

## **Mass-Balance to Seismic Facies: Lower Cretaceous of Saudi Arabia**

**David M. Steinhaff<sup>1</sup>, Nikolaos A. Michael<sup>1</sup>**

<sup>1</sup>EXPEC ARC, Saudi Aramco, Dhahran, Eastern, Saudi Arabia.

### **ABSTRACT**

Basin-scale mass-balance, source-to-sink analysis (MBSS) predicts grainsizes, lithologic distributions, sediment sources, and accommodation space from borehole cuttings. Generalized environments of deposition (EOD) are typically gleaned from MBSS. New approaches are suggested: (1) how can MBSS outputs translate to specific EODs by incorporating seismic facies (SF), (2) how can MBSS corroborate and evaluate EODs interpreted from SF, and (3) how will MBSS work for carbonate rocks? Four Lower Cretaceous EODs interpreted from SF and cores were evaluated with MBSS. Oldest to youngest, EODs range over from 70,000 to 7,000 km<sup>2</sup>, and include (1) Shu'aiba carbonates, (2) NahrUmr/Khafjisiliciclastics, (3) Mauddud carbonates, and (4) Safaniyah siliciclastics. The EODs were integrated from +100 boreholes over a greater area (+100,000 km<sup>2</sup>). Coarse-grained carbonates are present in the Shu'aiba, confirming that shallow marine carbonates are present. Fine-grained siliciclastics are typically present in the NahrUmr/Khafji. Coarse-grained carbonates (grainstones and packstones) are present for the Mauddud over the platform and fine-grained lithologies in the basin. Coarse- and fine-grained siliciclastics are observed in the Safaniyah for EODs interpreted from SF. The Safaniyah provides an example where MBSS can help extrapolate deltaic EODs beyond areas interpreted from SF. Lithologies consistent with siliciclastic point sources are observed at up-dip positions, lithologies consistent with tide-to-wave dominated deltas are observed where EODs were interpreted from SF, and fine-grained siliciclastics are observed at distal positions. With an inverse approach, risks presented to top seal can be evaluated with MBSS. For example, the NahrUmr/Khafji typically provides top seal for Shu'aiba reservoirs. Areas with coarse-grain sand can be avoided as they present risk to seal (i.e., thief sands). These examples suggest MBSS outputs can be interpreted in greater detail when SF are considered and can corroborate and evaluate EODs interpreted from the SF.