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Did thrusting cease in the Northern Alpine Foreland Basin at 12Ma? - Answers from low-temperature thermochronology

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It remains an open question whether the present-day Alpine front is located in a distal position, i.e. north of the Jura fold-and-thrust belt, which implies northward propagation of the orogenic wedge, or if the current deformation front is located south of the Swiss Molasse basin, implying a back-stepping of the orogenic front during Plio-Pleistocene times. The common view is that thrusting proximal to the Alps ceased at c. 12Ma, contemporaneous with the onset of folding in the Jura Mountains in the north. This view has been challenged by Cederbom et al. (accepted) who present apatite fission-track (AFT) data from wells in the proximal part of the basin that indicate Plio-Pleistocene thrust reactivation.

This study aims to shed light on the late phase of evolution of the Molasse basin. We present new AFT and (U-Th-Sm)/He data in conjunction with previously published data and discuss different competing hypotheses for explaining the observed thermochronology-age pattern.

Here we present data from the two westernmost horizontal transects in our study area, Entlebuch and Rigi. Both profiles are crossing the triangle zone between the thrusted Subalpine Molasse and the flat-lying Plateau Molasse and are located south of the Jura fold-and-thrust belt. To understand the orogen parallel evolution of the age pattern, we collected data from a third profile, located east of the termination of the Jura Mountains.

Apatite FT and (U-Th-Sm)/He ages are mostly younger than their corresponding stratigraphic age. Late Miocene to Pliocene ages are obtained in both transects crossing the triangle zone, with slightly older ages in its centre in the Rigi profile. In the Entlebuch transect, an exhumed partial retention zone and partial annealing zone are exposed north of the triangle zone (von Hagke et al., 2010). A similar pattern is observed in the east, although the ages south of the triangle zone are older there. Moreover, our data in the Entlebuch transect show a strong cooling signal at c. 9Ma while a less abrupt or temporally delayed cooling signal is recorded in the Rigi area.

This cooling signal requires km-scale erosion to explain the data set. Time-temperature-path-modelling with HeFTy shows that glacial erosion and changes in the geothermal regime are not able to produce the observed signal and its lateral pattern. We conclude that the thrusts proximal to the Alps must have been tectonically active after 12Ma. Furthermore, our observations indicate that the deformation was not a local phenomenon, but extended beyond the eastern termination of the Jura fold-and-thrust belt.

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References:

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