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UHP eclogite from western Dabie records evidence of polycyclic burial during continental subduction

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Abstract

Understanding the behavior of continental crust during subduction is important for investigating dynamic processes at convergent plate margins. Although simulations have predicted continental crust may experience multiple burial-partial exhumation cycles during subduction, petrological evidence of these cycles is scarce. In this study at Sidaohe, western Dabie, we combine microstructural observations and mineral chemistry with phase equilibrium modeling, Amp-Pl thermobarometry and Zr-in-rutile thermometry to constrain the *P-T* evolution for three eclogite samples. All samples have a similar mineral assemblage of garnet + omphacite + symplectite (amphibole + plagioclase ± clinopyroxene) + quartz, with accessory rutile/ilmenite. Element mapping and analytical traverses across large garnets from two samples show obviously systematic variations in Ca and, less strongly, Mg, Fe, and X_{Mg} [Mg/(Mg+Fe^{2+})]. Based on phase equilibrium modeling and calculated isopleths for grossular, pyrope and X_{Mg} in garnet, we show that *P* first increased from 23.0 to 28.5 kbar, then decreased to 24.0 kbar, before increasing again to a maximum of 30.5 kbar (±1.0 kbar, 2 sigma error) concomitant with a small increase in *T* from 580 to 605 °C (±20 °C, 2 sigma error) at the late prograde stage. These data are interpreted to indicate multiple burial cycles and partial exhumation of eclogite during ongoing continental subduction. After the P_{max} stage, *T* first increased to a maximum of 664–644 °C at 25.0–20.0 kbar, then decreased to 581–561 °C (±30 °C, 2 sigma error) at 15.0–10.0 kbar based on results of Zr-in-rutile thermometry. Further decompression and cooling occurred across *P-T* fields of 590–567 °C at 12.0–10.0 kbar and 520–504 °C (±40 °C, 2 sigma error) at 8.0 kbar. Fine-grained symplectite (clinopyroxene + plagioclase ± amphibole) in the matrix is interpreted to have formed after omphacite due to dehydroxylation of nominally anhydrous minerals during decompression from the P_{max} stage. By contrast, formation of coarse-grained symplectite (amphibole + plagioclase) and a veinlet of rutile + quartz that crosscuts one sample may be related to influx of externally sourced H_2O. This study shows that: (1) evidence of cyclic burial and partial exhumation may be retained in low-*T* eclogite during continental subduction, and (2) fluid contributing to widespread retrogression of eclogite during exhumation may be internally and/or externally sourced.

Keywords: Eclogite, phase equilibrium modeling, multiple burial cycles, continental subduction, western Dabie