YOUNG TECTONIC UPLIFT OF THE TATRA MTS
(FISSION TRACK DATA AND GEOMORPHOLOGICAL ARGUMENTS)

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Abstract: The new fission track datation was made. The samples from Tatra Mts, which according Burchart (1972) analysis were related with 10 – 26 Ma periods of uplift from the depth 5 km (100^0 C) are measured for obtain the age of uplift from 2 km depth (60^0 C). This uplift is very young 2-7 Ma. Geomorphological analysis of valleys dissection indicate assymetric features not only on the opposite slopes of Tatra massif but also in formation of Tatra foreland. North sloping Tatra Mts with Podhale flysch syncline are deeply dissected and even Quaternary incision is ca 100 m deep. The distinct morphological boundary between steep southern slope of Tatra Mts and gently sloping foreland with less dissected system of Quaternary fluvial/fluvioglacial fans is conditioned by active fault bordering Tatra massif from the south. For evaluation the rate of uplift close to this fault a new 4 samples were taken.

Key words: Tatra Mts, uplift history, fission track, valley incision, Quaternary

The Tatric pre-Alpine complexes have been no buried deeper than 12 km (ca 250^0 C) after the Permian (Kova◊ et all 1994). The uplift from 10-11km is documented by cirkon data (225^0 C) about 70-50 Ma. The uplift from 5 km (100◊C) was documented by apatite fission-track data (FT). For the Nizke Tatry it was ca. 53 Ma (summit area of Chopok) and 37 Ma (less uplifted zone Ru□omberok-Donovaly) according to Kral (Kova◊ et all. 1994). The Tatra Mts seem to be the younger uplifted core mountains in the Western Carpathians as was evidenced by Burchart (1972) and Kral (1977). The summit zone of the Tatra Mts both in the High and Western Tatras were uplifted form the depth of 5 km during 10-15 Ma.

This paper aims to demonstrate the youngest history of Tatra uplift from the depth of 2 km (60◊C). The samples which were measured by Burchart (1972) using fisson-track method (100◊C) now were analysed for evaluate period of uplift from 2 km. The samples resulting of 10-26 Ma (100◊C) indicate 2-7 Ma ages of uplift from the depth of 2 km. We must consider that 2 km depth means that the areas with present position ca. 2000 a.s.l. were 2 km deeper during the Pliocene. Thus, granitoid rocks close to Świnica-Kasprowy Wierch-Goryczkowe Czuby and Roha◊e were only 1 km deeper that present position of Zakopane located on the northern limit of the Tatras. The uplift rate can be calculated 0.3 – 1 mm/yr. The rate of Tatra uplift from the depth of 5 km can be evaluated 0.14 – 0.2 mm/yr. It means that Plio-Quaternary uplift rate is faster that the average uplift from Late Badenian/Serravalian period.

The geomorphological analysis, specially valley dissection (length and sloping of valleys) from N and S slopes of Tatra massif could be interpretated in term of differentiated evolution on both sides. On northeren sides the longer valley system (Biela Voda and Javorovy, Sucha Woda and Pańszczyca, Kościeliska and Chochołowska dissect deeply also Inner Podhale flysch foreland. The remnant of 4 planation surfaces (A-D) are dissected to 600 m a.s.l. Surface A is reconstructed at 1200-1150 m a.s.l., surface B (1000-900 m), surface C (850-7700m), and surface D (750-660m)(Baumgart-Kotarba 1984). It is interpreted as valley dissection of both uplifted areas of the Tatra and Podhale including Klippen Belt. The oldest Quaternary terrace is 100-70 m above valley bottom.

On the Slovak - southern side of the Tatra the more uplifted massif is morphologically very distinct above their foreland with system of fluvial/fluvioglacial fans (Lukni✶ 1968,1973). The dissection of apex zone of the fans is very small. Contrast of gentle sloping foreland with steep tectonic slopes dissected by narrow and unlevelled along the longitudinal profiles valleys confirms tectonic activity of southern fault. Geological and geophysical data document up to 400 m thick Quaternary deposits on less uplifted Tatra foreland (Halouzka ✂ Rączkowski 1993). Ticha and Koprova valleys are the only exception of mentioned regularity. Probably evolution of these valleys is related to tectonic intermediary zone between Western and High Tatra. For this section of main water divide is represented by crystalline Goryczkowa tectonic unit. Asymmetrical evolution of northern and southern slopes of the Tatra Mts, and their foreland is probably conditioned by higher rate of uplift on S fault bordering the Tatra Mts.

Another interesting problem is to document vertical rotation of the Tatra Mts during uplift. FT data collected on „Goryczkowa crystalline unit" and from core of Giewont fold (Burchart 1972) can be interpreted in term of vertical rotation considering the older FT (20-36 Ma) in the lower present morphological position from 1850 to 1320 m a.s.l., close to tourist chut at Kondratowa valley.

For elucidate of this problem four new samples were taken in the zone of south bordering fault of the Tatra massif (Fig. 1).

Probably for the model of Tatra massif uplift it must be taken into consideration both rotation horizontal and vertical one. Horizontal clockwise rotation of Tatra massif seems to be evidenced by paleomagnetic measurements carried out by Grabowski (2000). Close to the north-western corner of the Tatras (Bobrovec) paleomagnetic direction is Dc = 34⟐and Ic = 60⟐, and in the north-eastern corner (Havran) direction is Dc = 40⟐, Ic = 59⟐. It means that during uplift Tatra massif was more rotated in his eastern part (10⟐).

