

# THE UJGOROD TECTONIC WINDOW – A HISTORICAL COMMENT

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**Abstract.** The Ujgorod Tectonic Window is a tectonic structure belonging to the high Alpine deformed basement of the north-eastern domain of the Neogen Pannonian Depression. It was firstly cartographically represented and published in 1980 (Săndulescu, 1980a). It was frequently mentioned in several regional geotectonic syntheses concerning the Carpatho-Alpine area (Săndulescu, 1980b, 1984, 1989, 2009; Debelmas *et al.*, 1980; Debelmas, Săndulescu 1987 etc.). The Ujgorod Tectonic Window represents the easternmost equivalent of the Engadine, Hoche Tauern and Rechnitz windows of the Central and Eastern Alps. This fact supports the strict correlation of the Austroalpine nappes of the Eastern Alps and the Tatric-Subatric nappes of the Central West Carpathians. Consequently, it should be accepted a large allochthony of the Tatric units – corresponding with the Lower Austroalpine nappes – above the Main Tethyan Suture units. The Ujgorod Unit which “crops out” within the Ujgorod Window is built up of an ophiolitic and sedimentary ankimorphosed formations of Jurassic age. A temporal analysis concerning the Cretaceous-Paleogene tectogenetic developments of the Austroalpine-Central West Carpathians is also discussed.

*Key words:* Pannonian Depression, Alpine basement, Tatric-Subatric nappes, Main Tethyan Suture Zone.

**Résumé.** La Fenêtre Tectonique de Ujgorod est une structure tectonique appartenant au soubassement Alpin fortement déformé du secteur nord-oriental de la Dépression Néogène Pannonienne. Elle a été pour la première fois cartographiée et publiée en 1980 (Săndulescu, 1980a). Ensuite elle a été souvent mentionnée dans plusieurs synthèses régionales concernant l’aréal Carpatho-Alpin (Săndulescu, 1980b, 1984, 1989, 2009; Debelmas *et al.*, 1980; Debelmas, Săndulescu, 1987 etc.). La Fenêtre Tectonique de Ujgorod représente le correspondant le plus oriental des fenêtres tectoniques d’Engadine, Hoche Tauern et Rechnitz des Alpes centrales et orientales. Ce fait est un argument essentiel pour la stricte corrélation des nappes Austroalpines des Alpes Orientales avec les nappes Tatric-Subatriques des Carpathes Occidentales Centrales. Par conséquence, il faut accepter une large allochtonie des unités Tatriques – qui correspondent aux nappes Austroalpines inférieures – par dessus les unités de la Suture Majeure Tethyssienne. L’Unité d’Ujgorod qui « affleure » dans les limites de la Fenêtre de Ujgorod est constituée principalement par des formations ankimétamorphiques, ophiolitiques et sédimentogènes, d’âge Jurassique. Une analyse temporelle concernant les développements tectogénétiques Crétacé-Paléogènes de l’ensemble Austroalpin-Central Ouest Carpathique est également discutée.

*Mots clés:* Dépression Pannonienne, socle Alpin, nappes Tatriques–Subatriques, Suture Majeure Tethyssienne.

## INTRODUCTION

The Ujgorod Tectonic Window was firstly sketched and described in a Romanian geological journal (Săndulescu, 1980a). In this publication were interpreted, in a new geotectonic framework, the drilling data of the Eastern Slovakia and the Western Transcarpathian Ukraina (Vialov *et al.*, 1963, Fusan *et al.*, 1972 fide Săndulescu 1980a) concerning the geological formations which built up the folded basement of the north-eastern sector of the Pannonian Depression. The reason of this interpretation was the existence of ankimetamorphic formations, considered at that time, of Paleozoic and/or Mesozoic ages, surrounded by Precambrian and Paleozoic metamorphic formations, the latest, belonging to the Tatric and “Subatric” units. Consequently, it was logical to suppose the existence of a tectonic window within the folded basement of the north-eastern Pannonian Depression within which “outcrops” the ankimetamorphic formations mentioned above (Fig. 1).

