Carbonaceous matter from the Horoman Peridotite Complex, Hokkaido, NE-Japan

Yoshihiro Sawada[1]; Yoshikazu Sampei[1]; Takeshi Aratani[2]; koji Seto[3]; Kiyoaki Niida[4]; Ichiro Matsumoto[5]

[1] Geoscience, Shimane Univ; [2] Dept. Geosci., Fac. Sci. Eng., Shimane Univ.; [3] ReCCLE, Shimane Univ.; [4] Earth and Planetary Sci., Hokkaido Univ; [5] Faculty of Education, Shimane Univ

Voluminous carbonaceous matter derived from subducted slab is supplied to the wedge mantle. It is generally believed that organic matter is decomposed to gas or fluid phases in the upper mantle, or may be graphitized (and may form diamond) or be trapped as fluid inclusions in minerals. However its behavior in this environment is not clear. Several authors have reported hydrocarbons from mantle peridotite xenoliths, and carbonaceous matter including organic matter has been described from igneous rocks formed from magma which interacted with sedimentary rocks. Organic matter of mantle wedge or fluxed fluid origin has also been identified as inclusions in high-Mg andesite olivine and clinopyroxene phenocrysts and bulk rocks.

Here we report the results of EPMA areal compositional mapping, C-N-S elemental analysis, pyrolysis-gas chromatography (py-GC), py-GC mass spectrometry (py-GC-MS) and stable carbon isotope analysis of bulk rock samples from the Horoman Peridotite Complex before and after HCl/HF treatment. The complex is divided as in previous work, namely MHL: main harzburgite-lherzolite; SDW: spinel dunite-lherzolite; BDH: banded dunite-harzburgite(Takahashi,1991). Facies abbreviations used below are Lz : lherzolite, P-Lz : plagioclase lherzolite, Hz: harzburgite, Dn: dunite, Gb: gabbro. The results are:

(1) EPMA areal compositional mapping (a) Carbonaceous matter (CM) (hydrocarbon and graphite or amorphous carbon) occurs along grain boundaries and as inclusions in olivine and orthopyroxene (opx); (b) Some CM inclusions in olivine from Lz (MHL) contain Cl, S, B, and N. However, CM along grain boundaries does not contain B and N; (c) Opx from Lz (MHL) contains CM inclusions containing Cl and S, and olivine from Hz (MHL) has CM inclusions with Cl, N and S; (d) Hz (BDH) contains carbon inclusions; (e) Carbonaceous matter from Dn (SDW) occurs only along grain boundaries; (f) Plagioclase from gabbro contains CM inclusions with Cl, and carbonaceous matter along grain boundaries contains Cl, S and N.

The fact that CM and its associated elements differ in occurrence, i.e., as inclusions in minerals or along grain boundaries, suggests that the origin and formation processes of such CM also differs.

(2) C, N, S analyses (values in ppm). (a) Organic carbon: Lz =90, Hz (MHL)=480-130, Hz (BDH)=350-250, P-Lz=200-90, Dn(SDW) 230-140, Gb=470-200. (b) Carbonate carbon: Lz=80, Hz(HMK)=less than 400, Hz(BDH), P-Lz=220-30, Dn (SDW)=570-20, Gb=less than 10. (c) Total N: Lz=less than 10, Hz(MHL)=less than 20, Hz(BDH)=less than 13, P-Lz=less than 10, Gb=less than 13. (d) Total S: Lz=less than 10, Hz (MHL,BDH) =less than 10, P-Lz=120, Dn=less than 350, Gb=450-120. Differences in C and N concentrations are recognized in differing rock types. Sulphur contents of Dn and Gb are greater than those of the other rock types.

(3) py-GC-MS analyses at 600 C-deg Aromatic compounds with Cl and N were detected from Lz and Hz (MHL), and aromatic compounds with Cl from P-Lz. These are consistent with the EPMA compositional mapping. n-C8 Alkane was detected in Lz, Hz and P-Lz (MHL), and n-C8 alkane and n-C11-12 alkane were found in Hz (BDH). Cyclic octahedral atomic sulfur was recognized in Gb.

(4) Stable carbon isotopes. d13C values (values in per mil vs PDB)of organic / carbonate carbon are Lz (MHL): -25.5, Hz (BDH): -23.4/-13.1, and Dn (SDW): -21.9/ -10.3 and -28.0/ -17.8. Differences between organic and carbonate carbon in Hz (BDH) and a Dn (SDW) are about 10.