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Multiple Sulfur and Triple Oxygen Isotope Systematics of Stratiform Barites, Mangampeta, Cuddapah Basin, Southern India: Genetic Implications

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Stratiform barites carry significant implications for paleoceanography, tectonic evolution, and economic geology, and yet their genesis remain controversial. The Mesoproterozoic (~1450 Ma) Mangampeta stratiform barites represent one of the world's largest deposits; they are developed in the organic-rich Pullampet (Cumbum) Formation, Cuddapah Supergroup, Southern India. In this study, we report multiple S and O isotope data for these barites to understand their origin.

Petrographic and SEM-EDS observations of barite crystals reveal their rhomboid crystal shape and petal cluster growth pattern reflecting precipitation from weakly supersaturated to highly supersaturated solutions, respectively (cf. [1]). Sulfur isotope measurements of the Mangampeta barites show highly positive $\delta^{34}S$ values, ranging between +41.93‰ and +51.14‰ (V-CDT). Similarly high $\delta^{34}S$ values are found in recent cold seep barites and are often ascribed to microbial activity within anoxic sediments. The textures and high $\delta^{34}S$ values in the Mangampeta stratiform barite deposits suggest a cold seep setting similar to that for the Paleozoic and modern stratiform barite deposits lacking polymetallic sulfides[1]. Furthermore, pyrite separated from these stratiform barites shows a $\delta^{34}S$ value of +22.08‰, which indicates closed-system sulfur isotope dynamics influenced by hydrocarbon seepage and rapid microbial sulfate reduction with near-to-quantitative sulfate consumption. Barites and pyrites from the Mangampeta stratiform barite deposits show a mass-dependent range of $\Delta^{33}S$ values from -0.047‰ to -0.003‰ and $\Delta^{36}S$ values from -0.52‰ to +0.02‰. Measured $\delta^{18}O$ values range from +10.0‰ to +12.9‰ V-SMOW with $\Delta^{17}O$ values of -0.20‰ to -0.12‰. The small negative range of $\Delta^{33}S$ values and their correlation with $\delta^{34}S$ values suggest the effect of Dissimilatory Sulfate Reduction (DSR) and the gentle slope on the cross-plot of $\delta^{34}S$ vs. $\delta^{18}O$ values implies high sulphate reduction rates associated with DSR. The Mangampeta stratiform barite deposits are suggested to be formed via the biologically mediated precipitation of $BaSO_4$ at the redox boundary developed in the continental margin organic-rich sediments due to the release of cold seep hydrocarbon and barium-enriched fluids during diagenesis of organic-rich sediments along a fault zone to the sediment-water interface.

1 – Torres et al., 2003, Geology 31, 897-900.