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マントルかんらん岩との反応による珪長質メルトの組成改変プロセス：北海道曲り沢かんらん岩体に見られる珪長質脈からの示唆
Chemical Modification of Felsic Melt by Reaction with Peridotite: Implications from the Magarisawa Peridotite, Hokkaido

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It has been well-documented that subduction zone magmatism is induced by partial melting of the hydrated wedge mantle (e.g., Sakuyama, 1982) and/or of subducting slab (e.g., Wyllie and Sekine, 1982). In the latter case, felsic partial melts would have to undergo interaction with peridotites during upward migration through the overriding wedge mantle (e.g., Kay, 1978). However, the detail of felsic melt/peridotite interaction processes has not been fully described due to very rare natural occurrence suitable for petrological examinations (e.g., Shimizu et al., 2004).

We found felsic veins of various size (microscopic order to ca. 50 – 60 cm in width) and with a wide compositional range in the Magarisawa Peridotite (MP), northern Hidaka Mountains, Hokkaido. The MP, one of the mantle peridotite masses situated along the base of the Hidaka Magmatic Belt (Maeda et al., 1986), is mainly composed of Pl lherzolite, and surrounded by pelitic granulites and their anatectic equivalents. Here we present zircon SHRIMP U-Pb age, major element compositions, and $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ isotopic ratios of felsic veins, in order to discuss the chemical modification process of the felsic melts by interaction with mantle peridotite observed in the MP.

On the basis of lithology and whole-rock compositions of the felsic veins, we subdivided them into three facies: (1) Granitic Vein (GV; Qz + Kfs + Pl + Phl + Opx $\pm$ Cpx $\pm$ Zr $\pm$ Ap $\pm$ Rtl $\pm$ Sph), characterized by higher-SiO_2 (64.0 – 74.5 wt%) and -K_2O (2.1 – 5.8 wt%), and lower-MgO (0.4 – 2.1 wt%) contents, (2) Pl-veinlet (PV; Plagioclase $\pm$ Opx $\pm$ Kfs $\pm$ Phl $\pm$ Zr $\pm$ Ap), which is a thin veinlet branched from the GV, (3) Noritic Vein (NV; Pl + Opx $\pm$ Phl $\pm$ Zr $\pm$ Ap $\pm$ Fe-Ni sulfide $\pm$ Ox), characterized by lower-SiO_2 (55.0 – 60.0 wt%) and -K_2O ($<$0.8 wt%), and higher-MgO (2.3 – 6.5 wt%) contents. Although continuous transition between the GV and the NV has not been observed in the field until now, whole-rock composition of the both veins represent a single trend on the Harker diagram. The PV is intermediate on the trend between the GV and the NV.

Orthopyroxenite (0.5 – 1.5 mm in thickness) composed of mosaic-shaped secondary Opx with subordinate amounts of Phl is always observed along the vein/peridotite boundary, clearly suggesting that the veins were formed from SiO_2-oversaturated melts and reacted with Ol in peridotites (e.g., Sen and Dunn, 1994). Furthermore, the microscopic/microprobe analyses indicate that secondary Opx is also formed by reaction between the felsic melts and primary Opx, Cpx, and Spl in the host lherzolite.

Zircon U-Pb age of the Noritic Vein is 19.5 $\pm$ 0.25 Ma, which corresponds to one of the main phases of the Hidaka magmatism and metamorphism (e.g., Maeda et al., 2010).

$^{87}Sr/^{86}Sr$ initial ratios of GV, PV and NV are 0.70531 – 0.70550, 0.70541 – 0.70551 and 0.70560 – 0.70566, respectively, and $^{143}Nd/^{144}Nd$ initial ratios of them are 0.51258 – 0.51260, 0.51260 – 0.51261, 0.51245 – 0.51260, respectively. Isotopic compositions of all felsic veins are apparently similar to those of the pelitic granulite/anatexite surrounding the MP (Maeda and Kagami, 1996).

Because formation of Opx from Ol consumes SiO_2 in the melts, the successive melt should become less-silicic, indicating the continuous modification of the melt composition from the GV through the PV to the NV. We have performed simple mass balance calculations to derive the NV from GV for major element composition. The results show that the composition of the NV can be modeled by addition of Ol, Cpx and Spl (in the host peridotite) to and subtraction of Opx and Phl (in the orthopyroxenite) from the GV.

In summary, we propose that the felsic veins within the MP record a significant chemical modification of SiO_2-oversaturated felsic melt during the interaction with mantle peridotite.