Isotopic and REE constraints on the origin of stromatolitic phosphorites from the Paleoproterozoic Aravalli Supergroup, NW India

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The micritic dolomites of the ~ 2.0 Ga old Jhamarkotra Formation belonging to the Aravalli Supergroup show ^{13}C enrichment in their carbonate carbon ($\delta^{13}C_{carb}$ up to 12‰; $\delta^{13}C_{org}$ of ~ -25‰ V-PDB) in consonance with the global $\delta^{13}C$ excursion between 2.22 and 2.06 Ga [1]. On the contrary, the stratigraphically younger stromatolitic phosphorites of the same formation show ^{13}C enrichment in their organic carbon ($\delta^{13}C_{org}$ up to -11.1‰ with $\delta^{13}C_{carb}$ of ~ 0‰) as a consequence of localized high productivity conditions. The stromatolitic phosphorites also show about 3 to 5‰ depletion in their $\delta^{18}O_{carb}$ values when compared to the non-phosphatic dolomites underlying them. The rare earth element (REE) patterns of the phosphorite fractions of the stromatolites show flat light REE with moderate enrichment in the middle to heavy REE patterns when normalized against Post-Archean Australian Shale. They do not show any significant Ce or Eu anomalies. The $^{87}Sr/^{86}Sr$ values of all the carbonate units of the Jhamarkotra Formation exhibit higher range of ~ 0.709 to 0.712.

The depletion in $\delta^{18}O_{carb}$ values and REE characteristics of the stromatolitic phosphorites indicate freshwater (riverine) input during their deposition. Shallowing of depositional environment following the accumulation of basal volcano-sedimentary unit (Delwara Formation) and the upwelling of phosphorous-rich water appears to have led to the deposition of stromatolitic phosphorites. The increase in phosphorous concentration possibly is in response to enhanced burial of organic carbon [2] that has resulted in the deposition of ^{13}C enriched carbonate rocks. The absence of negative Ce anomalies in these phosphorites, which deposited soon after the global $\delta^{13}C_{carb}$ excursion, indicate that the oxygen concentration was not significantly high in their environment of deposition. Importantly, phosphorous enrichment appears to have led to the initiation of different pathways of organic carbon fixation as early as the Paleoproterozoic.

References

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