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Structural style of a compressive wedge with salt and coal shale decollement levels: Analogue and seismic modelling of the Kuqa Thrust Belt (North Tarim, China)

Jean Paul Callot (1), Wang Guichong (2), Isabelle Moretti (3), Gu Yongxing (2), Jean Letouzey (4), and Shengyu Wu (5)

(1) LFC-R, UMR 5150, Université de Pau et des Pays de l'Adour, Pau, France (jean-paul.callot@univ-pau.fr), (2) Korla Branch of the Geophysical Research Institute, BGP Inc., CNPC, (3) GDF-Suez, Exploration-Production, Tour T1, 1 place Samuel de Champlain, La Défense, France, (4) Letouzey consulting, Viroflay France, (5) C & C Reservoirs, Houston, USA.

The Kuqa foreland fold and thrust belt developed at the contact between the uplifted basement block of the Tien Shan and the Tarim basin in foreland setting, since early Oligocene. It is mainly controlled by two major decollement levels. Thin skin deformation and Mesozoic thrust sheet develop above the Triassic and Jurassic coal and shale layers. The Paleogene and Neogene salt ridges and synclines developed above the stacked thrust sheets through the Paleogene salt layer. 4D Analogue models imaged with X-ray tomography are used to analyse the relative importance several parameters such as (1) the kinematic boundary conditions, (2) the rheological behaviour of the main decollement levels, and (3) erosion and sedimentation, on the present structure evolution. The experiments demonstrate that the geometry of the belt is controlled by the regional distribution of both decollement levels. The lower decollement requires a weak frictional behaviour, pinching toward the south, whereas the viscous Paleogene salt layer, pinching regularly to the South and passing gradually to clastic deposits to the North close to the Tien Shan boundary. The geometry of salt ridges and diapirs dvlopped during the early tectonic phase associated with a low sedimentation rate controls the shape and localisation of the future foreland synclines and boundaries. The synclines grow during the late stage of evolution with a rapid increase in flexure and sedimentation rate. The backstop geometry is the second major element, controlling the dip of the Mesozoic stacked thrust sheet below the salt. Inverted basement block associated to a basement short cut emplaced during the late stage of evolution are both needed to generate the overall geometry of these units. Based on the analogue models, the geometry of the thrust sheet and foreland syncline is used to perform a synthetic seismic profile in order to test the ability to image the deep parts of the thrust sheets below complex structures. The recovered seismic data demonstrate that the sub-thrust sheet could not be well imaged considering the well velocity data and realistic geometry as deduced from surface seismic data.