Supra-subduction Zone Origin for Ultramafic Rocks from the Seventymile Ophiolitic Terrane, Eastern Alaska

Genevieve Llewellyn[1], Marlon M. Jean[1], Michael Bizimis[2], Matthew Loewen[3]

[1]Department of Geological Sciences, University of Alaska-Anchorage, 3211 Providence Dr., CPSB 101, Anchorage, AK 99508
[2]School of the Earth, Ocean and Environment, University of South Carolina, 701 Sumter St., EWS 617, Colombia, SC 29208
[3]Alaska Volcano Observatory, 4230 University Dr., Suite 100, Anchorage, AK 99508

We use geochemical characteristics to investigate potential tectonic settings of the Seventymile ultramafic complex (SUC) in eastern Alaska. The SUC, a component of the upper Paleozoic Slide Mountain-Seventymile Terrane (SMST), is thought to represent part of a dismembered ophiolite suite obducted onto western ancestral North America during the late Paleozoic to Triassic. The petrogenesis of the SMST is unclear. It occurs as discrete, tectonized, fault-bounded klippen that overlie the Yukon-Tanana Terrane (YTT) in eastern Alaska and western Canada, a composite of allocthonous and parautochonous Paleozoic metavolcanic assemblages previously separated by an ocean basin. It has been previously proposed that the SMST klippen are remnants of this ocean basin.

We use new whole-rock and mineral analyses to constrain the relative roles of hydrous flux-melting (i.e., supra-subduction zone – SSZ) versus decompression melting (i.e., "abyssal" or mid-ocean ridge - MOR) origins for SUC peridotite samples, which include spinel harzburgite and spinel lherzolite. Thin-section petrography and whole-rock and silicate-phase geochemistry of the Seventymile peridotites are compared with other MOR- and SSZ-derived peridotites. The SUC peridotites display minor, yet distinct, chemical variations that can be used to differentiate between MOR-, back-arc basin (BAB-), and SSZ-type peridotites, such as Cr# and Mg# in spinel grains and Al_2O_3 wt. % in pyroxenes. Preliminary peridotite whole-rock compositions have heavy rare-earth element (HREE) contents 0.1–0.8 times N-MORB (normal mid-ocean ridge basalt) values and positive normalized REE slopes. Volcanic samples associated with the ultramafic rocks have more variable HREE (up to 2 times N-MORB) and display light REE enrichment up to 5 times N-MORB. Olivine in peridotite is typically $Fo_{91.1}$ Average TiO_2 in orthopyroxene, clinopyroxene, and spinel are 0.02%, 0.05%, and 0.12%, respectively. Orthopyroxene has an average Mg# of 91.3 ± 2.3 and an average Cr# of 9.7 ± 6.0. Clinopyroxene has an average Mg# of 94.5 ± 1.9 and Cr# of 13.9 ± 7.1.

Previous interpretations of the petrogenesis of the Seventymile Terrane have suggested all three tectonic settings that are often presented for ophiolites: SSZ, MOR, and BAB. We find that the major-element chemistry of olivine-orthopyroxene-clinopyroxene is consistent with a SSZ origin. However, Mg# for most spinels ranges from 60 - 70 and Cr# from 25 - 45, which is more consistent with MOR peridotite. The occurrence of both MOR- and SSZ-like peridotites is not unusual in SSZ-derived ophiolites. Additionally, whole rock REE values are 0.1x – 0.8x depleted MORB mantle, which is consistent with the highly depleted nature of SSZ peridotites. The petrographic texture and spinel compositional ranges may also indicate reactions with later melts. In aggregate, the geochemical features of the ultramafic rocks and minerals suggest a SSZ setting for SUC rocks.