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Trace elements record depositional history of an Early Archean stromatolitic carbonate platform

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Abstract

Rare earth elements and selected trace elements were measured in 48 samples of carbonate and chert from stromatolites and associated facies in the 3.45 billion year old Strelley Pool Formation, Pilbara Craton, Western Australia. The samples show coherent REE+Y patterns that vary systematically with sedimentary facies. Chert samples from bedded cherts beneath the Strelley Pool Formation and from the upper bedded chert members in the formation show REE+Y patterns consistent with originating by precipitation from hydrothermal and mixed marine-hydrothermal fluids. In contrast, carbonates and cherts from the stromatolitic reef member share the essential shale-normalized characteristics of other Archean marine precipitates (LREE depletion, positive La and Gd anomalies, absence of a negative Ce anomaly and a strongly superchondritic Y/Ho ratio). The close correspondence between REE+Y signatures and independent sedimentary facies interpretations is viewed as strong evidence for the primary nature of REE+Y patterns. They can thus be used as a proxy for the fluids from which sediments precipitated. Mixing hyperbolae can be constructed that reproduce the chemistry of cherts and carbonates by mixing of hydrothermal and marine fluid endmembers throughout the entire vertical succession from beneath the Strelley Pool Formation to the uppermost cherts. The mixing hyperbolae provide semi-quantitative confirmation that the trace element compositions across the suite of cherts represent different mixtures of ambient seawater and hydrothermal fluids.

Our results indicate that the Earth's oldest supracrustal carbonates and associated cherts record important aspects of the REE geochemistry of the waters in which they precipitated, and provide valuable information on possible habitats of some of Earth's earliest biota.

Keywords

Rare earth element; Archean; Stromatolite; Carbonate; Chert; Pilbara

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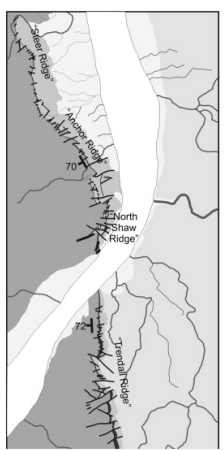
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