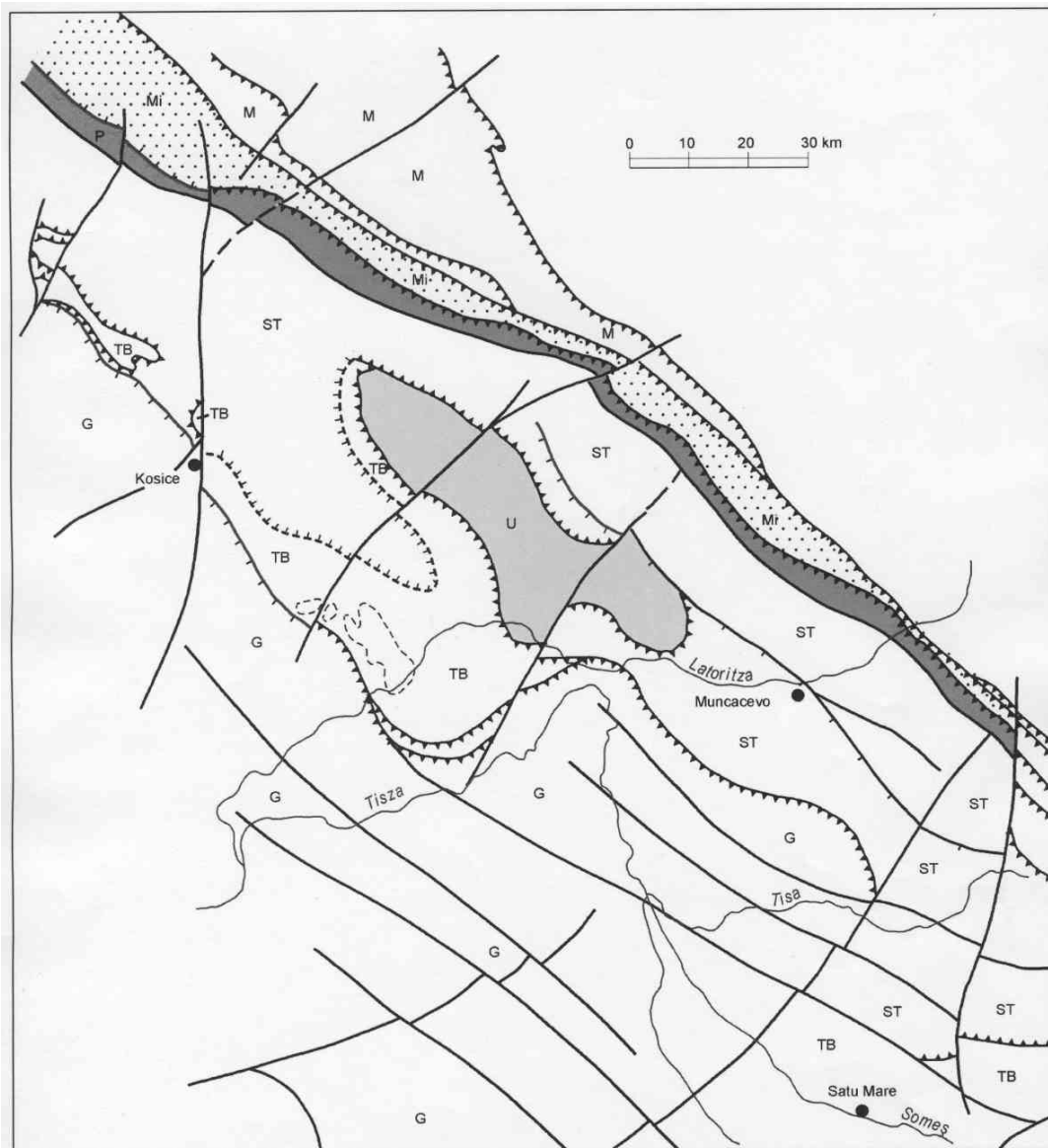


Fig. 1 – The first cartography image of the Ujgorod tectonic window (acc. to Săndulescu, 1980a)  
 M – Median and outer Magura Nappe; Mi – Inner Magura Nappe; P – Pieniny Klippen Belt; U – Ujgorod Unit;  
 TB – Tatro-Biharides; ST – Subatric nappes; G – Gemerides.

