12.03: Geologically constrained evolutionary geomechanical model of the Tarfaya basin

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ABSTRACT

We use information from a sequential restoration model to mechanical evolution of the Sandia salt diapir located in the Tarfaya basin, NW African Coast. We develop a 2D evolutionary geomechanical model that couples the sedimentation rates extracted from the restoration model with salt flow and regional shortening to simulate the evolution of the system (Fig. 1). We find that temporal and spatial variation in sedimentation rates is a key control on the kinematic evolution of the salt system. We also find that the change in shortening rates can significantly affect the present-day stress state above salt (Fig. 2). Overall, geologically constraining evolutionary models enables more realistic geomechanical results and provides insights into the evolution on geologic systems.

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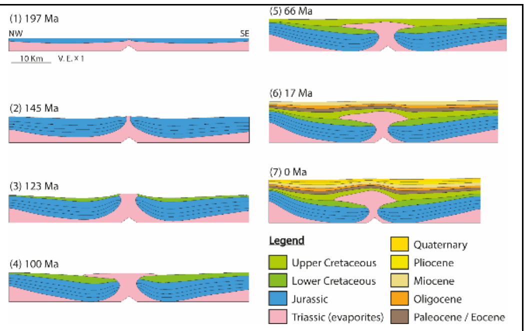


Fig 1: Different stages of evolution for the Sandia diapir (Tarfaya basin) predicted by a 2D evolutionary geomechanical model with inputs of sedimentation rates derived from a kinematic restoration model. The Sandia diapir rises during the rapid deposition of Jurassic, welds during the Early Cretaceous and reactivates during the Atlas inversion.

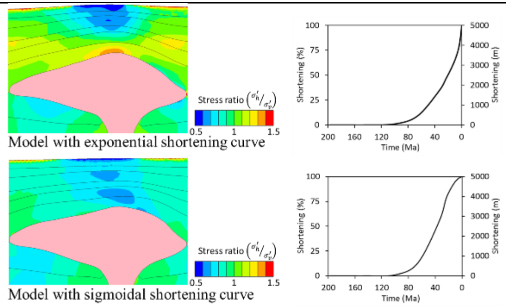
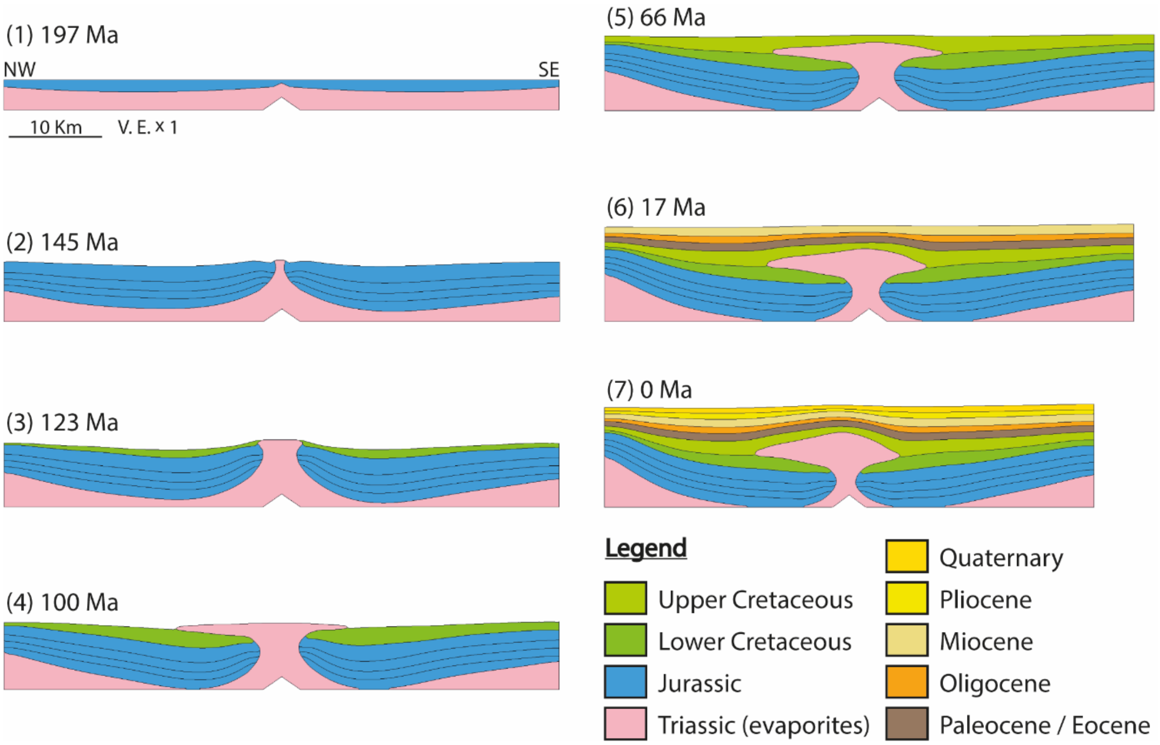


