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Prediction uncertainties in salt detached fold and thrust belts – examples from the surface and subsurface of the Northern Calcareous Alps (Austria)

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As shown for fold and thrust belts worldwide and for the Northern Calcareous Alps (NCA) in particular, the initial thickness and spatial distribution of autochthonous salt exerts fundamental control on deformation localization and structural style. The initial sedimentary geometries of mini-basins formed by downbuilding into or rafting on salt do influence the geometries of thrust sheets during subsequent shortening. The lateral extent and spacing of individual thrust sheets and the overall cylindricity of structures is governed by initial facies changes and thickness variations within and across mini-basins and salt ridges between them. During convergence, remaining inflated salt localizes shortening whereas mini-basins may react as rather rigid blocks. As deformation culminates at these secondary welds that eventually become thrusted and squeezed, apparent structural closures might become exploration targets but potentially yield more complex internal geometries and less predictable facies distribution.

In this contribution we show several cross sections constrained by surface and subsurface data in the eastern NCA and below the Vienna Basin. We compare areas with abrupt changes in stratigraphic thickness, limited lateral extent of individual thrust sheets and highly non-cylindrical structural style along strike to areas where thrust sheets extend over several tens of kilometers along strike with remarkably cylindrical structures, little thickness variations and less abrupt facies changes. Predictive capabilities in underconstrained areas (i.e., insufficient seismic imaging and/or resolution, lack of well control, bad outcrop conditions) are analyzed and compared to closures with well control and pre-drill expectations. Evidently, culminations can be predicted with more confidence in areas with little variation in facies and sedimentary thicknesses. Reliability of predictions generally degrades with decreasing thrust sheet size, observable non-cylindricity within and in between thrust sheets, and with increased complexities at the edges of mini-basins (e.g., squeezed and thrusted flaps). Internal geometries of mini-basins need to be imaged and analyzed properly to narrow down these uncertainties at potential culminations along the edges.