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Palinspastic reconstruction of the Alpine thrust belt at the Alpine-Carpathian transition – A geological Sudoku

A. Beidinger (1), K. Decker (1), A. Zamolyi (1), M. Hölzel (1), M. Hoprich (1), and P. Strauss (2)

(1) University of Vienna, Department of Geodynamics and Sedimentology, Althanstrasse 14, 1090 Vienna, Austria (andreas.beidinger@gmx.net), (2) OMV, EOP-AUT Exploration, Gerasdorferstrasse 151, 1210 Vienna, Austria

The palinspastic reconstruction of the Austroalpine thrust belt is part of the project Karpatian Tectonics, which is funded by OMV Austria. The objective is to reconstruct the evolution of the thrust belt through the Early to Middle Miocene in order to obtain information on the palaeogeographic position of the Northern Calcareous Alps (NCA) in the region of the present Vienna Basin. A particular goal of the study is to constrain the position of reservoir rocks within the Rhenodanubic Flysch units and the NCA with respect to the autochthonous Malmian source rocks overlying the European basement below the Alpine-Carpathian thrust wedge, and to constrain the burial history of these source rocks.

Reconstruction uses regional 2D seismic lines crossing from the European foreland into the fold-thrust belt, 3D seismic data covering the external thrust sheets, and lithostratigraphic data from a total of 51 selected wells, which were drilled and provided by OMV Austria. The main criterion, whether a well was suitable for palinspastic reconstruction or not, was its penetration of Alpine thrust sheets down to the Autochthonous Molasse of the foreland. Additional wells, which do not penetrate the entire Alpine thrust complex but include the Allochthonous Molasse or the external Alpine-Carpathian nappes (Waschberg and Roseldorf thrust unit, Rhenodanubic Flysch nappes) in their well path, were also taken into account. The well data in particular comprise stratigraphic information on the youngest overthrust sediments of the different thrust units and the underlying Autochthonous foreland Molasse. These data allow constraining the timing of thrust events in the allochthonous thrust units and overthrusting of the Autochthonous Molasse.

In the particular case of overthrust Autochthonous Molasse, additionally to the timing of overthrusting, which can be derived from the youngest overthrust sediments, the palaeogeographic position of the Alpine Carpathian thrust front could directly be inferred from well data for the specific time period. By further utilization of geological maps, geological cross sections and two regional c. 80 km long composite 2D seismic sections through the external Alpine thrusts, the positions of major thrusts could be approximated for five time slices. This procedure was applied for the front of the allochthonous Molasse units, the floor thrust of the Roseldorf thrust unit, the Waschberg thrust unit and the frontal thrusts of the Rhenodanubic Flysch and the NCA. In addition, several out-of-sequence thrusts within the Waschberg unit, the Molasse unit, the Rhenodanubic Flysch and the Calcareous Alps (floor thrust of the NCA and two internal thrusts) were taken into account. The reconstruction results in 5 palinspastic maps for the time slices early Egerian (25 Ma), early Eggenburgian (20 Ma), Ottnangian (17.5 Ma), Lower Karpatian (16.5 Ma) and the Karpatian/ Badenian stage boundary (16 Ma). Convergence rates, which were calculated for the four intervening time intervals, range from about 3 mm/yr to 5 mm/yr. These values compare well with estimated convergence rates reconstructed for the Miocene in the western Eastern Alps (Schmid et al., 1996), as well as with plate tectonic constraints on Tertiary convergence rates (Dewey et al., 1989).

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