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WEST DIRECTED THRUSTING OF THE DACHSTEIN AND HALLSTATT NAPPE (ECHERNTAL, HALLSTATT, UPPER AUSTRIA): A COMPARISON

Mario HABERMÜLLER[1], Klaus ARNBERGER[1], Bernhard GRASEMANN[1], Erich DRAGANITS[2] & Nikolaus SCHMID[1]

[1] Structural Processes Group, Department of Geological Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria. (m.habermueller@gmx.at)
[2] Institute for Engineering Geology, Vienna University of Technology, Austria

The Northern Calcareous Alps (NCA) represent a fold-and-thrust belt that is affected by thin-skinned tectonics, constituting the northernmost part of the Upper Austroalpine thrust complex. The carbonate-dominated successions were decoupled along detachment-horizons with relatively low shear strength like evaporites or shales. Permoscythian evaporites of the Austroalpine Haselgebirgs-formation make up the basal detachment of the NCA comprising a ductily deformed polymict breccia that consists mainly of a halite-clay matrix and components of anhydrite, halite, carbonate and clay.

The studied area of Hallstatt is situated in the central part of the NCA where pelagic sediments of the Hallstatt nappe are separated from the lagoonal Dachstein nappe by the E-W striking Echerntal valley. A critical feature of the Hallstatt unit is the presence of evaporitic Haselgebirge that forms one of Austria's most prominent saltdeposits. Especially nappe structure and structural relation of both units were controversial subjects and are still a matter of discussion (e.g. Frisch and Gawlick, 2003 and references cited therein). While the dominant tectonic model demands a top-to-N displacement of the NCA (e.g. Plöchinger 1995 – with a compilation of cross-sections), some authors suggest partially large scale thrusting towards the west to northwest (e.g. Linzer et al. 1995). Field observations in the Echerntal and adjacent areas confirm this model: Thrust faults and sedimentary surfaces are generally dipping towards the east, indicating a westward thrustening that produces large scale duplex structures, kink band geometries and internal antiformal stacking within the same lithological units. Besides these geometric constraints, evidence for a top-to-W movement was found in bedding-plane parallel slickensides, which evolved by interbed slip. Further information has been collected by analasing kinematic indicators in cataclasites.

Although the Dachstein and Hallstatt nappe both display the same direction of movement, a clear difference in the style of deformation is evident. Hinterland sloping duplex stacks and fault-bend-folding are the common features within the Dachstein nappe, whereas thrusting in the Hallstatt nappe constituted detachment folds and foreland-sloping structures as well. Analogue modelling (Costa and Vendeville 2002, Cotton and Koyi, 2000) demonstrates that geometry and kinematic history of fold-and-thrust belts with evaporitic décollements deviate from such with higher basal friction: Forward-vergent imbricates develop above frictional substrates, whereas both foreland and rearward vergent imbricates evolve above ductile evaporitic layers. Additionally the deformation style is governed by thickness of the ductile layer with respect to the overburden thickness. The differential rate of propagation of the deformation front between adjacent areas with ductile and frictional décollements generates an inflection and strike-slip faulting sub-parallel to the shortening direction (Cotton and Koyi, 2000).

We conclude that thrusting of the Dachstein nappe must be controlled by a décollement of different composition and thickness than the Permian Haselgebirge of the Hallstatt nappe. A potential décollement is provided by Carnian sediments composed of black shales and sandstones below the Dachstein limestone of Norian age (Linzer et al, 1995).

The deformation structures of the Hallstatt and Dachstein Nappe are both covered by clastic sediments of the Upper Cretaceous Gosau Group. As these sediments transgressed with an angular unconformity contact, not revealing the same tectonic history as the underlying sequence, they post-date folding-thrusting of the NCA (Wagreich & Decker, 2001). Therefore the age of thrusting in the Hallstatt and Dachstein nappe is considered to be Eoalpine or at least pre-Gosau.

References

COSTA, E., VENDEVILLE, B.C. 2002. Journal of Structural Geology 24, 1729-1739
COTTON, J.T., KOYI, H.A. 2000. Geological Society of America Bulletin 112 (3), 351-368
FRISCH, W., GAWLICK H.-J., 2003, International Journal of Earth Sciences 92 (5), 712-727
LINZER, H.-G. et al. 1995, Tectonophysics 242, 41-61
MITRA, S. 1986. AAPG Bulletin 70 (9), 1087-1112
PLÖCHINGER, B. 1995. Memorie di Scienze Geologiche 47, 73-86
WAGREICH, M. & DECKER, K. 2001, International Journal of Earth Sciences 90 (3), 714-726