Carbon Isotope and Gamma-Ray Signatures with Sequence Stratigraphy for Reservoir Characterization in the Lower Triassic Mahil Formation, Northern Oman Mountains

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Abstract

This study delves into the carbon isotope curves of the Lower Triassic Mahil Formation in the Northern Oman Mountains, specifically the Lower Mahil KS-1 Formation on a homoclinal carbonate platform. The primary goal is to elucidate the facies-isotope relationship by analyzing 174 micrite samples for carbon and oxygen isotopes, addressing potential influences like weathering. Despite diagenetic alterations, notably in the Saiq Plateau section, the Lower Mahil Formation maintains carbon isotope patterns with minimal diagenetic impact.

The δ13C values within the same facies reveal inconsistencies in carbon isotope trends. While caution is advised in applying these findings universally, the Lower Mahil Formation's carbon isotope records remain valuable for understanding patterns associated with KS1. The research significantly establishes correlations between outcrop and subsurface data, offering insights into Lower Triassic carbon isotopes.

Additionally, this study focuses on the Lower Mahil KS-1 Formation's sequence stratigraphy, incorporating high- resolution carbon isotope, spectral, and total gamma-ray data to establish a reliable stratigraphic framework. Analyzing whole-rock samples for δ13C and δ18O isotopes at 0.5m intervals and capturing spectral gamma-ray measurements at 10 cm intervals, the research identifies distinct sea-level trends within the third-order sequence, dividing KS1 into two parts. Five fourth-order depositional sequences, marked by transgression and regression phases, are discerned. Notably, the δ13C curve correlation with similar formations in the Tethys region positions the Lower Mahil KS-1 Formation as a reference section for future studies, benefitting from higher precision data and a focused examination of KS1. Two distinct patterns of third-order sea-level changes during transgression and regression are revealed through total and spectral gamma-ray analysis and carbon isotope.