

# **Syndepositional Fractures in High-Relief Carbonate Margins: Outcrops in the Canning Basin, NW Australia, as Analog for Tengiz Reservoir, Kazakhstan**

**Wayne Narr<sup>1</sup> and Eric Flodin<sup>2</sup>**

<sup>1</sup>Chevron

<sup>2</sup>TengizChevroil

## **ABSTRACT**

Natural fractures significantly influence productivity in Tengiz field, which is one of several giant light-oil accumulations trapped in isolated carbonate platforms in the Pricaspian Basin of Kazakhstan. Outcrop analogs are particularly important for understanding reservoir fracture systems because many aspects of fracture character (e.g. height, length, nature relative to stratification geometry) cannot be measured with sub-surface data.

The Devonian margin of the Canning Basin in NW Australia presents well-exposed outcrop analogs for steep margin and slope deposits of Tengiz field. Fracture data from Tengiz core and image logs suggest affinity to fractures in the Canning outcrops in terms of origin, orientation, and density. Information from outcrop study leads to improved understanding of stratigraphic influence on fracture character.

Syndepositional fractures – those formed prior to significant burial, including neptunian fractures – are the most important for reservoir productivity at Tengiz field. These fractures dip steeply and strike dominantly parallel and/or normal to the local orientation of the depositional margin. They are most well-developed in brittle, boundstone-dominant facies of the outer-platform to upper slope environment. Tectonic fractures are present in the Tengiz reservoir but do not show the same strong contribution to fluid flow that syndepositional fractures do. This may be due to dissolution within the syndepositional fractures which has led to enlargement of apertures, ranging from small to caverns, and the large size of early-formed fractures. In Tengiz field cavernous fractures pose a risk of lost-circulation and the reward of highly productive wells.

Outcrop data from the Canning Basin show fractures in the mid- to upper-slope facies and reef core are commonly not limited by bedding and hence taller than fractures in the reef flat and outer platform. Fracture height cumulative distributions are mainly exponential, and they differ between stratigraphic settings. Such size differences will have significant impact on fracture connectivity, drainage, and permeability in a reservoir. Fracture density, which is measured routinely in the Tengiz reservoir, was measured with long pseudowells (i.e. scanlines) “drilled” along Canning outcrops. Fracture density shows significantly less variation among facies than does fracture height. Thus, outcrop-based data adds to our understanding of key fracture system characteristics that are unavailable from well data alone.