Acta Mineralogica-Petrographica, Szeged, XXXII, 43—47, 1991

PRELIMINARY ZIRCON FISSION TRACK RESULTS IN THE KŐSZEG PENNINIC UNIT, W. HUNGARY

A. DEMÉNY and I. DUNKL

Laboratory for Geochemical Research,
Hungarian Academy of Sciences*

ABSTRACT

Zircon fission track ages were determined in quartzphyllite samples of the Hungarian side of the Kőszeg-Rechnitz Penninic series. The data scatter between 15.1 and 18.5 My, showing a slight areal variability which calls attention to different uplift rates in the unit. The results agree well with literature data gathered from far-lying Penninic units, that means, that the uplift of the Penninic Bündnerschiefer series might have taken place in the same time interval throughout the whole Alps.

KEYWORDS: zircon fission track, Penninic unit, Kőszeg-Rechnitz series.

INTRODUCTION

The relationship between the Kőszeg-Rechnitz metamorphic series and other Alpine Bündnerschiefer units was discussed first by SCHMIDT (1956), but direct evidence for the Mesozoic age of the Kőszeg-Rechnitz unit was provided by SCHÖNLAUB (1973). Beside these studies, a great number of authors has dealt with comparisons between the Kőszeg-Rechnitz series and other Alpine Penninic terranes. Similarities in the evolution history of the Tauern window and the Kőszeg-Rechnitz window were discussed by KOLLER (1985) from the side of metamagmatites and by DEMÉNY and KREULEN (1989) from the side of metasediments. These studies dealt with rock formation and metamorphic processes, but there has been no comparison regarding the age of uplift. While an extensive data set exists for the Tauern window (e.g. CLIFF *et al.* 1985), GRUNDMANN and MORTEANI 1985, STAUFENBERG 1987, *etc.*), only one author (KUBOVICS 1983) presents data for the Kőszeg-Rechnitz series. In this latter paper a 12 my whole rock K/Ar age was mentioned which figure is slightly lower than those of the Tauern window. As the K/Ar age data can be affected by deformation events, we intended to use a method independent of this effect.

This paper presents preliminary results of zircon fission track studies in the Kőszeg-Rechnitz series and correlations with other Penninic terranes.

* 1112 Budapest, Budaörsi út 45, Hungary

GEOLOGICAL BACKGROUND AND SAMPLES

The Kőszeg-Rechnitz unit belongs to the Alpine Bündnerschiefer series (SCHMIDT 1956, SCHÖNLAUB 1973) and consists of metamagmatites and metasedimentary rocks (BANDAT 1932, KISHÁZI and IVANCSICS 1976, 1984, KOLLER and PAHR 1980). The ophiolitic origin of the former rock type was discussed by KUBOVICS (1983) and KOLLER (1985). KOLLER (1985) correlated the series with the Glockner nappe of the Tauern window.

The metasediments are mainly phyllites with varying amount of carbonate, mica and quartz, and contain a significant quantity of detrital material as indicated by occurrences of conglomerate bodies (KOLLER and PAHR 1980). The origin of this detrital fraction has been discussed by DEMÉNY (1988) and DEMÉNY and KREULEN (1989).

The series has been affected by three metamorphic events: an oceanic hydrothermal, a subduction-related HP/LT type and a Tertiary metamorphism. The latter had the most extensive effect reaching 400 °C temperature and 2—3 kbar pressure. The conditions of these metamorphic imprints have been thoroughly studied by LELKES-FELVÁRI (1982), KOLLER (1983) and DEMÉNY (1990).

The zircon grains studied in this paper were separated from quartzphyllite samples of the Hungarian part of the Kőszeg-Rechnitz window (*Fig. 1.*). All but one (sample V) derived from drill-cores (see Table 1. for depths), while sample V was collected from a roadcut. The rocks consist dominantly of quartz, muscovite and chlorite, while opaque minerals, tourmaline, zircon, rutile and apatite appear as accessoric components.

TABLE 1.

Fission track results on detrital zircon crystals of quartzphyllites near Kőszeg

Samples	No. of data	Ns	Ni	Ps	Pi	FT AGE	+- 2s Poiss.	Uran. (ppm)
						Million years		
Velem, outcrop	4/4	245	449	12.9	35.6	18.5	+- 3.2	227
V—9 / 102.9*	27/27	1356	1353	26.6	26.4	18.5	+- 1.9	282
K—6 / 6.1	31/31	3134	3937	22.7	26.5	15.1	+- 1.2	283
K—6 / 120.3	33/33	2050	2350	23.9	26.7	16.1	+- 1.7	235
K—7 / 40.4	17/16	1157	1411	17.3	20.3	15.1	+- 1.4	286

No. of data: Crystal or field number investigated/concerned for the results.
Ns, Ni: Number of spontaneous and induced tracks.
Ps, Pi: Spontaneous and induced track density (10^5 tracks/cm^2).
Uran. (ppm): Uranium content of investigated crystals.
*: Depths (m)

The zircon grains on which fission track ages were measured reach 0.1 mm and show evidences for preserving the original crystal morphology in spite of their detrital origin. Since fission track dating does not give formation age, but the time of cooling to a certain temperature, we could use our data to estimate the age of uplift after the Tertiary metamorphism.

