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Supra-subduction and abyssal mantle peridotites of the Coast Range ophiolite, California: Initiation of Franciscan subduction along a large-offset fracture zone

S.H. Choi (1), J.W. Shervais (2), and S.B. Mukasa (3)

(1) Korea Polar Research Institute,Songdo Techno Park 7-50, Incheon 406-840, Republic Of Korea (chois@kopri.re.kr, +82-32-260-6208), (2) Department of Geology, Utah State University, Logan, Utah 84322-4505, USA (john.shervais@usu.edu), (3) Department of Geological Sciences, University of Michigan, Ann Arbor, MI 48109-1005, USA (mukasa@umich.edu)

The Coast Range ophiolite (CRO) of California is one of the most extensive tracts of oceanic crust preserved in the Cordillera, but its origin has long remained controversial. We present here new data on mineral compositions in mantle peridotites that underlie crustal sections of ophiolite, and show that these are dominantly refractory harzburgites related to high apparent melting in a supra-subduction zone (SSZ) setting. Abyssal peridotite occurs at one location, Stonyford, in the CRO where it is associated with SSZ mantle peridotite and volcanic rocks with both oceanic and arc-like geochemistry. SSZ mantle peridotites are associated with crustal sections containing arc-related volcanics, including boninites. This convergence between conclusions based on crustal lithologies and their underlying mantle sections confirms previous proposals that link the CRO to SSZ processes, and seriously undermines hypotheses that call on formation of the ophiolite at a mid-ocean ridge spreading center.
We also report on the radiogenic isotope characteristics of peridotite clinopyroxenes. Based on the Sr-Nd-Pb-Hf isotopic compositions and estimated temperatures, we suggest that the abyssal peridotite block represents a remnant of large-offset transform oceanic lithosphere at >172 Ma. East-dipping, proto-Franciscan subduction is likely to have been initiated along this fault zone, which produced the supra-subduction zone (SSZ) peridotites in the CRO. We propose that the remnant abyssal peridotites represent a snapshot of the mantle wedge composition prior to overprinting of large sectors by hydrous melting during the subsequent subduction-controlled SSZ processes.