Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SCG082-P15 Room: Convention Hall Time: May 24 17:15-18:45

Petrology of the mantle peridotite from the Ust'-Belaya ophiolite, Far East Russia; with emphasis on their hydration

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Ust'-Belaya ophiolite is exposed in the 80 km x 40 km area on the south of Ust'-Belaya (N65°30', E 173°17'), Far East Russia (Sokolov et al., 2003 Geol. Soc. London, Spec. Publ. 218, 619-664). The Ust'-Belaya ophiolite consists of tectonic slices of pillow lava with chert, dunite-peridotite with gabbro-anorthosite layers, and metagabbro with blueschist. The associated limestone suggests Devonian or older age of this ophiolite. Here we report the petrographical features and mineral chemistry of the peridotite from Ust'-Belaya ophiolite and discuss about their metamorphism and metasomatism.
Mantle section of the Ust'-Belaya ophiolite is composed of fertile lherzolite to moderately depleted harzburgite. Those peridotite is characterized by significant multiple hydration, which causes formation of secondary olivine, secondary cpx, amphibole, chlorite, antigorite, and opaque minerals. They are divided into three major types on the basis of the mineral assemblage; (1) olivine + Ca-amphibole + chlorite +/- talc, with or without relict minerals, (2) olivine + antigorite + Ca-Na-amphibole + chlorite and (3) olivine + antigorite + chlorite +/- secondary clinopyroxene. In some of antigorite bearing peridotites olivine shows an apparent "cleavage". In the main northern peridotite body (25 km x 15 km), antigorite-bearing peridotite tends to be distributed western part of the body. Basically secondary olivine occurs along with antigorite replacing primary olivine, and amphibole replaces primary pyroxene.
The amphiboles show different compositional trend corresponding to the mineral assemblage. The amphiboles in mineral assemblage (1) are calcic amphiboles, showing a pargasite/edenite-tremolite trend (retrograde trend; Nozaka, 2005 Jour. Metamorphic Geol., 23, 711-723), on the other hand amphiboles in mineral assemblage (2) show a richterite-tremolite trend with some pargasites.
Secondary olivines coexisting with amphiboles in both mineral assemblages (1) and (2) are lower in Fo contents (=100Mg/[Mg+Fe]=85~89) and poorer in NiO (=0.15~0.40 wt.%) than the primary olivine (Fo=90~92; NiO=0.35~0.45 wt.%). Although secondary olivines coexisting with antigorite in the mineral assemblage (2) and (3) also show lower Fo contents (=~90), their NiO contents are comparable to those of the primary olivines.
Pargasite/edenite in the mineral assemblage (1) and richterite in the mineral assemblage (2) may be formed following reaction (A) at relatively high temperature and (B) at relatively low temperature, respectively.
Reaction (A): Primary Olivine + Spinel + Pyroxene + Fluid --> Pargasite/Edenite + Secondary Olivine
Reaction (B): Primary Olivine + Pyroxene/Pargasite/Edenite(?) + Fluid --> Richterite + Secondary Olivine
The secondary olivines were also formed by following reaction (C).
Reaction (C): Primary Olivine + SiO2-bearing Fluid --> Secondary Olivine + Antigorite
Several amphiboles in the mineral assemblage (2) shows zoning composed of pargasitic core, tremolitic mantle and richteritic rim. This zoning indicates multiple stage addition of Na_2O with

Fluid. The cleavable olivines have reported from Spatial distribution of antigorite-bearing peridotites may mean that they represent effectively cooled part by hydrous fluids in the forearc mantle wedge.

Keywords: Ust'-Belaya ophiolite, mantle wedge, antigorite, amphibole, metasomatism, mantle peridotite