Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SMP08-04 Room:A05 Time:May 26 11:00-11:15

Lawsonite-blueschist in the Hakoishi sub-unit, Kurosegawa belt, Kyushu, Japan, as Water Carrier Into the mantle.

HIRAJIMA, Takao[1*] ; SATO, Eitaro[1] ; FUJIMOTO, Yoshikazu[1] ; KAMIMURA, Keinichiro[1]

[1]Division of Earth Planetary Sciences, Kyoto Univ.

Lawsonite blueschist (LBS) is considered to have formed in the past cold subduction system and to be one of the most hydrated metabasites in the relevant area, with more than 5 wt% of H2O (e.g., Hacker et al., 2003). In these rocks, lawsonite, pumpellyite and chlorite are major H2O carriers. The dehydration reaction owing to the breakdown of such hydrous minerals is considered to play the important role as the trigger of arc magmatism, deep intraslab earthquake and trace element recycling in the cold subduction system.

LBS, almost free from chemical and textural modifications during the exhumation stage, occurs in the Hakoishi sub-unit of the Kurosegawa belt, Kyushu, in the outer belt of Southwest Japan. The main constituents of the Hakoishi sub-unit, extending in east-west trending narrow horst like area of ca. 10 x 1 x at least 1 km3, are metabasites and metachert along with minor amount of metagabbro and metapelite. Our filed mapping cannot detect the significant discontinuity or tectonic contact within the unit, suggesting that the LBS facies metamorphic rocks in Hakoishi sub-unit form a coherent block up to 10 km length originated from the upper part of subducting oceanic crust in Paleozoic time.

Following main high-pressure metamorphic minerals are well developed in all types of protoliths in the sub-unit, such as lawsonite (Lws), pumpellyite (Pmp), Na-pyroxene (Napx), Na-amphibole (Namp), chlorite (Chl), albite (Ab) and quartz (Qz). The following westward progressive mineral assemblage change is identified even in 10 km horizontal distance in the sub-unit;

Pmp + Namp (Zone1),
Lws + Pmp + Namp (Zone2)
Lws + Napx + Namp (Zone3)
with excess Chl, Qz and Ab.

Jadeite component (XJd) of Napx gradually increases from Zone1 (XJd=0.15) to Zone3 (XJd=0.50). Glaucophane (Gln) component [YAl = Al/(Al + Fe3+)] of Namp also increases from Zone1 (YAl=0.15) to Zone3 (YAl=0.80).

Petrogenetic grid in NCMASH system reveals that the observed mineral assemblages are stable from 0.45 GPa and <300 C for Zone1 to 0.80 GPa and <300 C for Zone3 and that the following mineral reactions are inferred to define each zone boundary in NCF3+MASH system;

(1) 3.4 Pmp + 2.9 Chl + 12 Ab + 10 Qz + 2.2 hematite (Hem) + 9.5 H2O = 13.5 Lws + 6 Namp
(2) 3.3 Namp + Lws + 0.8 Hem + 2.2 Ab + 1.9 H2O = 9.7 Napx + 1.8 Chl + 10 Qz

These data suggest that the studied rocks were formed under extremely low geothermal gradient (ca. 5-10 C/km).

The above mentioned all metamorphic reac-tions are hydration type. Actually H2O content stored in hydrous minerals in studied blueschists (BS) increases from 2.4-4.2 wt % in Lws-free BS in Zone1 to 5.0-7.0 wt % in Lws-bearing BS in Zone2 and Zone3. These data verifies that the LBS in the Hakoishi sub-unit make clear the hydration mechanism in the cold subduction system.

Estimated P-T condition of the Hakoishi sub-unit well fits to a thermal modeling of the Philippine sea plate subducting beneath the Kii Peninsula (Peacock, 2009). Extensive seismic studies were also carried out beneath the Kii Peninsula. For example, Kato et al. (2014) found low velocity areas in three places, inside the arc crust between 5-20km depth, in the mantle wedge just overlying the Philippine sea plate between 35-50 km depth, and at the wedge shaped part between the tip of the mantle wedge and the Philippine sea plate. They ascribed the reason of low-velocity to deep fluid activities. In the latter two areas, H2O-rich fluid released by dehydration reactions are considered to be supplied from the subducting Philippine sea plate through the eclogitization of hydrated metabasite at the depth greater than 50 km (Kato et al., 2014).

Our data suggests that LBS forming reaction should have taken place in the layer 1 and 2 of Philippine sea plate at the depth of 15-25 km beneath the Kii Peninsula. We suppose the LBS would carry high water content of 5.0-7.0 wt% to the incipient depth of the eclogitization at the depth of 30-60 km.

Keywords: Lawsonite, blueschist, cold subduction