1. Overview

The question of quantifying surface uplift of an orogen through time has been long outstanding. In this contribution, we shall show how it is possible to constrain the changes in orogenic taper (i.e. a combination of surface and basal detachment slope) on a million year time scale, combining low temperature thermochronology with critical wedge dynamics.

We selected the Central European Alps (Figure 1) as suitable study area, due to the unparalleled amount of geological and structural data and the well studied present day kinematics. Additionally, countless studies document their exhumation history.

We report apatite fission track and apatite (U-Th)/He data from profiles across the Subalpine Molasse, which forms the southern, folded and thrust part of the foreland basin and is as such a key element, linking the Alps with their foredeep. We use these data to reconstruct the kinematic evolution of the Central Alps wedge since 10 Ma.

2. Thermochronometry

Thermochronology ages projected into the profiles and plotted above. Different shades of grey denote different tectonic sites (TS), which can be followed along strike the entire Central Alps. This profile is characterized by young AFT ages in the southern part while in the northern part the AFT ages are more than dispositional age in the North. The crossing point, i.e. the exhumed 9A/9B, is at the northern termination of the triangle zone. Note the offsets in AFT and AlpIn ages across the thrusts between TS-2 and TS-3 and TS-3 and TS-4.

3. Neogene shortening

We can detect a minimum of 20 km of post 10 Ma north-westward displacement of the Aar Massif on the frontal decollement. We can use for restoring the Late Miocene wedge geometry by combining it with its exhumation history.

4. Palaeo-taper

We can use exhumation calculations from the Aar Massif to restore the wedge geometry by combining it with the data from the foreland and the External Massifs.

5. Kinematic steady state

The change in taper angle (Δα) since 10 Ma is the difference between present-day surface taper angle and the taper angle resulting from restoring the material point (Tables 1 and 2). These values show that the taper in the Central Alps did not change within uncertainty.

Conclusions

- the shortening rates for the northern flank of the Central Alpine wedge are constant since at least 8 Ma and fall between 1 and 2 mm/a
- the taper angle of the Central Alps did probably change no more than 1° since Late Neogene times
- the Central Alps are at kinematic steady state since at least 8 Ma
- the mass flux between erosion and accretion in the pro-wedge is at steady state
- we have no evidence that Miocene to Pliocene climatic events influenced the wedge stability and kinematics on the northern flank of the Central Alps
- combining thermochronometry with critical wedge dynamics is a powerful tool to understand mountain building and the governing processes