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The Role of Fracturing in the Production Mechanism of the Asmari Limestone Reservoirs in S.W. Iran

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ABSTRACT

Fracture porosity and permeability has long been recognised as the major controlling factor in production of huge quantities of hydrocarbons from limestone reservoirs in S.W. Iran. The production mechanism remains poorly understood as does the nature and distribution of effective fracturing.

The Oligocene aged Asmari limestone, which forms the main reservoir of the Khuzestan oil fields, provides outcrops of completely exposed anticlines often separated only by complementary synclines from their producing counterparts at depth. The abundance of surface data available from such anticlines, which are virtual replicas of producing structures, makes possible a better understanding of reservoir characteristics.

Small scale and photoscale fracture and lineament patterns have been studied in terms of density and orientation with respect to structural position, both locally and regionally. Small scale fracture patterns are structurally unrelated to Tertiary folding; they show no preferred orientations and exhibit a constant density irrespective of structural position for a given bed thickness.

In contrast, photo or large-scale fracturing on exposed Asmari anticlines shows definite density variations with structural position and a simple orthogonal pattern related to tension fracturing as a result of Tertiary folding. The superficial nature of gravitational slump structures on surface structures is clear. It is thought that photoscale fracturing on surface structures may include fracturing and faulting of a superficial nature. The anticline is imagined as relaxing by outward movement of its flanks on the removal of overburden pressure. Data of this superficial nature is not regarded as applicable to buried anticlines. High production areas on developed fields are difficult to explain in terms of density of fracturing of the two scales already referred to. Smaller scale airphotos of an oilfield area, where Fars sediments (including mobile evaporites) cover producing reservoirs, were studied and all linear fractures plotted and processed. The resultant pattern of fracturing and density distribution was quite different from that expected. At this scale the lineament and fracture pattern exhibits three clear maxima, which do not appear to be related to Tertiary folding but rather to the structural grain of the underlying basement. The three maxima are aligned north-south, east-west and approximately N20°E. It is significant to note that high and low production areas on Bibi Hakimeh and Gachsaran oilfields are aligned along the N20°E trend of large scale linear features. It is suggested that renewed movements along these basement trends have resulted in the enhancement of small scale fracture porosity and permeability within the Asmari reservoir along preferred zones.

The relation of large scale fracture density to variations in well productions is not clear, but studies of rock porosity for Bibi Hakimeh field give some clue as to a possible production mechanism. By plotting wells according to fracture density and rock porosity, graphs can be drawn which relate production to predominant fracture porosity or predominant rock porosity or to both.

The usefulness of fracture and lineament studies as an aid to oil field development is clear.

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