Fig 2: Present-day stress state around the Sandia diapir (left figures) depending on the shortening rates used in the model (right plots). The contours show the stress ratio for the sediments around the salt structure (0.8, light blue, corresponds to K_0 conditions). For exponential shortening rates (figures at top) the stress ratio at the crest of the diapir increases above the uniaxial value. For sigmoidal shortening rates (figures at bottom) the stress ratio of the salt-roof sediments decreases below the uniaxial value.



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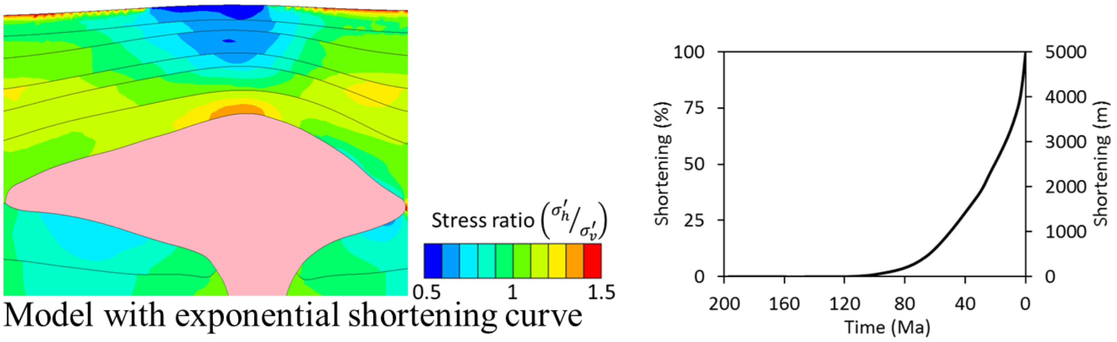
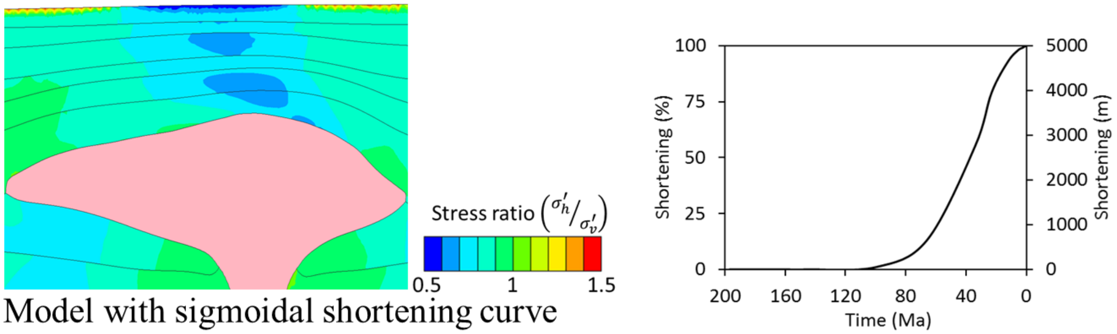


Model with exponential shortening curve



Model with sigmoidal shortening curve

Fig. 2: Present-day stress state around the Sandia diapir (left figures) depending on the shortening rates used in the model (right plots). The contours show the stress ratio for the sediments around the salt structure (0.8, light blue, corresponds to K_0 conditions)**.** For exponential shortening rates (figures at top) the stress ratio at the crest of the diapir increases above the uniaxial value. For sigmoidal shortening rates (figures at bottom) the stress ratio of the salt-roof sediments decreases below the uniaxial value.

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