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Diversity and origin of Moho in the northern Oman ophiolite

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We are planning the 21st-Century Mohole on the ocean floor to observe the in-situ Moho (Mohorovicic discontinuity) by drilling. There has been a controversy about the petrological nature of the Moho, which is defined seismically, although we almost agree on that typical oceanic Moho is represented by gabbro/peridotite boundaries. The Oman ophiolite, which is a slice of a kind of oceanic lithosphere, is a good place for us to understand (1) diversity, if any, and (2) origin of the Moho possibly formed at a spreading center.

The peridotite section beneath the layered gabbro has been serpentinized to various degrees, irrespective of the distance from the gabbro. In addition, chrysotile/lizardite, a low-T serpentine is far predominant over antigorite. This strongly indicates that the Moho as a serpentinization front cannot be found from the Oman ophiolite. Gabbro/peridotite transition represents the Moho in the Oman ophiolite as generally believed.

The gabbro/peridotite (dunite) boundaries can be classified into two types, gabbor-in-dunite and dunite-in-gabbro. In the former type, gabbros appear as intrusive bands or sills in dunite (or wehrlite) around the transition zone, and the transition is relatively gradual. In the latter type, the dunite (or wehrlite) (= “late-intrusive”) is intrusive to the crustal rocks (up to the base of sheeted dike complex), and the local gabbro/dunite transition is sharp. Some of the late-intrusive dunites (wehrlites) contain primary amphiboles. In addition, a dunite/wehrlite body with gabbroic bands (= within-crust dunite/wehrlite) was found within the layered gabbro, and possibly obscures the Moho.

Clinopyroxenes in the dunites/wehrlites in contact with gabbros are quite similar in trace-element characteristics, possibly being in equilibrium with MORB. Hydrous nature of the involved magma is also suggested. Only one tectonic setting, a back-arc environment where MORB-like hydrous magmas are available, is necessary for formation of the various types of Moho. Dunites/wehrlites are possibly an interaction product between harzburgite and melts, and the Moho likely starts to form during the interaction beneath the spreading center. They are equivalent to walls to melt conduits, and some of them are mobile as crystal mush and intruded into gabbros as late-intrusive rocks.