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STRUCTURE AND KINEMATICS OF THE NORTHERN CALCAREOUS ALPS ALONG THE TRANSALP-PROFILE

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In order to better understand the structural and kinematic development of the frontal Upper Austroalpine Thrust Complex a strip roughly 30 km wide of the Northern Calcareous Alps (NCA) was investigated between the rivers Isar and Inn. The main aim was the construction of a depth-extrapolated geological cross section along the TRANSALP seismic profile and a semiquantitative retrodeformation of the section. In addition to depth-extrapolated surface structures, reflection seismic lines and well data from Vorderriss 1 (located about 35 km to the west) yielded useful information on a possible model for the deep structures.

In the cross section area the NCA consist of 4 major structural units: the NCA-Borderzone, the Allgäu Sheet, the Basal-Lechtal-Imbricates and the Lechtal Sheet. The **NCA-Borderzone** is made up of two internally folded and imbricated tectonic units separated by a major thrust. The **Allgäu Sheet** is characterized by tight, N-verging fold structures which are modified in the west by bivergent thrusting. The overlying **Basal-Lechtal-Imbricates** are restricted to the central and eastern areas. They consist of incomplete Triassic-Jurassic successions and indicate that this tectonic unit was part of a horst in Early to Middle Jurassic time. The structural geometry of the frontal **Lechtal Sheet** was clearly influenced by major pre-existing Jurassic extensional faults. Development of these faults controlled rapid thinning of Triassic platform carbonates in the east and caused a down-section shift of the Lechtal Thrust in the west. The internal structure of the Lechtal Sheet is dominated by N-verging first-order folds with wavelengths of approximately 8km. Conspicuous NNE-SSW- to NE-SW-trending structures in the Achensee area probably resulted from anticlockwise rotations between high-angle transverse faults. The continuity of the fold trains in the Lechtal Sheet is modified by a major out-of-sequence fault (Achental Thrust). In the southsoutheast all structures are truncated by the steep sinistral Inntal fault zone.

Geological mapping, TRANSALP- and OMV-seismograms and well data from the borehole Vorderriss 1 constrain the extrapolated cross section along the TRANSALP-Traverse between the NCA-front and the Inntal fault zone. According to seismic data the top of the autochthonous European crust is located between 7.5 and 9 km below sea-level. Allochthonous units below the NCA taper southward and their cumulative thickness decreases to about 1km in the central and southern part of the profile. The lower unit of the NCA-Borderzone was intersected in the borehole Vorderriss 1; its trailing edge therefore is assumed to be located about 15 km south of the NCA frontal thrust. Field observations in the western area suggest limited displacement of the Allgäu Sheet over the upper unit of the NCA-Borderzone which therefore is expected to taper out only 2 km below the surface. According to reflection seismic data and tectonic half windows in the Vilstal/Lechtal Alps to the west and in the Weyerer Bögen to the east, the trailing edge of the Allgäu Sheet is located about 25 km south of the NCA-front. Its trailing part has been displaced 4 to 5km by the Achental Thrust the hangingwall of which displays a complex pop-up-structure. The Basal-Lechtal-Imbricates taper out

only 5 km west of the section, so a maximum continuation to depth of 2km is suggested. As the internal shortening of the Lechtal Sheet was transferred from folds onto thrusts the basal geometry of the Lechtal Sheet is considered to be rather even. **NCA-Basement** is expected at the base of the Lechtal Sheet somewhere south of the Achental Thrust trace. Semiquantitative retrodeformation of the profile yields a minimum shortening of the NCA along the TRANSALP-Traverse of 85km, corresponding to a relative shortening of approximately 75%. Internal shortening of the Lechtal Sheet amounts to about 13 km or 34%.

The timing of deformation in this part of the NCA can be unravelled by means of an analysis of the stratigraphic thicknesses, the occurrences of breccias, the basal contacts of synorogenic sediments, and their deformation. Between the Triassic and Early Cretaceous the region was dominated by extensional tectonics and differential subsidence. A Middle to Late Jurassic contractional event apparently did not significantly influence structures in the area investigated. Lower to Middle Jurassic coarse grained breccias in the southwest (Rofan Mountains) are thought to be linked to this contractional event and were probably shed from a scarp created along a foreland thrust belt located somewhere to the south. The first major contractional deformation occurred in late Early Cretaceous, leading to shortening along approximately NNW-directed thrusts. The distribution and basal unconformities of early Upper Cretaceous synorogenic sediments suggest contemporaneous E-W-folding at higher levels. The deformation was partitioned into folds and ESE-WNW-oriented dextral strike-slip faults which partly controlled the deposition of the Upper Cretaceous synorogenic Gosau clastics. Although folds in Gosau deposits show larger interlimb angles these structures correspond roughly to those observed in the subjacent strata and indicate that folding continued in post-Cretaceous time. Continuous sedimentation in the frontal NCA until Paleocene-Eocene time and the complete closure of the Penninic ocean not earlier than Eocene time constrain this second major contractional period. Late Eocene to Miocene deformation produced a tightening of folds, the creation of N-/NNW- and S-directed thrusts and strike-slip faults which cut across earlier developed fold-thrust structures, but did not displace the structures of the cross section area significantly.

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