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Understanding Permeability Controls in the Surat Basin – Structure, Stress and Natural Fractures

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Abstract

Efforts to understand permeability heterogeneity and its controls across the Surat Basin have been crucial to executing a successful and optimised field development. This poster seeks to examine the influence of the natural fracture system as a key control on permeability across QCLNG's Surat Basin acreage. The objective was to use a detailed structural understanding to explain variations in natural fracture patterns and in situ stresses (Figure 1). This has ultimately allowed for an improved understanding of permeability heterogeneity and the underlying geological controls. Image log data has been interpreted and categorised in a significant number of wells across QCLNG's Surat acreage. In situ stress, breakout intensity and coal fracture patterns have been analysed across a variety of structural settings ranging from low to high permeability.

An increased understanding of the variability of the stress field derived using borehole breakout has been achieved though integration with the structural model. This has allowed a better delineation of the maximum horizontal stress across the QCLNG acreage.

Resistivity based image logs have been used to interpret fractures and faults in coal and non-coal facies. The results have shown the presence or absence of key fracture populations and their respective orientations corresponds with significant changes in permeability within the Walloon Coal Measures. In certain areas, wells exhibiting bimodal type fracture populations can be linked to higher coal permeabilities while wells with unimodal type populations typically exhibit lower permeabilities. Importantly, this can be recognised from image log analysis in vertical wells that make up the vast majority of the dataset. It has been demonstrated that the present day structural configuration can be linked to variability in the fracture populations at specific locations and this allows for an improved spatial delineation of permeability.

Through integration of subsurface datasets, this study has generated a more complete understanding of the factors controlling in situ stresses and permeability. These learnings have been incorporated into field development planning to allow further optimisation of appraisal and development projects.

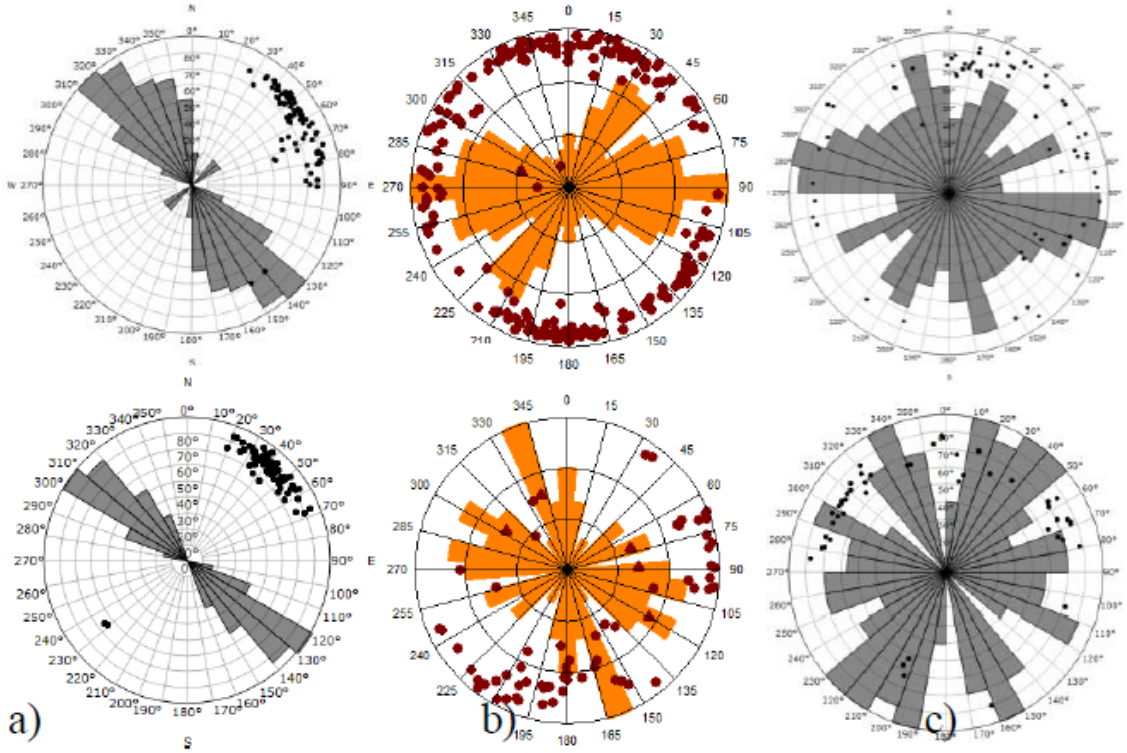

Figure 1. Example rose plots of Walloon coal fracture data illustrating typical end member coal fracture patterns a) unimodal fracture patterns found in lower permeability zones b) bimodal fracture patterns found in higher permeability zones c) uniform fracture patterns found in higher permeability zones.