the IODP Exp. 345.

The matrix part is troctolite consisting mainly of olivine (about 0.5 mm - 2 mm in size, amoeboidal, Fo₈₅~) and plagioclase (about 1 mm in size, An_{#77-82}). Spherical to ellipsoidal clinopyroxene oikocrysts (5-10 mm in size, Mg_{#85} to 88) is distributed in the matrix troctolite. In addition, clinopyroxene oikocrysts exhibit the following characteristics:

- (1) Clinopyroxene oikocrysts basically do not contain any olivine crystals. Rarely, they contain aggregates of plagioclase and olivine.
- (2) Orthopyroxene rims (about 100 μ m thick, film-like, Mg_{#85-87}) are observed only in matrix olivines (Fo₈₅~) near the rim of the clinopyroxene oikocryst. The olivine crystals rimmed by orthopyroxene are shrunk.
- (3) The decreases in Al and Cr contents towards the plagioclase chadacrysts are observed in clinopyroxene oikocrysts.
- (4) In the core of the clinopyroxene oikocrysts, we can find parts with Mg# higher than the values which can be in the Fe/Mg equilibrium with olivine in the matrix troctolite.

The facts of (1) and (2) indicate that the assemblage of olivine and plagioclase had already existed when the clinopyroxene oikocrysts crystallized from the melt. In additions, these facts suggest that the melt which formed clinopyroxene oikocryst was in a reaction relationship with olivine. These interpretations

are consistent with the hypothesis of Leuthold et al. (2018).

Keywords: clinopyroxene oikocrysts, Hess Deep, troctolite, Magma mixing, MORB