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Petrogenesis and Significance of Lawsonite-bearing Hybrid Rocks, Tavsanli Zone, NW Turkey

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Hybrid rocks, which have bulk rock compositions that do not correspond to any known sedimentary or igneous protolith, are found in paleosubduction complexes worldwide, where they have been interpreted as forming as a result of tectonic mixing and/or metasomatic interactions between mafic, ultramafic, and sedimentary rocks of the subducted slab. The formation and progressive metamorphism of these unique bulk compositions results in hydrous, low density, mechanically weak rocks that contain abundant sheet silicates and trace element-rich accessory phases. As a result of these physical and chemical properties, hybrid rocks have been proposed to play an important role in subduction zone dynamics, including influencing the strength of the slab-mantle interface and contributing to arc magma genesis.

In most paleosubduction complexes, chlorite-talc-amphibole rocks are the most volumetrically significant hybrid rock. However, in the Tavsanli Zone, lawsonite-chlorite rocks are the most common hybrid rock and chlorite-talc-amphibole rocks are less common. To understand the petrogenesis and metamorphic evolution of lawsonite-chlorite rocks, which may represent the dominant hybrid rock in subduction zones with normal-to-cool geothermal gradients, we conducted a petrologic and geochemical study of lawsonite-bearing and lawsonite-free hybrid rocks from different structural contexts (lithologic contacts, metamafic pod margins, shear zones). Regardless of context, all hybrid rocks have low SiO_2, Na_2O, and K_2O, and high MgO contents. CaO content is variable (3 – 13 wt%) and scales with the modal abundance of lawsonite. Trace element signatures in hybrid rocks vary depending on the lithologic context. Lawsonite-chlorite rocks formed at the contact between serpentinite and metamafic rocks generally have flat REE patterns and negative Ce anomalies; these features are also present in the REE pattern of the adjacent serpentinite. Hybrid rocks from all other contexts are enriched in LREE, lack Ce anomalies, and have REE concentrations ~1 – 23x MORB. Mineral-scale evidence in some lawsonite-chlorite rocks, including magnesium zoning patterns in garnet and clinochlore replacing lawsonite, is consistent with a later, Mg-metasomatic event. These results indicate that there may be multiple mechanisms for generating lawsonite-chlorite rocks, each of which can influence the mineralogy, trace element content and budget, and spatiotemporal distribution of hybrid rocks during subduction.