HIGHLY MAGNESIAN DUNITE FROM THE
MINEOKA BELT, CENTRAL JAPAN

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INTRODUCTION

Ultramafic rocks emplaced in the Mineoka Group, perhaps Paleogene in age (Kanehira, 1976), of the Mineoka belt, Chiba Prefecture, are characterized by plagioclase-bearing harzburgite (Uchida and Arai, in prep.), and dunite is very rare. Extremely magnesian character of dunite from the Mineoka belt is found, and chemical characteristics and genesis of the highly magnesian dunite are discussed.

MODE OF OCCURRENCE

Dunite reported here is stratified with harzburgite at the exposure (Locality 51, Fig. 1). At the weathered surface, dunite is yellowish brown and harzburgite is dark to yellowish green. Both dunite and harzburgite at the exposure are, as at the other exposures of ultramafic rocks of the Mineoka belt, intensely fragmentary or brecciated, being aggregate of slicken-sided blocks with powdered serpentine matrix.

DESCRIPTION OF THE DUNITE

Dunite is severely serpentinized and is almost composed of serpentine (lizardite-chrysotile), brucite, and opaque minerals (mainly mangetite). Thin veins of brucite and magnetite are frequently observed. The mode is as follows: olivine 3.5%, chromian spinel 1.2%, serpentine 87.2% and brucite 8.2%. Primary minerals are olivine

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and chromian spinel. Streaks of chromitite are occasionally found in the dunite blocks. Pseudomorph after pyroxene (orthopyroxene?) accompanied by chromian spinel is sometimes present. Talc and plagioclase (or saussurite) are not found. Pale green phlogopite is found, associated with chromian spinel. Relict olivine is clear and free from dusty inclusion which is one of the criteria of the olivine produced by deserperntization (Arai, 1975). Chromian spinel is brown in thin section and shows various morphological characteristics. In addition to the sparse large euhedral grains, small euhedral ones are ubiquitous. Chromian spinel also occurs as very thin discrete rectangular lamella and as vermicular lamella in olivine. The latter lamella is possibly a symplectite-like intergrowth with other phase(s), such as pyroxene. Chromian spinel lamellae in olivine were also reported from dunite and harzburgite of Iwanai-dake, Hokkaido (Arai, 1978).

Associated harzburgite bears plagioclase (now altered to saussurite) and is the most common rock type of the ultramafics of the Mineoka belt (Uchida and Arai, in prep.).

### Mineralogy

Constituent minerals were analyzed with JEOL EPMA Model JXA-5 according to the procedures of Nakamura and Kushiro (1970).

Olivine is highly magnesian, and its Fo component is higher than 94% (Table 1). NiO content is also high, 0.5 to 0.7 wt. % (Table 1). It is noted that CaO content is relatively high and often exceeds 0.1 wt. % (Table 1). Al and Cr are sometimes detectable although the contamination of sub-microscopic chromian spinel lamella is possible. Olivine in harzburgite is strikingly uniform regardless of the sampling locality, Fo91 to Fo92, at the Mineoka belt (Uchida and Arai, in prep.). NiO content of harzburgite olivine is 0.3 to 0.4 wt. %, and CaO content is far lower than 0.1 wt. % (Uchida and Arai, in prep.). Olivine in harzburgite does not bear any lamellar inclusions of chromian spinel.

Chromian spinel in the dunite is more Cr-enriched than that in harzburgite from  

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<td>FeO⁺</td>
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<td>MgO</td>
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<td>CaO</td>
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<td>NiO</td>
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Total = 99.1, 99.0, 99.3, 99.2, 99.4

