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Climate-induced rebound of the European Alps; the main mechanism behind early Pliocene large-scale erosion in the North Alpine Foreland Basin?

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The late Miocene and Pliocene development of the North Alpine Foreland Basin (NAFB) and the Alps is poorly understood, even though they constitute some of the most well-known and thoroughly investigated regions in the world. External massifs in the northern parts of the Alps are characterized by Pliocene mineral cooling ages, but a major unconformity between lower or midde Miocene and Quaternary sedimentary rocks in the basin precludes any direct information about the northern Alps and their foreland since c. 12 Ma. In a previous study, apatite fission track (AFT) analyses of three boreholes along a N-S trending transect across the Swiss part of the NAFB revealed that kilometer-scale erosion took place during the Pliocene. The recorded amount of erosion is too large to be explained solely by thrusting related to shortening in the Jura Mountains further north.

It is probable that the erosional unroofing of the Alps was greater than the crustal thickening at this time, which implies a net reduction in the total mass of the mountain belt. A mass reduction would have been regionally compensated by flexural uplift of the underlying plates, and hence caused flexural rebound and erosion of the foreland basin. The equivalent timing of the intensification of the Gulf Stream that potentially caused an increase in atmospheric moisture over Europe, the accelerated sediment discharge from the northern Alps and the recorded erosion in the NAFB suggests that climate change was the driving mechanism behind such flexural rebound.

In a new and more comprehensive study of the Pliocene erosion in the NAFB and its potential driving mechanisms, several additional boreholes have been sampled. Moreover, the tectonics are re-evaluated and the paleoclimate investigated in more detail.

Here we present preliminary AFT dating results from the foreland basin and discuss the potential driving mechanisms in the light of new findings.