Insights Into Polygonal Fault System Termination From Detailed Upper Fault Tip Analysis

James J. King[1], Joe Cartwright[1], and Bruce Levell[1]

[1]Earth Sciences, University of Oxford, Oxford, Oxfordshire, United Kingdom.

ABSTRACT

Polygonal faults are widely interpreted in hydrocarbon sealing sequences worldwide. They have been applied to the search for reservoirs in deep water frontier basins and are also important to factor in to any site planning for carbon sequestration. Polygonal faults are layer bound normal faults that are found exclusively in fine-grained sediments and form complex networks of interconnected normal faults. When observed in plan view, polygonal faults display spectacular polygonal patterns. It is well understood that polygonal faults are formed in isotropic stress regimes and are sensitive to even very subtle stress perturbations. However, despite over two decades of research the genetic mechanism(s) to explain polygonal fault nucleation and propagation remains debated and elusive. One of the least understood elements is the timing of polygonal fault system growth. More fundamentally perhaps is the unanswered question of what causes them to die out as a fault array? Here we use 3D seismic surveys located in the Exmouth Plateau region of the Australian Northwest shelf to show a polygonal fault system developed in Turonian to Middle Miocene fine-grained chalks and oozes, and analyse the geometries and displacement distributions of the upper fault tips. This analysis leads us to glean insights into internal and external controls on late stages of polygonal fault growth and cessation. In particular, the relationship between further fault propagation and these internal and external controls such as cementation of fault planes and the deposition of coarse-grained sediments, which both have the potential to trigger the termination of a polygonal fault array.