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A unique condition for the SSF diversification and the phosphogenesis in the Early Cambrian in Chengjiang, South China

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In the earliest Cambrian, a major diversification of small shelly fossils (SSFs) occurred as the first stage of the Cambrian Explosion. In order to clarify the precise location and environmental background of this event, we examined the detailed litho- and bio-stratigraphy of the SSF-enriched lowermost Cambrian in central Yunnan, South China.

In the Chengjiang area, ca. 40 m-thick lowermost Cambrian (the Zhongyicun Member of the Zhujiaqing Formation) is composed of interbedded phosphorite and limestone. Phosphorite is in fact composed of clastic grains with calcite matrix. This texture suggests that phosphate was primarily deposited in a relatively shallower setting than limestone, and eroded/transported into the depositional site of limestone as clastic grains. Primary phosphorite deposition likely occurred in an extremely shallow setting. At the Hongjiachong section, we subdivided the Zhongyicun Member into 5 units; i.e., Units A, B, C, D and E. Units A, D and E are mainly composed of phosphorite, whereas Units B and C of limestone. Units A, D and E were likely deposited in a site deeper than that of Units B and C. The depositional setting has likely changed from shallow to deep, and deep to shallow again. A unique sandstone bed occurs at the boundary of Units B and C. It is noteworthy that the sandstone truncated the bedding of the beds of Unit B. The sandstone is likely a turbidite bed that reached to the deeper part of basin intermittently. The SSFs occurred solely from this sandstone between Units B and C. As the SSFs occur in the same manner as phosphate clastics, they were also derived likewise from shallow environments.

At Hongjiachong, we identified 15 genera of SSFs from 10 horizons in the Zhongyicun Member, and recognized two distinct assemblages; one with *Anabarites* sp. and *Protohertzina* sp. from the bottom of Unit A, and the other with various mollusc shells, such as *Paracarinachites* sp. and *Ocruranus-Eohalobia* group from the sandstone and higher units. This assemblage shift, i.e., the major SSF diversification, occurred in the earliest Cambrian probably before that of the marker sandstone, i.e. during the deposition of Unit B of the lower half of the phosphorite-bearing sequence.

We speculate that phosphorites might have primarily deposited in a unique shallow-water environment where phosphorous-rich seawater was concentrated, such as a small restricted embayment, and that the SSF diversification possibly occurred in such extreme conditions.

Keywords: small shelly fossils, phosphorite, Cambrian, South China