EXPERIMENTAL METHODS

The zircon crystals were embedded in FEP-teflon. The spontaneous fission tracks were etched after polishing by eutectic melt of NaOH-KOH-LiOH at somewhat lower temperature (190 °C) than suggested by the prescriptions of ZAUN and WAGNER (1985). Etching was carried out for different durations in each preparate (38 to 49 hours). Neutron irradiation was made at the reactor of the Technical University of Budapest. The neutron fluence was determined using the NBS SRM 962a uranium glass standard. As the external detector method was applied (GLEADOW 1981), a mica external detector was put onto the preparates and the standard and after irradiation the induced fission tracks were etched by HF for 40 to 60 min.. Counting of spontaneous tracks was made in oil immersion under a Zeiss NU2 microscope, with a magnification of 1600. In case of the mica detectors dry optics of 800-time magnification were used. To compensate the different track registration geometry ($2\pi/4\pi$) between the external detector and the dated minerals, the geometry factor of 0.5 determined by GLEADOW and LOVERING (1977) was applied.

The ages were calculated on the basis of the weighted average of the measured track density proportions by the zeta method (HURFORD and GREEN 1983). The limits of error are given by the classical procedure, i.e. by the double Poisson dispersion (GREEN 1981).

RESULTS AND DISCUSSION

The results listed in Table 1. are shown together with sample localities in *Fig. 1.* The data scatter between 15.1 and 18.5 my indicating an areal variability. Samples lying close to each other (e.g. samples V and V9) give similar ages, which calls attention to a possible areal difference in uplift. Future work will aim establishing such variability throughout the whole window.

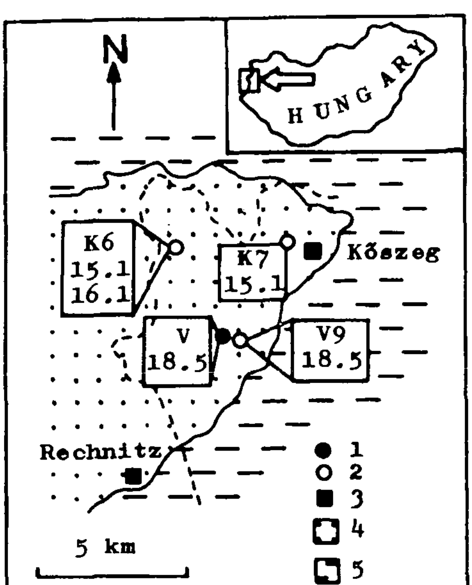

Fig. 1. Sample localities and fission track age results. 1. Sample from the surface, 2. Samples from drilling cores, 3. Settlements, 4. Penninic rocks, 5. Tertiary cover.

The next question is the comparison between our data and results on other Alpine Penninic units. The farest Bündnerschiefer series from which uplift data have been gathered is the terrane of the Lepontin Alps. HURFORD (1986) determined 11—19 My zircon fission track ages for uplift and cooling of this unit.

More information exists for the Tauern window, although the possible fission track ages can only be estimated from results of other dating methods. HURFORD (1986) discussed the possibilities of such estimation and gave blocking temperatures for various age determination methods. Following his approach we can derive the theoretical zircon fission track ages from Rb/Sr, K/Ar and apatite fission track results of RAITH *et al.* (1978), CLIFF *et al.* (1985), GRUNDMANN and MORTEANI (1985), STAUFENBERG (1987) and BLANCKENBURG *et al.* (1989). It can be concluded from these data that the Bündnerschiefer series of the Tauern window cooled to about 200 °C (zircon fission track blocking temperature) 10 to 20 My ago. This time gap agrees well with the zircon fission track data of HURFORD (1986) and with our results.

It is apparent from the above data series that although there are large distances between these far-lying Bündnerschiefer units, the uplift took place in almost the same time interval throughout the whole system.

ACKNOWLEDGEMENTS

The authors are indebted to late I. BÉRCZI for the irradiation experiments. A. Pahr is also gratefully thanked for the kind help he provided in the field work.

REFERENCES

BANDAT, H. (1932): Die geologische Verhältnisse des Kőszeg-Rechnitzer Schiefergebirge. Földtani Szemle. **I.2**. 140—186.

