Chapter 9: The Tishrine Oil Field, NE Syria:
A case study of fractures and migration

Notes for Slides:

Slide 1: The Tishrine Oil Field is a heavy oil field located in Northeastern Syria and operated by Sinopec.

Slide 2: The field is a candidate for enhanced thermal recovery but the status of the pilot project is unknown due to the civil unrest.

Slide 3: The Tishrine field is located on the eastern plunging nose of the Sinjar Uplift, which extends for northern Iraq into eastern Syria. The tectonics of the region are dominated by the sinistral transpression created by the collision of the Eurasian Plate and the Arabian Plate.

Slide 4: The tectonics of Syria are complex with a sinistral strike slip system located near the northern border with Turkey, a trans-tensional strike slip along the Mediterranean Coast, and a contractional fold and thrust belt trending through the centre of the country (Palmyrides).

Slide 5: A seismic line across the Sinjar uplift shows increased tectonic complexity with inversion tectonic and multiple tectonic periods

Slide 6: Stratigraphic section of Syria

Slide 7: Google Image of the Sinjar Uplift and Jebel Abd Al Aziz showing *en echelon* style.

Slide 8: Time structure of the Chilou Anhydrite seismic marker. The Sinjar uplift is made of a series of smaller *en echelon* structures, each with separate production

Slide 9: Gradient mapping of the Tishrine Field highlighting structural discontinuity interpreted as pre-existing normal faults that have been inverted and uplifted.

Slide 10: Deatails of the Time Structure of the Tishrine Field with the structural attitude of the beds overlaid. The bedding attitude is taken from the image logs and shows good correlation with the seismic data.

Slide 11: Idealized description of induced fractures and breakout patterns

Slide 12&13: Position of breakout patterns interpreted from image logs.

Slide 14: Breakout patterns determined from image logs (all wells).

Slide 15&16: Average S_{hmax} determined from analysis from image logs. Individual wells are also shown.

Slide 17: Position of stress direction calculated from breakout patterns placed on world stress map (from Zobak).

Slide 18&19: Permeability vs Porosity taken from core plugs

Slide 20: Distribution of length of horizontal wells with image logs

Slide 21-24: EUR calculations are dependent on initial rate so there is no surprize there is a correlation between the two. A more surprizing result is the poor correlation between fracture intensity and rate. Fracture intensity calculated using Fourier Analysis vs production. There appears to be no direct correlation suggestive that only a few fractures are necessary or fracture intensity is not important. Similarly there is a poor correlation betwenn length of lateral and initial production rate.

Slide 25-27: Fracture intensity is not evenly distributed through the reservoir. Most wells have low fracture intensity whereas a few wells are intensely fractured

Slide 28&29: Poles to fracture planes across the field showing good fracture connectivity

Slide 30: Distribution of the dominant fracture sets calculated from stereonet analysis of fracture planes identified on image logs from individual wells. An east pattern is seen in the northern portion of the field that is not observed in the southern portion of the field.

Slide 31&32: Curvature calculated from Seismic data.

Slide 33: Comparison of dominant curvature trends to fracture trends calculated from image logs.

Slide 34: Fractures as fluid conduits for hydrocarbon migration.

Slide 35: The Chilou and Jaddala interval are water wey but produce significant heavy oil through the fracture system. The system is charged by the underlying source rock of the Shiranish system.

Slide 36: Mapping the fracture system in the Tishrine Field.