An Overview of Salt- Controlled Structural Styles in South Oman: New Insights at Regional and Field Scale

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ABSTRACT

A large proportion of the world's discovered hydrocarbon reserves are associated with structures formed as a consequence of halokinetic movements. In the Middle East alone 60% of the 600 billion barrels of oil reserves are related to salt- related structures (Edgell, 1996). In the intracontinental South Oman Salt Basin (SOSB) and Eastern Flank (EF) all of the producing fields are directly or indirectly related to halokinesis, with the majority of these accumulations located within traps formed by salt movement and dissolution of the Neoproterozoic / E. Cambrian Ara Group above a complex, but subtle Neoproterozoic pre- salt topography (Heward, 1990; Al-Barwani & McClay, 2008). The understanding of the evolution and type of salt- related structure and interdependencies between adjacent salt-related structures is vital for unlocking further hydrocarbons in an ever maturing basin. Prediction and classification of these various trap styles particularly in challenging subsurface environments such as the SOSB and EF lead to a more optimal prospect, field appraisal and infill drilling and ultimately to lower overall development and production costs. The most dominant salt-related structural style within South Oman are the salt- withdrawal minibasins formed partially as a result of downslope translation above a detachment resulting from terrain collision of the Arabian Shield with the Oman Microcontinents. The geometries and dimensions of structural styles reflect the different stages of salt minibasin evolution and can be related to the location within the SOSB and EF. Consequently, a classification of salt- related structural domains from E to W can be established. In addition, the fidelity of new seismic data now allows various other salt- related trap styles to be recognized and for them all to be systematically classified, something that builds upon but modifies earlier observations (e.g., Al-Kindi & Richard, 2014). Significant hydrocarbon resources are produced globally from inverted salt- withdrawal minibasins ('turtle back structures') such as from the US Gulf of Mexico (e.g., Pilcher et al., 2011) or the Angolan margin (e.g., Marton et al., 2000). The same can be observed in South Oman with trap styles varying significantly from field to field, and even within single turtle back structures different structural domains can be present based on local and regional tectonic dependencies. Further observations focus on the presence or non- presence of salt weld formation and the different types of salt welds in particular within the centre of the SOSB and towards the Western Deformation Front (WDF). Salt thicknesses are generally the greatest in these parts of the basin and post Ara prospectivity has classically been perceived to be limited because of the presumed lack of access to charge from sub-salt, pre-Ara source rocks (Al-Kindi & Richard, 2014). With the gradual improvement of subsurface imaging and almost complete 3D coverage of South Oman east of the WDF a more diverse view on the prospectivity of post-Ara sequences related to charge access from deeper source rocks is established where touch-down and welding of the supra-salt section has occurred. The subsurface studies in the SOSB show a similarity to those displayed by the evolution of exposed Triassic mini basins of the Paradox Basin in Utah (Matthews et al., 2007) from which sub-seismic learnings can be imported.