Mineralogy of polygonal serpentine and chrysotile from Kyushu Kurosegawa Belt

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Serpentine minerals are 1:1 type phyllosilicate with ideal composition $Mg_3Si_2O_5(OH)_4$. They take various crystal structure due to the misfit between layers. Chrysotile have cylindrical nanotube like structure and is divided into clinochrysotile (chrysotile-2M_{c1}) and orthochrysotile (chrysotile-2Or_{c1}) by the β angle. Polygonal serpentine (PS) have a unique multi column shaped structure. It can also be divided into two types; "clino-type PS" with XRD pattern similar to clinochrysotile and "ortho-type PS" similar to orthochrysotile (Middleton and Whittaker, 1976; Krstanovic, 1997). Careful observation is required for accurate determination. In our former study, we revealed the types and distribution of polygonal serpentine and chrysotile from Kurosegawa belt, Kyushu, Japan (Enju et al., 2016). The chrysotile and PS from the Kurosegawa belt can be roughly divided into two groups; Ortho-type PS rich type and clinochrysotile-rich type which includes minor orthochrysotile. This biased occurrence is very unique. In this study, we researched the occurrence and chemical composition of PS and chrysotile from Kyushu-Kurosegawa belt to estimate the factors that cause the difference in forming species.

About 300 samples were collected at 28 areas in Kyushu Kurosegawa belt and analysed by XRD (Inoo and Uehara, 2009). Representative samples were chosen considering the result of X-ray diffraction (XRD), and were analysed by electron microprobe analyser (EPMA) and transmission electron microscope (TEM) in Kyushu university ultramicroscopy research center. Two types of TEM samples were prepared; dispersed grains on Cu-grids and ion milled thin sections.

The ortho-PS commonly occur as liner splintery veins, few millimetres in width (Shimotake, Fukami) or irregular veins (Wakayama) in host serpentinites. Clinochrysotile rich specimen occur as thin veins in serpentinites, or as massive aggregates. The clinochrysotile rich samples are Al poor (<0.02 *apfu*), while ortho-type PS rich samples showed various Al contents (0.01-0.09 *apfu*). Al contents of the ortho-type PS differed in localities; Fukami (0.01 *apfu*), Shimotake (0.04-0.05 *apfu*) and Wakayama (0.09 *apfu*). The Fe was mainly divalent estimated from charge balance, and showed no clear difference between the two types (0.03-0.11 *apfu*). The basic properties of ortho-type PS (15 sectored, 200-300nm in general) were common in all samples, but microtexture differed by locality. The chrysotile and PS in Fukami, have smaller diameters with sparse texture, while they occur as incomplete fractures with larger diameter in dense texture in Wakayama. Shimotake was intermediate.

Serpentine veins with different occurrence in Shimotake was observed to estimate the factor that causes different forming species. In Shimotake many splintery serpentine veins occur between spathic serpentinite, pale to apple green, opaque, few millimeters in width, which are all ortho-type PS near endmember. However there is also a wider vein (up to 1 cm) composed of many scale like blocks, yellowish to apple green, opaque to transparent, which is much less common. They are mixture of orthochrysotile and clinochrysotile, and the proportion change through out the vein. The composition of the chrysotile split into two types, Al rich phase (Al 0.02-0.04, Fe 0.04-0.08 *apfu*) and Fe rich phase (Al 0.01-0.02, Fe 0.09-0.12 *apfu*). The Al-rich phase is abundant in orthochrysotile rich specimen and Fe rich phase in clinochrysotile. Also considering that the chemical composition of Al rich phase is close to ortho-PS, the Al content may be responsible for clino-type vs ortho-type, but not for PS vs chrysotile.

Another interesting point is that ortho-PS are always homogeneous, although the composition slightly differs from vein to vein.

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