American Mineralogist, Volume 108, pages 120–126, 2023

Epidote as a conveyor of water into the Earth's deep mantle in subduction zones: Insights from coupled high-pressure and high-temperature experiments

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Abstract

Epidote is a major hydrous mineral in subducted mafic oceanic crust. Understanding its stability in the subduction zone environment is important for evaluating its role as a conveyor of water into the deep Earth. Here we report experimental results on epidote by simulating the high-pressure-temperature (*P-T*) conditions of the plate subduction environment. We used a diamond-anvil cell with an external resistance heating system, combined with in situ X-ray diffraction (XRD) and Raman spectroscopy techniques. Experiments at ambient pressure and high temperatures indicate that epidote starts to decompose at 1223 K and breaks down completely at 1373 K. In situ XRD analyses show no phase transition at temperatures up to 1272 K and pressures up to 14.0 GPa. Raman spectra indicate that epidote is stable at 1272 K and 14.0 GPa, but the energies of two Si-O bonds (ν_2,ν_5) and one M-O bond (ν_3) increase with increasing temperature. The cation H^+ moves for a distance when the *P-T* is increased to 13.0 GPa and 1123 K. Based on the thermal structure of subducted slabs in typical hot and cold subduction zones, we infer that epidote can convey water downward into the mantle transition zone through subducted mafic oceanic crust.

Keywords: Epidote, high pressure, high temperature, phase stability, structural variation, mantle transition zone