Multiple micro-area analyses of rhönite at the opacite rims of kaersutites

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The knowledge of both chemical composition and crystallographic information is indispensable for mineral identification. However, the identification of minute mineral grains depends only upon the chemical composition obtained by electron microprobe analysis and crystallographic analysis is not performed in many cases. Recently, crystallographic information in micro-areas (~1 µm) can be obtained by the development of various analytical methods using micro-beams. Such methods include micro-area X-ray diffraction by synchrotron radiation [1], electron back-scattering diffraction (EBSD) pattern [2], and micro Raman spectroscopy. In this abstract, we report employment of these multiple analytical techniques to analyze fine-intergrowth observed at the opacitized rims of kaersutite megacrysts (Ti-rich amphibole) (0.5-1 cm) in alkali trachyte from Oki-Dogo, Shimane Prefecture, Japan. The opacite margins are present at the fringes and along fractures and cleavages of the kaersutite megacrysts and constitute of intergrown dark color minerals (20 µm) and Ti-augites (color is pink). The previous study suggested that the dark minerals are alkali amphiboles [3]. However, we found that the chemical compositions of these minerals are closer to the rhönite composition rather than alkali amphiboles. Rhönite is a rare aluminosilicate belonging to the aenigmatite group of minerals. The general crystal-chemical formula of rhönite is written as $A_2B_6T_6O_{20}$, where A=Ca, B=Mg, Fe^{2+}, Fe^{3+}, Ti, T=Si, Al, Fe^{3+}. We analyzed this phase by the micro-area X-ray diffraction by synchrotron radiation to confirm that this phase is rhönite. We found that the obtained Laue diffraction patterns are identical to that of rhönite. The EBSD pattern of this phase also matches with that of rhönite. Finally, micro Raman spectra of this phase show different peaks than those of alkali amphiboles. Thus, our compositional and crystallographic analyses show that there is no doubt that the dark minerals at the opacitized margin of kaersutites are rhönite.

References

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Graphite-bearing garnet pyroxenite layers within mantle peridotites from the Northern Apennine (Italy)

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Graphite-bearing garnet pyroxenite have been found as meter-sized layers within mantle peridotites of the Northern Apennine orogenic belt. The peridotites are amphibole-bearing spinel-plagioclase tectonites to mylonites that locally contain up to centimetre wide websterite layers. The primary assemblage of garnet pyroxenites consists of pyrope-rich garnet ($Py_{53-45}Alm_{29-37}Grs_{11-20}$) + sodic Al-augite (Cpx I), characterized by high Na_2O and Al_2O_3 (respectively up to 2.7 and 12.0 wt.%) ± accessory Fe-Ni sulphides and graphite. The latter occurs as flakes and stacks of flakes with grain size up to 2-3 mm. Graphite crystals were analysed by microRaman spectrometry on fresh fracture surfaces. Well defined first (O-) and second order (S-) peaks, and the absence of first order D-peaks indicate a highly ordered structure similar to that of graphite crystallised at high T in peridotite xenoliths. Extensive development of symplectitic intergrowths of orthopyroxene (Opx 1) + plagioclase (An_{85-72}) + green aluminous spinel ± clinopyroxene (Cpx 2a) ± ilmenite are observed at the cpx-garnet interface. Large crystals of clinopyroxene (Cpx 2b) may show exsolutions, rims and symplectitic intergrowths with Na-rich plagioclase (up to 50 mol % of albite component). Recrystallised millimetre-sized domains composed of plagioclase + Cpx 3 + Opx 2 + Al-Spn are also observed. Decreasing amount of Ca-Tschermak and jadeitic substitution are shown by the second and third clinopyroxene generations. Fine-grained granoblastic aggregates of olivine + plagioclase may replace the opx-bearing symplectites. Thermobarometric investigations on the basis of chemical compositions of garnet and its clinopyroxene inclusions have yielded T = 1060-1100°C and P = 2.8 ± 0.5 Gpa (Simakov and Taylor, 2000). The later granulite facies decompression has been estimated to have occurred at T = 950-1000°C, on the basis of cpx-opx Fe-Mg exchange thermometry. Garnet pyroxenites have relatively high Al_2O_3 and CaO contents and may be divided in two subtypes (Type A and B) on the basis of trace element composition. Type A has nearly flat REE patterns and weak Eu and Sr positive anomalies, suggesting an origin from low pressure gabbroic protoliths involved in a subduction event. Type B displays extremely depleted LREE (Ce_N/Yb_N = 0.06-0.10, with HREE at 6-8 times chondrite) possibly due to partial melting during subduction. Stable (O, C) and radiogenic (Nd, Sr) isotope analyses are currently in progress to verify these hypotheses.

References

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