Modeling Stress Evolution around a rising salt dome

Maria A Nikolinakou, Research Associate, The University of Texas at Austin

Co-authors: G. Luo, P. Flemings, M. Hudec

ABSTRACT

We model the evolution of a salt diaper during sedimentation and study how deposition and salt movement affect stresses close to the dome (Fig. 1). Because the average density within the sediments is higher than the density of the salt, the sediments overpressure the salt base, which drives salt flow (Fig. 2). The salt swells outwards, resulting in an elevated horizontal stress and significant horizontal strains at the wall sediments. Stresses within the sediments rotate, in order for the major principal stress to be vertical to the salt interface. As a consequence, the vertical stress is less than the overburden value. We also show that the hoop is the minimum principal stress close to the rising part of the dome, implicating that radial faults could be expected in this region. Our results highlight that forward modeling can provide a detailed understanding of the stress history of mudrocks close to salt domes, which is critical for predicting stress, porosity and pore pressure in salt systems (Fig.1). We built this axisymmetric model within the large-strain Finite Element program Elfen. We model the salt as solid visco-plastic, with the Munson & Dawson (1979) model and the sediments as poro-elastoplastic, with a generalized MCC model (SR3, in Elfen).

CLICK ON IMAGE FOR LARGER VIEW

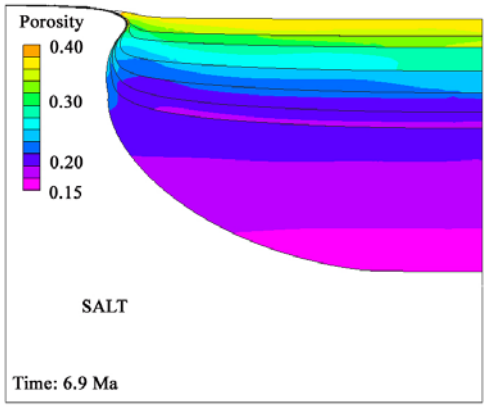

Figure 1: Porosity profile of sediments depositing on a salt body, leading to the rising of a salt dome. Because of the lateral thrust from the moving salt, the deposition is not uniaxial; Sediments are overcompacted near the vertical face of the dome, and slightly undercompacted closer to the base.

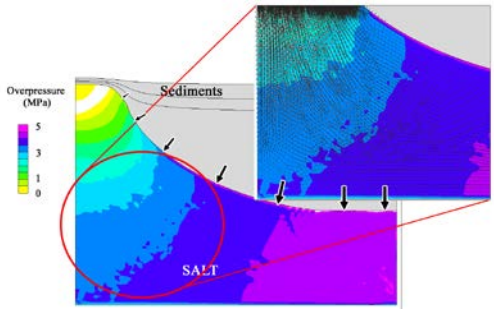

Figure 2: Overpressure within the salt, calculated as the difference between the salt stress – caused by the denser sediments – and the theoretical lithostatic value (density integration). The overpressure acts as the potential for the salt flow.