The Ujgorod Tectonic Window was integrated later (Săndulescu 1984) in a general tectonic sketch (Fig. 2) which expressed the correlations between the Central West Carpathians, the Apuseni Mts., and the north-eastern folded basement of the Pannonian Depression between Slovakia and Transylvania. In this sketch the ankimetamorphic formations “outcropping” within the Ujgorod Tectonic Window was integrated, together with the Pienides (Pieniny Klippen Belt and Magura Group) to the Main Tethyan Suture Zone.

Later (Debelmas, Săndulescu, 1987; Săndulescu, 1989) the Ujgorod Tectonic Window was integrated in the general tectonic sketches of the Inner Zones of the Carpathians and the Alps (Fig. 3). The Ujgorod Tectonic Window was correlated, in all this general synthesis, with the Rechnitz and the Hohe Tauern tectonic windows of the Eastern Alps.

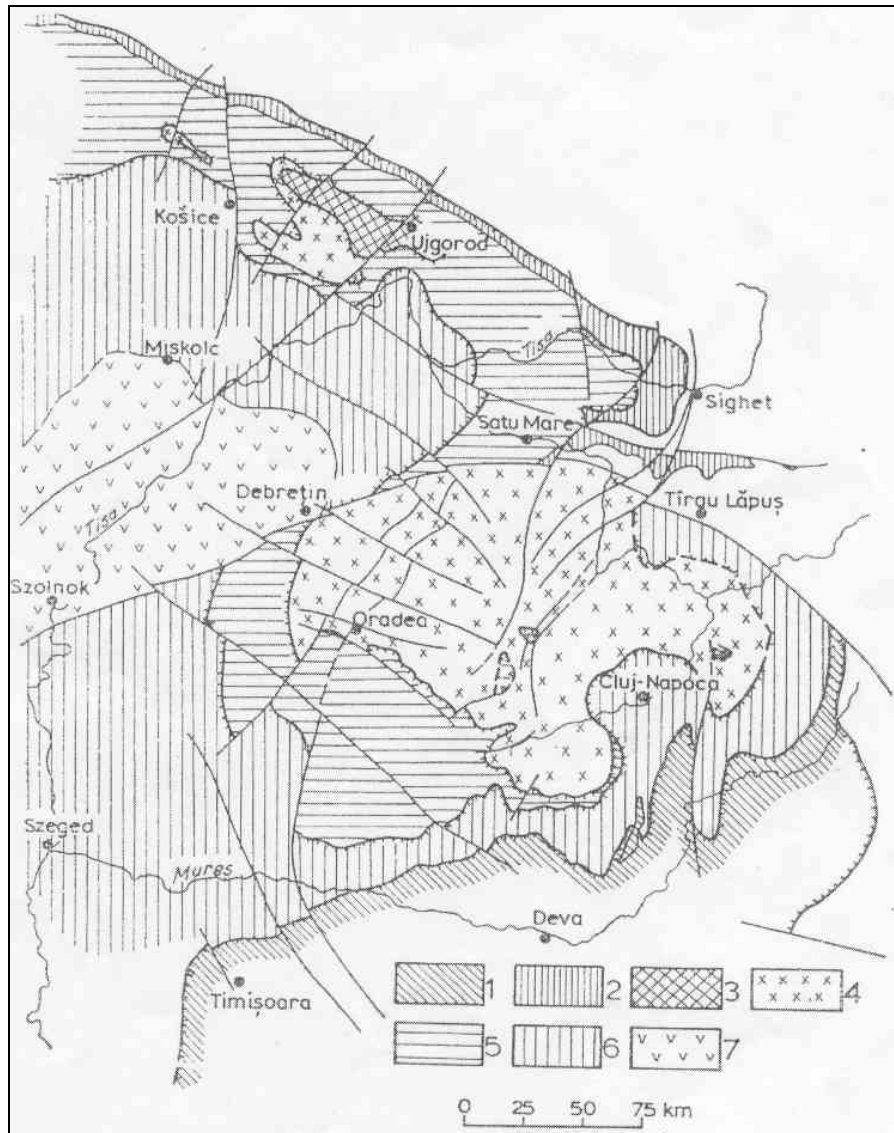


Fig. 2 – Tectonic sketch of the Inner Carpathians between Slovakia and Transylvania (acc. to Săndulescu, 1984). 1 – Transylvanides; 2 – Pienides; 3 – Ujgorod Window (1–3: units of the Major Tethyan Suture); 4 – Bihor Unit; 5 – Subatric Nappes = Codru Nappes; 6 – Biharia Nappes = Gemerides; 7– Bukk Unit and equivalents.

In all this geotectonic models it is clearly demonstrated the allochthony of the Central West Carpathians in respect with the Main Tethyan Suture Zone. This is a fundamental argument of the correlation of the Central West Carpathians and, subsequently, the Northern Apusenides, with the Austroalpine nappes of the Eastern Alps (Debelmas *et al.*, 1980; Sandulescu, 1980b, 1984; Debelmas, Sandulescu, 1987; Sandulescu, 1989).

The supposed Mesozoic age of the ankimetamorphic volcano-sedimentary formations which “crops-out” within the Ujgorod Window was confirmed at the Carpatho-Balkan Congress in Wien (1996) where a public contribution of the Slovak geologists sustained the Mesozoic, mostly Jurassic, age of the Ujgorod ankimetamorphic formations. This contribution was an other important argument to confirm the correlation of the Ujgorod Tectonic Window with the Rechnitz and the Hoche Tauern windows.

