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Late Neogene climatic, tectonic and geodynamic(?) forcing on the European Alps recorded by the erosion history of the North Alpine Foreland Basin

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The European Alps is a potential key location for deciphering interactions between surface and geodynamic processes. Repeated glaciations, base-level drop, changes in precipitation and increased climate perturbation were major climate events potentially affecting the orogenic wedge during late Neogene times. Whilst the degree of tectonic activity through this time appears limited, deep-seated mechanisms such as mantle delamination and lithospheric overthickening may have played a role too. Although young cooling ages in the Alps record extensive denudation, limited information about the wedge history is present for the past 13 Myrs due to a major hiatus in the foreland basin.

An extensive fission-track thermochronometry study of the North Alpine Foreland Basin (NAFB) has been conducted to constrain the onset, magnitude and variability of late Neogene exhumation in the basin, thereby gaining insight into the evolution of the Apine region as a whole. New apatite fission-track data from eight wells in the Swiss part of the basin reveal; (1) a uniform or slightly decreasing amount of erosion along-strike towards the SW, in the Plateau Molasse; (2) km-scale vertical offset due to thrusting in the Subalpine Molasse since c. 4.7 Ma; (3) an early/mid Pliocene onset of erosion in the NAFB.

The results have two major implications. First, the depositional age trend of the outcropping sediments in the Plateau Molasse (ie older sediments towards the SW) reflect

non-uniform Miocene deposition and not, as previously suggested, a strong gradient in the amount of post-molasse erosion. Second, the young, localised and steep thrusting recorded in the Subalpine Molasse is coeval with tectonic deformation elsewhere in the Alps, revealing slow but still active convergant forces for this time period.

The onset of km-scale erosion in the NAFB took place, not while the basin was incorporated into the wedge, but when thin-skinned shortening in the Jura Mountains had ceased. The mechanism(s) responsible for the erosion must hence be, at least partly, decoupled from the tectonic wedge growth during late Miocene time. Moreover, the onset of erosion in the NAFB occured while the orogen was still tectonically active. We conclude that single mechanism hypotheses cannot explain the AFT data trend in the NAFB. Instead, multiple climate, tectonic and perhaps geodynamic forcing, active over different time-scales and associated with different response times, have to be evaluated for future research on the late Neogene development in the Alpine region.