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Coupling between climate, erosion and tectonics in the European Alps and the North Alpine Foreland Basin during Neogene times

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In a previous study, mineral cooling ages from three boreholes along a transect, through Miocene successions in the Swiss part of the North Alpine Foreland Basin (NAFB), revealed that kilometre-scale erosion occurred during early Pliocene times (Cederbom et al., 2004). The erosion was coeval with a more than twofold increase in sediment flux from the Alps. It was proposed that an increase in atmospheric moisture, brought in by the Gulf Stream since 4.6 Ma, drove accelerated erosion of the Alps and isostatic rebound of its pro-foreland basin (the NAFB). In this new and more comprehensive study of the NAFB, the timing and magnitude of erosion in the foreland basin is examined over a wider region in order to test some of the inferences of the earlier study. Specifically, the new data provides new insight into the Miocene evolution of the NAFB, and into the tectonic development in the broader Alpine region during Pliocene times.

New apatite fission-track data from eight wells in the Swiss part of the basin illustrate that the amount of Pliocene erosion is uniform parallel to the thrust front, ie from the NE to the SW, although the depositional age of the Molasse sediments exposed at surface increases markedly towards the SW. In contrast, significant local variations are present within the deformed Subalpine Molasse. The results have two major implications. First, the southwestern part of the foreland basin must have experienced syn-depositional erosion and/ or sediment bypassing during Miocene times. This, in turn, suggests active shortening in the Jura Mountains, ie that the Swiss part of the NAFB was part of the accretionary wedge, already during Miocene times. Moreover,

the data support the hypothesis that the Jura shortening had come to an end before Pliocene times.

Second, kilometre-scale thrusting took place in the Subalpine Molasse during or later than c. 4.7 Ma. The young, localised and steep thrusting recorded in the Subalpine Molasse, and elsewhere in the central northern Alps and the Jura Mountains, indicate slow but still significant convergence. We propose that the Pliocene to recent pattern of erosion and tectonics in the North Alpine region illustrates a re-direction (steepening) of the internal deformation due to enhanced erosion of the pro-wedge during early Pliocene times. These results provide a sophisticated constraint on the response of the foreland basin/ Alpine thrust wedge system to enhanced erosion during Miocene and Pliocene times.

Cederbom, C., Sinclair, H. D., Schlunegger, F. and Rahn, M., (2004) Climate-induced rebound and exhumation of the European Alps. Geology v. 32, p. 709-712.