



What drives exhumation of the Alpine foreland basin? Climate, Tectonics, or Geodynamics?

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Due to a wealth of geological and thermochronology data the northern foreland basin of the European Alps is an ideal natural laboratory for understanding the dynamics of foreland basins and their interaction with surface and geodynamic processes. The northern foreland basin of the Alps has been exhumed since the Miocene. The timing, rate and cause of this phase of exhumation are still enigmatic. In particular the variability of the exhumation signal along strike and its relation to deep seated processes is unclear.

We compile all available thermochronology and organic maturity data and complement this data set with new temperature data from the eastern part of the basin. We use a new thermal history model, PyBasin to quantify the rate and timing of exhumation that can explain these data. We constrain the tectonic contribution to exhumation in the folded and thrust part of the basin by new structural cross sections.

Our results show that the vitrinite reflectance, apatite fission track data and cooling rates show no clear difference between the thrust and folded part of the foreland basin and the undeformed part of the foreland basin. The undeformed plateau Molasse shows a high rate of cooling during the Neogene of 40 to 100 °C, which is equal to >1.0 km of exhumation. The capture of the upper reaches of the Danube catchment by the Rhine in the Pliocene and Pleistocene has caused exhumation of the basin. However, the calculated rates of exhumation suggest that drainage reorganization can only explain a small part of the observed exhumation and cooling.

We conclude that the observed cooling rates suggest large wavelength exhumation that is caused by lithospheric-scale processes. In contrast to previous studies we find that the timing of exhumation is poorly constrained by apatite fission track data from boreholes. Uncertainty analysis shows that models with timing starting as early as 12 Ma or as late as 4 Ma can all explain the observed data.