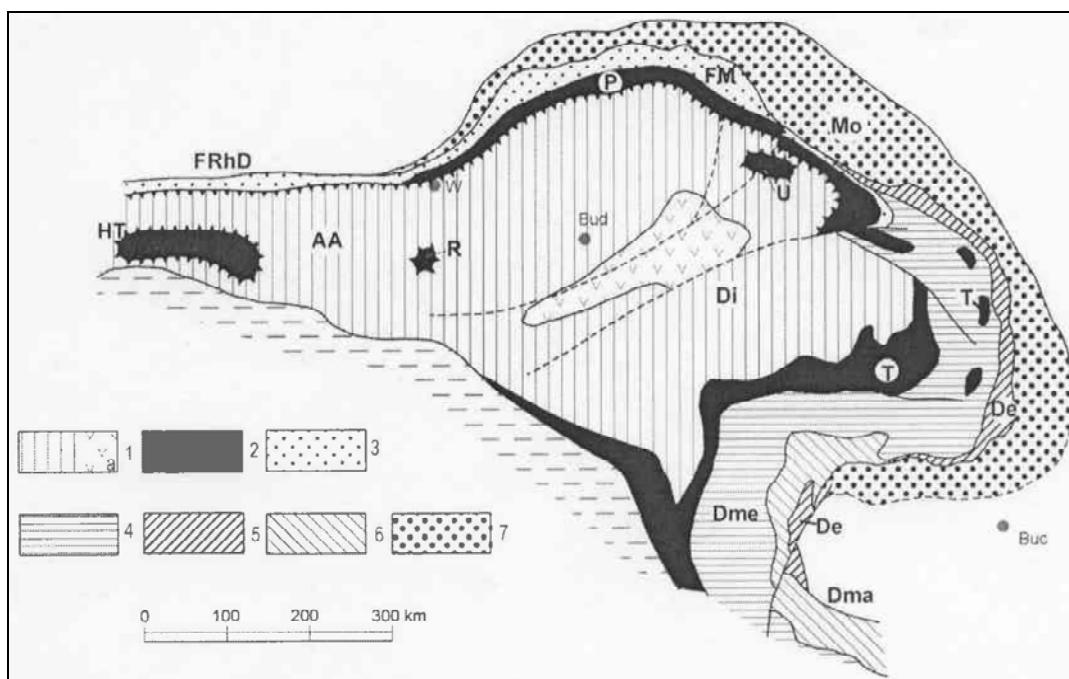


Fig. 3 – The main Tethyan sutures within the Eastern Alps and the Carpathians (acc. to Săndulescu, 1989).  
 1. Inner Dacides-Austroalpine (Di-AA), 1a. Bukk; 2. Main Tethyan suture (T – Transylvanides, P – Pieniny Klippen Belt + Hohe Tauern-HT, Rechnitz – R and Ujgorod – U windows); 3. Magura (FM) and Rhenodanubian Flyches (FRhD); 4. Median Dacides (Dme); 5. Outer Dacides (De); 6. Marginal Dacides (Dma); 7. Moldavides (Mo).

#### THE GEOTECTONIC SIGNIFICANCE OF THE UJGOROD TECTONIC WINDOW

The existence of a tectonic window “outcropping” within the Tatric and Subatric units, situated within the folded basement of the north-east area of the Pannonian Neogene Basin is of first geotectonic importance concerning the understanding of the Central West Carpathians tectonic structure and their correlation with the Austroalpine nappes system of the Eastern Alps. In the same time the existence of the Ujgorod Tectonic Window supports important paleotectonic reconstructions which documented the fact that, both in tectonic and palinspastic models, the Tatric Domain and the Pienides (Pieniny Klippen Belt and Magura Group) are, tectonically and paleogeographically, separated by Alpine units, belonging to the Main Tethyan Suture Zone, namely the ankimetamorphic Jurassic-Cretaceous formations known within the Ujgorod, Rechnitz and Hoche Tauern windows which may be considered the eastward prolongation of the Liguro-Piemontais Zone of the Central an Western Alps.

First of all, the existence of the Ujgorod Tectonic Window is a fundamental argument that the Tatric Unit is not an “autochthonous” unit. It is clearly a basement shearing nappe similar with the Unterostalpine nappes. This conclusion is supported, also, by the lithostratigraphic sequence of the Permian-Mesozoic formations of the Unterostalpine and Tatric units, but mostly by the structural position of this units: they are, both, the lowermost continental unit overthrust above the oceanic crust bearing Main Tethyan Suture Zone.

