

Trace Fossils, Outcrop Observations and Significance of Glossifungites-Demarcated Discontinuity Surfaces in the Jurassic Stratigraphic Succession of Saudi Arabia

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Abstract

Along the carbonate-rich, Jurassic-age stratigraphic succession of Saudi Arabia that crops-out along the eastern margin of the Arabian Shield, several boundaries between stratigraphic units display Glossifungites-demarcated discontinuity surfaces. These so-called 'hardgrounds' are marked by robust and abundant ichnofossil suites with borings and pseudo-borings at hard- and stiff-grounds. This study integrates ichnology, sedimentology and biostratigraphy in order to characterize some of the most prominent Glossifungites-demarcated discontinuity surfaces within the Jurassic stratigraphic succession of Saudi Arabia exposed along the eastern Arabian Shield. It discusses its: 1) ichnofossil assemblage, 2) significance in terms of genetic stratigraphy, and; 3) potential utility as correlative markers onto the subsurface age-equivalent units that make up some of the most prolific reservoirs in the world.

Sedimentological observations allowed the identification of deposition in shallow-marine ramp settings where the substrate firmness exhibit cohesive/compacted, or firm substrates leading to the formation of lithified or cemented (i.e. hardgrounds) pervasively bored by bioturbating organism. Biostratigraphic control contributes not only to constrain the age of these boundaries, but also serves as a tool to correlate them onto its age-equivalent, subsurface counterparts in the subsurface of the Eastern Province. In the studied outcrop localities, Glossifungites-demarcated discontinuity surfaces are commonly accompanied by encrustations, dissolution features, cementation and other signs of weathering. Prominent boundaries identified in outcrop observations and characterized by Glossifungites-demarcated discontinuity surfaces include: 1) the Tuwaiq Mountain-Hanifa Formations at Al-Amaaria town, marking the Middle and Late Jurassic boundary; 2) the Jubaila-Arab-D at Wadi Nissah, marking the Early and Late Kimmeridgian boundary; and, 3) the intra Early Jurassic Dhurma Formation D3-D4 reservoir boundary, near Al-Mounakh Town.

A trace fossil assemblage dominated by elements of the Glossifungites ichnofacies, along prominent weathering indicators suggest prolonged periods of exposure following exhumation and colonization by bioturbating organisms. The identified Glossifungites-demarcated discontinuity surfaces in outcrops are also commonly found in core-based studies in the subsurface of the eastern province. They display similar bioturbation patterns in terms of diversity and abundance and have the potential to be used as correlative surfaces to their outcrop counterparts. Their identification is important as: 1) they have genetic stratigraphic significance by contributing to our understanding of the stacking patterns; and, 2) serve as the basis to delineate subsurface reservoir boundaries; thereby, decreasing uncertainty in future exploration and development wells.