Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9196

Understanding the environment of Early life: Divergence, and environment using stable isotope of Badami sediments, Southern India.

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Stable isotope study has been carried out on carbonate-bearing Halkurki shale and carbonates of Konkankoppa limestone of Neoproterozoic Badami Group of Karnataka, southern India. Transition to carbonate from shale within a Neoproterozoic epeiric seaway characterizes the transition between partially restricted pools of a shallow shelf with limited siliciclastic supply and completely isolated depo-centres of a transitional coastal environment which preferred carbonate deposition, during shallowing up of sea level as a consequence of glaciation. U-Th-Pb isotope study on limestone provided apparent age of sedimentation as 960 Ma [1]. Age of mafics which intruded the underlying sequence [2] and recent works on tectonic and sedimentological models [3] also suggest an initial age of 900-800 Ma for Badami sediments and correlate it to break-up of Rodinia. Paleomagnetic study of Badami sediments showed tropical location for their deposition [3].

$\delta^{13}C$ (VPDB) values of Badami carbonate ranges from -1.44 ± 0.011‰ to 3.62 ± 0.008‰ reflecting the change in paleoproductivity in tropical region during Neoproterozoic time. $\delta^{18}O$ (VPDB) ranges from -9.63 ± 0.014‰ to -4.26 ± 0.016‰. A change in carbon isotope composition reflects a cyclicity of sedimentation interfacing with microbial activity where positive $\delta^{13}C$ excursion defines high microbial activity. Several cycles, with rhythmic change of $\delta^{13}C$ & $\delta^{18}O$, have been recognized in Halkurki shale member where $\delta^{13}C$ & $\delta^{18}O$ are mainly showing negative correlation. Lighter oxygen isotopic composition indicates freshwater input into the shallow marine waters inducing brackish water ecosystem, where microbial life proliferated (heavier $\delta^{13}C$ value). In case of Konkankoppa limestone, $\delta^{13}C$ & $\delta^{18}O$ are showing coherent relationship, where high microbial activity was supported by gradual shallowing up of sea level and consequent increase in evaporation supported with rare presence of desiccations towards the top of the cycle. Such shifts in the isotopic pattern along the succession suggest microbial process initially was supported by the nutrient-rich freshwater discharge contributing clay-rich sediments and later hydrothermal activities and evaporation actuated in shallower water leading to precipitation of microbially-induced limestone.

References:

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