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Lawsonite Eclogite and other high-pressure assemblages in the southern Motagua Fault zone, Guatemala: Implications for Chortis Collision and Subduction Zones

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Left-lateral displacement along the Motagua fault juxtaposed Maya (North American plate) and Chortís block (Caribbean plate). Some tectonic slices of serpentinite contain blocks of eclogites, amphibolites, and jadeitites. The southern serpentinite bodies, adjacent to Chortís basement, contain abundant lawsonite eclogite, glaucophane eclogite, blueschist, jadeitite, and other high P/T rocks. In lawsonite eclogite, lawsonite occurs with omphacitic clinopyroxene as inclusions in garnet, indicating eclogite facies conditions during garnet growth. The inclusion assemblage of lawsonite eclogite includes phengite, biotite, zoisite, albite, rutile, zircon, allanite, and various sulfide minerals. A second generation of lawsonite and phengite (typically with sodic amphibole) occurs in irregular, undeformed patches. Experimentally derived P-T grids for lawsonite eclogite indicate minimum pressures of 20-25 kbar. Geothermometry on garnet rims and matrix clinopyroxene gives values from ~400 – 550 °C. Results from clinopyroxene inclusions with garnet cores yield slightly lower T = 350 to 450 °C.

Variable major element, trace element and REE geochemistry indicates the metabasites encompass diverse protoliths, including MOR and primitive IA basalt. High initial $^{143}Nd/^{144}Nd$ (ε_{Nd} = +8.8) and low $^{87}Sr/^{86}Sr$ (0.70379) of clinopyroxene suggests a depleted source, as expected from MORB. Preliminary Sm-Nd geochronology indicates that the lawsonite eclogites formed at 161 +/- 20 Ma (2σ). Ar-Ar geochronology on phengite indicates cooling of eclogite and jadeitite through ~350 °C at 113-125 Ma.

Jadeitite veins from the same serpentinite slices contain unusual assemblages, which include lawsonite, pumpellyite, quartz, and rutile; these are estimated to have formed at T = ~100-400 °C and P = 5 to 20 kb. Occurrence of these coexisting rock types points to a very high pressure and cold origin for the terrain, especially considering the amounts of lawsonite and pumpellyite. This terrain is an excellent field example of lawsonite carrying water into the mantle, as has been predicted by laboratory experiments and thermal models. The chemical and geochronological data indicate either a long-lived mature subduction zone, or possibly a Jurassic to Cretaceous collision zone existed between the Chortis block and Mexico.

KEYWORDS: lawsonite, jadeitite, high-pressure metamorphism, subduction zone, Caribbean tectonics