Pore pressure evolution and flow focusing around a rising salt wall

Mahdi Heidari and Maria Nikolinakou

ABSTRACT

We use an evolutionary finite element model to study pore pressure evolution and flow around a rising salt wall. Pore pressure in sediments near a salt diapir forms due to sediment overburden, loading from salt rising, and overpressure transmission from far-diapir sediments along highly permeable sand layers in the basin. We first run the model with a basin composed totally of mudrock and show that overpressure increases in sediments near the salt wall due to high lateral pressure imposed on the sediments due to the diaper rise.

We then run the model with a sand layer in the basin. Because of overpressure transmission along the sand layer, pore pressure increases significantly near the diapir and decreases in deep sediments far from the diapir (Fig. 1). We show that the pore pressure increase near the diapir helps the diapir develop faster by reducing the shear strength of sediments over the diapir. We also show that the overpressure increase near the diapir increases the chance of wellbore failure near the diapir (Fig. 2). Our study provides insight into the coupling between basin hydrodynamics and the evolution of the salt system, and may provide approaches to safer and more economic production from reservoirs near salt diapirs.

CLICK ON IMAGE FOR LARGER VIEW

(a) (b)

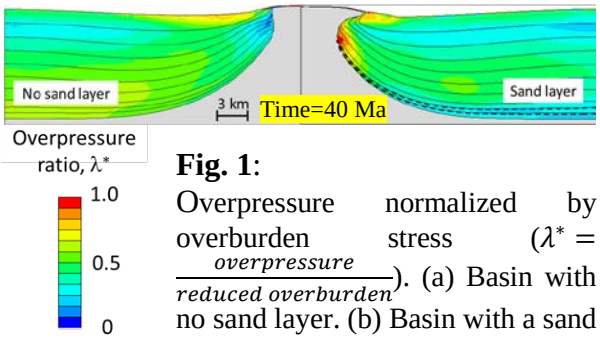

Fig. 1: Overpressure normalized by overburden stress ($\lambda^* = \frac{overpressure}{reduced\ overburden}$). (a) Basin with no sand layer. (b) Basin with a sand layer (shown in dashed line). The high overpressure transmitted by the sand layer from deep sediments far from the salt wall creates a high overpressure ratio in shallow sediments near the diapir.

(a) (b)

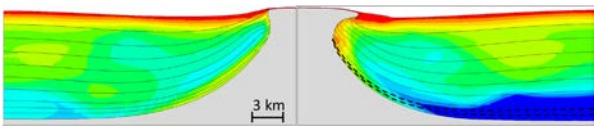

Fig. 2: Mudweight window between minimum stress and pore pressure. (a) Basin with no sand layer. (b) Basin with a sand layer (shown in dashed line). The overpressure transmitted by the sand layer increases pore pressure in sediments near the salt wall, decreasing the safe mudweight window for drilling wellbores in these sediments.

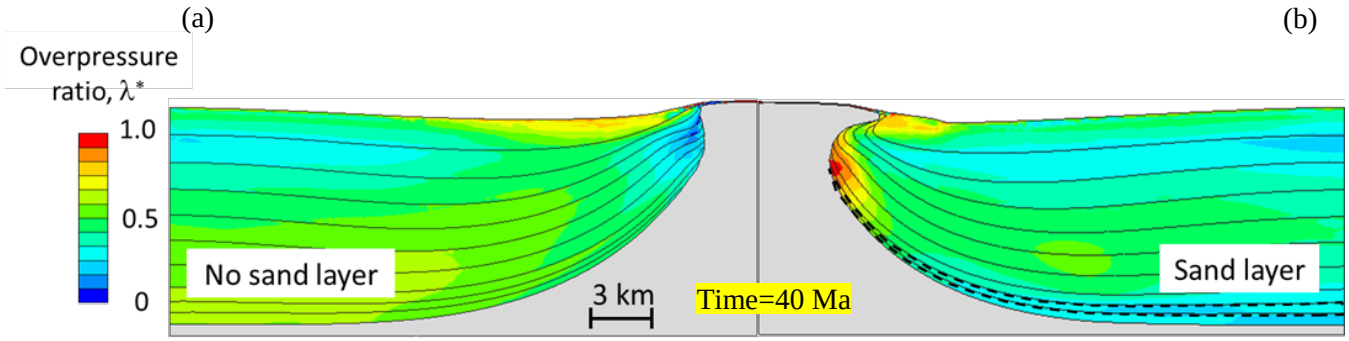

Figure 1: Overpressure normalized by overburden stress ($\lambda^* = \frac{overpressure}{reduced\ overburden}$). (a) Basin with no sand layer. (b) Basin with a sand layer (shown in dashed line). The high overpressure transmitted by the sand layer from deep sediments far from the salt wall creates a high overpressure ratio in shallow sediments near the diapir.

Back

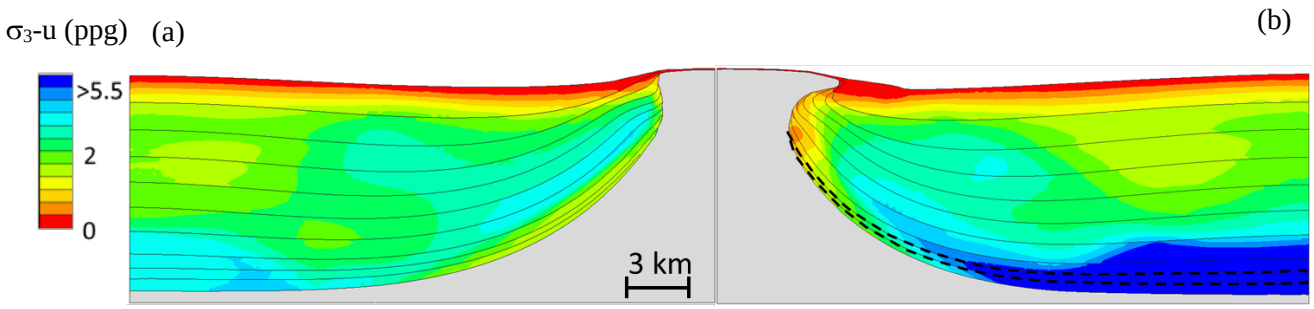

Figure 2: Mudweight window between minimum stress and pore pressure. (a) Basin with no sand layer. (b) Basin with a sand layer (shown in dashed line). The overpressure transmitted by the sand layer increases pore pressure in sediments near the salt wall, decreasing the safe mudweight window for drilling wellbores in these sediments.

Back