Redox variations in the early Ediacaran shallow ocean: evidence from the Doushantuo Formation, South China

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The Ediacaran represents a period of fundamental biogeochemical changes that have generally been related to oxygenation of the Earth's atmosphere and oceans. Recent geochemical studies suggest high spatial heterogeneity of oceanic O_2 conditions and dynamic marine shelf oxygenation in a dominantly anoxic ocean during the Ediacaran. Here we present mineralogical data from the lower Ediacaran Doushantuo Formation from South China which shed new light on the redox variations of the shallow ocean.

The lower Doushantuo Formation is characterized by glauconitic sandstones and phosphorites deposited in peri-tidal environments. The glaucony minerals mainly occur as interstitial aggregates cementing detrital minerals and phosphatic intraclasts and suggest in situ formation in suboxic pore waters. The glaucony-hosting phosphorites, on the other hand, do not show evident negative Ce anomalies, consistent with deposition of phosphate precursor in anoxic environment near the sediment/water interface. Moreover, pyrite and marcasite form submillimeter-sized rosettes, which suggests highly variable pore pH during early diagenesis. Collectively, the data suggest that the lower Doushantuo Formation deposited in a redox unstable shallow ocean environment. Authigenesis and early diagenetic mineral growth and transformations were controlled by O_2 levels and Fe-redox cycling likely have played key roles in the unprecedented phosphogenic events.

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