### Number of atoms

O   4.000
Si  0.982
Al  0.000
Ti  0.000
Cr  0.000
Fe  0.117
Mn  0.002
Mg  1.902
Ca  0.004
Na  —
K   —
Ni  0.011
Mg* 0.942
Cr/Cr+Al 0.612
Fe/Fe+Fe⁺ 0.021
FeO⁺ and Fe⁺, total iron as FeO and Fe, respectively. nd, not determined. Mg*, Mg/Mg+Fe* atomic ratio (Nos. 1, 2 & 5) or Mg/Mg+Fe⁺² atomic ratio (Nos. 3 & 4). No. 1 & No. 2, olivine. No. 3, large euhedral spinel. No. 4, small euhedral spinel. No. 5, phlogopite.
the Mineoka belt (Uchida and Arai, in prep.). Cr/(Cr+Al) atomic ratio of the dunite spinel is higher than 0.6. Large euhedral grain tends to be lower in (Al/Al+Cr) ratio and Fe'''' content than small euhedral grain (Table 1). The latter is chemically zoned and Cr/(Cr+Al) ratio often rapidly changes at the margin. Large euhedral grain is magnesian and Mg/Mg+Fe'''' atomic ratio is around 0.7. Small euhedral grain is less magnesian (Table 1). TiO₂ content ranges from 0.1 to 0.2 wt % (Table 1).

Phlogopite is characterized by the enrichment of Mg and Cr, and Ti content is very low (Table 1). It is deficient in (K+ Na+Ca), of which number of atoms is 0.781 for O=11 (on anhydrous basis), to fulfil the phlogopite stoichiometry.

Brucite and serpentine. Brucite is the least magnesian silicate in the dunite described here. (Mg/Mg+Fe*) (total Fe) atomic ratios of coexisting brucite and serpentine are 0.913 and 0.958 respectively. K_D=(X_Mg/X_Fe)brucite (X_Fe/X_Mg)serpentine is about 0.46 and is comparable to the ordinary value (0.5) in serpentinitized dunite (Evans and Trommsdorff, 1972).

Discussion

Dunite with olivine of Fo₉₄ described here is one of the most magnesian rocks of all ultramafics (alpine-type or nodule) ever documented. Sinton (1977) also reported a magnesian olivine (Fo₉₄) in dunite from Red Moustain, New Zealand. Assuming the distribution coefficient K_D=(X_MgO/X_FeO)liquid (X_FeO/X_MgO)olivine of 0.3 (Roeder and Emslie, 1970), the Mg/(Mg+Fe²⁺) atomic ratio of the liquid coexisting with olivine of Fo₉₄ (Table 1), is about 0.83. The Mg/(Mg+Fe²⁺) value of 0.83 is too high for the ordinary basalt and is comparable with those of komatiites (e.g. Arndt et al., 1977) or of some picritic basalts (e.g. Brooks and Hart, 1974). Olivine in komatiites is characterized by the high contents of Ca and Cr (Green et al., 1975; Arndt et al., 1977; Nisbet et al., 1977), which are consistent with the relatively high contents of Ca and Cr of olivine of the dunite described here, though Cr is now concentratred in spinel lamella (Arai, 1978). Picrite basalts, also distributed in the Mineoka Group, have the Mg/(Mg+Fe*) ratio around 0.83 (Samishima, 1970; Tazaki, 1975). If the bulk chemical composition of the picrite basalt exposed in the Mineoka belt represented that of liquid and Fe³⁺ content was almost nil, it is the most likely counterpart of the highly magnesian dunite described here.

The relationship of dunite and harzburgite observed at the exposure (Fig. 1) may have not been produced by the igneous activity, because the Fo content of olivine of the dunite (>94) is too much different from that of the harzburgite (<92). The stratification of dunite and harzburgite (Fig. 1) was probably formed by the post-igenous events, such as piling of tectonic sheets. It may not be impossible that dunite and harzburgite (Fig. 1) are alternating beds of ultramafic conglomerates or slumping deposits.

REFERENCES


Brooks, C. and Hart, S.R. (1974), On the signifi-
Highly magnesian dunite from the Mineoka belt, central Japan


Geological Survey of Japan (1976), Geological map of Tokyo Bay and adjacent areas (1:100,000).


