

下部地殻の加水反応に関する実験的研究：
斜長石＋単斜輝石系における優先的な斜長石の反応

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Experimental simulation of lower crust hydration: preferential
plagioclase reaction in the plagioclase + clinopyroxene system

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Recent experimental studies have revealed the preferential reaction of a mineral during the hydration of polymineralic rocks, which results in the formation of metastable product mineral assemblage in the effective bulk rock composition enriched in the preferentially-reacted mineral component. The preferential mineral hydration could affect the fluid circulation in subduction zones at least transiently via modulating the volume change during the reaction. To simulate the hydration reaction of the lower crustal rocks and evaluate its influence on crustal fluid infiltration, we conducted hydration experiments in the plagioclase + clinopyroxene systems with 15 wt% H₂O at 500 °C and 1.0 GPa for 672 hours. The augite (Mg# = 69) and labradorite (An# = 60) powders with grain sizes of 38–53 μm were utilized to prepare the three experimental systems: (1) PL: labradorite 100%, (2) CPX: augite 100%, (3) PL+CPX: labradorite 50% and augite 50% by weight. The reaction products were composed of clinozoisite (Fe-poor epidote) + paragonite + Na-rich plagioclase + quartz in the PL system. In the CPX system, chlorite-like phase + actinolite + quartz + Fe-oxide was formed. In the PL+CPX, epidote + chlorite-like phase + muscovite + Na-rich plagioclase + quartz was observed. Mass balance calculation revealed that plagioclase reacted preferentially in the PL+CPX system in which the effective clinopyroxene/plagioclase ratio was 0.28. High aluminum activity imposed via the preferential dissolution of plagioclase could suppress the crystallization of aluminum-poor amphibole (actinolite) at 500°C. Preferential plagioclase reaction leads to the dominant formation of epidote whose density (~3.4 g/cm³) is much higher than that of the primary plagioclase (~2.7 g/cm³). This can lead to ~1% decrease in the overall volume in the PL+CPX system, which is in strong contrast to the volume-increasing serpentinization reaction in the ultramafic system. Hydration of mafic rocks may thus enhance the fluid infiltration in the lower crust via the volume-decreasing reaction.

Keywords: lower crust, hydration reaction, plagioclase, clinopyroxene

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