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FINAL EPISODES OF THE COOLING HISTORY OF EASTERN TERMINATION OF THE ALPS

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The formation and metamorphic ages of the major alpine units are known for decades, however on the last interval of the t/T stories only very limited pieces of information exist (Frank et al., 1987). The most promising techniques to date the <200°C events is the fission track method. The investigated formations in the most cases contain both apatite and zircon, which enable to identify two points or intervals on the cooling pathes. The interpretation of apatite and zircon results possible only in the simplest way, as cooling ages. A minority of samples were suitable for the AFTA method, to estimate the duration spent in the 70-120°C temperature range in course of cooling. The considered blocking temperatures for the minerals are: 100 20°C for apatite, and 200 30°C for zircon.

The four investigated tectonic units and their lithofacieses are the following (starting with the highest one, see Fig. 1):

(1) Neogene intramontane sediments (sandstone, conglomerate, fanglomerate),
(2) Sieggraben unit (gneisses of MAA),
(3) "Grobgneis" unit (orthogneiss and micaschist members of the LAA),
(4) Wechsel/Waldbach unit (gneiss, schists, Permomesozoic metasediments of LAA),
(5) Penninic unit (quarz phyllite, greenschist, metagabbro).

In some cases the FT results are in harmony with the structural position of the terrains, the upper ones served older ages. Such type of results could determined in several orthogneiss samples of the LAA unit; they show late Cretaceous-Paleocene apatite ages. These results are accounted rather old in the crystalline domains of the Eastern Alps and express that the exhumation of LAA unit happened soon after its Cretaceous metamorphism (see Dallmeyer et al. in this vol.). Moreover zircon data are very close to the apatite cooling ages which proves that the uplift was very rapid in the Cretaceous and the eastern termination of this terrain was in a cool, near-surface position in the last 60-70 Ma (Dunkl, 1991).

There is a characteristic difference between the apatite results of the orthogneisses and the micaschist members of LAA unit. The schists show Middle Eocene-Early Oligocene ages, which are younger than the apatite data measured in the gneisses by 23-29 Ma. Three possible interpretations are on these discrepancies, namely:

- the schists were the most mobile bodies in the "Grobgneis" unit in course of Tertiary tectonics, and this Tertiary event was recorded only locally in the apatites of the schists at the northeastern part of the LAA unit,
- the Tertiary data are mixed ages produced by the partial rejuvenation of the significant Neogene tectonics,
- some traces of hydrothermal events were found in these formations, maybe the rejuvenation linked to an enhanced fluid activity in course of Eocene-Oligocene.

We may reject the fourth (the simplest) explanation, to interpret the Cretaceous and Tertiary ages as signs of different uplift episodes. It is not realistic, because two pairs of the sites sampled with different ages are very close to each other.

The Wechsel unit cropped out in some windows from below the "Grobgneis" unit show a Neogene cooling event by the apatite FT ages with a weighted average of 10.4 Ma. The range of 6 to

