11.16: Stress, pressure, and strength of mudrocks near extensional faults

Maria A Nikolinakou, Research Scientist

ABSTRACT

We study stress and pressure in an extensional basin with a critically oriented pre-existing fault. We find that the presence of a fault with lower frictional resistance than the intact sediment leads to re-orientation of principal stresses near the fault (Fig. 1), and abrupt changes in the minimum principal stress across the fault. Sediment rollover in the hanging wall leads to stress arching, which re-orients principal stresses in the upper parts of the hanging wall (Fig. 1) while extension is active. We also show that stress arching drives overpressures in the hanging wall, despite the regional extension. Finally, during development of a growth fault, the resulting faster deposition in the hanging wall amplifies overpressure (Fig. 2). We built these transient evolutionary simulations with Elfen, and model sediments as a poro-elastoplastic material. Compression, strength, and permeability properties are calibrated using experimental observations on Resedimented Gulf of Mexico Eugene Island material.

CLICK ON IMAGE FOR LARGER VIEW

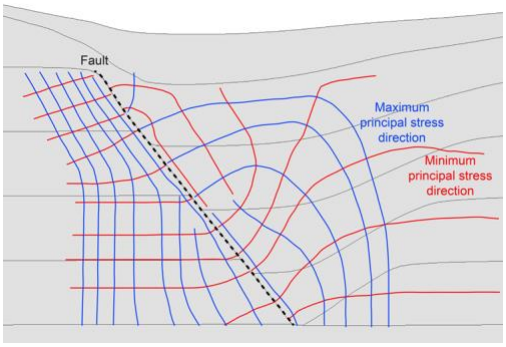


Figure 1: Orientation of maximum principal stress (blue) and minimum principal stress (red) during regional extension. At the shallower parts of the fault, the maximum principal stress on the hanging wall side juxtaposes the minimum principal stress on the footwall side.

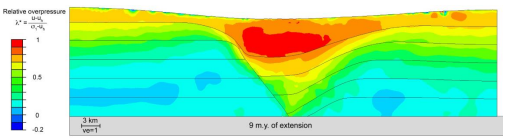
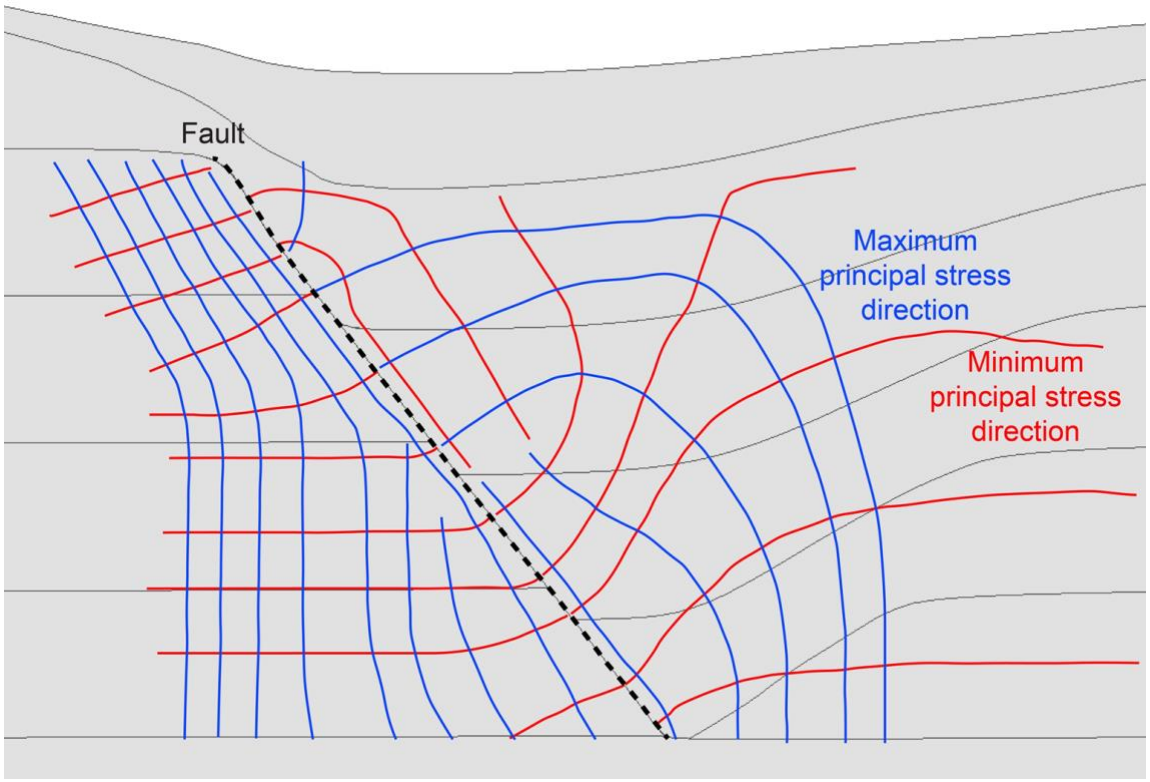


Figure 2: Relative overpressure during development of growth fault, illustrating that the faster deposition in the hanging wall side amplifies overpressure.



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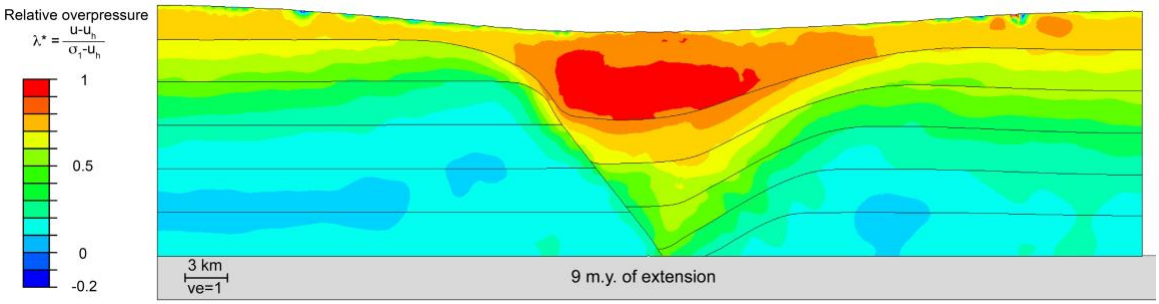

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