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Please fill in your abstract title.	Subsurface Stratigraphy Problem Resolved from Outcrop Stratigraphy: A Case Study from the Late Jurassic Hanifa Formation, Saudi Arabia

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Abstract

The Hanifa Reservoir is a prolific hydrocarbon target in many oilfields in Saudi Arabia that is currently undergoing a major development campaign. A Hanifa reservoir study in one field revealed differential reservoir development due to antecedent topography, however, the study results were challenged by a second interpretation that suggested a major erosional channel cutting through the reservoir. To confirm either interpretation, a Hanifa outcrop study was conducted to document similarities and differences to the subsurface in terms of depositional facies and environments.

The Jurassic outcrops of the Tuwaiq Mountains Belt in Central Arabia are extensive, where the Hanifa Formation carbonate rocks have been studied at regional and local scales. The study involved measuring fifteen sections of the Hanifa outcrop, over a distance of 260 km along the Tuwaiq Escarpment. In addition, 295 samples were collected from the field for petrographic analysis. The data were then integrated to identify and interpret the depositional environments of the Hanifa facies, which represented the fundamental data for constructing the first stratigraphic framework of the Hanifa Formation exposure using the principles of sequence stratigraphy.

The stratigraphic analysis yielded five third-order depositional sequences within the Hanifa Formation that now offer a means for correlating the surface geology data with that of the subsurface. In particular, the Hanifa Reservoir in a nearby oilfield (approximately 150 km east of the outcrop) was found to correlate to the fourth and fifth sequences of the Hanifa Formation. Within these two sequences, a new area in the outcrop was discovered that mimic precisely the reservoir facies stacking pattern as seen in the subsurface, in the sense that grainstone facies is overlain by coral buildups and both are laterally equivalent to mud-dominated facies. This discovery confirmed the initial interpretation that paleotopography controlled the Hanifa Reservoir development in the nearby field. In addition, this area provides a rare glimpse of reservoir facies lateral continuity and spatial geometries at the inter-well scale that are difficult to predict in 3D reservoir simulation models.

The outcomes of this study pave the way for additional work on the sedimentary outcrops in Central Arabia as they still have great potential of expanding the knowledge and understanding about the Kingdom’s stratigraphic history and provide 3D analogs for subsurface studies. This will translate into building robust and realistic 3D geological models for reservoir simulation and development.