Present day tectonic regime in the frontal part of the Eastern Alps inferred through an integrated approach

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GPS velocities indicate active convergence between Adria and the European plate, leading to back-pressuring in the Southern Alps, uplift in the Tauern Window and to complex strike-slip tectonics associated to the lateral escape of the Alps East of the Tauern Window. The amount of convergence transferred to the frontal part of the Alpine thrust belt is unknown, due to a lack of seismic and geologic evidence.

The active tectonic regime in the frontal part of the Eastern Alps of Austria has been analyzed through the integration of different data sources. The orientation of the maximum horizontal stress has been inferred from the analysis of in situ failures in 62 deep boreholes with high resolution image logs (FMI and FMS) between Salzburg and Steyr, covering the frontal of the belt (Flysch and Helvetic Units, Imbricated Molasse) and its foreland (undeformed Molasse, Bohemian Massif and its Mesozoic Cover). \( S_{\text{max}} \) is oriented close to N-S, perpendicular to the front of the thrust belt, with very little variations. Furthermore, the orientation of \( S_{\text{max}} \) is not affected by the tectonic position. Indications of perturbations of the stress field are observed only in two wells, both located in the eastern part of the study area (close to Steyr) at the northern edge of the thrust belt. In both wells the anomalous rotation of the stress induced failures occurs in an interval close to a large thrust fault located at the base of the Imbricated Molasse. Structural analysis of borehole image logs and seismic data suggests out-of-sequence thrusting as the cause of this anomaly. The observed stress perturbations suggest activity of the out-sequence-thrust fault in recent times.

The geomechanical models of 10 wells located in different tectonic/geographic positions along the Alpine Foreland Basin indicate that active thrusting is found mostly in the Flysch and Imbricated Molasse around the area of Steyr, whereas a strike slip regime prevails in the central and western sectors of the study area.

Further evidences of active thrust tectonics in the area of Steyr are provided by the record of quaternary fluvial-glacial terraces and by a morphometric analysis of creeks. The terraces of the Mindel Glaciation (MIS 12) appear to be uplifted up to 20 meters along out-of-sequence thrust faults that emplace the Helvetic Units on top of the Rheno-Danubian Flysch Units. Further active thrusting in the same area is observed in the Northern Calcareous Alps, where the profile of a few creeks displays characteristic morphometric shapes associated with mapped out-of-sequence...
thrust faults.

The results of this study suggest that active thrusting in the frontal part of the Eastern Alps is confined to the Eastern Sector of the study area around the city of Steyr, located a few tens of kilometers West of the area where the Bohemian Massif spur collided with the thrust belt, resulting in intense out-of-sequence thrusting in the hanging wall. This indicates a potential relationship between the observed active tectonic regimes and the subduction of the Bohemian Massif below the Eastern Alps.