Multiply hydration events of pyroxenite and amphibolite in the middle crustal conditions, Sør Rondane Mountains, East Antarctica

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Fluids in the crust are important for ore deposition, crust evolution and geothermal activity in subduction zones. Fluids supplied from the subducting slab cause hydration reactions, which induce mass and heat transport, redistribution of elements, formation of new minerals, and changes rheology of rocks. The extent, chemistry, time of infiltration, distribution and flow mechanisms mode of such hydration reactions are determined by fluid flow rate, fluid sources and properties of rocks where reaction has happened. Therefore, it is important to understand flow rate and source of fluid for estimating evolution of the Earth’ s crust in terms of fluid-rock interaction. The main target of this study is estimating of time and conditions of fluid infiltration.

Pyroxenite and amphibolite that is partly hydrated along veins and fractures were collected from Mefiell, Sør Rondane Mountains, East Antarctica during JARE-51 (2009-2010 years). The basement rocks of Sør Rondane Mountains can be divided into amphibolite-facies to granulite-facies Sourthwestern terrane and granulite-facies to greenschist-facies Northeastern terrane. NE-terrane exhibits a clockwise pressure–temperature–time (P–T–t) path and the SW-terrane exhibits a counter-clockwise P–T–t path (Osanai et al., 2013). Samples analyzed in this study were collected from SW-terrane.

For pyroxenite, the host rock is dominated by clinopyroxene, orthopyroxene, plagioclase, potassium feldspar with minor amount of ilmenite, apatite and biotite, which are replaced partially by hornblende, biotite, apatite in the veins. Calculated weight percentage of water ranges from 0.1% for host rock to 1.3% as the maximum for the veins.

In the vein, altered clinopyroxene grains are surrounded by hornblende and orthopyroxene grains are surrounded by cummingtonite and actinolite. The X_{Mg} is different between two pyroxenes (X_{Mg} around 0.61 for clinopyroxene in the vein, 0.59 in the host rock and X_{Mg} around 0.48 for orthopyroxene in the vein, 0.46 in the host rock).

In some plagioclase grains cores are represented by albite and rims by anorthite. Anorthite rims boundaries are in contact with tschermakite rims boundaries which surrounding hornblende cores. Conditions estimated by hornblende-plagioclase (Holland and Blundy, 1994), Ti in biotite (Henry et al., 2005) thermometers and Al in hornblende geobarometer (Anderson and Smith, 1995) reveal that P-T conditions of vein formation was estimated to be around 6 kbar and 635±50˚C for hornblende and 575±75˚C for tschermakite respectively. Contrary, application of two pyroxene thermometer (Wells, 1977) to the host rock shows 850±50˚C.

These results suggest that hydration of the pyroxinite had occurred through brittle fracture during cooling from granulite-facies to amphibolite-facies under middle crustal condition.

For amphibolite, major minerals are orthopyroxene and amphiboles, with minor amount of ilmenite, anorthite, spinels, muscovite and apatite. In the vein actinolite, serpentine, epidote and magnetite were observed.

Symplectite consists from muscovite and anorthite surrounded by spinels was found along veins. Temperature around 400±50˚C was estimated using ilmenite magnetite thermometer (Andersen and Lindsley, 1985) for the veins.

Cl and F were enriched in apatite and micas in the veins.

Foliation parallel veins were formed by hydration events under greenschist-facies to amphibolite-facies, and then foliation vertical veins were occurred in later stage which suggests several infiltration events.

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