Paper Number: 2769

Origin of the Ediacaran Doushantuo phosphorites in the Yangtze Gorges area, China

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The Ediacaran Doushantuo phosphate depositshave almost been found in the north wing of the Huangling anticline, but could not be explored out in the south wing in the Yangtze Gorges area, China. In the south wing, however, there isthe same developing Doushantuo Formation composed of cap dolomites, black shales, and carbonates, but only chert nodules and bands, perhaps phosphorous, occurin the same unit as the phosphorite rocks in the north wing.

In the north wing Zhangcunping deposit, the lower Doushantuo phosphorus-bearing sequence begins with repeated shale-phosphorite cycles and evolves upward into phosphorites with minor dolostones and eventually into thick-bedded dolostones with chert nodule and band without phosphorite [1]. The phosphorite rocks have an age of ca. 614±8Ma [2] and contain P_2O_5 over 32wt%. We investigated geochemical and isotopic characteristics of phosphorite and adjacent shale, dolostone, and chert in this sequence. The phosphorites show $\delta^{13}C_{carb}$ values in the range of −5.0 to −7.7‰ VPDB, significantly lower than the values of −1.9 to 2.2‰ VPDB for the adjacent dolostones. Similarly, the $\delta^{18}O_{carb}$ values of the phosphorites in the range of −12.3 to −15.3‰ VPDB are also lower than the values of −3.4 to −6.1‰ VPDB for the adjacent dolostones. The isotope evidences suggest that the phosphorites formed during the post-sedimentary diagenesis, different from the carbonate formation. In addition, the phosphorites, chert nodules and bands display a MREE-rich pattern, consistent with the typical REE pattern of the ferromanganese nodules/crusts in modern ocean floor. However, the adjacent dolostones have a left-leaning REE pattern similar to those of ancient seawater. The REE patterns indicate that the basic P and Si components composed of the phosphorites, chert nodules and bands were originally derived from Fe-Mn oxide sediments. The good reverse relationship between P and Si contents in our studied phosphorite samples also supports that the primary P an Si source is from sedimentary Fe-Mn oxides [3].

Therefore, the dissolved P and Si cameprimarily from strong continental weathering after the snowball Earth and they absorbed mostly by Fe-Mn oxides in the oxic intra-shelf. Within a dynamic and stratified

ocean, fluctuant redox-conditions caused accumulations of bioavailable P and Si in the anoxic deep water and then they were transported to the shallow-water shelf by upwelling. She et al. [4] found cyanobacterial blooms with rapid scavenging of phosphorus. The phosphogenesis finally took place with massive burial of organic matter and consequently diagenetic processes.

References:

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