Mineralogical characterization of gastropod nacre and its growth mechanism

Hiroki Mukai[1]; Kazuko Saruwatari[2]; Hiromichi Nagasawa[3]; Toshihiro Kogure[4]

[1] Earth and Planetary,Tokyo Univ.; [2] Univ. of Tokyo; [3] Agricultural and Life Sciences, Univ. of Tokyo; [4] Earth and Planetary Sci., Univ Tokyo

The nacreous layer of mollusk is composed of thin aragonite tablets intercalated with intercrystalline organic sheets which are regularly spaced at a distance of approximately 0.5um. It is also known that aragonite tablets at the growth front of gastropod nacre form pyramid-like stacks, whereas those of bivalves usually show a step-like structure.

In this study, gastropod nacre, especially pyramids at its growth front, was investigated by using scanning electron microscopy (SEM), electron back scattered diffraction (EBSD), and transmission electron microscopy (TEM) with Focused ion beam (FIB) micro-sampling technique. The FIB system is a comparatively new technique and by using this system, specimens were made for TEM from the arbitrary regions precisely. Kikuchi patterns were used in both SEM (EBSD) and TEM to investigate the change of the crystal orientations in the specimens.

In SEM observation of abalone nacre, tablets of pyramids have pseudo-hexagonal shape and correspond to (001) aragonite form surrounded four {110} and two (010) facets are usually developed in aragonite. This observation indicates a tablet of abalone is a single crystal. Furthermore, tablets of pyramids in abalone and Omphalius rusticus were investigated by EBSD in SEM or in TEM. The analyses results confirmed that the aragonite tablet is twin-free and a single crystal regardless of its morphology.

Next, by FIB technique, the cross-section of pyramids were processed and investigated in TEM. By using HRTEM, lattice images confirmed that adjacent tablets are connected completely in mineral bridges between intercrystalline organic sheets. On the other hand, Kikuchi pattern analyses showed that the crystal orientations of tablets were generally aligned between tablets in the stacking. However, remarkable changes of the crystal orientations were occasionally observed and it was noticed that they have the relationship of {110} twinning. Such relationship between tablets could be also found in SEM observation of pyramids.