Contrasting Mo–U enrichments of the basal Datangpo Formation in South China

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Introduction

The increase of atmospheric oxygen was protracted and is hypothesized to have proceeded in two main steps. Unlike the Great Oxygenation Event, which has been verified by multiple lines of evidence, much remains elusive about the second oxygen rise. Recent work based on trace metal enrichments from black shales of the Doushantuo Formation in South China suggested substantial oxygen increase immediately after the Marinoan cap carbonates. This finding lends support to the notion that elevated atmospheric oxygen levels fundamentally permitted the evolution of metazoans. However, sponge biomarkers and sponge-like fossils have been found well before the termination of the Marinoan glaciation. Thus, new geochemical data before the Ediacaran are highly needed to illuminate the role of changing redox conditions on early animal evolution.

Results and Discussion

We report pyrite morphology, trace metal enrichments, and total organic carbon data from interglacial black shales of the lower Datangpo Formation at Daotuo area, northeast Guizhou Province, South China. A contrasting Mo–U enrichments pattern emerges (Mo = 41.6 ± 8.2 ppm, U = 3.2 ± 0.3 ppm; mean ± SD), despite the persistently euxinic local environment as testified by the presence of abundant tiny pyrite framboids. This decoupled Mo–U signature integrated with a simple mass balance model suggests that euxinia only covered a small proportion of the predominantly anoxic global seafloor, thus allowing dissolved Mo to accumulate to significant level in seawater. The enrichment degrees of Mo, although nontrivial, are still much lower than those from Phanerozoic equivalents. Contrarily, they are quite close to the total mean abundance for Mesoproterozoic euxinic shales. Such a muted increase of marine Mo inventory is therefore inferred as recording no dramatic rise in oxygen levels following the Sturtian glaciation.