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## **Geology, geochemistry and genesis of the Neoproterozoic-Early Cambrian phosphorites in South China**

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The formation of marine sedimentary phosphorite mainly occur throughout the Phanerozoic, however, the Chinese phosphorites occur mainly in Neoproterozoic and early Cambrian strata. These phosphorites source more than half of the total phosphorus reserves in China and provide a key monitor of the chemical evolution of contemporaneous seawater, continental weathering and the biogeochemical cycle.

The Neoproterozoic phosphorites occur in the Doushantuo Formation in South China and contains exceptionally well-preserved fossils of putative earliest animal embryos [1]. The phosphorites occur as massive and banded ores of mostly >20% and as much as 36% P<sub>2</sub>O<sub>5</sub> (e.g., Kaiyang deposit in Yunnan). In contrast, the Lower Cambrian phosphorites occur mainly as banded ores and phosphatic concretions within the organic-rich sequence that generally contains <20% P<sub>2</sub>O<sub>5</sub>. These phosphorites (in particular in Guizhou Province) may contain high content of rare earth elements with REE<sub>2</sub>O<sub>3</sub> as much as 0.03%-0.235% [2]. For example, the proven REE reserves are about ca. 1000t HREE+Yttrium in the Xinhua phosphorite deposit from Zhijin, Guizhou Province [3]. The REE concentrations show a positive correlation with P<sub>2</sub>O<sub>5</sub> contents, suggesting the REEs are hosted in the phosphate. Some of the Chinese Lower Cambrian phosphorites also show a close association with Mn mineralization. For example, the Tiantaishan phosphorite-Mn carbonate deposit in Shaanxi Province contain averages 31% P<sub>2</sub>O<sub>5</sub> c and 16% MnO in interbedded rhodochrostones [4]. Small amounts of microcrystalline uraninite and orthobrannerite and monoclinic brannerite have been discovered in the Lower Cambrian phosphorites in Hunan Province, suggesting a genetic link of phosphorous and uranium mineralization [5]. Onofrite has also been reported in these uranium-rich phosphorites [6].

The genesis of the phosphorites has been debated. Most researches invoke the “upwelling seawater model” for the phosphogenesis with some advocating a vital role of diagenesis and microbially-mediated process (e.g., [7, 8]). In contrast, a number of researches (e.g, [5, 6, 9]) advance an alternative model that involves significant seafloor hydrothermal fluid during formation of these phosphorites as supported by mineral paragenesis and geochemical features such as Al-Fe-Mn, Sr/Ba, Co/Ni, U/Th and REE patterns and Eu anomaly. The depositional environments for most of these phosphorites were dysoxic and anoxic.

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