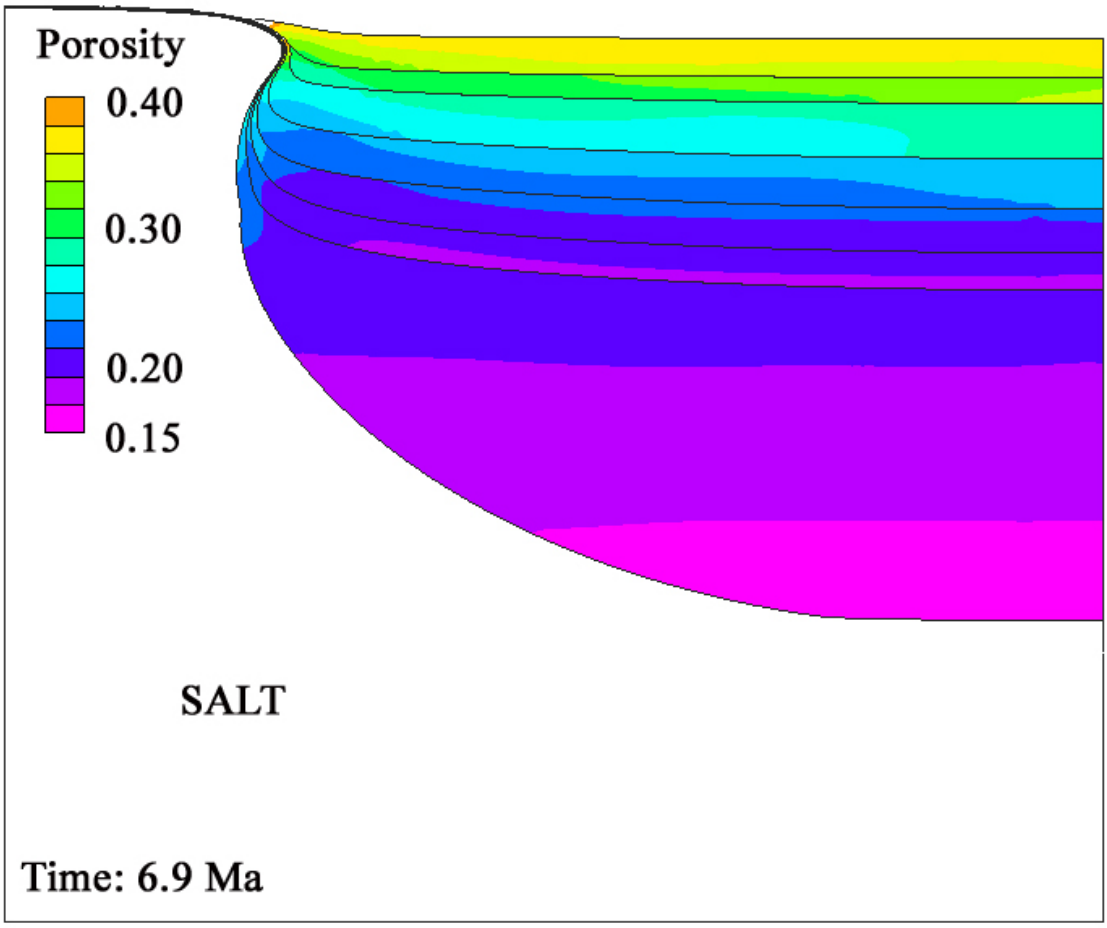

Figure 1: Porosity profile of sediments depositing on a salt body, leading to the rising of a salt dome. Because of the lateral thrust from the moving salt, the deposition is not uniaxial; Sediments are overcompacted near the vertical face of the dome, and slightly undercompacted closer to the base.

Back

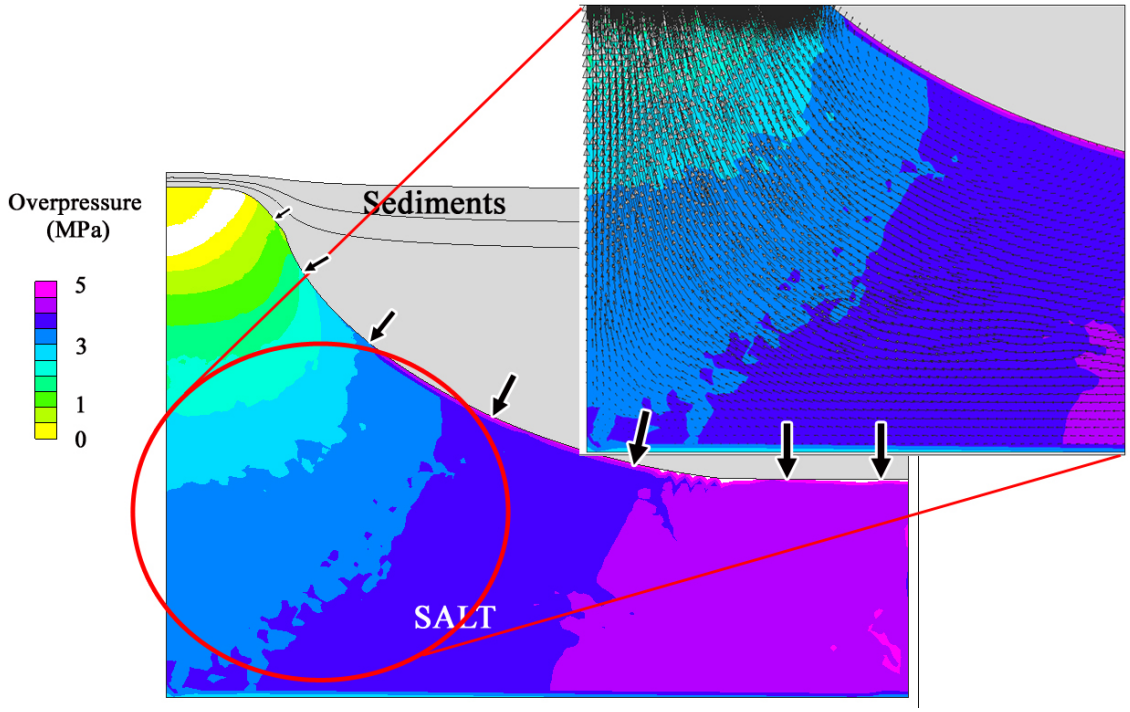

Figure 2: Overpressure within the salt, calculated as the difference between the salt stress – caused by the denser sediments – and the theoretical lithostatic value (density integration). The overpressure acts as the potential for the salt flow.

Back