



Oxygen and Carbon Isotopic Signatures of Middle to Upper Jurassic Carbonates in Central Saudi Arabia: Implications for Stratigraphic Surfaces and Diagenesis

Ammar Abdulmutalib and Osman Abdullatif

KFUPM, Geosciences, Dhahran, Saudi Arabia (osmanabd@kfupm.edu.sa)

Isotope analysis is one of the powerful tool that are used for many purposes such as: rock dating, identification of different stratigraphic surfaces and sequences, and characterization of various diagenetic features such as micritization and cementation. In this study we measured Carbon and Oxygen isotopic compositions of one hundred samples that belong to carbonate formations within Jurassic succession in central Saudi Arabia. These formations have high economic hydrocarbon significance in the subsurface. We described the Jurassic outcrop equivalents and collected total of one hundred samples. The field outcrop description was integrated with thin section petrography, XRD powder mineralogical analysis, carbon and oxygen isotope analysis and Scanning Electron Microscopy (SEM). Six paleo-environments were identified based on the previously determined bio-components, they are: (a) the open marine/intrashelf basin; (b) transitional basin-shoal; (c) shoal complex; (d) deep lagoon; (e) shallow lagoon; and (f) shore-intertidal. Four maximum flooding surfaces (MFS J30, MFS J50, MFS J60, and MFS J70) were identified using both Oxygen and Carbon isotope compositions. Generally, all surfaces are characterized by decreasing Oxygen and Carbon isotopic compositions ($\delta^{12}\text{C}=0.8\text{‰ PDB}$, $\delta^{16}\text{O}=-7\text{‰ PDB}$ for MFS J30; $\delta^{12}\text{C}=3.0\text{‰ PDB}$, $\delta^{16}\text{O}=-4\text{‰ PDB}$ for MFS J50, $\delta^{12}\text{C}=0.8\text{‰ PDB}$, $\delta^{16}\text{O}=-14\text{‰ PDB}$ for MFS J60, $\delta^{12}\text{C}=2.0\text{‰ PDB}$, $\delta^{16}\text{O}=-6\text{‰ PDB}$ for MFS J70). This relative depletion is due to continental supply of lighter isotopes ($\delta^{12}\text{C}$ and $\delta^{16}\text{O}$) that are verified by the existence of quartz and clay mineral in some zones (specially in Tuwaiq Mountains Formation). Regarding diagenesis, micritization and marine cementation are responsible of enriching isotopic composition. Meanwhile, meteoric cements cause the depletion of both types of isotopes. Marine cement is found in the form of prismatic and elongated morphology of aragonite and high magnesium calcite cement while meteoric cement is characterized by blocky equant calcite cement. Comparison with global and regional studies of Jurassic equivalents our results showed similarities and some minor differences which might be attributed to differences in depositional and diagenetic settings.