

Topotaxial replacement of olivine by a lizardite and brucite mixture in the Higashi-akaishi ultramafic body

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Fluid-rock reactions in the ultramafic system cause a wide variety of serpentinite. Analyses of the natural occurrences of serpentinite provide important constraints on contributions of variable factors controlling the development and related fluid chemistry. We present detailed petrological observations of lizardite and brucite (Liz+Brc) serpentinite, that is a retrograde product in a subduction zone environment, in the Higashi-akaishi ultramafic body.

We identified two end members of penetrative structures consisting of a fibrous Liz+Brc mixture: topotaxial vein and non-topotaxial mesh structure. Non-topotaxial vein can be regarded as an intermediate. Topotaxial veins are characteristically developed in a coarse-grained dunite and an optical X axis of a Liz+Brc mixture is sub-parallel to a c-axis of host olivine. Mesh textures overprint porphyroclastic textures of dunite and a Liz+Brc fibers are normal to olivine grain boundaries. The topotaxial veins are localized in the central part of the body whereas non-topotaxial mesh is more dominant in the peripheral part close to the surrounding schists.

Topotaxial veins preserve mineralogical and chemical zonings, indicating a Liz formation at a reaction front and a diffusive extraction of Fe to form magnetite (Mgt) at the center of the vein. Micro-Raman mapping reveals a close relationship between stripes of Brc and Mgt at a vein center. This indicates that Fe ion released at Ol-vein interface has transported through a channel filled by Brc. The Mgt formation was controlled by a reaction: Fe-rich Brc + SiO₂ -> Liz +Mgt. A topotaxial relation between Ol and Liz(+Brc) is probably due to a low mobility of Si and high confining pressure. Non-topotaxial meshes show similar mineralogical features but they are rich in Liz and have abundant Mgt at the core. The difference between topotaxial and non-topotaxial replacements can be explained by mobility of elements and a supply of SiO₂ depending on activities of aqueous fluids.

A topotaxial replacement of Ol by Liz+Brc possibly take place in shallow mantle where a supply of water-rich fluid is restricted. The case of the Higashi-akaishi body indicates that it can cause a significant amount of Liz+Brc serpentinite with stress-dependent anisotropic structures.