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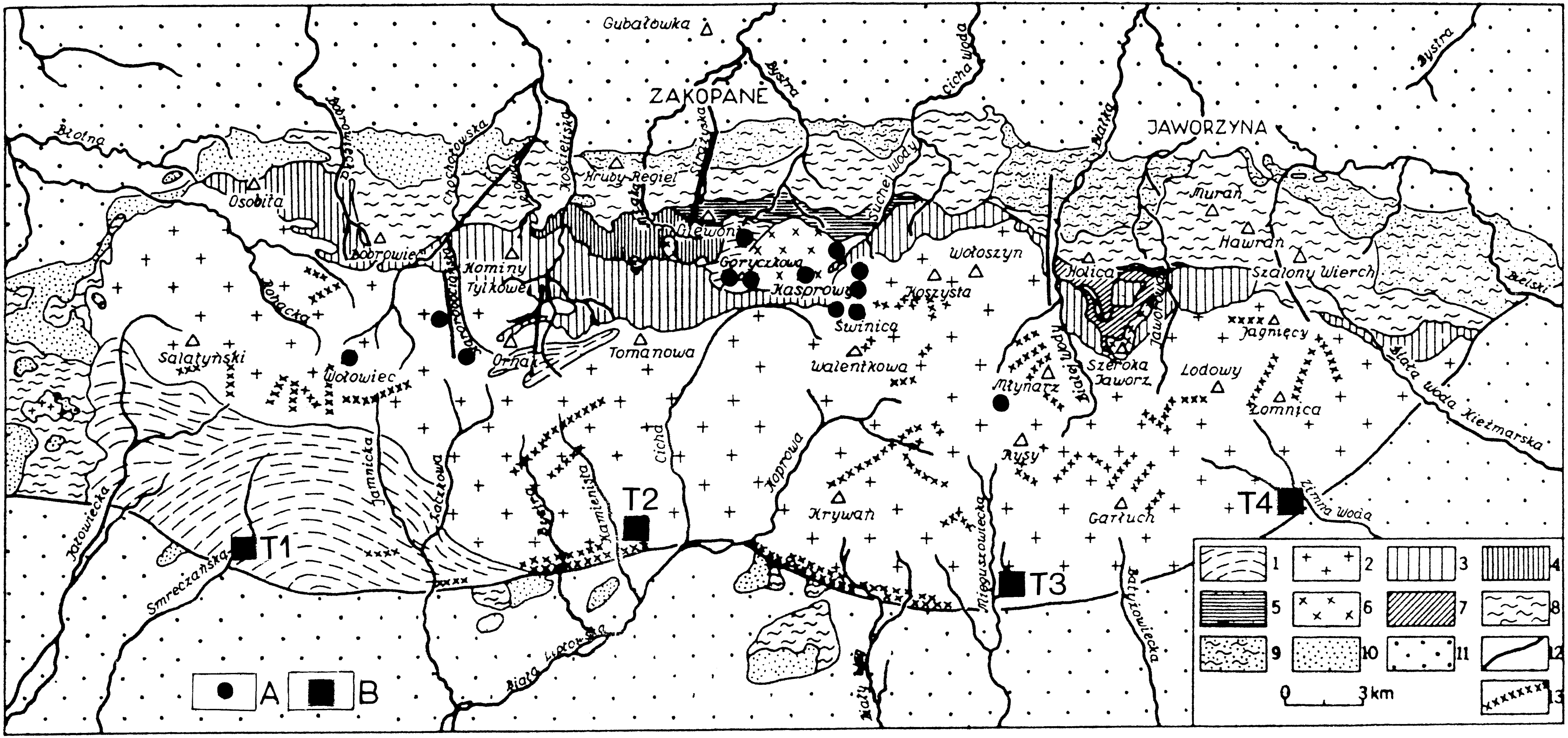
Fig. 1. Location of FT dated samples, A – sites of sampling by Burchart (1972), B – sites of sampling by the authors (in 2001) on the background of geological structure of the Tatra Mts according to Passendorfer (1974). 1 – metamorphic rocks, 2 – granite of crystalline core, 3 – paraautochtonous, 4 – Czerwone Wierchy fold, 5 – Giewont fold, 6 – crystalline core of Giewont unit, 7 – Szeroka Jaworzyńska unit, 8 – southern range of Sub-Tatric succession, 9 – northern range of Sub-Tatric succession, 10 - Cho◈ nappe, 11 – Paleogene, 12 – faults and flexures, 13 – mylonites.


Gubałówka
ZAKOPANE
JAWORZYNA
Bystra
Cicha Woda
Białka
Osobita
Bobrowiec
Chochołowska
Kościeliska
Hruby Regiel
Giewont
Goryczkowa
Kasprowy
Świnica
Koszysta
Wołoszyn
Suchej Wody
Holica
Murań
Hawrań
Szalony Wierch
Kominy Tyłkowe
Salatyński
Wołowiec
Ornak
Tomanowa
Walentkowa
Młynarz
Szeroka Jaworz.
Lodowy
Jagnięcy
Łomnica
Biała Woda Kieżmarska
Rysy
Garłuch
Krywań
Koprowa
Cicha
Kamienista
Jamnicka
Raczkowa
Jałowiecka
Smreczańska
Biała Liptowska
Mięguszowiecka
Batyżowiecka
Zimna Woda
T1
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T4
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B
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