Microstructure of serpentine minerals in “Chikuyoseki” from Matsubasemachi, Uki, Kumamoto prefecture, Japan

*Hirakawa Mami[1], Seiichiro Uehara[1]

1. Kyushu University

Serpentine is a major mineral of serpentinite and is the 1: 1 type layered silicate mineral containing Si - O tetrahedral sheet and Mg - O octahedral sheet. The crystal structure differs depending on the way in which these sheets are stacked, and it is classified into lizardite, chrysotile, antigorite and like. Microstructure observation using a transmission electron microscope (TEM) has been performed for many years against various serpentine minerals, but after the 1990's, antigorite (Dodony et al., 2002 etc.) and polygonal serpentine (Baronnet and Devouard, 2005, etc.) are frequently observed by high resolution transmission electron microscopy (HRTEM), while they are only few studies on other serpentine minerals and accompanying minerals. Veblen and Buseck (1979) observed the symbiotic relationship of serpentine and talc in the electron microscope and reported the change from serpentine tabular structure to columnar structure. Also, since 2000, an aberration correcting electron microscope has been developed, and the resolution of TEM has been significantly improved. However, the structure of serpentine and microstructural studies of serpentinite including talc and hornblende using aberration correcting electron microscope have not progressed.
Matsubasemachi, Uki , Kumamoto belongs to the Higo metamorphic belt, and it is known that ultramafic rocks called "chikuyoseki" are distributed in metamorphic rocks for a long time (Otsuki, 1902). Chikuyoseki contains olivine elongated in bamboo leaf shape, which is altered to serpentine containing fine magnetite (Mizuta, 1978). Since there are many petrological studies on this chikuyoseki, this research aims to clarify the mineralogical properties, including the microstructure of serpentine in this production area.

For X-ray diffraction experiments, M18XHF22-SRA manufactured by Bruker AXS, for chemical analysis and microstructure observation, SEM-EDS (JSM-7001F manufactured by JEOL), TEM (JEM - 3200 FSK and JEM - ARM 200 F made by JEOL) of Kyushu University Ultramicroscopy Research Center was used, and sample preparation was carried out by ion polishing method by Gatan PIPS II.

According to the X-ray diffraction experiment, the black part (hereinafter, this is called the bamboo leaf part) elongated in a bamboo leaf form are mainly composed by lizardite and chrysotile, a small amount of magnetite and talc, and the gray part surrounding the bamboo leaf part (hereinafter, this is called the surrounding part) are composed by talc and lizardite, a small amount of chrysotile and forsterite.
In the bamboo leaf part, mesh texture is observed by polarization microscopy and SEM observation, and magnetite is distributed along the mesh texture. Both the mesh rim and core are serpentine composition, but the mesh cores are richer in iron. In TEM observation, a microstructure composed of low crystallinity serpentine containing chrysotile (Fig. 1a), and a coarse grain structure of lizardite with good continuity (Fig. 1b) were observed.
At the surrounding part, parallel intergrowth of serpentine and talc in various scales ranging from about 10 μm to 0.5 μm was observed by SEM and TEM observation. In TEM observation, chrysotile of incomplete structure and antigorite are confirmed in serpentine. In addition, a structural change leading to chrysotile structure from a lizardite structure as reported in Veblen and Buseck (1979) was also observed (Fig. 1c).

Keywords: Serpentine, Chikuyouseki, Lizardite

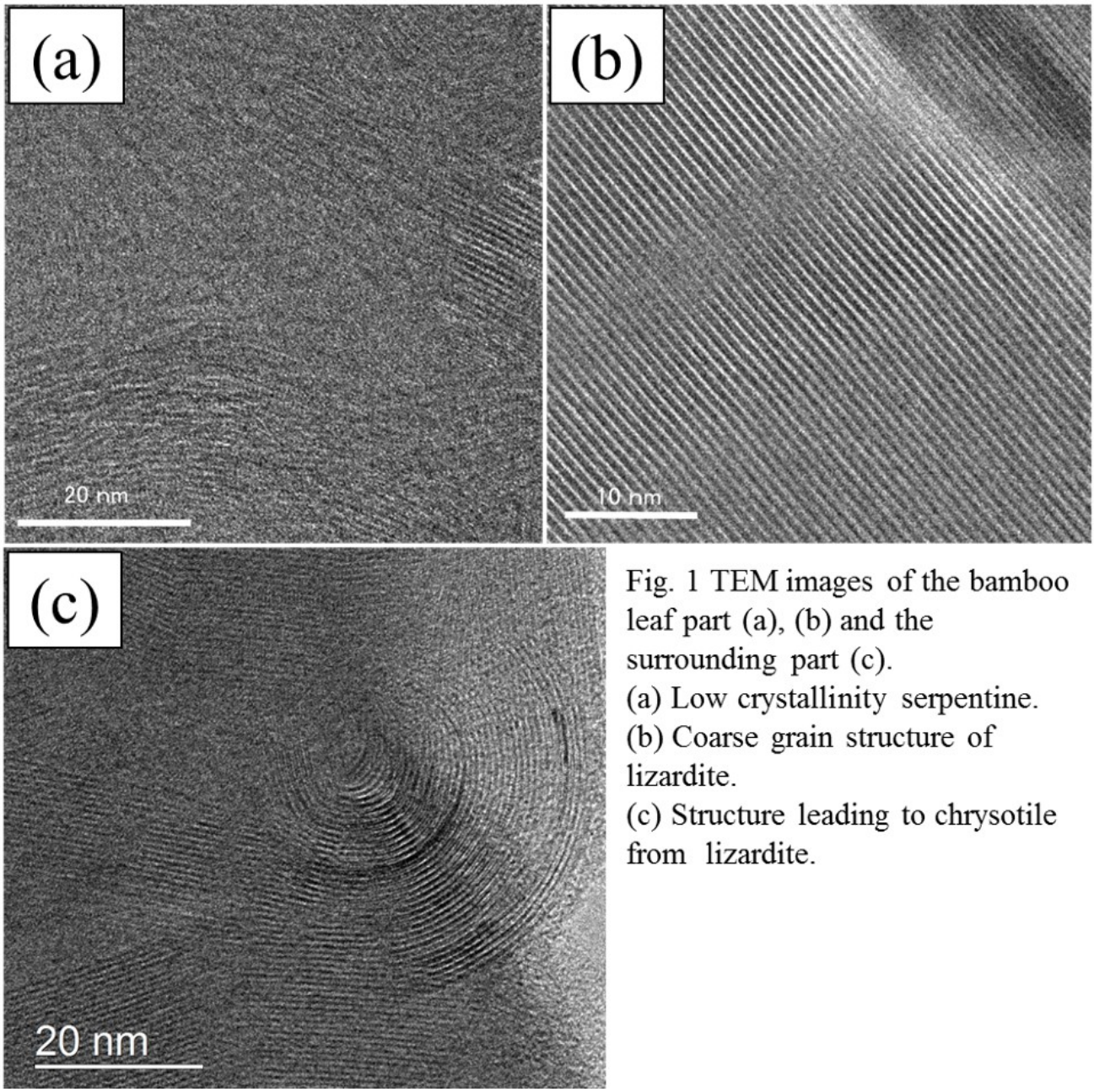

Fig. 1 TEM images of the bamboo leaf part (a), (b) and the surrounding part (c).
(a) Low crystallinity serpentine.
(b) Coarse grain structure of lizardite.
(c) Structure leading to chrysotile from lizardite.

