EGU22-11281, updated on 11 Aug 2022
https://doi.org/10.5194/egusphere-egu22-11281
EGU General Assembly 2022

From foreland thrust belt to accretionary wedge: Synorogenic sediments monitor a changing geodynamic setting in the Northern Calcareous Alps of the European Eastern Alps

Hugo Ortner and Anna-Katharina Sieberer
Institute of Geology, University of Innsbruck, Innsbruck, Austria (hugo.ortner@uibk.ac.at)

Synorogenic sediments have often been used to constrain nappe movements and geodynamic processes. This contribution presents a case study from the Alps, in which synorogenic deposition (Lech-, Rossfeld-, Losenstein-, and Branderfleck Fms., Gosau Group) is affected by processes on different scales, that have led to a bewildering multitude of interpretations. We add another one.

Presently, the Northern Calcareous Alps (NCA) are a thin-skinned fold-and-thrust belt in the external part of the Austroalpine unit, which represents the upper plate during Cenozoic Alpine orogeny. However, orogeny started in the late Early Cretaceous, when large parts of the Austroalpine and the entire NCA were in a lower plate position. This major geodynamic change also controlled deposition of synorogenic sediments.

Prior to Cretaceous onset of subduction, the NCA were still in sedimentary contact with the underlying lithosphere. Most paleogeographic reconstructions show the NW edge of the Adriatic microplate at the transition from a passive margin in the SW to a transform-dominated margin in the N, as a consequence of Jurassic-Cretaceous opening of the Alpine Tethys. These transform faults apparently offset oceanic units dextrally to the east, however, they have sinistral kinematics, as a result of the northward propagating opening of the Atlantic Ocean.

At the turn from the Early to the Late Cretaceous, the NCA of the external Austroalpine had already been affected by major nappe movements in the foreland of an intracontinental subduction that had initiated along sinistral, roughly E-striking intracontinental transform faults within the Adriatic microplate (Stüwe and Schuster, 2010). Thrusting had propagated across the Adriatic plate to its northern transform boundary (Ortner and Kilian, 2021 in press).

As a consequence, oceanic crust in the N neighboured continental crust S of a transform zone. When shortening resumed in the early Late Cretaceous, continental lithosphere was subducted and replaced by oceanic lithosphere. Thus, the foreland thrust belt became an accretionary wedge. Its surface subsided to bathyal depth, as the surface of oceanic crust is isostatically in a depth of about 4.5 km below sea level, and the surface of continental crust is typically near sea level (e.g., Kearey et al., 2009).

Synorogenic sediments were deposited throughout shortening. They were affected by (i) ongoing

contraction associated with tear faulting on the local scale, (ii) thickening of the orogenic wedge by emplacement of thrust sheets on the regional scale, and (iii) subsidence of the thin-skinned wedge controlled by replacement of continental by oceanic lithosphere. Such a multi-scale explanation may solve the long-disputed question of the tectonic setting of the Cretaceous synorogenic sediments of the NCA.

References

Kearey, P., Klepeis, K.A., Vine, F.J., 2009. Global tectonics (3rd ed.). Wiley-Blackwell, Oxford.

Ortner, H., Kilian, S., 2021 in press. Thrust tectonics in the Wetterstein and Mieming mountains, and a new tectonic subdivision of the Northern Calcareous Alps of western Austria and southern Germany. Int. J. Earth. Sci. https://doi.org/10.1007/s00531-021-02128-3

Stüwe, K., Schuster, R., 2010. Initiation of subduction in the Alps: Continent or ocean? Geology, 38, 175-178. https://doi.org/10.1130/G30528.