REEVALUATION OF THE NEOGENE BRITTLE TECTONICS OF THE MECSEK–VILLÁNY AREA (SW HUNGARY)

by

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Abstract

Previous brittle tectonic measurements made in the Mecsek and Villány Mountains (SW Hungary) have enabled us to differentiate 5 paleo-stress-fields of Neogene and unknown ages. Further analyse of the data and of detailed maps have precised the proposed stroy of tectonic events in the Neogene.

These mapping, fracture and sedimentological data suggest that the most intense deformations occur in well known strips i. e. the Northern Thrust Zone, the Southern Mecsek Lineament, and the thrusts of the Villány Mountains. Basins between and around these zones are very probably related to the strike–slip tectonics and they witness the superposition of the different tectonic events.

We suppose a NW-SE directed compression in the Lower Miocene, creating right lateral wrench faults of E-W strike and NNW-SSE oriented left lateral ones in discrete zones (fig.3.). This stress would be followed by N-S compression in the Badenian and by NE-SW compression in the Lower Pannonian. The latter one has created NE-SW trending left lateral and N-S trending right lateral wrench faults and thrusts in the previously existing wrench zones. Because of intense folding of Pannonian sediments, the first mentioned stress-field, the NW-SE compression is very likely to be rejuvenated in the Upper Pannonian (Pontian).

Introduction

The present paper deals with the Mesozoic-Tertiary outcrops of the Mecsek and Villány Mountains, which are part of the South Pannonian (BALLA, 1984) or Tisia (KOVÁCS, 1982) microcontinent. We have studied the microtectonic features of these mountains by measuring the fault related features (like slickenslides, gauges, etc.) and have deduced 5 different stress-fields (BERGERAT and CSONTOS, 1989). Since this work was completed, we have carried on the study of Neogene brittle tectonics in the Pannonian basin, and we have analysed a detailed map of the Mecsek Mountains (HETÉNYI et al., 1982; CHIKÁN et al., 1984). These works enabled us to reevaluate the importance and timing of the main stress-fields affecting the Mecsek-Villány region in the Neogene and to give some ideas on the main deformation zones, limiting the Mesozoic outcrops.

The bigger deformation zones of SE Hungary

The maps of the Mecsek-Villány area *(fig. 1)* reveal three important E-W trending fault zones : the Northern Thrust Zone (WEIN, 1963), the Southern Thrust zone (the Mecsek lineament W from Pécs), and the thrusts of the Villány Mountains (LÓCZY, 1912). In all of these places, we have measured dextral and sinistral strike-slips and oblique thrusts *(figs. 2, 3)*.

Although the NNW-SEE and N-S trending strike-slips are widespread in the Mecsek Mountains, the main location of them seems to be a strike-slip zone between the E- and the W- Mecsek (NÉMEDI-VARGA, 1983), or elsewhere called the Villány-Szalatnak deep fracture zone (KASSAI, 1973). Both sinistral and dextral movements can be measured on these fault surfaces *(figs. 2, 3)*.

The map analyse shows that two major NE-SW trending deformation zones exist in the area : the S-Mecsek Lineament (NÉMEDI-VARGA, 1983), and the Kapos Lineament (NÉMEDI-VARGA, 1977) *(fig. 4)*. They are probably main strike-slip surfaces, functioning at various times, for example in the Pannonian and may be even in the Pleistocene (op. cit.). The microtectonic data *(fig. 2)* reveal intensive sinistral movements on similarly oriented surfaces.

All of the above zones are subject to polyphase deformation. Several generations of slicken-slides, often in opposed directions can be observed in these zones (BERGERAT and CSONTOS, 1989). Naturally, these observations point to longer strike-slip zones functioning at several episodes. The nature of the movement on these surfaces is often changing in time : we can frequently find or deduce dextral or sinistral wrenching followed by oblique reverse faults, resulting in the complexity of these zones.

