Omphacite as a proxy for fluid availability in HP–UHP eclogites: Evidence from the Sulu terrane and the Sanbagawa belt

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Fluids at convergent plate boundaries influence arc magmatism, metamorphic reactions, and seismicity. Even trace amounts of H_2O in minerals can strongly modify rock physicochemical properties and rheology. Quantitative constraints on mineral water contents are therefore essential for understanding deep Earth water cycling and related processes. In deeply subducted crustal materials, most hydrous minerals break down, but nominally anhydrous minerals (NAMs) such as garnet and omphacite can incorporate trace hydrogen as structurally bound hydroxyl (OH). Omphacite is a major constituent of eclogite and can host relatively high OH among NAMs, yet it remains unclear whether its OH content primarily reflects peak pressure–temperature conditions or is modified during later retrograde evolution. Here, we quantify structurally bound OH in omphacite from high-pressure (HP) to ultrahigh-pressure (UHP) eclogites in contrasting tectonic settings: the Sulu terrane (eastern China) and the Sanbagawa belt (southwest Japan). Fourier transform infrared (FTIR) spectroscopy reveals diagnostic O–H stretching bands of omphacite in all samples. We estimated water contents from integrated absorbance using the Beer–Lambert law. Mean omphacite water contents are 200–280 ppm H_2O in the Sulu samples and approximately 410 ppm H_2O in the Sanbagawa sample. Core-to-rim transects within individual grains reveal nearly flat intragrain profiles with no systematic OH gradients, indicating limited grain-scale modification during retrograde metamorphism. The measured OH contents therefore likely approximate the composition at the time of equilibration, near peak metamorphism or during early exhumation. The higher OH content in the Sanbagawa sample relative to the Sulu sample suggests that omphacite hydration depends not only on pressure but also on fluid availability and tectonic setting. Our results highlight that FTIR-derived OH contents in omphacite (and other NAMs) should be interpreted together with microtextures, mineral growth history, and retrograde evolution.

Keywords: Omphacite, Water content, Fourier transform infrared (FTIR) spectroscopy, Sulu terrane, Sanbagawa belt

