

# **The Gharif Formation: Improving Prospecting and Field Development Success by Understanding the Role Syndepositional Tectonism and Salt Movement Play in Focusing Sandstone Accumulations within the South Oman Salt Basin, Oman**

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## **ABSTRACT**

The Gharif Formation is a vertical succession of clastic deposits of Early Permian age. It has been subdivided into three members. The upper two consist almost entirely of fluvial deposits while the lowermost is primarily deltaic. One of the Sultanate's most prolific reservoirs, the lateral distribution of sandstone remains a significant exploration risk factor. Odd since there is nothing unique about Gharif fluvial systems to justify the risk. This perception likely reflects an under-emphasis of the role stratigraphic trapping plays in defining why and where current oil accumulations are found.

Tectonic activity during Middle and Upper Gharif time consisted of uplift in the headland portion of the depositional basin and salt movement across the basin. Consequently, the energy gradients of the fluvial systems experienced numerous perturbations. These forced changes in the nature of the rivers and drainage networks, leading to the focusing of thicker sand deposits which would become today's reservoirs in some areas, and thinner sands intermixed with silts and shales which would prove to be poor reservoirs but reasonable seals in other, sometimes adjacent areas.

Regionally the fluvial systems consisted of laterally unconstrained, bed load-dominated, braided rivers. Sediment supply was not an issue given the headland uplift underway at the time. Two types of fluvial system changes are observed in response to energy gradient perturbations caused by contemporaneous salt movement.

In Response 1 topographic ridges/domes are avoided. A river's total length and sinuosity increase, stream energy decreases and deposits consist of a mix of sand, silt and shale. Sand bodies can be spatially isolated, and overall connectivity decreases.

In Response 2 incision into the topographic ridges/domes occurs. River gradients increase, length and sinuosity decrease, and stream energy increases. Once through the topographic obstruction a gradient adjustment occurs resulting in the deposition of thick sands that possess lateral and vertical continuity.

Both responses result in the best quality sandstone deposits occurring on the downstream side of salt ridges and rarely on the crests of domes. Unfortunately such ridges and domes form the current structural highs and attract the attention of explorationists. The real targets should be

those subtle structures formed post-deposition and located where the best sands were originally deposited during Middle and Upper Gharif time.