In the following, we trz to give the main events generating, or rejuvenating the deformation yones, and we will not deal with allt he 5 episodes, differentiated

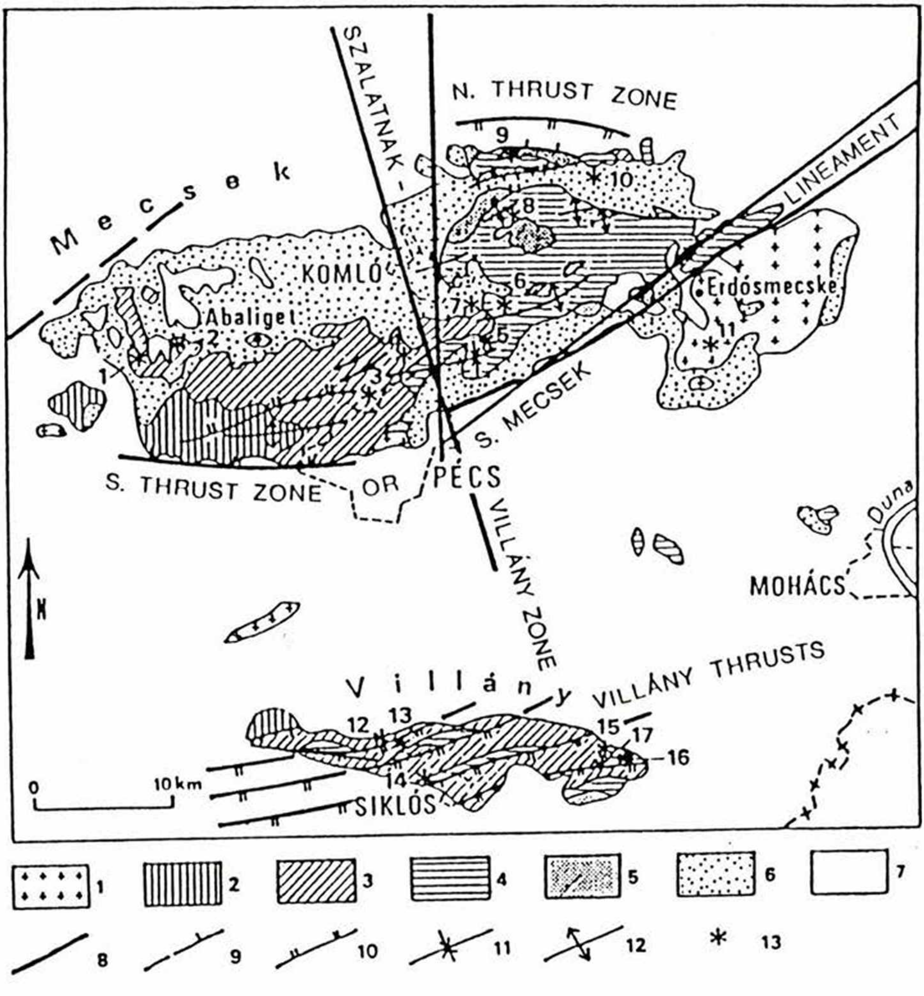

Fig. 1. The main deformation zones of the Mecsek-Villány area.
1. Hercynian granitoids; 2. Permian; 3. Triassic; 4. Jurassic; 5. Cretaceous; 6. Miocene without Lower Pannonian; 7. Lower Pannonian to Quaternary; 8. Main brittle tectonic surfaces and zones (mostly strike-slips); 9. Smaller faults; 10. Thrusts; 11. Sycnlines; 12. Anticlines; 13. Site of microtectonic investigations

