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Multi-step release of slab-bound fluids caused by blueschist metamorphism in the subducting slab (Bridge River Blueschist, British Columbia, Canada)

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The subducting oceanic crust undergoes several metamorphic transitions on its downward path. During these transitions, fluids that are adsorbed onto clay minerals, present in pores, or mineral-bound are progressively released. This overall process plays a key role in the chemical exchange between the crust and mantle, the flux melting of the mantle wedge, and intra-slab seismicity. The fluid release during the transition of blueschist to eclogite has gained considerable attention in subduction zone research. Conversely, slab devolatilization during the transformation of altered oceanic crust to blueschist, which likely has a larger fluid budget, is not well-characterized. This is probably due to the scarcity of rocks preserving a record of this process due to intense prograde and/or retrograde overprinting. The Bridge River Blueschist (BRB), British Columbia, Canada, provides an unusual exception to this, allowing for the investigation of the reaction mechanisms and element budgets of early slab devolatilization, a process that has significant bearing on the physico-chemical conditioning of the slab. In the BRB multiple parageneses are preserved, from igneous precursor minerals to pumpellyite and lawsonite-blueschist facies assemblages, all coexisting on the mm- to cm-scale. The samples exhibit a multitude of vein sets that vary in geometry and mineralogy, reflecting a progressive series of events involving fluid release and fluid-rock interaction. Perhaps the most striking feature of the BRB are randomly oriented glaucophane-dominated veins forming a network, pervasively present in a massive pumpellyite-facies host rock. These veins represent dehydration veins that likely formed due to fluid liberation induced by the breakdown of pumpellyite. The local preservation of this vein network allows for a rare glimpse into the mechanisms of internal fluid production and transport, as well as the stepwise development and overall geometry of fluid channel networks in subducting rocks. The metamorphic record of the BRB will be discussed in this presentation and will provide improved insight into the processes and mechanics that govern slab devolatilization during early stages of subduction.