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How Much Information is Preserved During Slab Exhumation: Insights from Tianshan Ultrahigh Pressure Metamorphic Terrane

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The Western Tianshan ultrahigh-pressure metamorphic belt in northwest China represents a rare case of exhumed oceanic slab that was subducted beyond >100 km depth. Therefore, the region provides a unique record of subduction and exhumation dynamics. The lack of buoyant continental materials involved presents a puzzle for the exhumation of dense slab fragments. Metamorphic rocks are a powerful tool to unravel subduction kinematics. The P-T-t information preserved in these rocks and the distribution pattern of coesite has led to several hypotheses for the exhumation process, such as in a pelitic mélange, or as a series of juxtaposed tectonic slices. In this study, we compare a series of eclogites retrogressed to various extents, to assess how robust exhumation information has been preserved through partial retrogression. The study area is characterized by voluminous pelitic schist that embeds eclogite lenses of various sizes. We focus on samples from an eclogite lens about ~4m in diameter that is suspended in a host schist. These core-to-rim samples showing increasing hydration and carbonation are compared to one another and the schist to establish the petrologic and geochemical changes that occurred during retrogression. The fine-grained omphacite matrix is progressively replaced by granular blue-green amphiboles, accompanied by the growth of white mica and carbonate minerals. On the other hand, chemical maps of euhedral garnets from all samples still show sharp concentric zonation. Ca and Mg increase towards the garnet rim, and a minor upturn in rim Mn signals weak resorption. Combined with P-T phase equilibria modeling, the garnet zonation generally indicates a heating and decompression path from 515 °C, 2.8 GPa to 570 °C, 2.2 GPa. The record terminates where lawsonite decomposes completely. Geochemical variation also reflects the predicted rehydration during retrogression. Light rare earth elements and water-soluble elements are enriched with reference to the pristine eclogite. These preliminary results, in combination with further C-O isotope analyses, will provide a comprehensive illustration of retrograde metamorphism of UHP eclogite, contributing to a better understanding of the kinematics of slab exhumation within subduction zones.