Pathways of barite and phosphate formation following Neoproterozoic glaciations (Sete Lagoas Formation, Brazil)

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The Ediacaran period witnessed major changes in the Earth system, including the termination of global glaciations, a rise in the oxygen level of the atmosphere-ocean system, and the radiation of complex multicellular eukaryotic life. Carbonates from the lower part of the Sete Lagoas Formation (NE São Francisco craton, Brazil) record the seawater chemistry, biological activity, and oceanographic changes. We report the association of seafloor precipitates (carbonate and barite fans) and authigenic and diagenetic minerals (apatite and barite) in order to discuss their significance for global seawater chemistry and sedimentary environments following the glaciation. The carbonate fans are composed of calcite units, which resemble (sub-)acicular (needlelike) crystals with hexagonal cross sections, representing pseudomorphs after aragonite. These fans are encrusted by isopacheous and void-filling cements of apatite. Barite is also present as small crystals as isolated grains in the matrix, inclusions within carbonate fan crystals and minor void-filling cements. In our sedimentary model, these minerals were formed near the sediment-water interface (oxic-anoxic boundary). Iron reduction below the redox boundary released Fe^{2+}, which diffused up to the sediment-water interface and inhibited nucleation of carbonate, thereby allowing for growth of aragonite. Concurrently, iron reduction freed phosphate absorbed onto iron-(oxyhydr)oxide particulates, and in conjunction with remineralization of organic phosphorus via sulfate reduction deeper in the sediment, created conditions to formation of authigenic and/or early diagenetic apatite. Deeper in the sediments, sulfate reduction and methanogenesis led to formation of pyrite and diagenetic barite. Overall, our work documents a close association between aragonite fan formation and phosphogenesis in the Ediacaran, illuminate the paleoenvironments of cap carbonates with seafloor precipitates, and contributes to understanding of the phosphorus cycle following global glaciations.