

The suboxic Ediacaran ocean— constraints from the Doushantuo phosphorites and their REEs

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The Ediacaran Doushantuo period (635Ma—551Ma) is an important phosphogenic stage in south China and the widely-occurred phosphorites implies changes in ocean chemistry at aftermath of the Marinoan glaciation.

We investigated the phosphorus-bearing Doushantuo sequence in the Zhangcunping area, Yichang city, and found differences in the REE characters. The phosphorites (>30% wt P₂O₅) and carbonaceous shales have high REE contents, distinct Ce anomalies and REE patterns normalized by PAAS. The dolostones have low REE contents, moderate Ce negative anomalies, and left-leaning REE patterns signing the ancient seawater. Interestingly, all the phosphorites, chert nodules and bands have the same MREE-rich patterns, but the chert REE contents are at least one order of magnitude lower than the phosphorites. The Doushantuo phosphatic REE characters, low REE content (relative to the Phanerozoic [1]) and MREE-rich pattern, are also documented by the upper- and the lower-bed phosphorites from the Weng'an deposits, Guizhou [2]. The Doushantuo MREE-rich patterns, consistent with the typical REE pattern of the Fe-Mn nodules and crusts in modern ocean floor, suggest that the Doushantuo cherts and phosphorites had the same origin, i.e. the coeval Fe-Mn oxyhydroxide sediments. Thus, there is a good inverse correlation between P and Si contents in the Zhangcunping phosphorites.

During the Ediacaran Doushantuo period, the low REE content and MREE-rich pattern recorded in the phosphorites indicate that the postglacial Ediacaran ocean may be suboxic, where the Fe-Mn oxyhydroxide sediments accumulated in oxic or suboxic shallow ocean and the REE-rich phosphates formed perhaps in the same shallow ocean changed to the anoxic environment.

[1] Emsbo *et al.* (2015) *Gondw. Res* **27**, 776-785. [2] Chen *et al.* (2003) *Chem. Geol* **201**,103-118.