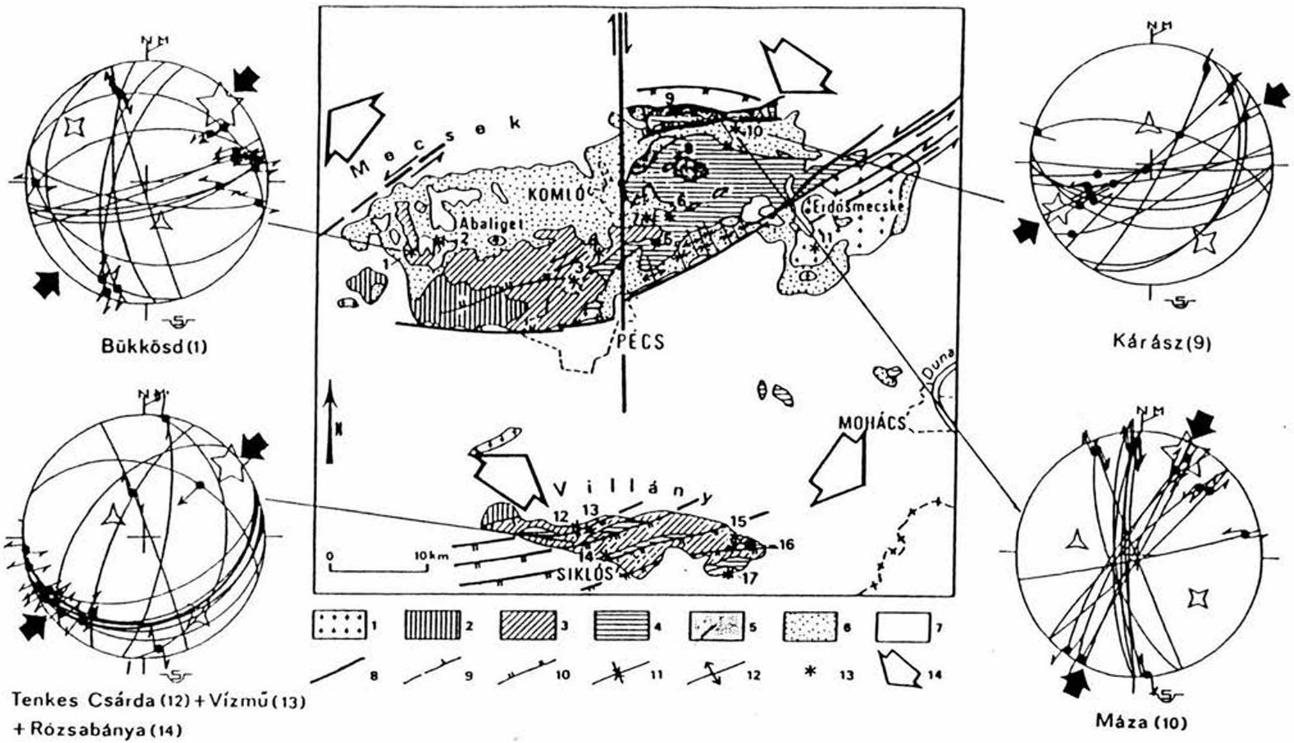

Fig. 2. Structures of the NE-SW compression. Same legend as for fig. 1. 14, Arrows show the direction of compression and that of extension for the whole area. The stereograms are made on a Schmidt net, lower hemisphere projection. The faults are represented by their trace. Movement on them is indicated by the small arrows. An arrow pointing towards the center of the projection indicates a reverse fault, that pointing in the opposite direction indicates a normal fault. Open diamond: O3 Open triangle: O2 Open star: O1

