In-situ high-pressure and high-temperature spectroscopic studies of phengite in UHP eclogite: Implications for water transport during ultra-deep continental subduction

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Phengite is a critical hydrous silicate mineral in continental subduction zones, transporting water and potassium to the upper mantle. Phengite generally forms under metamorphic environments and is a common hydrous mineral in UHP eclogites from orogenic belts. The Dabie-Sulu orogenic belt in east-central China records a well-documented history of ultrahigh-pressure (UHP) metamorphism (3.0-4.5 GPa, 700-850 ℃).

In this study, pressure and temperature responses of natural phengite in UHP eclogite from the main hole of the China Continental Scientific Drilling Project (CCSD) have been studied using *in-situ* high-pressure mid-infrared and high-temperature Raman spectroscopic measurements up to ~20 GPa and 800 ℃, respectively. Linear positive pressure dependences were observed for the infrared absorption bands associated with the aluminosilicate vibrations up to ~19 GPa, indicating the steady compression of the structure framework. The frequencies of the O-H stretching doublet bands, initially at 3601 and 3626 cm^{-1}, displayed linear downshifts up to 16.6 GPa at -2.02 and -2.72 cm^{-1}/GPa, respectively, implying a high stability of the hydroxyl groups under compression. In the high-temperature Raman spectra, the bands initially centered at 265, 420, 703, and the O-H stretching modes at 3620 cm^{-1} exhibited modest linear negative shifts with increasing temperature up to 800 ℃. The experimental results may suggest that in continental slabs with high subduction rates, phengite would possibly not suffer significant dehydroxylation at elevated pressures up to 16.6 GPa. Comparisons between experimental results of the present study and those of the previous studies make it plausible to infer that phengite with a higher Si content, i.e., a higher tetrahedral Si/Al ratio, would have higher stabilities both under high pressure and under high temperature, and would be likely to transport water to greater depths during subduction processes.

Keywords: phengite, hydroxyl, continental subduction, high-pressure FTIR spectroscopy, high-temperature Raman spectroscopy

