Geomechanical Modeling of Induced Seismicity Due to Fluid Injection

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Abstract

The paper addresses the effect of a layered lithological structure in the sedimentary infilling on the spatial variation in microseismicity. Numerical modeling is used and two natural cases are studied. The modeling approach simulates the depth variations of the tensile and shear failure criteria. It takes into account the strength, the stiffness rock properties and the in situ pore pressure. The stiffness variation, obtained from well data, induces a variation in the local state of stress as a function of the layering. We show that the depth distribution of recorded microseismic events is highly correlated to the variation of the failure criteria as imposed by the interplay of rock strength and stress concentration due to lithological layering. A high density of events is observed in layers that must fail in tension during the fluid injection indicating that the initiation of tensile fractures is a key mechanism. The layers that do not fail in tension are associated to a decrease in the number of events. Shearing may also be an important mechanism during the fluid injection and we highlight shear reactivation induced by the fluid injection.

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