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Climate Induced Facies Variations in Outcrop as a Tool for Subsurface Correlation, Amin Formation, North Oman

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ABSTRACT

The Cambrian Amin Formation of the Haima Supergroup is a prolific gas/condensate reservoir of North Oman, and a major oil reservoir in South Oman. The Amin reservoir typically consists of a few hundred metres of predominantly clean sandstones deposited by fluvial and aeolian processes in a semi-arid to arid terrestrial setting.

Present day reservoir properties in the Amin show marked lateral variations between wells and fields, and vertically within individual wells. In order to understand these variations and hence optimise future exploration campaigns and well placements, a comprehensive multi-disciplinary investigation of the large available Amin subsurface dataset is required, for which a meaningful stratigraphic framework is needed.

Determining a stratigraphic framework within a terrestrial Cambrian succession distributed over several depositional basins with various sediment sources is, however, far from straightforward. Detailed description of outcrops of the Amin Formation in the Huqf area of Central Oman, including the collection of outcrop gamma-ray data, has partly been used to address this. The outcrop work has revealed large-scale (tens of metres thick) variations in depositional environment, from fluvial channel dominated to sabkha and aeolian dune dominated, bounded by key surfaces, which give rise to a three-fold subdivision of the Amin. The three distinct Amin outcrop subdivisions and their bounding surfaces can be traced laterally for kilometres across the entirety of the available exposures. Such large-scale correlatability and their relative internal homogeneity suggests that climatic variations were the primary driving force behind their formation, although other factors such as basinal subsidence, local sediment sources and perhaps autocyclicity may also have played a role.

Climatic changes should have had a synchronous effect across the Amin depositional system, from the sediment source areas to the interiors of the depositional basins. Thus the three-fold climatic subdivision of the Amin recognised in outcrop should also be represented in the subsurface. Comparison of the distinctive gamma-ray and facies signatures of the outcropping units with those of key Amin wells reveals a good degree of correlation, thereby supporting this methodology of subdivision as a way of establishing a framework for understanding subsurface variations in rock properties in this kind of reservoir succession.