What do podiform chromitites tell us?

S. Arai

Department of Earth Sciences, Kanazawa University, Kanazawa 920-1192, Japan

Podiform chromitites (simply chromitites below) are commonly found in the upper mantle section of ophiolites as well as in solid intrusive peridotite complexes. They show irregular pod-like forms enveloped by dunite, which most commonly grades to harzburgite through replacive contacts. Based on this mode of occurrence and mineral chemical characteristics, the chromitites have been interpreted as shallow cumulates filling melt conduits within the upper mantle. Peridotite/melt reaction, associated with incongruent melting of orthopyroxene in harzburgite, and subsequent melt mixing play an essential role in formation of spinel-oversaturate melts (e.g. Arai and Yurimoto, 1994). One of petrographical features of chromitites is presence of primary inclusions of hydrous minerals, especially pargasite, in chromian spinel, which possibly indicates a low-P origin of chromitites.

These low-P features of chromitites are apparently discordant with the recent discovery of ultrahigh-P (UHP) minerals such as diamond in some chromitites, e.g., those from Luobusa, Tibet (e.g., Robinson et al., 2004). Exsolution lamellae of coesite and pyroxenes were also reported from the Luobusa chromitite (Yamamoto et al, 2009). Some of the UHP features can be explained by deep recycling of ordinary low-P chromitites via mantle convection (Fig. 1). We examined two structural types of chromitite, discordant and concordant ones, from Wadi Hilti, northern Oman ophiolite. Chromian spinel in the discordant chromitite contains abundant hydrous mineral inclusions and free from silicate lamellae. In contrast, chromian spinel contains silicate lamellae and only sparse minute hydrous mineral inclusions. The two types of chromitites from Oman are essentially low-P products, but the concordant chromitite is possibly of deeper origin. The involved magma was also different between the two types; one (for the concordant one) was less hydrous than the other (for the discordant one). I would like to propose a new classification; chromitites can be classified into three types, (1) shallow magmatic, (2) deep magmatic, and (3) recycled types (Fig. 1).

The recycled UHP chromitites can be a good indicator of mantle dynamics. If we can obtain UHP chromitites from oceanic mantle drilling (MoHole), they may tell us origin of the MORB source.

Figure 1. A model of chromitite recycling. Three types of chromitite can be recognized in terms of mantle dynamics.