Zhao, X.P. and R.P. Young. (2011) Numerical modeling of seismicity induced by fluid Injection in naturally fractured reservoirs. *Geophysics*, 76, 169-184.

Numerical modeling of seismicity induced by fluid Injection in naturally fractured reservoirs

Abstract

The interaction between hydraulic and natural fractures is of great interest for the energy resource industry because natural fractures can significantly influence the overall geometry and effectiveness of hydraulic fractures. Microseismic monitoring provides a unique tool to monitor the evolution of fracturing around the treated rock reservoir and seismic source mechanisms can yield information about the nature of deformation. In this paper, a numerical modeling study using a 2-D distinct element particle flow code (PFC^{2D}) was used to simulate realistic conditions and increase understanding of fracturing mechanisms in naturally fractured reservoirs through comparisons with results of the geometry of hydraulic fractures and seismic source information (locations, magnitudes and mechanisms) from both laboratory experiments and field observations. A suite of numerical models with fully dynamic and hydro-mechanical coupling have been used to examine the interaction between natural and induced fractures, the effect of orientation of a pre-existing fracture, the influence of differential stress, and the relationship between the fluid front, fracture tip and induced seismicity. The numerical results qualitatively agree with the laboratory and field observations and suggest possible mechanics for new fracture development and their interaction with a natural fracture (e.g. a tectonic fault). Therefore, the tested model could help in investigating the potential extent of induced fracturing in naturally fractured reservoirs and in interpreting microseismic monitoring results in order to assess the effectiveness of a hydraulic fracturing project.

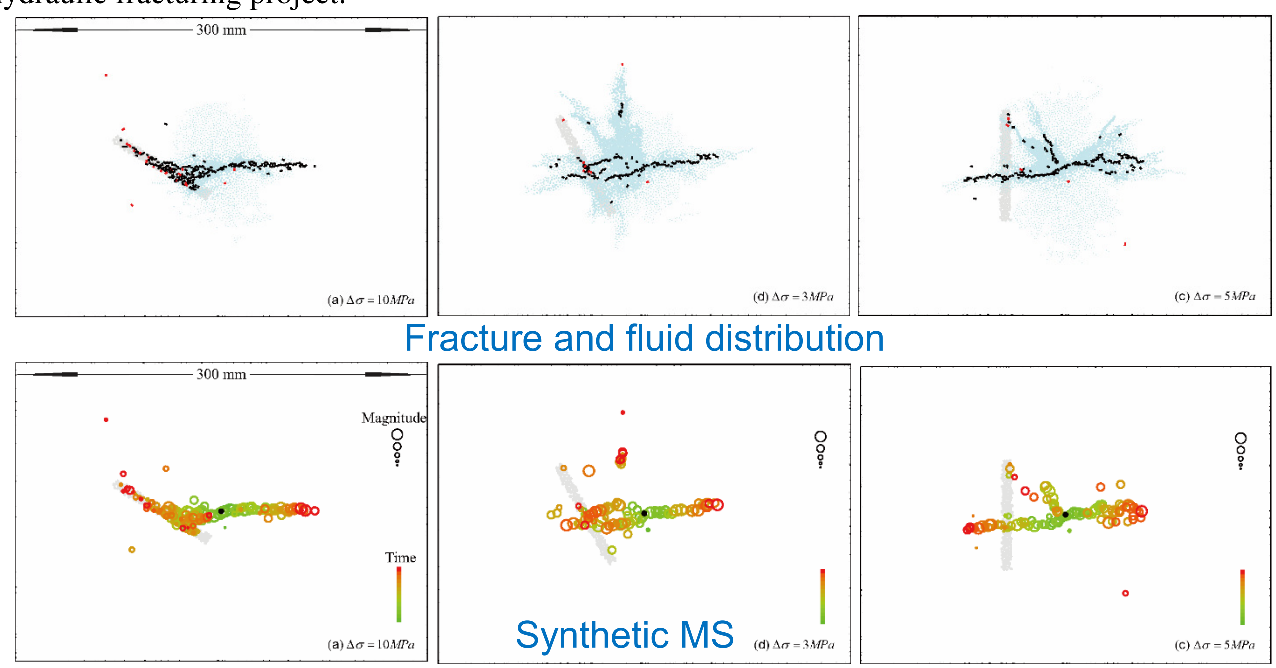

Figure: *Interaction as shown in Arrestment, Dilation and Crossing between natural and hydraulic fractures with the variations of in-situ stress and interaction angles.*

Website: http://geophysics.geoscienceworld.org/content/76/6/WC167

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