Coupled hydromechanical model for assessing land subsidence due to salt layers dissolution

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COUPLEDHYDROMECHANICAL MODEL FOR ASSESSINGLAND SUBSIDENCE DUE TO SALT LAYERS DISSOLUTION

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Long term evolution of salt mine depends on elasto-viscoplastic behavior of the material but also on specific conditions like the intrusion of water into working areas. Such phenomenon has been observed in the Nancy Basin where brine percolates through access shafts accompanied by significant subsidence at the surface level, bringing about growing societal concerns.

In order to understand the mechanismsand kinetics of dissolution of salt inducing the phenomenon of subsidence, a numerical model is implemented. The model simulates the circulation of water between the salt layer and the impervious layer and the creation of dissolution channels.In active dissolution zones, thechannel network constantly evolves: new channels appear with new dissolution zones while others collapse because of their too important dimensions.

Initial porosity and hydraulic conductivity fields, related to each other by a cubic law, are assumed to follow a Weibull distribution. From this initial state, the transient model calculates the evolution of porosity with time, taking into account Darcy's velocity as it was formulated by Yao *et al*. (2014, [2]). Progress in dissolution and transport gives rise to the creation of dissolution channels (in red in ***Figure 1***).

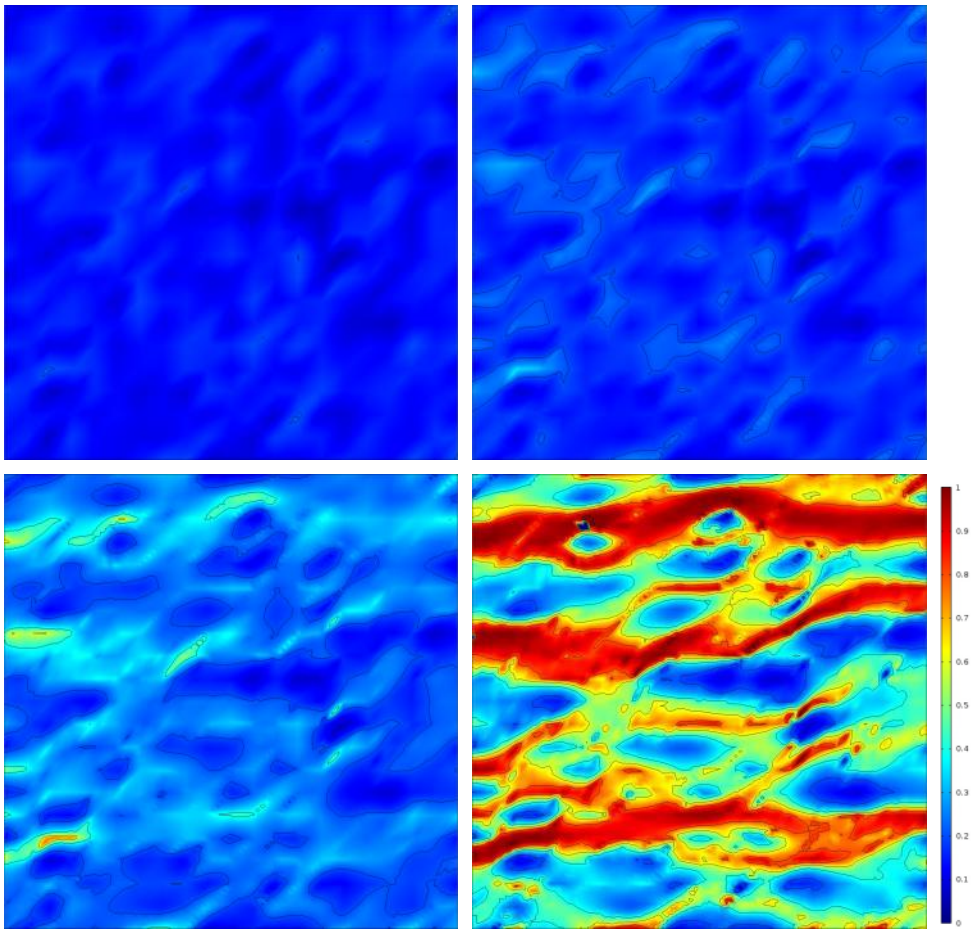

***Figure 1**:Evolution of porosity with time: creation of dissolution channel in salt layer*

Channels mechanical behavior is investigated through extending 2D model into 3D one. The calculations show that open channels collapse when they reach a width of approximatively one meter.The results of these investigations are consistent with the *in situ*measurements, notably with the estimation of the subsidence rate.

The coupled hydro-mechanical model developed in the frame of this study that allows realistic simulation of creation and collapse of dissolution channels is a powerful tool for assessing the ground stability around a salt mine. In particular, this model can be used to describe accurately the environmental consequences of salt mine closure on land stability and groundwater quality.

Key words:
Salt mine, Subsidence, Dissolution, Model

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