Bidirectional replacement zoning developed in metasomatic reaction of olivine during serpentinization on olivine-plagioclase system

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Serpentinization reaction, affects both chemical and physical properties of oceanic lithosphere. Mesh texture characterizes most serpentinized peridotite. However, it is difficult to interpret the processes of mesh texture development and related volumetric changes and mass transfer from texture.

In this study, we conducted hydrothermal experiments using mineral powder of plagioclase and olivine, and found Al-rich serpentine (Al-serpentine) which has a characteristic chemical zoning was formed around contacts between olivine and plagioclase. Al content in Al-serpentine once decreases from core to rim, and increases. At the center of chemical zoning which has relative low Al content, and a clear outline is observed in its texture. It could be interpreted that the outline preserves an outline of pre-existed olivine, therefore it suggests reaction front propagated both inside and outside direction of olivine. Hydration reaction proceeds toward inside direction requires removal Mg, Fe, and Si to fluid on serpentinization. The removed components from olivine and Si and Al from plagioclase were transported to pore and precipitated.

Our experimental results represent an analogue of serpentinization in natural hydrothermal systems with a high porosity and suggest that mesh rim and core could be formed in same stage. On that, the thickness of mesh core represents the thickness of olivine that has been replaced while mesh rim was enlarged with volumetric expansion.