

Earliest Cambrian fossil embryos and their paleoceanographic background

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The uppermost Neoproterozoic Dengying Formation, the lowermost Cambrian Kuanchuanpu and Guojiaba Formations are distributed at Shizhonggou section in Ningqiang County, southern Shaanxi province, China, which was located at the northern margin of Yangtze Platform. Among the sediments, the lowermost Cambrian Kuanchuanpu Formation, ca. 55m thick, consists of limestone, dolostone, phosphorite and chert, and is significant in its paleontological records. Fossil embryos from phosphorite and limestone are now intensively subjected to paleontological studies as a record of the animal evolution in a period from Snowball Earth to Cambrian Explosion. Despite of the intensive paleontological researches, much less attention has been paid to sedimentary facies and compositions of this formation, which are essential to consider the preservation process of the fossil embryos. In this study, fossilization and paleoceanographic conditions are investigated with data of mineral, trace element and isotopic compositions, in addition to optical and SEM observations.

Fossils yielded from the Kuanchuanpu Formation were mainly permineralized by carbonate and apatite, interior of the embryos are usually filled with carbonate and rarely barite. Filamentous bacteria permineralized by apatite were sometimes seen in fossil embryos. Most of the observed embryos were thought to be the developmental stages as blastula to gastrula, so these embryos would have had fertilization membranes.

Carbon isotopic ratios indicate fluctuations in some horizons containing PC/C boundary, and also gradual decreasing tendency from the uppermost Dengying Formation to the upper Kuanchuanpu Formation. Because fossils could not be seen in the lower part of this section but abundant in the upper part, decrease of the carbon isotope might result from decomposition of organic matters. This tendency has been commonly reported from other PC/C section, and therefore represents the global trend.

High Mn and Fe concentration in the Dengying Formation, correspond to the results of the previous studies of other areas, and was thought to have been associated with revival of deepwater circulation. By the upwelling deepwater that was used to be layered, transported Mn, Fe and phosphate to shallower environments. Despite of oxidized Mn and Fe were extracted from the water, but phosphate remained its high concentration in seawater throughout the depositional period of the Kuanchuanpu Formation. This phosphate concentration and bacterial effect would permineralized embryos. Redox state of the depositional site was oxidative to consume free Mn and Fe ion, but was reductive to prevent oxic decomposition of the embryos and to facilitate permineralization of relatively strong organic compounds, such as fertilization membrane.

We will also present and discuss the, measurement results on organic substances.