A revised late-stage exhumation history of the Aar and Gotthard crystalline rocks based on FT data

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The present-day picture of the Eurasian plate basement units in the Central Alps is that of a Variscan consolidated continental crust that towards S (and with increasing metamorphic grade) changes into an body of increasing Alpine deformation with tectonic slicing in the north but nappe formation in the south. The current outcrops of the crystalline rocks within Helvetic and Subpenninic units has been attributed to late shortening and thrusting within the crystalline basement and erosion of their cover. Fission track (FT) data enable us to quantify the late-stage exhumation and illustrate the relatively late incorporation of the Aar and Gotthard crystalline rocks into the Alpine orogeny in the Tertiary (Herwegh & Pfliffner 2005). The classic FT studies of Soom (1990) and Michalski & Soom (1990) from the Aar and Gotthard crystalline rocks describe the cooling of the Aar and Gotthard massifs as the result of shortening and doming on one hand and continuous erosion on the other. Climatic forces have only recently been proposed as another possible driving force (Cederbom et al. 2004).

For our revised thermal history, 18 apatite FT ages are added to the previous data set of Michalski & Soom (1990), mainly from the E ends of both "massifs", and the thermal history of the massifs is re-investigated with respect to the following questions: (a) Did the Aar and Gotthard crystalline rocks acted as one single body after apatite closure? (b) Do fission track data show any internal tectonic movements? (c) Do the FT ages contain clear evidence of a drastic change in erosion rate at around 5 Ma as proposed on the basis of FT data from the Molasse basin (Cederbom et al. 2004)?

In close agreement to previous studies (Schär et al. 1975, Wagner et al. 1977, Soom 1990, Michalski & Soom 1990), the apatite FT pattern reveals a strong heterogeneity and regional variation of the FT data that may be explained by the beginning influence of topography on the FT age pattern. The central area around Gotthard Pass reveals a time period of steady exhumation between 5 and 10 Ma, while other areas show a clear increase in cooling rates between 8 and 5 Ma and in one case of sufficiently young ages a decrease in cooling rates after 5 Ma. None of the data profiles reveals any sign of late-stage movement along the Urseren sediment zone, however, lines of equal FT age are disturbed in the vicinity of potential zones of thrusting activity, suggesting that latest movements along these zones took place during cooling of the rocks across the partial annealing zone of the apatite FT system. The most prominent example is found at the Jungfrau, suggesting that the Grindelwald phase (i.e. shortening within the Aar massif) continued until at least 8 Ma. Late-stage doming within the crystalline massifs has continued until recently as is visible from bended iso-age lines in the Western Aar massif next to Brig and in both Aar and Gotthard massifs at their eastern ends. For the Chur dome, iso-age contours between 7 and 3 Ma indicate a shift of the dome centre to the ENE, for the Brig dome shift in opposite direction is less obvious. The pattern suggests a lateral growth of the Aar and Gotthard massif dome through time, probably caused by the propagation of the arcuate Adriatic indenter.

REFERENCES


