

Raman and IR imaging of spheroidal microfossils from the Precambrian

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The Cambrian, beginning 540 million years ago, is the earliest period in whose rocks are found animal fossils with external skeletons. This sudden appearance of hard body fossils is referred to as the Cambrian explosion. The acquisition of hard tissues (minerals) is considered to be one of possible origins of Cambrian explosive animal evolution. However, the mechanisms for the hard tissue formation are not known. One possible explanation is the mineral formation on biomolecular templates such as collagen based on present day biomineralization of phosphates (bones and teeth) and carbonates (shells).

In order to characterize association of organic matter with minerals in the Ediacaran animals, spheroidal microfossils from the Ediacaran were analyzed by SEM-EDX, Raman and infrared spectroscopy.

SEM-EDX showed no differences in P and C distributions between the interior and the exterior of the fossil.

Two-dimensional Raman imagery showed detailed microscopic distributions of organic and mineral components. The spheroidal microfossils were found to be surrounded by a thin layer with an absorption band at 964 cm^{-1} (phosphate). Numerous spherical phosphate particles of about 10 to 20 micrometers are also distributed inside this microfossil.

IR spectra of the microfossil showed absorption bands at 3538 and 965 cm^{-1} , which can be attributed to hydroxyapatite, together with 2990, 2935 and 2880 cm^{-1} bands due to aliphatic CH and 1617 cm^{-1} band due to C=C groups. These results indicate that the microfossil is the mixture of hydroxyapatite with organic components.

Further detailed studies are being conducted for the relationships between organic components and minerals.