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Mode of occurrence of chlorine-rich biotite and zircon in the pelitic gneiss from Sor Rondane Mountains, East Antarctica

Fumiko Higashino[1*], Tetsuo Kawakami[1], M. Satish-Kumar[2], Noriyoshi Tsuchiya[3], Masahiro Ishikawa[4], Geoff Grantham[5]

[1]Kyoto University, [2]Shizuoka University, [3]Tohoku University, [4]Yokohama National University, [5]Council for Geoscience, South Africa

The Bt-Grt-Sil gneiss from northern Balchenfjella, Sor Rondane Mountains, East Antarctica contains Grt porphyroblast (5-10 mm in diameter) and fine-grained Grt (100-200 um in diameter). The Grt porphyroblast has characteristic zoning in P. The core is P-rich with oscillatory zoning in P, and the rim is P-poor without oscillatory zoning. In this way, the core-rim boundary is defined by the discontinuous P zoning. This discontinuity suggests that the Grt porphyroblast has experienced resorption and recrystallization (e.g., Kawakami & Hokada, 2010). The Grt core is homogeneous in composition while Fe and Mn increase and Mg and Ca decrease toward the rim. This trend is significant where the Grt is in contact with matrix Bt. The fine-grained Grt has similar composition with the Grt porphyroblast rim, suggesting that the rim and the fine-grained Grt crystallized simultaneously.

Chlorine-rich Bt (0.08-1.08 wt%) and coarse Zrn (100 um in diameter) are included exclusively in the rim of the Grt porphyroblast. Bt in the matrix and that included in the core of the Grt porphyroblast are Cl-poor ($<$ 0.06 wt%). Coarse-grained Zrn is present in the matrix and also included in the fine-grained Grt. Only one grain of tiny Zrn (20 um in diameter) is found included in the core of the Grt porphyroblast so far.

Almost all of the Cl-poor Bt grains in the matrix give lower X_{Mg} [= Mg/(Mg+Fe_{total})] (X_{Mg} = 0.56 +/- 0.03) than the Cl-rich Bt included in the P-poor rim of the Grt (X_{Mg} = 0.60 +/- 0.04). Detailed examination of retrograde Fe-Mg exchange between the inclusion Bt and the host Grt revealed that the Cl-rich Bt was originally as Mg-rich as the matrix Bt and changed its composition to the Mg-rich one through the retrograde Fe-Mg exchange reaction between Grt. There is a possibility, therefore, that matrix Bt was once Cl-rich and lost Cl via interaction with the Cl-poor fluid that subsequently infiltrated into the matrix.

The presence of resorption texture at the core-rim boundary of the Grt porphyroblast, and the intimate coexistence of Cl-rich Bt and coarse-grained Zrn in the rim of the Grt porphyroblast implies the genetic relationship between them. The Cl-rich Bt may be formed through the effect of Cl-rich fluids during metamorphism (e.g., Sisson, 1987) or through magmatic-hydrothermal evolution (e.g., Coulson, 2001). Therefore, it is likely that the Cl-rich Bt included in the garnet rim is the evidence for the infiltration of Cl-rich fluid, and coarse-grained Zrn (at least the rim part) and the Cl-rich Bt were formed almost simultaneously, during or after the Grt porphyroblast resorption. Future dating of included Zrn may help constrain the timing of Cl-rich fluid infiltration during the metamorphism in the Sor Rondane Mountains.

Keywords: chlorine, zircon, resorption, metamorphic fluid