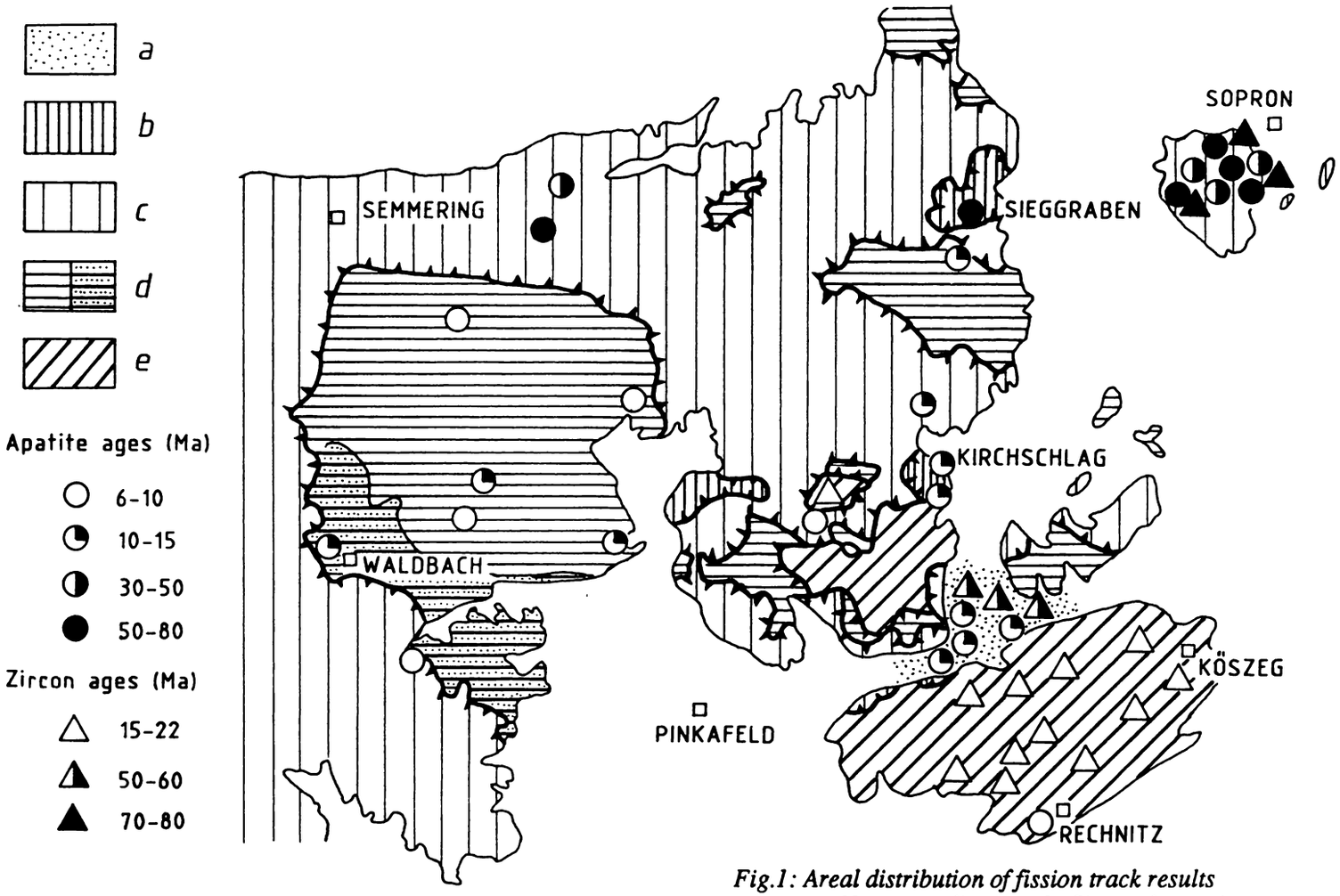

Fig.1: Areal distribution of fission track results
a: Neogen sediments, b: Sieggraben unit,
c: "Grobgneis" unit, d: Wechsel/Waldbach unit,
e: Penninic unit
(geology after Neubauer and Frisch, 1992)

15 Ma ages were recorded not only in the Wechsel rocks but the covering "Grobgneis" formations served similar ages south and east of the Wechsel window. Two ways of explanation are possible on these young ages: (a): The samples situated in the lower part of "Grobgneis" unit, and their cooling happened simultaneously with the uplift of the Wechsel dome. (b): The Neogene ages are not connected to the position of the samples within the LAA unit, rather to the warming up in course of Neogene extensional tectonics. So these rejuvenated ages are produced by the increased heat-flow.

Similar Neogene ages were determined in a greenschist and in a metagabbro sample of the Rechnitz-Köszeg window. The Penninic apatite ages somewhat younger than the Wechsel apatite samples, may express the later uplift of the Rechnitz window. (However it is noteworthy that the difference is not significant, a great part of the apatite ages have extremely large uncertainity due to the low uranium concentration.) The petty difference between the FT ages of the Wechsel and the Penninic apatites indicates that the formation of these two structures is connected to the same extension stage.

Zircon ages between 15 and 22 Ma from the Penninic rocks express the date of passing through the 200°C isotherm surface. Apatite and zircon cooling data make possible to calculate the cooling rate for the Neogene uplift. It is derived 10°C/Ma, close to the published results of other Penninic terrains of the Central and Western Alps.

The Sinnersdorf beds consist of silty sandstone, conglomerate, and fanglomerate. Their deposition was connected to intramontane basin formation in Miocene time. The petrography of the pebbles proves that at the time of the erosion/deposition the Penninic rocks had not reached the surface. The FT ages of detrital apatite and zircon grains of the conglomerate reflect that the cooling of the formations were exposed in course of the Neogene tectonics and basin formation. Strong difference were found between the ages of the apatite and zircon grains. The apatites form a population with a mean of 13-14 Ma; the zircon group is significantly older, it can characterized by a 51-58 Ma peak. Both of the two groups are very compact, sharp, the peak/with ratios of the two populations are nearly identical. In the apatite group the number of grains older than 25 Ma are negligible (the age distribution is symmetric with a tiny tail). At the evaluation of the apatite results we have to take into consideration that the Neogene sediments of the extensional basins were affected by the increased heat-flow during the opening of the basins. The measured apatite ages may reduced by a post-depositional reheating recorded by the maturation of the organic matter (Sachsenhofer, 1991). Because there are no evident results about the possible reheating of the dated outcrops now the apatite FT data are considered as cooling ages of the source terrains. What kinds of considerations can we drown from these facts?

- The sample sites contain debris only from rock bodies which reached the surface just before the erosion.
- No grains of units cooled under 100°C before the Miocene uplift were deposited into the samples beds.
- The zircon grains cooled under their blocking temperature in course of a Paleocene-Eocene uplift stage.
- The contribution of the zircons older than late Cretaceous is insignificant.
- The missing of the Neogene zircon grains proves that the early Miocene tectonics unroofed maximum the upper 4-6 km thick layer.

References

Dunkl, I. (1991): Uplift and last thermal event of the eastern end of Grobgneis, Lower Austroalpine Unit, Hungary. Terra Abstract, 3, 225.

Frank, W., Kralik, M., Scharbert, S. and Thöni, M. (1987): Geochronological data from the Eastern Alps. In: Flügel, H.W. and Fangl, P. (ed.) Geodynanamics of the Eastern Alps, 272-281.

Herrmann, P. and Pahr, A. (1988): Geologische Karte der Republic Österreich 1:50000, Erläuterungen zu Blatt 138 Rechnitz.

Neubauer, F., Frisch, W. (1992): The Austroalpine metamorphic basement east of the Tauern window. In: Renner, J. and Neubauer, F. (eds.) Pre-Mesozoic geology of the Alps. Springer Verlag, Heidelberg (in press).

Sachsenhofer, R.F. (1991): Maturity in the Styrian Basin. Erdöl, Erdgas, Kohle, 106.