Six analysed whole rock samples from the Srbsko formation gave identical mean crustal residence Nd single stage model ages, suggesting that the source rocks of the sediments were derived from a depleted mantle at ca 1.6 Ga, i.e. similar to the Nd model ages for Barrandian Proterozoic graywackes (1.6–1.8 Ga; Janoušek and Vokurka 1998). Collectively, our U-Pb zircon and Nd whole-rock data suggest that the studied Givetian sediments were mostly derived from Proterozoic rock sequences, with contribution of Cambro-Ordovician magmatic rocks. Significant contribution of Devonian magmatic and metamorphic rocks still remains unclear.

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Apatite Fission Track Analyses from the Polish Western Carpathians

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Introduction

The Polish Western Carpathians (PWC) form the northernmost part of the Carpathian belt, which belongs to the Alpine-Carpathian orogenic system (Fig. 1). The PWC are subdivided into two main tectonic units: 1) The Inner Carpathians (IC), interpreted as representing the Southern (Apulian) margin of the Tethyan ocean and 2) The Outer Carpathians (OC) composed of turbiditic sequences (Fig. 2) developed on the northern margin of the Tethys, which are commonly correlated with the Alpine flysch (e.g., Csontos et al., 1992). The OC flysch sequences were thrust towards NNE during early-middle Miocene forming a nappe stack (Żytko, 1999), (Fig. 2). The IC and the OC are separated by the narrow Pieniny Klippen Belt (PKB), which comprises dominantly strongly deformed carbonates. Between PKB and the Tatra Mts. an intra-mountain Podhale basin developed, which contains Paleogene flysch deposits (Fig. 2).

In order to constrain exhumation history of the PWC and to estimate the effects of Neogene thrusting on the thermal structure of the OC, we performed apatite fission track analyses (AFT) on major tectonic units along Kraków – Zakopane section (Fig. 2). Our preliminary results are presented below.

Results

Seven samples were analysed from the crystaline rocks of the Tatra Mts, which represent the IC unit. Our results are broadly similar to those obtained by Burchart (1972). Three samples from the High (eastern) Tatra (T5-T7) yielded nearly identical ages of c. 11 Ma (Fig. 1), while other three, from the Western Tatra (T1-T3), show a rather wide scatter of ages from c. 12 to 20 Ma. This difference in ages is probably resulting from slightly larger uplift in the High Tatra and some faulting. Track length analyses suggest moderate exhumation rates (Fig. 2).

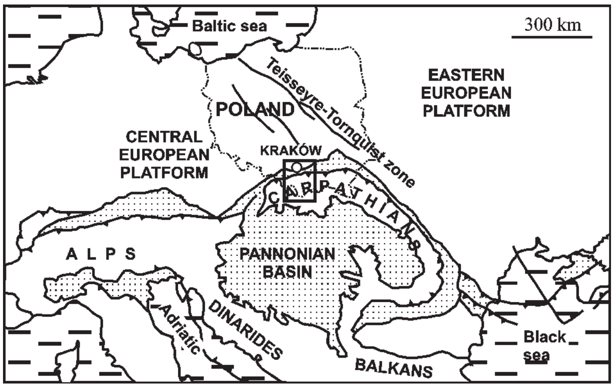

Fig. 1 Simplified geological map of the Alpine-Carpathian belt (based on Roca et al., 1995). Rectangular marks area shown in Fig. 2.

