Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MIS31-P01 会場:コンベンションホール 時間:5 月 24 日 17:15-18:30

カムチャツカ弧，火山フロント下マントル由来かんらん岩捕獲岩の特徴
The nature of mantle xenoliths from three frontal volcanoes of the Kamchatka arc: toward a general view of the sub-front

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We have a large amount of data about petrological and geochemical features of upper mantle peridotites, but the nature of sub-arc mantle, especially beneath a volcanic front, has not been fully understood due to the scarcity of occurrences of mantle-derived materials there. Mantle-wedge peridotites are opened to the impact of fluids or melts released from downgoing slab. They induce magma production and modify the petrological and geochemical features of the mantle wedge. To identify the nature of sub-arc mantle and the metasomatic agents, peridotite xenoliths trapped in arc magma is one of the most useful tools. Kamchatka Peninsula is one of the active volcanic arcs, and peridotite xenoliths derived from the upper mantle beneath the volcanic front are obtained from 9 of its volcanoes (Erlich et al., 1979). Avachinsky (Avacha) volcano is the most famous of them because of its easy accessibility and high xenolith production. Peridotite xenoliths from Avacha record high degree of melting and multiple stages of metasomatism (e.g., Ishimaru et al., 2007; Ionov, 2010). Formation of secondary orthopyroxenes replacing olivine is one of characteristics of arc-derived peridotite xenoliths (e.g., Arai & Kida, 2000; McInnes et al., 2001). In addition, we found peculiar metasomatisms, e.g., Ni enrichment (e.g., Ishimaru and Arai, 2008), in the Avacha peridotite xenolith suite. We examined additional peridotite xenoliths suite from other two volcanoes of the volcanic front of Kamchatka arc, Shiveluch and Bezymyanny volcano, to obtain a more generalized view of the mantle-wedge process there.

We examined 2 harzburgite xenoliths from Bezymyanny and 13 xenoliths of pyroxenites with/without olivine and 3 xenoliths of peridotites (2 dunites and 1 metasomatized harzburgite) from Shiveluch. Both of them are brought up to the surface by calc-alkaline series andesite to dacite. To clarify the residual features of the mantle peridotites, we only dealt with 3 peridotites from Shiveluch, because most of Shiveluch pyroxenites show textures of cumulate and/or extensively modification by interaction with the host andesite. The mantle peridotites from both Bezymyanny and Shiveluch are composed of fine-grained minerals (cf. Arai and Kida, 2000), and occasionally contain hornblende and/or phlogopite. Almost all orthopyroxenes show irregular shapes and replace olivine, indicating a secondary origin. At the boundary between the harzburgite and host andesite, we observed hornblende and secondary orthopyroxenes. At the interior of the xenoliths, the Fo content of olivine in Bezymyanny and Shiveluch samples is 91-92 and 94, respectively, and the Cr# (= Cr/(Cr + Al) atomic ratio) of chromian spinel is high, 0.43-0.69 and 0.63-0.72, respectively, and the former decreases to 76 at the boundary with the host andesite although the Cr# is almost constant. These petrographical and geochemical features are shared with Avacha peridotite xenoliths (e.g., Ishimaru et al., 2007). Orthopyroxenes in the both peridotite suites do not show simple residual feature in REE pattern, but instead are LREE-enriched and MREE-depleted. These REE concentrations of orthopyroxene indicate the metasomatic agents, which formed olivine replacing orthopyroxene, for Bezymyanny and Shiveluch were strongly enriched in LREE and SiO_2-oversaturated melts or fluids (= evolved magma?).

We will make discussion about the nature of sub-frontal mantle peridotite and metasomatic events with additional geochemical data.

キーワード: 島弧マントル, かんらん岩捕獲岩, 火山フロント, 交代作用
Keywords: arc mantle, peridotite xeloliths, volcanic front, metasomatism