Petrological characteristics and origin of the Hahajima Seamount serpentinites

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Introduction and Geology: The Hahajima Seamount is a fore-arc seamount that is located at about 20-60km west of junction of the Izu-Bonin Trench and the Mariana Trench. The Hahajima Seamount displays a rectangular shape 60×30 km in NW-SE direction, and has two summit areas of the northern summit (NS) and the southern summit (SS). Serpentinized harzburgite and dunite, island-arc and MORB-types mafic rocks, sedimentary rocks and a few metamorphic rocks have been dredged. Ishii (1985) proposed a model of "Fore-arc ophiolite" from the assemblage of dredged igneous rock types. Recently, models of a rootless serpentine seamount (Miura et al., 2004), fragments of an ophiolite (Ishiwatari et al., 2005) and a tectonic block of both oceanic and island-arc rocks (Fujioka et al., 2005) have been argued. In this study, the serpentinites dredged in the NS area (Station No. 2003 St.3) and in the SS area (Station No. 2001 St.5) were examined to understand petrological characteristics of the Hahajima Seamount serpentinites. Using spinel data of this work and the published data (Ishii, 1985; Ishii et al., 2000; Ishiwatari et al., 2005), a petrological reconstruction will be attempted.

Petrography: 22 serpentinizad harzburgites and 5 serpentinized dunites were described. The harzburgites show a protogranular texture. Orthopyroxene, spinel and clinopyroxene were observed as primary minerals in harzburgite. No fresh olivines are reserved. Spinels well remains in dunite. Olivine and orthopyroxene are replaced by lizardite-chrysotile (rare antigorites). Spinels are 0.2~3.0mm in diameter and are dark reddish brown to yellowish brown. Spinels in harzburgite are anhedral. Spinels in dunite are euhedral to anhedral. Clinopyroxenes are <0.15mm in diameter and are <1~2% in modal composition.

Mineral chemical composition: Primary minerals of 2 harzburgites (Sample Nos. 3-11 and 3-12) and 1 dunite (No. 3-FR) from the NS area, and 1 harzburgite (No. 5-1) from the SS area were analyzed. Serpentinites in the NS area analyzed with EPMA. The Cr# (100Cr/(Cr+Al)) of spinels from the SS area (5-1) ranges from 61.3 to 70.3 and the Cr# of spinels from the NS area (3-11, 3-12, 3-FR) ranges from 43.1 to 53.6. TiO_2 wt% of spinels is very low (<0.1wt%). The Mg# (100Mg/ (Mg+Fe^{2+})) of the clinopyroxenes ranges from 92.7 to 95.4. Clinopyroxenes are very low in Ti and Na contents. The Mg# of the orthopyroxenes ranges from 91.6 to 93.2.

Results: The Cr#-Mg# data of spinels from this study, Ishii (1985), Ishii et al. (2000) and Ishiwatari et al. (2005) are summarized in the Cr#-Mg# diagram (Fig.1). Fig.1 indicates the following three characteristics.

1) The Cr# of spinels in the Hahajima Seamount peridotites widely ranges from 43 to 86 and suggests a wide degree of depletion.
2) The Cr# of spinels from the NS area and Ishii et al (2000) includes the lowest range, which is overlapped with the higher Cr# range of the abyssal peridotite (Dick and Bullen, 1984).
3) The Cr# of spinels from the Ishiwatari et al. (2005) and Ishii et al (2000) coincides the highest range, which is overlapped with that of the boninite (Cameron et al., 1980).

Concludingly, the origin of the Hahajima Seamount serpentinites can be explained as a model of composite mantle peridotites having different mantle signatures in terms of Cr# (degree of depletion), for example, boninite source, island-arc tholeiite source, and MORB source mantles.

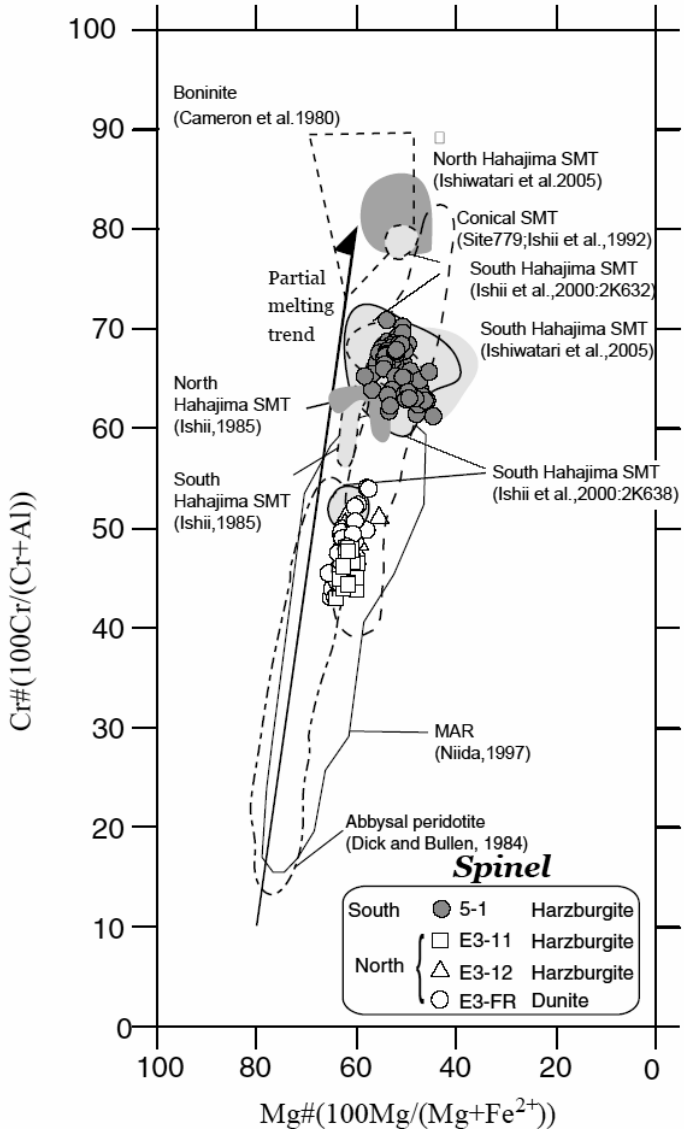

Fig.1. Cr#-Mg# diagram of spinel, summarized this study, Ishii (1985), Ishii et al. (2000) and Ishiwatari et al. (2005)