TECTONOSTRATIGRAPHIC TERRANES AND ZONES JUXTAPOSED ALONG THE MID–HUNGARIAN LINE: THEIR CONTRASTING EVOLUTION AND RELATIONSHIPS

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Abstract: The Mid-Hungarian (or Zagreb–Zemplin) Lineament of WSW–ENE strike divides the Pannonian basement into two megaunits, the Tisia Terrane on the SE and ALCAPA Composite Terrane on the NW. They become juxtaposed not earlier than the Middle Miocene (Karpathian). The presently adjacent zones of these terranes show very different Variscan and Alpine evolution and relationships, which are briefly reviewed here.

The Mid-Hungarian Lineament

The Mid-Hungarian (or Zagreb–Zemplin) Lineament is defined as the NW border of the Tisia Terrane (Fülöp et al., 1987). It is drawn on maps based on borehole data, although on deep seismic sections it does not appear unambigously (Csontos and Nagymarosy, 1998).

Northern zones of the Tisia Terrane

are proven by associated radiolarian cherts. Upper The Variscan basement of the SW part of the Alpine Tisia Terane is made up by the (Slavonia–)Dravia Unit (Variscan Terrane), extending from Croatia (Papuk and Psunj Complexes) to the N of the Drava River. Beginning from the area of the Mecsek and Villány Mts. towards the ENE, the Kunság Unit (Variscan Terrane) forms the basement of the Alpine Mecsek and Villány(–Bihor) zones in the basement of the Great Plain. The Mórágy Complex (basement of the Mecsek Zone) is characterized by a Variscan syncollisional granite range (age: 350-340 Ma according to the most recent U-Pb dating; Klötzli et al., in press), accompanied by migmatites--gneisses and micaschists on its both flanks. In the Körös Complex (basement of the Villány Zone) the medium-grade metamorphic rocks predominate, granitoids are less common. Both in the (Slavonia–)Dravia and Kunság Units two characteristic metamorphic events can be recognized: an earlier, medium-pressure, Barrow-type with the index mineral kyanite (average age: 350-330 Ma) and a later, low pressure – high temperature one with the index mineral andalusite (age: 330-320 Ma) (Szederkényi, 1996: Lelkes-Felvári et al., 1996). The former was accompanied by the anatectic granitization. Relics of low to very low grade metamorphosed units (as Variscan nappe outliers or in wrench-zones) and high-pressure metamorphics (of ?early Variscan age) are also known.

In the junction area of the (Slavonia–)Dravia and Kunság Units (region of Mecsek and Villány Mts.) a fault-controlled basin was formed after the Variscan orogeny, in which up to 3500m thick Upper Carboniferous to Upper Permian molasse sediments accumulated, with a significant rhyolitic volcanism in the Early Permian.

Other parts of the Hungarian part of the Tisia Terrane were denudational areas during the Late Variscan times.

The Alpine overstep sequence in the northern zones of the Tisia Terrane began with Lower Triassic Buntsandstein-type redbeds (however, shallow marine sedimentation in the southern zones began already at this time; Bleahu et al., 1994). Evaporite-bearing sediments indicate the beginning of marine transgression in the Early Anisian (corresponding to the German "Röt"), followed by a typical "Wellenkalk" succession (Török, 2000) and Ladinian dolomites. The Mecsek and Villány Zones began to differentiate in the Late Triassic: the former become a rapidly sinking, in part half-graben zone, whereas the latter remained in elevated ridge position. In the Mecsek Zone up to 4500m thick thick succession accumulated till the early Middle Jurassic (up to the Bajocian): Upper Triassic continental siliciclastics, lowermost Jurassic paralic coal-bearing "Gresten facies", followed by thick "Fleckenmergel" succession. At the same time, on the Villány Ridge only 0-30m thick lacunose succession (with Carpathian Keuper-type siliciclastics in the Upper Triassic) was accumulated. The siliciclastics of the Mecsek Zone derived from a northerly lying granitoid–metamorphic provenance. Cessation of siliciclastic input and appearence of "ammonitico rosso" facies, as well as change of the fauna from boreal to Mediterranean type (Vörös, 1993) indicate the separation of the future Tisia Terrane from its continental hinterland. Deep-water, pelagic carbonate sedimentation continued till the end of the Jurassic, followed by alkaline rift-type basalt volcanism in the earliest Cretaceous. In the Villány Zone prograding shallow marine Late Jurassic and Urgon-type Early Cretaceous carbonate sedimentation was followed by flysch-type siliciclasctic sedimentation in the Albian to Cenomanian. The first stage of north-vergent thrustings was lokely coeval with the latter. In the Senonian flysch complexes were deposited in the eastern part of both the Mecsek and Villány Zones, in flexural basins formed in front of the advancing nappe piles. In the former zone flysch sedimentation continued in the Paleogene (named Szolnok flysch zone, continuation of the Inner Carpathian Maramures flysch), on the northern continental slope of the Tisia Terrane, very probably in "foreland basin" setting.