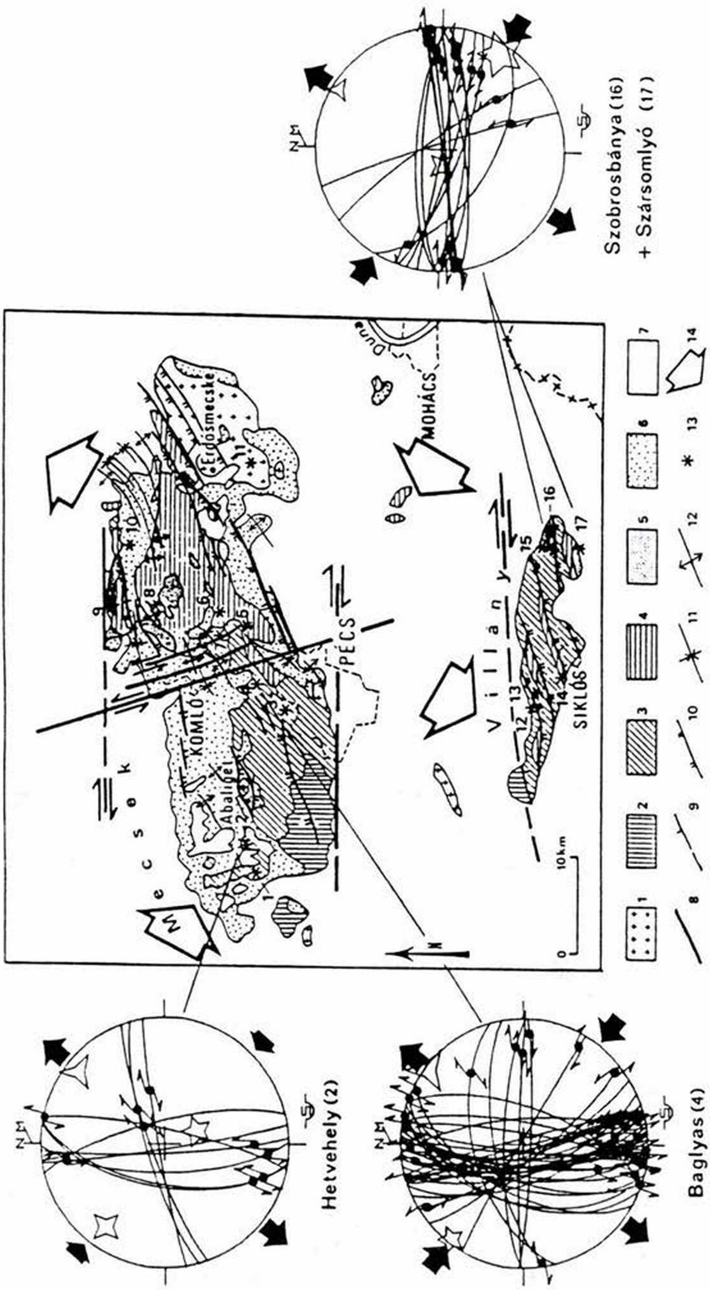

Fig. 3. Structures of the NW-SE compression. Same legend as for fig. 2.

