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# Understanding and Predicting Fractures at Tengiz – A Giant, Naturally Fractured Reservoir in the Caspian Basin of Kazakhstan

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Tengiz oil field in Kazakhstan produces from an isolated limestone platform (areal extent 160 km2) of Devonian and Carboniferous age. The build-up consists of a flat platform surrounded by an elevated rim demarking transition to the slope. Natural fractures impact producibility of the rim and flank.

Fracture characterization has two primary objectives: - A consistent, qualitative, geological conceptual model. - A quantitative model for fluid-flow simulation.

Most Tengiz fractures formed syndepositionally due to gravitational collapse of the laterally expanding Tengiz carbonate platform. Many are equivalent to neptunian dikes. Syndepositional faults may also be present, but in smaller abundance. The Tengiz fractures strike parallel to the depositional margin and are in greatest abundance in the vicinity of the paleo-rim and slope. The Permian Capitan shelf margin, Guadalupe Mountains, New Mexico, contains analogs for these fracture styles.

Constructing a flow-simulation model involves progressing from discrete fractures to effective-medium flow properties for cells. Fracture data come primarily from image logs and core. Discrete fractures are converted to fracture density logs (fracture surface area/m3). We use neural-net software for modeling spatial distribution of fracture properties. Various distributed properties (matrix porosity, facies, etc.) determine spatial distribution of fracture density. The approach is similar to non-linear multiple regression; the input parameters predict the output distribution. The choice of distributed properties is based on geologic knowledge.

The final step combines fracture density, geometry, and matrix permeability to compute permeability tensors for grid cells using a boundary-element model that combines the interacting effects of fracture- and matrix-flow.