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Abstract

3D geological model is a representation of subsurfaces and associated structures. It integrates both existing and new data in a region (lithological boreholes, geophysical logs, seismic lines, cross-sections, etc). Such model enables 3D geometrical coherency of the different stratigraphic units in relation with the major faults controlling the basin depocentres. Besides the research dedicated to the tectono-stratigraphic evolution, basin kinematics, and paleo-environmental reconstructions, the modelling results are powerful for reservoir characterisation, fluid flow simulation, storage and resources evaluation for energy transition. The presented work focuses on the Permo-Carboniferous series of the Lorraine Basin buried below the Paris Basin, in the southwestern continuation of the exposed Saar basin in Germany.

The Permo-Carboniferous Lorraine-Saar Basin (LSB) was formed during the late Variscan orogeny as part of the Saxo-Thuringian retrowedge. In Lorraine, this basin consists of thick continental series (up to 6 km) deposited from Late Mississippian to Early Permian, over about 70 My. Despite the investigations dedicated to coal and petroleum explorations over the last century, there is no coherent regional stratigraphy and tectonic history between both Lorraine and Saar regions. In Saar this basin is considered as an inverted half-graben with a strike-slip component, whereas the Lorraine part displays a stronger compressive imprint, with a fold and thrust belt developing during the Pennsylvanian (i.e. Asturian) and Early Permian (i.e. Saalian phase). Moreover, 2D seismic lines in the Lorraine show evidences of inverted thrusts, allowing the accumulation of the Stephanian (Late Pennsylvanian) series in some half-graben structures. These tectonic phases are characterised by rapid subsidence, migration of depocentres (towards the NE along the Metz-South Hunsrück fault system), significant erosion and changing sediment sources.

To date there is no 3D representation and coherency between the buried structures and established stratigraphy. In the frame of the DEEPSURF project, existing structural cross-sections, interpretation of newly reprocessed 2D seismic lines, borehole data and geophysical logs are used to build a GOCAD 3D model of the Permo-Carboniferous series and controlling faults. The resulting 3D geometry of the series will enable to analyse spatial variations of subsidence and uplift across this intramountain basin, thereby providing new constraints on the slab dynamics along the bounding Rheno-Hercynian suture zone.

Keywords: 3D geological model, Saar-Nahe Permo-Carboniferous alluvial series, intramountain basin