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The Triassic–Jurassic Boundary in Ras Al Khaimah, United Arab Emirates: Evidence for Global Change from Carbonate Sedimentology and Chemostratigraphy

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ABSTRACT

The chronostratigraphy of the Triassic to mid-Jurassic of the Arabian Plate is difficult due to the scarcity of index fossils that would allow for the identification of stages and substages. Consequently, the evaluation of Triassic-Jurassic petroleum systems across the Arabian Plate is largely based on lithostratigraphic correlation, with a considerable level of uncertainty. We have used carbon-isotope stratigraphy and detailed sedimentological analyses of several outcrops in Ras Al Khaimah, UAE, to identify the Triassic/Jurassic boundary and correlate the evolution of depositional environments.

The Triassic/Jurassic (T–J) transition was a time of significant environmental perturbation and is considered to be one of the six largest extinction events of Earth's history. This event was associated with large perturbations of the global carbon cycle, as recorded in the isotopic composition of organic and marine carbonate carbon. This has been elsewhere associated with widespread ocean acidification and a major disruption in marine carbonate production in neritic and pelagic environments.

During the Triassic, the future Arabian Plate was part of the extensive shelf of Gondwana. A significant influx of siliciclastic material during the Upper Triassic (Norian–Rhaetian) was possibly the result of increased erosion of the Arabian Shield. In the northeastern UAE, carbonate production recovered during the Rhaetian, as recorded in shallow- water limestones of the Ghalilah Formation with characteristic Late Triassic reefal and lagoonal biota of the Asfal and Sumra members. These fossiliferous limestones are followed by a thick sequence of oolites and cross-bedded pack- rudstones (Sakhra Member). The Early Jurassic Shuba Member consists of predominant intertidal dolostones, with intercalated siliciclastics and abundant evidence of subaerial exposure.

Stable carbon isotopes from bulk carbonate through this interval show a negative excursion in the Rhaetian deposits followed by a longer-lived positive excursion in the oolites above. The presence of originally aragonitic ooids in the boundary interval indicates a shallow-marine system supersaturated with respect to calcium carbonate, in marked contrast to ocean acidification invoked for many other Triassic/Jurassic boundary sections. The results of our study emphasize the use of chemostratigraphy for regional and global correlation in sedimentary sequences with limited biostratigraphic control.