Southern zones of the ALCAPA Composite Terrane

In the higly sheared (Zagorje–)Mid-Hungarian–Bükk Zone (in its SW part enclosed between the Mid-Hungarian and Periadriatic–Balaton Lineaments) elements of the eastern Southern Alps and of the Inner Dinarides occur (Haas et al., 2000; Haas and Kovács, 2001). In these units no Variscan metamorphism can be proven, and there was a marine sedimentation almost throughout the Late Paleozoic, continuing into the Triassic. In the Bükk Parautochthon a hiatus can be recorded in the Early Permian, however, coeval marine sediments are proven in the Hungarian extension of the South Karavank Unit. The Alpine sedimentary cycle began in the Middle Permian with evaporites. From the Late Permian to the end of the Triassic shallow marine, mostly carbonate sedimentation took place, interrupted in the Early Ladinian by a significant calcalkaline (mostly andesitic) volcanic event. Differentiation of platform and basin environments occured in the Ladinian and Late Triassic in the Bükk PA. Upper Jurassic distal flysch-type sediments of the "Eohellenic phase" terminate the Alpine sedimentary cycle. In the ophiolite melange remnants (Kalnik, Darnó and Szarvaskõ Units) both Triassic (Ladinian–Carnian) and Jurassic (mostly Bathonian–Callovian) MOR-type basalts Jurassic olistostromes are related to the Neotethyan oceanic closure ("Eohellenic tectogenesis"). Palogene deposits usually

do not overstep the Balaton Lineament, but a few scatterd occurrences are known also S of that.

Relationships

Detailed geochemical, petrological and geochronological correlative studies revealed, that the granitoid range of the Mecsek Zone (Mórágy Complex) could be the eastern continuation of the Variscan Moldanubian Zone and could be located in the vicinity of the SE part of the Bohemian Massif (Buda, 1995;Klötzli et al., in press). Variscan metamorphic rocks of the more southern zones of Tisia could represent the continuation of the Median Crystalline Zone of the Variscan basement complexes of the Alps (in sense of Neubauer and von Rauimer, 1993). During the Triassic the Mecsek Zone belonged to the Peritethyan zone and could be located similarly close to the SE corner of the Bohemian Massif (Török, 2000). Paleomagnetic data indicate an anomalously high (45o N) paleolatitude in the Anisian (Márton, 2000). According to sedimentary and faunistic record, the separation of Tisia from this position initiated in the Bathonian (evidently due to the Penninic rifting). However, paleomagnetic data show a significant anticlockwise rotation only in the Berriasian to Valanginian (ca. 130 Ma ago), during the early stage of the alkaline rift-type volcanism (Márton, op. cit.).These volcanics show affinity with coeval ones of the Beskides of the Polish Carpathians (Harangi, in press).

In contrast to the northern zones of Tisia, Variscan and Late Variscan evolution of the elements of the Zagorje--Mid-Transdanubian--Bükk Zone reveal, that they belonged southernmost Variscan Zone, to the Noric--Bosnian Zone (in sense of Neubauer and von Raumer,1993), or to the Carnic--Dinaridic “microplate” in sense of Vai, 1998 (in Kovács et al., 2000). Late Paleozoic and Triassic evolution of the Bükk Terrane of NE Hungary, the Jadar Terrane of W Serbia and Sana--Una Terrane of NW Bosnia show especially close relationships and indicate their original proximal or adjacent position (Protic et al., 2000; Filipovic et al., in press; in Haas and Kovács, 2001). The same is valid for the ophiolite melange complexes, which represent a displaced continuation of the Dinaridic Ophiolite Belt (Dimitrijevic et al., in press).

Conclusions

1. The presently adjacent southernmost zone of the ALCAPA Composite Terrane (Zagorje--Mid-Transdanubian--Bükk Zone) and the northernmost zones of the Tisia Terrane (Mecsek and Villány Zones) show entirely different Variscan and Alpine evolution and relationships. They became juxtaposed along a major dextral transpressional regime (what can be kinematically considered as the “Mid-Hungarian Zone”, cf. Csontos and Nagymarosy, 1998) only at the end of the Early Miocene (Karpathian), by large-scale opposite rotations of the two megaunits. The timing of juxtaposition can be constrained by the facts, that SE of Budapest the Paleogene formations are cut by the Balaton--Mid-Hungarian lineament system, which is overstepped by Badenian sediments.

2. In this shear zone, Inner Dinaridic and eastern South Alpine elements of the Zagorje–Mid-Transdanubian--Bükk Zone are (in most part) squeezed along the Mid-Hungarian Line s.s., which is the NW border of the Tisia Terrane per definitionem.

3. The northernmost zone of the Tisia Terrane (e.g. the Mecsek Zone) showed a typical rifted margin evolution during the Late Jurassic – Early Cretaceous. This fact contradicts some models published in the last 10 years, in which the Mid-Hungarian

Zone appears as a suture zone or the Mecsek Zone as an active margin during this time interval.