Another important conclusion correlated with the existence of the Ujgorod Window concerns the fact that between the Pieniny Klippen Belt and the Tatric Unit there are, from a structural point of view, other units belonging to the Main Tethyan Suture Zone (cf. above). The Ujgorod Mesozoic ankimetamorphic formations are an argument in this way. It is important to stress out that similar

arguments are known also in the north-western Roumanian East Carpathians and within the north-eastern basement of the Pannonian Depression in south-easternmost Ukrain and north-westernmost Romania. It was stressed out several times (Săndulescu, 1984, 1989; Săndulescu *et al.*, 1993; Săndulescu, 2009) that, in this areas, inward in respect with the Pieniny Klippen Belt there are different units (Botiza, Kritchevo, Băbești-Tijacevo) which are built up of Mesozoic and Paleogene sedimentary formations. From the tectonical and paleogeographycal points of view these units are situated between the Pieniny Klippen Belt and the Central West Carpathian units. The Mesozoic formations shows, within these units, different lithofacial developments in respect with the Pieniny Klippen Belt even if in some cases (Kritchevo) similarities may be accepted – as, for example, the Senonian Red Marls lithofacies. All these units, situated between the Pieniny Klippen Belt and the Tatric Unit, may be integrated within the Main Tethyan Suture Zone. Within the Băbești Unit there are known remnants of oceanic crust represented by mafic and ultramafic Mid-Triassic magmatic rocks (Băbești borehole). The Tijacevo Formation of Jurassic age, drilled, bellow the Neogene formations of the north-eastern area of the Pannonian Basin, in the Ukrainian Subcarpathians, is lithologically similar with the Ujgorod Formation which is known within the Ujgorod Window. Both may be correlated with the Jurassic magmato-sedimentary formations of the Liguro-Piemontais Zone of the Alps.

