Evidence of decarbonation process in a skarn deposit from Matanumadh formation, Kachchh Basin, India

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We investigated the origin of a carbonate deposit crosscutting "tuff-like" friable (host) rocks, possibly representing the basal part of the Paleocene Matanumadh Formation [1]. The carbonate body hosts Fe and Mn rich nodules consisting of Jacobsite which also occur within the host rocks. In order to understand the genesis of the carbonates, closely-spaced samples (few mm apart) were retrieved using handrill and microdrill techniques and were subjected to geochemical and isotopic investigation.

PAAS normalized REE plots of the carbonates show negative Ce anomalies, HREE-enriched patterns; these rocks also preserve depletions in HFSE, enrichments in Pb, Sr and U in primitive-mantle normalized multi-element plots and $^{87}Sr/^{86}Sr$ of 0.709881.In contrast, the Fe-Mn nodules displayLREE depleted but flat-HREE patterns in PAAS normalized REE plots, and although they also preserve depletions in HFSE and enrichment in Pb in the mantle-normalised plots, Sr is depleted rather than enriched. Compared to the carbonates, the nodules contain more radiogenic $^{87}Sr/^{86}Sr$ (0.711224) as well as $\varepsilon Nd_{(0)}$(~+4). The host rock REE patterns are similar to the nodules although the absolute concentrations of HREE are lower. In contrast to both the nodules and carbonates, the host rock displays enrichment in HFSE.$^{87}Sr/^{86}Sr$ of the host rock (0.711555) is similar to the nodule composition whereas their $\varepsilon Nd_{(0)}$(+1.8) is slightly less radiogenic. Δ_{47} shows a clumped temperature range of 50°C to 160°C (Using eq. by Kluge et al.[2]) with covariation in $\delta^{13}C$ (7.9 to 21.5‰) and $\delta^{18}O$ (-7.81 to -4.30‰) consistent with decarbonation involving heating of the primordial carbonate in the absence of fluid.

We used closed- and open-system models to constrain the composition of initial carbonate. The inference drawn is that the original carbonate must have been highly enriched (20‰ w.r.t PDB) and was later metamorphosed to yield depleted end members. Elevated carbon isotopic values together with the characteristics of the REE pattern is suggestive of microbial carbonate precipitation in reducing conditions. The role of methanogenic bacteria in carbonate precipitation is not discounted.

[1] Biswas (1992), *JPSI*, **37** [2] Kluge et al., (2015) *GCA*, **157**