Breakthrough Thinking Regarding the Enigmatic Athel Siliciylites of the South Oman Salt Basin

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Abstract

The South Oman Salt Basin has been extensively researched to understand the geology and oil habitats of the enigmatic Ediacaran-Cambrian sequences. Geological and geochemical studies have contributed significantly to the understanding of these rock sequences.

Within Oman's Ediacaran to Cambrian sequences, one of the most enigmatic units is the intra-salt Athel Formation. The Al Shomou Member of the Athel Formation (Athel or Al Shomou Siliciylite) occurs mainly as discrete intra-salt bodies in the South Oman Salt Basin and has been correlated to A4C Ara carbonate stringer (Amthor et al. 2005). Existing studies and publications have suggested that the thick Athel Siliciylite was chemically deposited in a deep rift basin in an anoxic environment (Al Rajaibi, et al., 2014; Ramseyer et al., 2013).

A second siliciylite (argillite) unit is also present in the deeper, presalt stratigraphy of the Nafun group (e.g., wells MKS-2, DH-1, TH-6, Forbes, et al. 2010). This older basinal silicilyte, although of less interest than its Athel counterpart, extends widely across the South Oman Salt Basin, and has recently been correlated to be part of the basinal facies of the Buah Formation (Gomez-Perez et al., in press).

This study is focused in OXY South Blocks, Oman where the area is extensively covered and mapped with 3D seismic, and recent deep wells have encountered both the intrasalt and presalt siliciylite. The uppermost intrasalt silicilyte is 122 meters in thickness and has an aerial extent based on seismic of 11 km2. The deeper silicilyte, also 122 meters, varies laterally in thickness until it pinches out to the north towards the Buah platform. Publications and stratigraphic studies attribute the uppermost siliciylite to the Athel Formation, while the deeper presalt siliciylite is interpreted as the basinal equivalent of the Buah Formation, in the Nafun Group.

However, looking at the rock succession, rock properties, geophysics, and pore-pressure characteristics this study infers that rather than two depositionally different siliciylites, instead there is a tectonically repeated section, with the decollement zone within the black shales at the base of the Buah silicilyte.

This tectonic interpretation avoids the stratigraphic inconsistency of requiring discrete, isolated local rift depocenters of deep oceanic anoxic waters within an overall regional evaporitic, restricted marine environment. Furthermore, there is no evidence of rifting below the Athel slab to create local depocenters in Ara times.

Regional tectonic studies indicate Early Cambrian collisional compressional tectonics, which formed the Western Deformation Front in the subsurface of west Oman (e.g Cozzi et al., 2012) and would be the driving forces for the tectonic emplacement of the siliciylites into the Ara

salt. Similar thrusts may be interpreted in the Al Noor and Al Shomou fields in Block 6 Oman (Amthor et al., 2005) to further demonstrate the intrasalt repetition.

The resulting interpretation is that siliciylites were deposited in pre-salt times and are older than the Ara Group. The Ara Group Siliciylites are local tectonically driven discrete thrusted bodies that were emplaced into the Ara Salt. Their variable burial and diagenetic evolution within the salt impacted their petrophysical properties, resulting in intrasalt reservoir units and deeper, tight non-reservoir presalt units. This model has major implications for the exploration of the deep plays across south Oman.