The allochtony of the Tatric Unit, stressed out by the existence of the Ujgorod Window, may be accepted without problems north and north-west in respect with the North Transylvanian Fault. The correspondent unit of the Tatrides within the Northern Apusenides, south of the North Transylvanian Fault, is the Bihor Unit (Debelmas *et al.*, 1980; Săndulescu, 1984; 1989; Debelmas, Săndulescu, 1987; Săndulescu, 2009). Nevertheless, it is aleatory to conclude if the Bihor Unit is also large allochtonous above the Main Tethyan Suture Zone. In this way it is to stress out that:

- North of the North Transylvanian Fault (NTF) within the Main Tethyan Suture Zone, Late Paleogene and Early Lower Miocene overthrustings was generated (Magura Nappe, Pieniny Klippen Belt, Botiza and Kritchevo units etc.);
- South of the NTF, overthrustings of this age are not recorded within the Main Tethyan Suture Zone.

The most important overthrustings within the Northern Apusenides are of Pre-Gosau age (Bleahu *et al.*, 1981; Săndulescu, 1984). They are documented mainly for the Codru-Arieșeni Nappe System which are tectonically overlapping the Bihor Unit.

Following these remarks it seems that:

- the Bihor Unit, situated south of the NTF was, perhaps, overthrust together with the whole North Apusenides Block above the Main Tethyan Suture Zone by a left-lateral movment of the NTF, only during the Pre-Gosau and/or End Cretaceous compressions;
- the amplitude of this overthrusting might be of less importance, and
- anyone or less important Paleogene or Lower Miocene overthrustings of the Bihor Unit above the Main Tethyan Suture Zone may be supposed.

Following this data and taking into account also the geotectonic evolution of the Eastern Alps it is possible to discuss the age of the overthrusting of the Central West Carpathians nappes system, including the Tatric Unit, above the Mesozoic ankimetamorphic formations of the Ujgorod Window. This overthrusting must be certainly later as the Pre-Gosau tectogenetic deformations of the Austroalpine and Central West Carpathians nappes system. It is evidently, following the tectonic relationships between the different units of the Central West Carpathians along the “erosional” contour of the Ujgorod Window, that the Pre-Gosau structured nappes was overthrust “en bloc” above the Main Tethyan Suture Zone. This is evident for the Ujgorod Window, but also the Rechnitz, the Hoche Tauern and the Engadine windows, of the Eastern Alps. In the easternmost part of the Central West Carpathians they are overthrust, “en bloc” above Paleogene Formations belonging to the Kritchevo, Botiza and, also, the Pieniny Klippen Belt. In the western part of the Austroalpine nappes they are also tectonically overthrust above Paleogene formations (Pratigau, Engadine, frontal part of the Eastern

Alps, etc.). Consequently it seems logic to conclude that the youngest overthrusting, “en bloc”, of the Austroalpine and the Central West Carpathians, above the Main Tethyan Suture Zone is of a Tertiary age. Most probably the Latest Paleogene. It was followed later by the more external overthrusting of the Magura Nappe, belonging to an external part of the Main Tethyan Suture Zone. The age of this external overthrusting seems to be Intra-Burdigalian.

