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Rare elements concentration related to behavior of the H2O, F, B and P, in Nagatare pegmatite, Fukuoka Prefecture

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Nagatare pegmatite, located at the western area of Fukuoka City, Fukuoka Prefecture, is considered that it derived from the Sawara granite, which intruded into the Itoshima granodiorite (Karakida et al., 1994). The pegmatite also intruded into the Sangun metamorphic rocks. The most characteristic properties of Nagatare pegmatite is the enrichment of rare elements such as Li, Cs and Ta, resulting as the occurrence of various rare element minerals. We have been investigating about each mineral in detail (e.g., Shirose and Uehara, 2014). There are differences for each dyke on constituent minerals and internal textures. Li enriched pegmatite is only one dyke located in Mt. Nagatare, and many of the dykes are simple pegmatites, bearing a common granite composition. In this study, the variation of constituent minerals, and chemical compositions of accessory minerals were studied, and the forming process of Li pegmatite were discussed with a focus on H_2O, F, B and P as flux components in granite melts.

Li mineral deficient pegmatites often occurred with aplites, with a dyke-shape body, 5-20 m in width and elongating along N20^{o}W, which is concordant with lamination structures of Sawara granite. The pegmatites were mainly consisted of quartz, K-feldspar, albite and muscovite, showing simple pegmatite compositions close to the chemical composition of granite. However, some pegmatites contained rare elements minerals such as beryl and columbite, without Li minerals, indicating the concentrations of rare elements including Be, Nb and Ta. In addition, they contained garnet and gahnite, indicating the peraluminous compositions. A pegmatite dyke intruding metamorphic rocks had tourmaline as borosilicate mineral, in addition to garnet and beryl. In Li pegmatite, in addition to the minerals above, triplite and montebrasite-amblygonite occurred as fluorine phosphates, and abundant lepidolite existed as F enriched mica.

As for chemical compositions of tourmaline, Fe and Mg were dominant without F contents in the tourmaline from the pegmatite intruding metamorphic rocks, while the tourmaline from Li pegmatite show fractionated trends from Fe-Li to Li-Al dominant chemical compositions with F enrichment. F contents of montebrasite-amblygonite show a high F concentration at the central part of Li pegmatite, 1.4-2.0 wt% F contents, using the partition coefficient to melt estimated by London et al. (2001). Columbite group minerals [(Fe, Mn)(Nb, Ta)$_2$O$_6$] were common accessary minerals in the Nagatare pegmatite. The chemical trends are Mn/(Mn+Fe) = 0.3-0.6 with Nb enrichment in the simple pegmatites, and Mn/(Mn+Fe) = 0.4-1.0 with Nb to Ta enrichment on Mn endmember. Their chemical trends coincide with that of columbite group minerals, suggested by Wise et al. (2012), corresponding to F contents of pegmatite.

In Li pegmatite from Nagatare, primary Li-tourmaline and K-feldspar had undergone alteration to clay minerals such as muscovite and cookeite. Montebrasite-amblygonite also altered into various secondary phosphates and muscovite. These reactions are hydrothermal replacement by H_2O enriched residual fluids in the late stages of pegmatite forming process, and it is suggested as a characteristic reaction in the H_2O enriched Li pegmatite. On assuming the latest elemental behavior, it is required to reveal these alteration processes and behaviors of B and Li released by tourmaline breakdown.

It is assumed that chemical and zonal developments of pegmatite are highly controlled by flux components in granite melts such as H_2O, F, B and P. As for Nagatare Li pegmatite, it is characterized by enrichment of F contents. In many cases, these elements are derived from peraluminous granite, considered to melt matasedimentary rocks, and we need to focus on properties of the surrounding granite, in addition to P-T conditions of formations.

Keywords: Li pegmatite, Nagatare, rare elements, tourmaline, fluorine, flux