

Petrology of peridotites from the Southern Mariana Trench

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It has been well known that a deep-seated lithospheric section of the lower crust to the uppermost mantle is widely exposed in the lower inner slope of the Southern Mariana Trench (Dietrich et al., 1978; Bloomer & Hawkins, 1983; Fryer, 1992; Ishii et al., 1992; Ishii et al., 1998, Ohara and Ishii, 1998). In 1992, more than 600 peridotitic samples were dredged at the Station KH92-1-D02 (11°41.16'N, 143°29.62'E) from the trench slope. The dredge peridotites are mostly composed of highly serpentinized harzburgite and dunite with a small amount of pyroxenite (Ishii et al., 1992). Here we examined 76 samples of rather fresh peridotites to understand the petrological characteristics and to detect a recent stage modification of the upper mantle peridotites.

The 76 samples examined here include 18 harzburgites, 56 dunites, and 2 pyroxenites. Based on the primary phase assemblage and the additional amphibole types, the peridotitic samples of the KH92-1-D02 are classified into the following lithological types.

Rock type	Primary minerals	Additional amphibole	Origin
sp.H type1 (sp.H-1)	ol, sp, opx	free	residual mantle peridotite
sp.H type2 (sp.H-2)	ol, sp, opx	replacement am	
am.sp.D	ol, sp, interstitial am	replacement am, vein am	magmatic cumulate
sp.D	ol, sp	replacement am, vein am	

H: harzburgite, D: dunite, ol: olivine, sp: spinel, opx: orthopyroxene, am: amphibole,

Harzburgite (sp.H-1) consists of large residual phases of primary olivine, orthopyroxene and spinel with a various amount of secondary alteration minerals. No primary clinopyroxene has been found in the harzburgite. The Mg# ($Mg\# = 100Mg/(Mg+Fe)$) of primary olivine core ranges between 91.5-93.0. The NiO content ranges between 0.33-0.44 wt%. The Cr# ($Cr\# = 100Cr/(Cr+Al)$) of the primary spinel ranges between 65-74 and the Mg# of spinel ranges between 50-60. All the above data suggest that the harzburgite represents a highly depleted upper mantle peridotite.

Harzburgite (sp.H-2) consists of olivine and orthopyroxene porphyroclasts coexisting with fine subgrains of olivine, orthopyroxene and euhedral spinel. Again in this type harzburgite, no primary clinopyroxene has been found. Characteristically, sp.H-2 contain a small amount of replacement amphiboles, indicating a later stage modification by hydration. The Mg# of primary olivine core ranges between 91.5-93.0. The NiO content varies widely between 0.24-0.52 wt%. The sp.H-2 spinel composition is characterized by more Fe-enrichment ($Mg\# = 50-62$) with rather stable Cr# between 45-55. It is considered that the harzburgite (sp.H-2) represents a modified harzburgite type from the primary uppermost mantle peridotite of sp.H-1.

Dunite (am.sp.D and sp.D) commonly displays an adcumulate texture, indicating the nature as a magmatic cumulate. The Mg# of olivine core ranges between 90.8-92.0 and the NiO content ranges between 0.17-0.38 wt%. The Cr# of spinel ranges between 57-84 and the Mg# of spinel core ranges between 25-48 (Fig. 1). The olivine and spinel are more Fe-rich than those of both

the harzburgite types sp.H-1 and sp.H-2. The am.sp.D contains interstitial amphiboles, coexisting with primary olivine and spinel grains, which are pargasitic with higher Na (A) and Al (VI) than those of replacement- and vein-type tremolitic amphiboles. It is suggested from the 3 different types of amphibole that the dunites examined here have been modified at different conditions of multiple stages.

Concludingly, we attempt to reconstruct an uppermost mantle section for the Southern Mariana Trench peridotites (KH92-1-D02) having a highly depleted signature in association with large amounts of dunite. This is a close feature in lithology to that of the Oman ophiolite (Nicolas, 1995). However, the peridotites are more depleted and more strongly modified into Fe-rich ones.

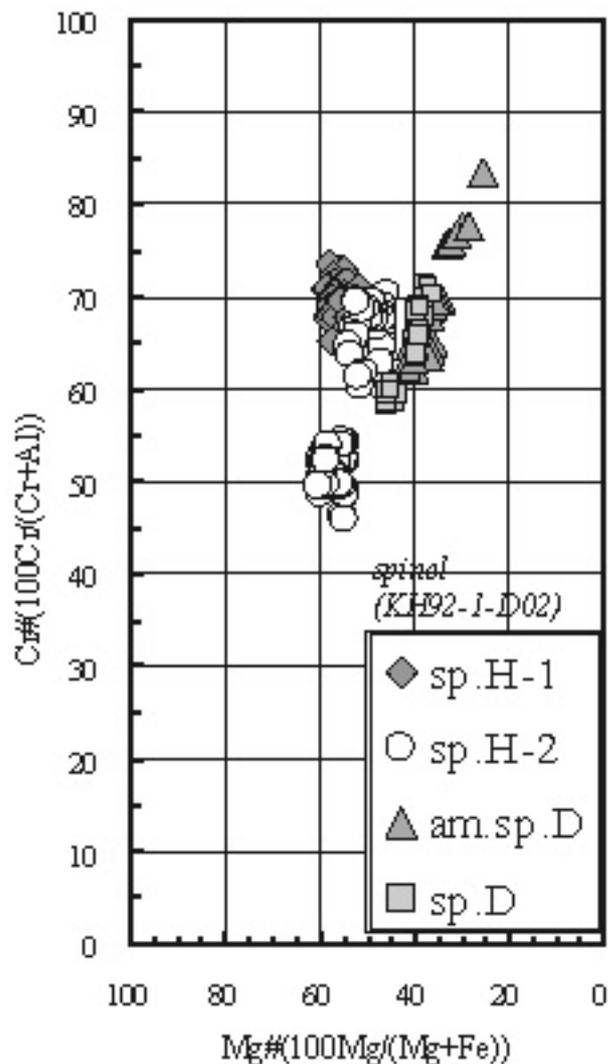


Fig.1 Cr#-Mg# correlation of spinels for the Southern Mariana Trench (KH92-1-D02) harzburgite (sp.H-1 and sp.H-2) and dunite (am.sp.D and sp.D).