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High resolution isotopic characterization of Maximum Flooding Surface MFS J30 in Central Saudi Arabia

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Maximum Flooding Surface J30 is located between D5 and D6 Members of Dhruma Formation which is considered to be the outcrop equivalent of lower Fadhili Reservoir in eastern Saudi Arabia. It is characterized by thick fissile shale bed that separates deepening upward transgressive subtidal units from shallowing upward regressive barrier unit (Fig. 6a and 7a). Oxygen isotope is depleted and became more negative with increasing shale content and related increasing temperatures (sea level rise), having the minimum value corresponding to the MFS (δ16O= -7 ‰ PDB). Above the maximum flooding surface, the oxygen isotope composition is again enriched due to the relative decreasing temperature associated with sea level fall. The high frequency small scale cyclicity is reflected on the Oxygen isotope signature. Carbon isotope is also depleted (i.e. δ12C=0.8 ‰ PDB) with approaching to the MFS J30 where we have thick bed of fissile shale (subtidal lithofacies) due to limited organic productivity and diagenetic meteoric cements. It is again enriched above the MFS associated with regressive barrier lithofacies. However, it is depleted associated with the uppermost lagoonal part. Total of five isotopic cycles have been identified based on Oxygen isotope and thought to be equivalent to the high frequency sequences. Each of these sequences contain small scale fifth order cycles each cycle is shallowing upward with overall lightening upward for each cycle, these small scale (high resolution) are culminated by MFS J30 corresponding to thick beds of fissile shale, this is followed by lighter isotopic composition corresponding to transgressive sequence with restricted heavier composition associated with shallow lithofacies. Strong breakthrough in Oxygen isotope signature is observed associated with the intraformational rudstone lithofacies that indicates initiation of new depositional sequence above which isotopic composition become relatively heavier related to relatively cooler conditions that witnessed regression stage responsible of shallow lithofacies deposition. This study shows more positive values comparing with equivalent from Oman and Jordan. this can be caused by several reasons: The current study targeted only MFS J30 and surrounding regressive and transgressive cycles which is belonged to D5 and D6 Members while the other two studies cover all Dhruma Formation, different diagenetic processes and features, different depositional setting: D5 and D6 Members have some barriers and slightly rimmed shelf setting while in Oman, this might trigger slight differences in the organic matter productivity which is reflected on the Carbon isotope signature. The Oxygen isotope composition shows similar ranges in the three studies which implies the same paleo-climatic and paleo-geographic conditions near the equator. This study might help to understand, correlate and predict stratigraphic events and paleogeography within Jurassic carbonates in the Arabian Peninsula and surrounding areas.