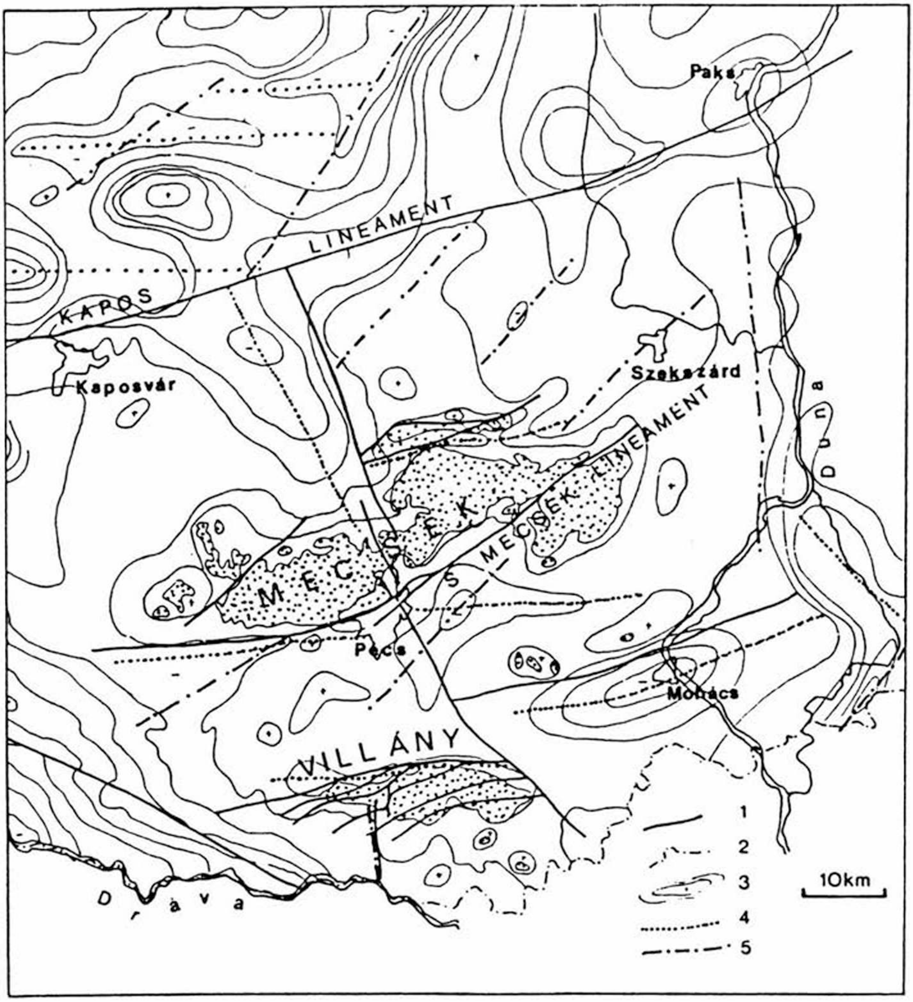

Fig. 4. Basin subsidence directions related to the deformation zones of SW Hungary. After FÜLÖP et al., 1987, modified.

1. Main deformation zones; 2. State boundary; 3. Depth of Neogene basins. isodepth lines are at 500 m intervals. + means relative rise, – means basin. 4. Axis of E-W directed, and of NNW-SSE directed subsidence. 5. Axis of NE-SW directed subsidence.

by earlier work (BERGERAT and CSONTOS, 1989), but we will select the 2 most important of them.

Chronological control

One of the main results of the compilation of data on Tertiary brittle tectonics (BERGERAT et al., 1989) was that we have found very similar tectonic events in the whole Pannonian basin. This, and a space problem in BALLA's model (1984) suggests that there is probably no major microcontinent rotation of the Tisia during Neogene. That doesn't exclude larger scale horizontal movement of microcontinents, but this conclusion enables us to use – with sufficient reserve – the chronological constraints of stress-fields gained elsewhere in the Pannonian basin.

The timing constraints of tectonic events in SW Hungary come from different sources. We have observed most of the brittle tectonic events in the Lower Miocene volcanites (BERGERAT and CSONTOS, 1989). Two important events have remained however undated : the NW-SE compression and the NE-SW compression.

Further analyse of our data has shown that the latter has affected the Lower Miocene strata, hence its age is younger. Geological evidence in the Mecsek (S. Mecsek Lineament and N. Thrust Zone) shows that an ENE-WSW directed large scale strike slip separates the mesozoic from the Pannonian sediments (WEIN, 1963; NÉMEDI-VARGA, 1989) *(fig. 2)*. In the above mentioned zones and in the Villány Mountains (NAGY and NAGY, 1976), even Pannonian sediments are implied in the polyphase thrusting on E-W directed, steeply dipping surfaces. Striae on these faults indicate an inverse oblique slip, pointing to a NE-SW compressional regime *(fig. 2)*. In the Mecsek, NW-SE directed folds affect even Sarmatian and Lower Pannonian sediments (HÁMOR, 1966) *(fig. 2)*. From widespread observation in the other parts of the Pannonian basin (e. g.: CSONTOS, 1988) this NE-SW compression has acted in the Upper Pannonian (Pontian).

