Salt Tectonics Outcrops and 3D Drone Images from the Sivas Basin (Turkey) compared to High-Resolution Seismic Lines

Jean-Claude Ringenbach*[1], Jean-Paul Callot[2], Alexandre Pichat*[2], Etienne Legeay[2], Charlotte Ribes[1], and Charlie Kergaravat[1]

[1]TotalEnergies – TotalEnergies S.E., TotalEnergies SE – France
[2]Laboratoire des Fluides Complexes et leurs Réservoirs – TOTAL FINA ELF, Université de Pau et des Pays de l'Adour, Centre National de la Recherche Scientifique – France

Résumé

The outstanding outcrops of salt tectonic structures of the Sivas basin in Anatolia are now well known. A drone acquisition in November 2018 provides 3D images to visualize and interpret the structures to better analyze subsurface data from salt domains and since, many pictures have been acquired by the first author with a Mavic drone. Drone images, now widely used in structural geology, allow building 3D qualitative models of the outcrops. Seven structures among the most demonstrative of salt tectonics have thus been imaged in the secondary minibasins.
The Sivas basin, an elongated Oligo-Miocene north-verging multi-phased foreland basin, developed above the Neotethys suture zone. Evaporites deposited at the end of the early compression phase (Bartonian), filled the foreland basin and covered eroded thrust sheets and folds to the south. Primary minibasins formed during a period of quiescence from Late Eocene to Early Oligocene, associated to the building of an evaporite canopy. The system further evolved during convergence of the Arabian and Eurasian plates in the Late Oligocene-Early Miocene with a renewed compression on the north verging fold-and-thrust belt (FTB). This resulted in the formation of secondary minibasins, ultimately tilted and welded.
In the last decades, huge improvements in seismic imaging under thick allochthonous salt have been made in the Gulf of Mexico and Angola. Wide-azimuth towed-streamer (WATS) 2D as well as 3D seismic acquisitions allow far better imaging along steep subsalt diapiric flanks and welds. However, major drilling disappointments still do occur, due to unseen megaflaps and small-scale structures such as halokinetic sequences at various scales or small faults cannot be seen. Field analogs then become the only guide for a better assessment of the traps. Striking geometric analogies between the Sivas outcrops and seismic images from the classic petroleum provinces controlled by salt tectonics will illustrate the extraordinary quality of the Sivas basin as a geometrical field analog for the Angola and the Gulf of Mexico salt basins. Analog modelling imaged with X-ray tomography under a medical scanner will also be used for comparison.

Mots-Clés: Tectonique salifère, séquences halocinétique, prisme compressif, diapir, weld, Anatolie

*Intervenant