

Grs₅₀Prp₅₀ garnet-bearing composite inclusion in Cr-rich pyrope from Garnet Ridge, the Colorado Plateau

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Garnet having near Grs₅₀Prp₅₀ composition is very rare in nature because of the large difference in ionic radii between Ca²⁺ and Mg²⁺. So far, only two occurrences have been reported from Garnet ridge, Arizona (Wang *et al.*, 2000) and the Kokchetav UHP Massif, Kazakhstan (e.g., Ogasawara *et al.*, 2000; Sobolev *et al.*, 2001). At Garnet Ridge, Wang *et al.* (2000) described four grains of Grs₅₀Prp₅₀ garnet as a constituent of composite inclusions in pyrope-rich garnet in kimberlitic diatremes. In the Kokchetav UHP Massif, Grs₅₀Prp₅₀ garnet is a major constituent mineral of UHP dolomite marble, and contains abundant microdiamonds. Takebayashi *et al.* (2017) has stated that CaO₈ and MgO₈ clustering around a SiO₄ tetrahedron stabilized ca. Grs₅₀Prp₅₀ compositions on the basis of the overlapping of R(SiO₄)⁴⁻ Raman bands corresponding to Grs (372 cm⁻¹) and Prp (364 cm⁻¹), and considered that two main factors controlled the formation of this strange garnet; (1) the bulk chemistry of the host rock (Ca:Mg = 1:1) and (2) UHP conditions.

Recently, we discovered one grain of Grs₅₀Prp₅₀ garnet from the Garnet Ridge; the garnet occurs as a constituent of composite inclusion in the host Cr-rich pyrope (Group A by Sakamaki *et al.*, 2016), which is of garnet Iherzolite origin. Cr-rich pyrope (Group A) is an original material for Cr-poor pyrope (Group B) during mantle metasomatism. The found composite inclusion, which shows spherical form measuring 150 μm across, consists of pargasite and dolomite with minor Cr-spinel, phlogopite and apatite. The other composite inclusions consist of pargasite, dolomite, Cr-spinel with minor apatite and magnesite. We conducted laser Raman spectrometry on this Grs₅₀Prp₅₀ garnet, and focused on the band attributed to R(SiO₄)⁴⁻ at 365 cm⁻¹. The overlapping of R(SiO₄)⁴⁻ bands corresponding to Grs and Prp in a single Grs₅₀Prp₅₀ crystal was observed. Our results of Raman spectrometry were consistent with those of the Kokchetav Grs₅₀Prp₅₀ garnet by Takebayashi *et al.* (2017).

Almost all composite inclusions contain dolomite/magnesite and show rounded or spherical form. This suggests that these composite inclusions was trapped carbonate-silicate melt during the mantle metasomatism. The Grs₅₀Prp₅₀ garnet in the found composite inclusion was formed from such trapped melt which had the bulk chemistry, near Ca:Mg = 1:1, at very high pressure.

The Grs₅₀Prp₅₀ garnet described by Wang *et al.* (2000) could have formed by the same process from trapped carbonate-silicate melt, and the inclusion Grs₅₀Prp₅₀ garnet was not in equilibrium with the host pyrope-rich garnet. Their interpretation about the genesis of Grs₅₀Prp₅₀ garnet including very low formation temperature based on the coexistence with the host may be wrong.

References

- Ogasawara, Y., Ohta, M., Fukasawa, K., Katayama, I., Maruyama, S., 2000, *Island Arc*, **9**, 400-416.
- Ogasawara, Y., Sakamaki, K., Takebayashi, T., Suzuki, H., Saito, T., 2016, *AGU Fall Meeting*, SR33A-2673.
- Sakamaki, K., Sato, Y., Ogasawara, Y., 2016, *Progress in Earth and Planetary Science*, **3**, 1-17.
- Sobolev, N.V., Schertl, H.-P., Burchard, M., Shatsky, V.S., 2001, *Doklady Earth Science*, **380**, 791-794.
- Takebayashi, T., Saito, T., Suzuki, H., Sakamaki, K., Ogasawara, Y., 2017. *JpGU Meeting Abstract*.
- Wang, L., Essene, E.J., Zhang, Y., 2000, *American Mineralogist*, **85**, 41-46.

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