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Structural Controls on the Development of Sweet Spots in Tight Reservoirs

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SUMMARY

Reservoir sweet spots represent areas of improved permeability in tight reservoirs. Sweet spots are considered critical exploration targets to maximize productivity in deep tight reservoirs. Historically the process of identifying sweet spots from direct or indirect indicators relied mainly on seismic data analysis. This study presents concepts for development of three major types of sweet spots in tight reservoirs relied mainly on structural concepts: the structural-stratigraphic sweet spots; and the structural-digenetic sweet spots, based on the geologic processes involved in their generation. Integration of gravity, magnetic, seismic and outcrop data in the eastern Arabia province, with concepts of strain analysis are the basis of this study.

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The structural sweet spots include areas with open fractures developed in association with horizontal strata, faulted and folded reservoirs. Open fractures can be developed in numerous structural settings. These include:

- 1) In horizontal strata when maximum stress is vertical; in this case fractures are developed as vertical sets parallel to the minimum horizontal stress with maximum fracture spacing approximately equal to the bed thickness.
- 2) In downthrown sides of normal faults where stresses generate a corridor of open fractures parallel to the fault strike with about 30 degrees dip at the fault plane.
- 3) In the footwall sides of reverse faults where stresses generate a corridor of open fractures perpendicular to the fault strike.
- 4) In the two ends of strike-slip faults, where stresses generate two spots close to the fault in the sides opposite to the movement directions
- 5) Above deep-seated pre-Cambrian fault blocks and paleo-fault scarps where bands of highly fractured areas (thief zones) are developed due to extra stress concentration.
- 6) In folds where folding produces open mode fractures through several mechanisms.

The structural-stratigraphic sweet spots include areas of relatively high permeability resulting from accumulation of better reservoir facies in areas controlled by specific structural settings at the time of deposition.

The structural-diagenetic sweet spots include areas where first the diagenetic processes cause a substantial increase in the rock brittleness; and second the tectonic activities generate open fractures in the diagenetically affected areas.

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