Styles of fault-related folding at the front of the Northern Calcareous Alps

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The Bajuvaric Nappe Complex represents the lowermost tectonic unit at the leading edge of the Northern Calcareous Alps (NCA), which is overthrusted by the Tyrolic and Juvavic Nappe Complexes. Notable differences in the deformational style were observed in these units: Narrow synclines and anticlines are described from the Bajuvaric, whereas faulting and thrusting rather than folding is reported from the Tyrolic (Mandl, 2000).

A structural field study was conducted in the Ternberg- and Reichraming Nappes, which form part of the Bajuvaric Nappe complex in the southeast of Upper Austria. Published structural interpretations and cross-sections from this area present tight to isoclinal buckle folds with thickened hinge zones that are cut by relatively few thrust faults (Tollmann, 1976; Hamilton, 1989; Egger & van Husen, 2011).

Field work has identified fault-related folding rather than buckle folds, thus revealing a different structural style than suggested by previous interpretations. Isoclinal folding does not exist, instead a high number of thrust faults was mapped that control the geometry of the nappe stack. Thrust faulting appears on all scales, causing upright repetitions of strata.

A change of the structural style is evident within the mapped Bajuvaric Nappes: contraction is accommodated by fault-bend folding in the southern zones of the Reichraminger Nappe, whereas fault-propagation folds with typically steep front limbs and blind thrusts are detected in the northern Ternberger Nappe. Commonly the fault-related folds are stacked as duplexes or imbricate thrust systems as a consequence of the low thrust spacing. In particular the frontal area near the base thrust on the Flysch Zone shows a marked decrease of the thrust spacing.

Consistent top NNW shortening along the thrust faults is derived from fault slip data, analysis of SCC'-fabrics and fold geometries. Fold axis trend horizontally in ENE-WSW direction in the entire study area. An exception to this trend is found in the area of Trattenbach, where folds plunge at considerably higher angles up to 40°. Analytical solutions have shown that steep fold plunges up to 50° can be caused at lateral terminations of folds that are either the consequence of oblique/lateral ramps or of lateral displacement gradients (Wilkerson et al., 2001). Simple 3D kinematic forward modeling was used to generate structures with steep fold terminations and to approximate the geological map expression of such structures. The best match with the map was obtained by introducing a lateral ramp that causes displacement of Mid-Triassic marker lithologies as well as steeply plunging folds at the edge of the thrust folds.

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