SEQUENCE STRATIGRAPHY AS PREDICTIVE TOOL IN LOWER GORU FAIRWAY, LOWER AND MIDDLE INDUS PLATFORM, PAKISTAN

Nadeem Ahmad[1], Paul Fink[1], Simon Sturrock[2], Tariq Mahmood[1], and Muhammad Ibrahim[1]

[1]OMV (Pakistan) Exploration GmbH, Islamabad, Pakistan; nadeem.ahmad@omv.com.pk; +92-300-5196572

[2]Strat-Trap Pty. Ltd., Australia

Despite several discoveries in the Early Cretaceous Lower Goru Fairway of the Lower and Middle Indus platform, significant potential remains untapped due to a limited understanding of the distribution of reservoir quality sands and a lack of understanding of the subtle stratigraphic trapping mechanism. Creaming curve analysis for the Lower Goru play indicates significant remaining potential. Predictive tools such as sequence stratigraphy are being proposed for the exploration of subtle traps and successful prediction of reservoir sands in the platform part of the Middle Indus Basin in southcentral Pakistan.

Integrated use of log motifs, core sedimentology, stratigraphic correlations, and seismic stratigraphy has helped reconstruct a regional sequence stratigraphic framework of the Sembar and Lower Goru Megasequences. The following sequences are identified from bottom upwards: Sembar-1, Sembar-2, Lower Goru "A" Sequence, "B" Sequence, "C" Sequence and the "D" Sequence. Deposition of the Sembar-2 and upper "A" lowstand (potentially aggradational) left behind an extensive shelf on which the Lower Goru paralic sequences were deposited. Between each of the sequences identified, a normal succession of gradual vertical facies stacking is interrupted, with offshore to lower shoreface fines of the previous transgressive/ highstand directly overlain by coarse-grained proximal sand with sharp-based log motif. Such 'out-of-sequence' sandy wedges are formed by abrupt basinward shift in coastal onlap. Such forced regressive wedges or detached shoreface wedges (FRW/ DSW) are located in a more basinward position encased within the distal fines. Tidal currents and northerly strong longshore drift stacked the shoreface sands eastward of the NNE-SSW oriented ramp margin. The transgressive facies act as a seal, but transgressive ravinement erosion can often erode the coarse-grained upper shoreface reservoir quality sands. Eastward tilt, eastward coastal onlap against the fines, and westward and lateral facies changes form subtle stratigraphic traps that offer high-risk high-reward exploration opportunities. In structural traps, precise sand prediction can help find upside. Useful sand prediction criteria include: (1) Abrupt west/northwestward shift of coastal onlap/offlap-break, (2) Staying eastward of the shelf margin built out by Sembar-2 & "A" lowstand, (3) Within each sequence, staying westward of the coastal onlap and eastward of the offlap-breaks of the progrades, and looking for subtle thickness anomalies eastward of the progrades' offlap-breaks, (4) Looking for laterally correlative sharp-based sandy log motifs in the offset wells, (5) A combination of accommodation space, transgressive erosional processes and the extent and period of downstepping (forced regression) before the next transgression can cap the shoreface would determine the preservation of upper shoreface facies, and (6) Ensuring the proximity to fluvial input which allows coarse sand emplacement and fresh-to-marine water mixing that forms early Fe-Chlorite coatings around coarse quartz grains. Such early cement is essential for preserving the porosity-permeability during deep burial. These criteria of predicting seal, trap and reservoir sands have helped in the past and can help in the future to tap the remaining hydrocarbon potential associated with the detached regressive and forced-regressive reservoir sands as indicated by the Creaming Curve of the Lower Goru Play.