Geophysical Research Abstracts
Vol. 18, EGU2016-2524, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

Slab rollback orogeny in the Alps inferred from the stratigraphic evolution of the Swiss Molasse basin

Fritz Schlunegger (1) and Edi Kissling (2)
(1) Institute of Geological Sciences, University of Bern, Switzerland, (2) Institute of Geophysics, ETH Zurich, Switzerland

The stratigraphic development of foreland basins have been related to orogenic processes, where continent–continent collision resulted in the construction of topography and the downwarping of the foreland plate. These mechanisms have been used to explain the Oligocene to Miocene evolution of the Molasse basin, situated on the northern side of the European Alps. Continuous flexural bending of the subducting European lithosphere as a consequence of topographic loads alone would imply that the Alpine topography would have increased at least between 30 Ma and ca. 5–10 Ma when the basin accumulated the erosional detritus. This, however, is neither consistent with observations nor with isostatic mass balancing models. In particular, the use of empirical relationships between the spacing of alluvial megafans, orogen width and morphometric properties of stream channels feeding the fans imply a general trend towards an increasing total fluvial relief until 1,900±1,000 m at ca. 20 Ma, followed by a prolonged period of time during which this variable has remained nearly constant. Accordingly, larger topographic loads cannot be invoked to explain the continuous deflection of the foreland plate. Alternatively, a scenario where horizontal forces cause a downward dragging of the foreland plate would offer a valuable explanation for the decoupling between basin depth and topographic loads. However, such a scenario would be associated with the occurrence of compressional forces within the foreland plate, which is not in agreement with observations in the Molasse Basin, at least for the present, where focal mechanisms of current seismic events imply the occurrence of extensional forces at work. We suggest that rollback orogeny, driven by the gravitational pull of the European slab, provides a mechanism to explain the increasing deflection of the foreland in the absence of larger topographic forcing, and it agrees with the geologic record that the subducting European plate did not move south while the overriding Adriatic plate shifted north. In conclusion, a rollback mechanism yields an orogeny/foreland basin ensemble where subsidence and thrusting are partly decoupled at the scale of the orogeny. These mechanisms explain the formation of the Alps through the delamination and accretion of crustal rocks from the subducting plate, yielding in the stacking of Alpine nappes. Such a model is capable of reconciling previously conflicting stratigraphic, palaeotopographic, seismic and plate tectonic observations in the Central Alps and the Molasse Basin (Schlunegger and Kissing, 2015).

Schlunegger, F., Kissling, E. (2015) Slab rollback orogeny in the Alps and evolution of the Swiss Molasse basin. Nature Communications, 6, 8605, DOI: 10.1038/ncomms9605 | www.nature.com/naturecommunications