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Numerical Modelling to Predict Fracturing Rock (Thanet Chalk) due to Naturally Occurring Faults and Fluid Pressure

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Abstract

Outcrop mapping of a chalk cliff and wavecut platform in Thanet, Southeast England show a complex fracture pattern that seems to be controlled by meso-scale strike-slip faults within the chalk. The response of these faults to changes to in situ stress and fluid pressure is thought to control the nucleation and propagation of fractures in the chalk. In this study the DEM (Discrete Element Method) technique has been employed as a follow up to previous field and numerical (boundary and finite element method) investigations to ascertain the role of the faults in the initiation and nucleation of fractures The role of fluid pressure, in-situ stress, and fault geometry are recognised as focal factors. The generation of localised areas of tensile stresses due to fluid pressure and stress perturbations have been shown to cause the initiation of fractures around the fault bends. For releasing bends, localised tensile stresses tend to occur along the central segment of the fault bend, whereas for restraining bends, tensile stresses are more likely to develop on the outer edges of the fault bend. The dissimilarity in the fracturing process due to differences in the geometry of pre-existing faults demonstrates the significance of both fault geometry and fluid behaviour in controlling fracturing.

Keywords: Discrete Element Method; Fracture; Fluid Pressure; Faults; Subsurface; Chalk

1.0 Introduction

Discontinuities within a rock mass could occur due to non-homogeneity, naturally occurring faults, artificially induced fractures, folds and stratification. Some aspects involving the role of discontinuities in the general fracturing process have been studied (e.g., Hofmann *et al.*, 2016, Singhal and Gupta, 2010, Mahrer *et al.*, 1996). Discontinuity is a general term that connotes shear bands, fractures, joints, faults, cleavages, foliations, bedding planes, unconformities, intrusive contacts, etc. (Singhal and Gupta, 2010). Layering and changes in material properties can also be regarded as discontinuities.

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