BLANCKENBURG, F. V., VILLA, I. M., BAUR, H., MORTEANI, G., STEIGER, R. H. (1989): Time calibration of a PT-path from the Western Tauern Window, Eastern Alps: the problem of closure temperatures. Contributions to Mineralogy and Petrology. **101**, 1—11.

CLIFF, R. A., DROOP, G. T. R., REX, D. C. (1985): Alpine metamorphism in the south-east Tauern Window, Austria: 2.Rates of heating, cooling and uplift. J. Metamorphic Geol., **3**, 403—415.

DEMÉNY, A. (1988): Determination of ancient erosion by zircon morphology and investigations on zoned tourmaline in the Kőszeg-Rechnitz Window (Western Hungary). Acta Mineralogica-Petrographica, Szeged. **XXIX**, 13—26.

DEMÉNY, A. (1990): Mineralogical, geochemical and stable isotope studies in Penninic rocks of Hungary: comparison between the Kőszeg-Rechnitz series and the Tauern window. Thesis. Eötvös Loránd University of Budapest. 100 pp. (In Hungarian).

DEMÉNY, A., KREULEN, R. (1989): Carbon isotopic compositions of graphites in the Penninic windows of Eastern Austria and Western Hungary and the Tauern Window. TERRA Abstracts, 1, pp. 332.

GLEADOW, A. J. W. (1981): Fission track dating methods: What are the real alternatives? Nuclear Tracks. **5**, 3—14.

GLEADOW, A. J. W., LOVERING, J. F. (1977): Geometry factor for external detectors in fission track dating. Nuclear Track Detection. **1**, 99—106.

GREEN, P. F. (1981): A new look at statistics in fission track dating. Nuclear Tracks. **5**, 77—86.

GRUNDMANN, G., MORTEANI, G. (1985): The young uplift and thermal history of the central Eastern Alps (Austria/Italy), evidence from apatite fission track ages. Jb. Geol. B.-A., **128**, 197—216.

HURFORD, A. J. (1986): Cooling and uplift patterns in the Lepontine Alps, South Central Switzerland and an age of vertical movement on the Insubric fault line. Contributions to Mineralogy and Petrology. **92**, 413—427.

HURFORD, A. J., GREEN, P. F. (1983): The zeta age calibration of fission-track dating. Chem. Geol., Isot. Geosci. Sect., **41**, 285—312.

KISHÁZI, P., IVANCSICS, J. (1976): Standardized investigations on metamorphic rocks in Western Hungary. II. The Rechnitz Metamorphic Complex. Hung. Geol. Survey, internal report. Manuscript. (In Hungarian)
KISHÁZI, P., IVANCSICS, J. (1984): Guide-book to the geology of the Kőszeg schist series. Hung. Geol. Survey, internal report. Manuscript. (In Hungarian)
KOLLER, F. (1985): Petrologie und Geochemie der Ophiolite des Penninikums am Alpenostrand. Jb. Geol. B.-A., **128**, 83—150.
KOLLER, F., PAHR, A. (1980): The Penninic ophiolites of the Eastern end of the Alps. Ofioliti. **5**, 65—72.
KUBOVICS, I. (1983): Petrological characteristics and genetic features of the crossitite from Western Hungary. Földtani Közlöny. **113**, 207—224. (In Hungarian with English abstract)
LELKES-FELVÁRI, GY. (1982): A contribution to the knowledge of the Alpine metamorphism in the Kőszeg-Vashegy area (Western Hungary). N. Jb. Geol. Palaont. Mh., **1982. 5**, 297—305.
RAITH, M., RAASE, D., KREUZER, H., MÜLLER, D. (1978): The age of the alpidic metamorphism in the western Tauern Window, Austrian Alps, according to radiometric dating. In: CLOSS, H., ROEDER, D. H., SCHMIDT, K. (eds): Alps, Apennines, Hellenides. Inter-Union commission on Geodynamics, Scientific Report No. **38**, 140—148., Stuttgart, 1978.
SCHÖNLAUB, H. P. (1973): Schwamm-Spiculae aus dem Rechnitzer Schiefergebirge und ihr stratigraphischer Wert. Jb. Geol B.-A., **116**, 35—48.
SCHMIDT, W. (1956): Die Schieferinseln am Ostrand der Zentralalpen von Rechnitz, Bernstein und Möltern. Mitt. Geol. Gesellschaft in Wien., **47**, 360—365.
STAUFENBERG, H. (1987): Apatite fission-track evidence for postmetamorphic uplift and cooling history of the Eastern Tauern Window and the surrounding Austroalpine (Central Eastern Alps, Austria). Jb. Geol. B.-A., **130**, 571—586.
ZAUN, P. E., WAGNER, G. A. (1985): Fission track stability in zircon under geological conditions. Nuclear Tracks. **10**, 303—307.

Manuscript received, 26 November, 1990