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Extensional Deformation Styles in Outcrop: Examples From the Eastern Gulf of Suez

Characterisation of fault and fracture systems in outcrop is essential in understanding sub-surface structural heterogeneities. Field analogues from the eastern Gulf of Suez are used to develop models for fault and fracture character in other rift settings.

In the eastern Gulf of Suez, the orientation of faults is influenced by extension direction, pre-existing basement fabrics and structural position. In outcrop, large offset faults consist of single fault planes or of distributed fault zones. Fault zones are closely associated with extensional fault-propagation folds within which beds can be vertical and cut by faults and fractures that have been rotated to low angles. Smaller offset intra-block faults are distributed between major faults, typically oriented normal to the extension direction or parallel to major faults. Faults with oblique orientations and cross-faults occur within displacement transfer zones and locally adjacent to larger faults.

Fault and fracture styles are controlled by fault throw and lithology. In competent lithologies faults are typically planar and steeply dipping, possessing discrete slip surfaces. In interbedded sequences of sandstone, shale and limestone deformation patterns can be complex. Shale units provide local detachment layers into which faults sole out. Large offset faults are associated with thick shale smear zones.

Fault damage zones occur around faults with meters to kilometres of offset. They consist of dense networks of shear fractures that decrease in intensity away from master faults and are especially well developed in sandstones.

Fault and fracture models are proposed and their significance for hydrocarbon systems is discussed.