

Secondary phosphatization of the earliest Cambrian shelly fossil *Anabarites*

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Biom mineralization may have an extremely long evolutionary history since the Paleoproterozoic, while the widespread biom mineralization among metazoan lineages started at the earliest Cambrian. However, the primary mineralogy of *Anabarites* shell remains controversial.

Optical microscopic observations combined with the BSE and EDS analyses are used to study the shell of the fossil *Anabarites* from the Kuanchuanpu fauna in southern Shaanxi Province in China, which is correlated to the Cambrian Fortunian Stage. The EDS analysis shows that the phosphorus-rich layer closely adjacent to the calcified layer exhibits a Ca: P: C ratio compositionally similar to the bioapatite. The results that the calcified layer and the phosphorus-rich layer have different chemical compositions is consistent with the optical observation that there is an obvious gap between these two layers and the phosphorus-rich layer can extend to the phosphatic material inside of the tube, suggesting the phosphorus-rich layer doesn't belong to the original shell. We suggest that the phosphorus-rich layer is diagenetic in origin, precipitated as a result of phosphorus release during the decay of organic matter by microbes. Considering the biologically controlled carbonate shell (OCS) should display different isotopes information from the carbonate matrix (i.e., OCS is ¹²C concentrated on the assumption that the biogenic organic matter template is readily rich in ¹²C), NanoSIMS was used to map ion distributions of C and N in the shell of *Anabarites* and matrix. However, ion images barely show ¹²C, ¹³C and ²⁶CN concentration differences between the OCS and the matrix, while ¹²C and ²⁶CN are supposed to be enriched in the OCS. The minor isotopic differences between the shell and the matrix is hard to be detected by NanoSIMS, at least in our sample.