All these features point to a young, at least Pannonian NE-SW compressional event which could have originated in the Upper Badenian (Middle Miocene).

The NW-SE compression hasn't been recorded by the Ottnangian rocks but this can be due to lack of observation.

The Miocene-Pliocene rocks record an extensive folding with generally NE-SW or locally E-W directed axis (HÁMOR, 1966, CHIKÁN et a., 1984, HETÉNYI et al., 1982, NÉMEDI-VARGA, 1983) *(fig. 3)*. In the vicinity of Komló the axis of some folds are even slightly distorted in a left lateral way, along a main NNW-SSE fracture zone. These folds are fitting perfectly in a

NW-SE compressional strike-slip type stress-field. That also means that this compression has to be young, i. e. younger than Upper Pannonian.

There is however a timing problem : the same event is calibrated as Karpatian (Lower Middle Miocene) in the Vienna basin (FODOR et al., 1989). The main surfaces of this event are E-W trending wrench faults, which create subsidence of basins of similar strike *(fig. 4)* in the nearby Zala basin at the same age (KŐRÖSSY, 1988).

An early creation of E-W strike dextral faults and NNW-SSE strike sinistral faults in supported by the fact that all the "thrust sheets" in the Mecsek-Villány area are acting as paleogeographic boundaries in the early Neogene. Moreover, they bear oblique sinistral striae on their steeply dipping surfaces *(fig. 2)*. In a NE-SW compression (former paragraph) the E-W directed surfaces are not ideally oriented, they are certainly not created but only rejuvenated as oblique left lateral faults. That is why these zones or at least their root zones must have been created by a former stress-field, not by the NE-SW compression.

Although it is difficult to prove, we suppose, on the base of analogies, that a NW-SE compression has acted first in the Karpatian then in the Upper Pannonian.

There is a further, seemingly much less important strike-slip type stress-field with N-S compression directions. This N-S compression affects the Lower Miocene volcanites, thus its age is younger. We have encountered this type of compression in the Lowermost Miocene and in the Badenian (Middle Miocene) in the Pannonian basin. The one found in the Mecsek is evidently the younger than the Badenian one.

Proposed history of Miocene brittle tectonic events in SW Hungary

Assessing the given data we have compressional stress-regimes of strike-slip type in the Mecsek-Villány area during Miocene-Pliocene with main directions σ_1 and σ_2 changing in time. The σ_1 direction (maximal compression) is seemingly pointing towards the NW-SE in the Lower Miocene. It changes to N-S in the Middle Miocene and to NE-SW in the Upper Miocene. Most probably the NW-SE compression appears once more after the Upper Pannonian (Pontian). We understand quite poorly the reappearence of this latter stress-field. For a detailed analyse we should know the present day stress-field, the basic data of which are being collected by others.

We haven't deal with the various extensions measured in SW Hungary (BERGERAT and CSONTOS, 1989) but we are persuaded that these phenomena, although very important, are only accompanying the basic strike-slip tectonics. Multitude of seismic data (e. g. RUMPLER and HORVÁTH, 1988) acquired in Hungary shows, that the Neogene tectonics are controlled by large wrench faults.

The present day configuration of the major fracture zones and the basins of SW Hungary is in our opinion due to several tectonic events and processes *(fig. 4)*. The early fault zones and basins have been probably formed during the Lower Miocene. These structures generally have an E-W strike. New basin directions of NE-SW direction are overprinted on the older ones probably in the Middle Miocene. The subsidence in these basins is continuing during the Pannonian, when the older structures are rejuvenated. At the end of the Pannonian (Pontian) we experience a drastic change in the compression directions, creating folds even in Lower Pannonian strata, and once more rejuvenating the old E-W directed deformation zones. This polyphase evolution is the probable reason of the curious crescent shape basins and rises and of the complex "thrust zones" of SE Hungary *(fig. 4)*.

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