

カルシウムを含む物質の生物鉱化作用の進化シナリオ

A possible scenario for the evolution of the biomineralization of calcium containing materials

戎崎 俊一^{1*}

EBISUZAKI, Toshikazu^{1*}

¹ 独立行政法人理化学研究所

¹RIKEN

Biomineralization of calcium containing materials such as calcium carbonate or calcium phosphate is important in the evolution of animals. I here present a possible scenario for its evolution: 1) Biomineralization of calcium carbonate (calcification) started as the byproduct of uptake of bicarbonate ions as a carbon source for photosynthesis in cyanobacteria. The hard external shells protect soft biological bodies inside against harmful UV-B radiation (280-315 nm) as well as other external threatening (predators, mechanical forces like waves, and desiccation): Since biological calcium carbonate is composed of numerous numbers of particles as small as several hundred nanometers, it selectively scatters UV radiation with shorter wavelengths than optical radiation with longer wavelengths. 2) The common ancestor of metazoans got genes necessary for calcification by horizontal gene transfer through symbiosis with photosynthetic bacteria in Ediacaran period. 3) The external skeletons were developed extensively in metazoans for sunshield and mechanical protection in Cambrian period. In particular, Trilobite invented first imaging eyes with calcite lenses and triggered explosive evolution of metazoans through the light switch. Some of them also have external skeletons made by hydroxylapatite (calcium phosphate) in phosphate rich (probably oversaturated) environment with minor changes of the genes for calcification. 4) Ancestors of vertebrate started to store the apatite skeletons inside their body to adapt phosphate poor (unsaturated) environments as early as Ediacaran period, since phosphate starvation is commonly seen on the Earth.