Origin and significance of Paleoproterozoic redbeds in the FA Formation, Franceville Basin, Gabon: Geochemical and isotopic constraints

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Redbeds are extensively used as a proxy for atmospheric oxygenation in the Paleoproterozoic. Redbeds in ~2.15 Ga unmetamorphosed FA Formation of the Franceville Basin, Gabon were geochemically, petrologically, and mineralogically characterized to constrain the processes and timing of the redbeds formation and the rise of atmospheric oxygen. Petrographic observations indicate that ferric oxides are dispersed in clay filling intergranular pores and along platy cleavage in altered phyllosilicates. Grain-coating hematite is absent. The data suggests that hematite precipitation probably started shortly after sediment deposition and continued during early diagenesis. The ferric iron was likely sourced internally by alteration of ferromagnesian minerals in sediments. Enrichment and depletion of Fe in the rocks is suggested by variations in Fe/Mg ratio. Good correlation between Fe/Mg ratio and δ^{56}Fe composition suggests hematite formation in sediments during early diagenesis. Relationships among Fe^{2+}, Fe^{3+}, Fe_T, and iron isotope (δ^{56}Fe) compositions suggest that the isotopically heavy iron oxide was present in the rocks during early diagenesis, and that green (reduced) facies likely replaced red facies later during diagenesis or burial. Large range of δ^{56}Fe values in the rocks extending towards positive values, up to 1 per mil, is similar to that observed in Paleoproterozoic and Archean iron formations, suggesting partial oxidation of Fe under mildly oxidizing or suboxic conditions during early diagenesis. In addition, positive correlation between Cr/Fe ratios and δ^{56}Fe values, especially in the fine-grained sandstone and mudstones facies, is an evidence for authigenic Cr enrichment under oxidizing conditions in a fluvial setting during early diagenesis at the early stage of the Great Oxidation Event.