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Biopyribole evolution during tremolite synthesis from dolomite and quartz in CO_2-H_2O fluid

Krassimir N. Bozhilov,[1,*] Daniel Brownstein,[2,†] and David M. Jenkins[2]

[1]Central Facility for Advanced Microscopy and Microanalysis, University of California, Riverside, California 92521, U.S.A.
[2]Department of Geological Sciences and Environmental Studies, Binghamton University, Binghamton, New York 13902-6000, U.S.A.

Abstract

A series of experiments with and without sample retreatment was performed on a starting mixture of dolomite plus quartz at 0.5 GPa and 600 °C in a CO_2-H_2O fluid with a mole fraction of CO_2 of 0.2 for durations up to 582 h. The initial reaction of dolomite and quartz led to rapid formation of talc and calcite instead of tremolite and calcite by the intended reaction: 5 dolomite + 8 quartz + H_2O = tremolite + 3 calcite + 7 CO_2. With continued treatment, the talc + calcite + quartz assemblage gradually reacts to form increasing amounts of tremolite and diopside with the eventual loss of quartz and nearly complete loss of talc.

The detailed structure of the amphibole and the nature of the Mg enrichment were revealed using AEM analysis of individual amphibole crystals. The most abundant defects are triple-chain chain multiplicity faults (CMFs), which appear as isolated lamellae with single periodicity in short-duration experiments and increasingly as groups of lamellae with variable multiplicity and periodicity in longer duration experiments and especially in a long-duration experiment without retreatment. In this latter experiment, a calcian clinojimthompsonite domain extending 15 unit cells along the **b** axis was observed. The sample after 582 h and five retreatments shows, on average, 3.5% true solid solution with Mg expressed as the Mg-cummingtonite (MC) component after correction for the presence of CMFs. This sample is thought to most closely approach the equilibrium composition for the amphibole. The sample after 250 h with three retreatments has about 10%, whereas that after 582 h without retreatment has 0.6% MC component, the latter having a relatively high density of CMFs. This study affirms the importance that precursor non-amphibole biopyriboles play in the formation of tremolitic amphibole.

Keywords: Tremolite, HRTEM, analytical electron microscopy, mineral growth, calcian clinojimthompsonite