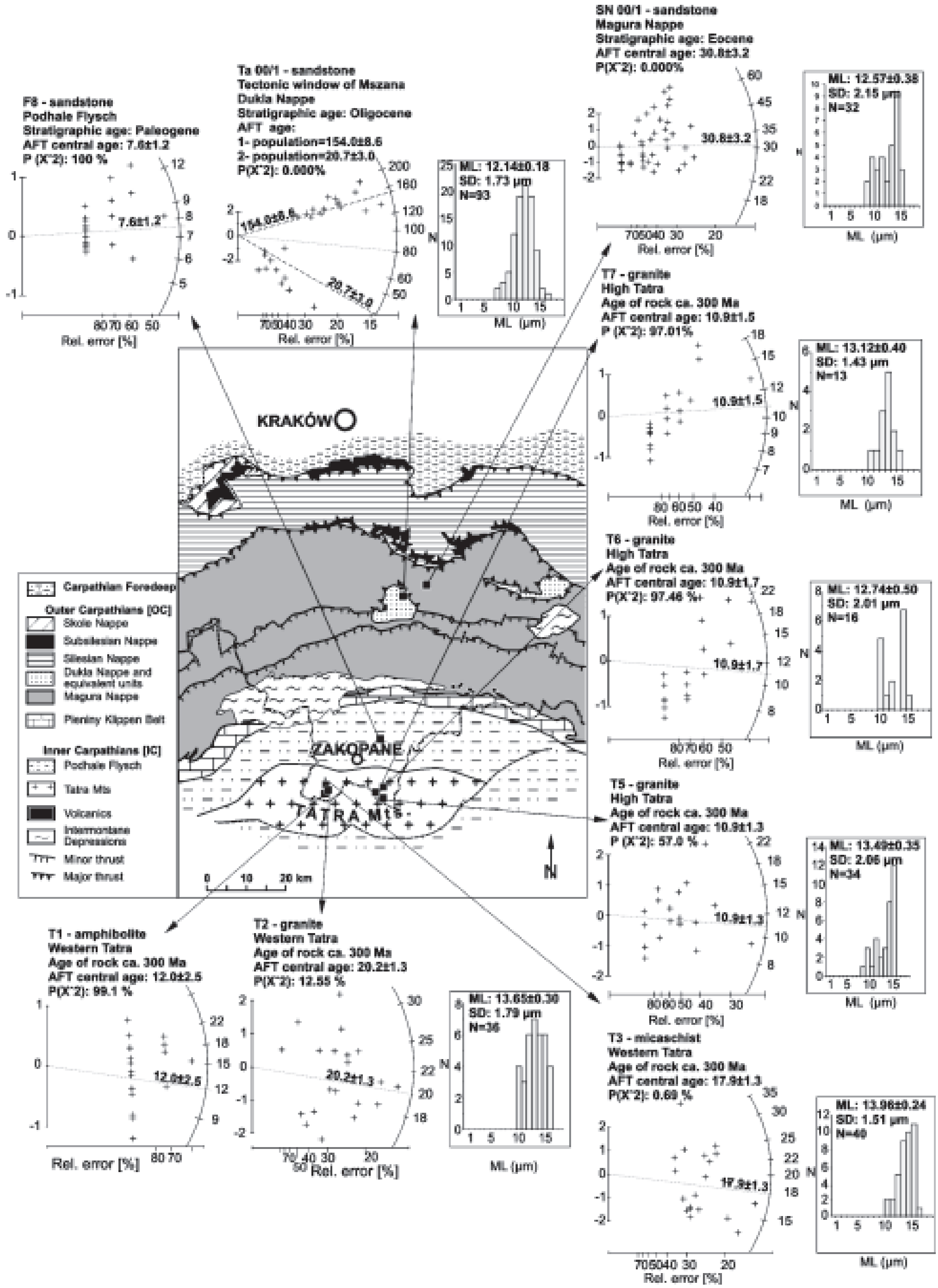

Fig. 2. Sample locations and analytical results (radial plots and confined track length histograms) for apatite fission track analyses. Simplified geological map of the Polish Western Carpathians based on Żytko et al., (1988).

Sample F8 from the Paleogene Podhale flysch yielded 7.6 ± 1.2 Ma age. Two million years difference between AFT ages for the High Tatra and for the Podhale basin is probably related to the difference in elevation (c. 1500 m) and/or due to possible difference in geothermal gradient between the two areas. Similarity of obtained ages suggests contemporaneous uplift and exhumation of the Podhale basin and the Tatra Mountains.

In the OC, sample Ta 00/1 represents the Oligocene sandstone of the Dukla nappe (exposed in the Mszana tectonic window, Fig. 2), which is the structurally deepest unit in the investigated region (Fig. 2). Apatite grain age distribution from this sample shows two distinct populations: 154.0 ± 8.6 and 20.7 ± 3.0 Ma (Fig. 2). Track length distribution determined for the older population (Fig. 2) indicates lack of significant annealing since c. 150 Ma. The age of the younger population overlaps with the stratigraphic age of the sequence within its analytical error. Thus, we interpret the obtained ages as reflecting the cooling history of the source area(s). The second analysed sandstone sample (Sn 00/1) comes from the flysch deposits of the Magura Nappe, whose stratigraphic age is determined as Eocene (Fig. 2). It shows a wide scatter of individual grain ages from c. 100.3 to 6.7 Ma, which, together with the bimodal track length distribution (Fig. 2), indicate the presence of different source rocks and a partial resetting after the deposition.

Conclusions

The Internal Carpathians together with the Podhale basin underwent Miocene uplift at moderate rates. However, the High Tatra seem to have undergone slightly larger amount of uplift relatively to the Western Tatra. Taking into consideration that biotite Ar-Ar ages from the same area gave Variscan ages (Janak, 1994), the maximum amount of Tertiary exhumation can be determined as c. 8–10 km.

The present erosional level in the OC has only reached the top of the AFT partial annealing zone, which points to less than c. 3–5 km of exhumation. The presence of partial fission track annealing in the structurally higher Magura Nappe and lack of significant annealing in structurally deeper unit of the Dukla Nappe indicates, that the most of partial AFT resetting in the Magura Nappe occurred in the Eocene sedimentary basin prior to Miocene nappe stacking.

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Preliminary Results of Detailed Seismological Monitoring in Hrubý Jeseník Mts.

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In the year 2001 a temporary local seismological network was put into operation in order to monitor natural and induced seismicity in the broad environment of the Dlouhé Stráně Pumped-Storage Power Plant (Hrubý Jeseník Mts.). The network consists of four stations (SVYC, ALFC, KAMC, ANAC), each instrumented by Guralp equipment including three-component seismometer 40T-1 with eigenfrequency of 1 Hz, DM24 digitizer, SAM acquisition unit and GPS receiver of time information. The stations work in continual mode with sampling frequency of 100 Hz. The geographic situation of the seismic stations is outlined in Fig. 1. Seismological data are recorded on removable SCSI discs with the storage capacity of 4.5 GB. Offline data processing is performed at the Institute of the Physics of the Earth, Brno. After data complementation with the records from permanent broad-band station MORC (the village of Červená by Libava) and short-period mobile station MUTC (the village of Mutkov) the phase identification and arrival time picking is performed. The hypocentres of tectonic events are computed using the HYPO3D programme and simple 3D velocity model.

During the period April-December 2001 a total number of 70 local tectonic events with local magnitudes up to 1.4 was registered and 36 of them were localized. It is clear from their spatial distribution that the events occur repeatedly in close positions forming the clusters of epicentres (Fig. 1). In the following paragraphs we discuss possible relations of these clusters to the tectonic structures of the Nízký and Hrubý Jeseník Mts.