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Salt tectonics in the Eastern Carpathian Bend Zone, Romania: an analogue modelling approach

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Scaled sandbox models with layered brittle and ductile materials are used to gain more insights in the structural evolution of subsalt duplex structures, detachment folds, and the early evolution of salt tectonics in the Eastern Carpathian Bend Zone (ECBZ), Romania. The ECBZ is a prolific hydrocarbon area, which is part of the Romanian Carpathians. This hydrocarbon province has a strong relation to salt tectonics and hosts the largest onshore oil fields in Romania. The reservoirs are structurally complex due to superposed tectonic events (from Miocene to Recent).

Poor seismic quality (mostly sub-salt and in the proximity of the diapirs) brings difficulty in mapping the structures. As most of the shallow fields have been discovered, the current focus of exploration and production are the sub-salt, deep reservoirs. The most recent structural interpretation of the area (Schléder et al., 2016, in prep.) evokes the formation of detachment folds and sub-salt duplexes in the early stage of shortening (mid-Miocene).

In order to gain a better understanding of the structural evolution of this area, we adopt an experimental approach which is known to provide critical insights in fold-and-thrust belts. To be quantitatively and qualitatively representative, the analogue models have been geometrically, kinematically and dynamically scaled. Colored dry quartz sand was used to model brittle behaviour of both the subsalt layers and the overburden while the ductile behaviour of the salt was modelled using silicone. The lower detachment was modelled using 200-300 μm glass beads.

The experimental setup consists of a fixed horizontal box with one glass sidewall, below which a mobile base plate is pulled against at a constant rate. Deformation monitoring has been achieved with the use of side- and top-view 2D digital image correlation techniques (DPIV- Digital Particle Image Velocimetry). 3D digital elevation models (DEM) of the experiments were obtained with the use of an IR projector and camera. After post-experiment treatment, the model was serially sectioned and photographed. These vertical sections were used to build 3D digital models of the experiments.

Experimental results show the overall fold-belt geometry, position of the duplex structures and highlight the complex geometries that can be expected both sub- and supra-salt layers. Those findings can be used to improve seismic interpretation and predict subsurface geometries in the poorly constrained areas, supporting both development and further exploration potential of this mature hydrocarbon area. At the reservoir scale, understanding the small-scale fault networks and how they can vary on strike can aid in a better characterization of reservoir compartmentalization.