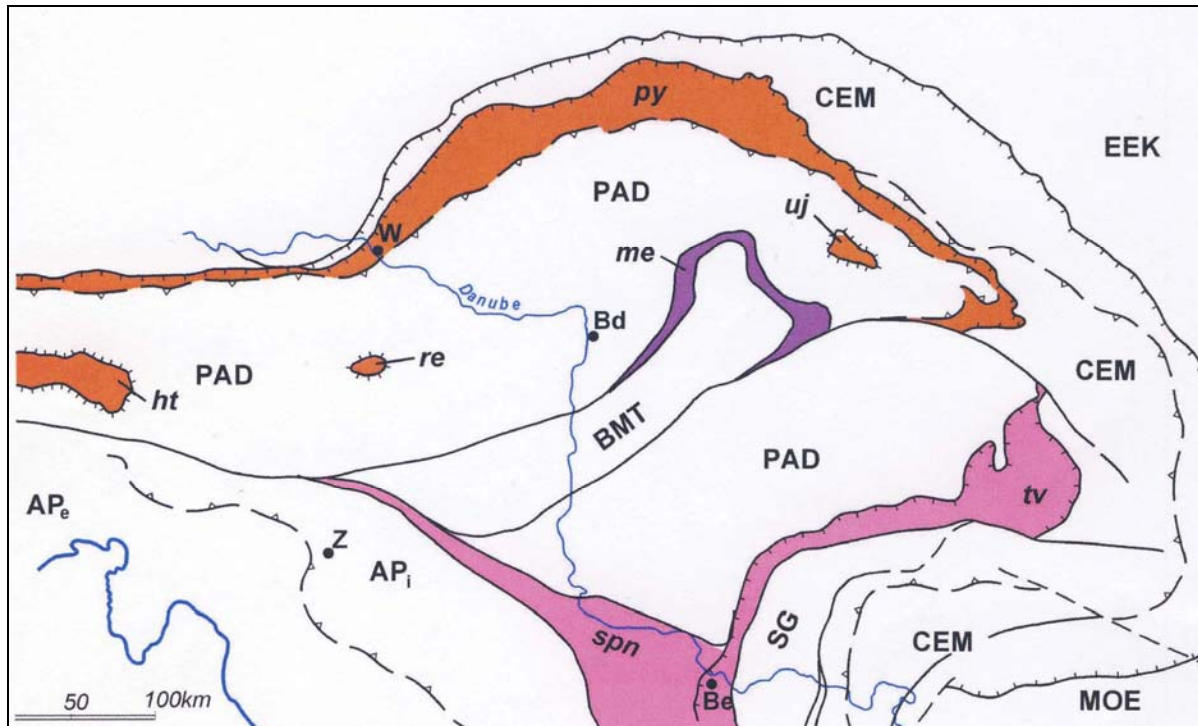


Fig. 4 – General tectonic sketch showing the position of the Main Tethyan Sutures within the Alpino-Carpathian Orogenic Area: py-Pienidian Suture and Hohe Tauern (ht), Rechnitz (re), Ujgorod (uj) windows; tv – Transylvanidian Suture; spn – South Pannonian Suture; me – Peri-Meczek-Bukk Suture; AP – Apulian Domain (i – inner, e – outer); PAD – Preapulia Domain; MBT – Meczek-Bukk Terraine; CEM – Deformed European Continental Margin (SG-Supragetic units); MOE – Moesian Platform; EEK – East European Kraton.

It is very important to stress out that the above expressed conclusions (cf. *supra*) concern the Central West Carpathians units and the Main Tethyan Suture Zone situated north of the North Transylvanian Fault (NTF). Tertiary compressive deformations within the Transylvanides developed south of the NTF was not, yet, recorded or they are of minor importance.

## CONCLUSIONS

The importance and the geological framework of the Ujgorod Tectonic Window was frequently sustained since 1980 by different international publications. The consequently geotectonic interpretations were several times stressed out in publications of large international development. Unfortunately, the conclusions of the existence of the Ujgorod Tectonic Window were never consequently used and objectively sustained by a lot of, misinformed ?!, Carpathian geologists.

The existence of the Engadine, Hoche Tauern, Rechnitz and Ujgorod tectonic windows confirms the large allochthony of the Austroalpine-Central West Carpathians group of nappes which was defined as a Pre-Apulian Domain. In the same time the reality of these windows supports the large development of the Main Tethyan Oceanic Suture, much larger than outcropping areas of the belonging tectonic units.

The above cited conclusions are positive concerning the geotectonic importance of the North Transylvanian Fault during the Late Cretaceous and also during the Late Paleogene tectonic events. This is an important argument concerning the large allochthony of the Pre-Apulian Domain and the eastward thrusting of the Bihor Unit.

The ignorance of the existence of the Ujgorod Tectonic Window diminishes the general and regional understanding of the tectonic structure and evolution of the Eastern Alps, the Western Carpathians and a large part of the folded basement of the north-eastern part of the Pannonian Neogene Depression.

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