

Intraplate tectonics in the Bulgarian part of the Moesian Platform during the Jurassic

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П. Чумаченко, И. Сапунов — Внутриплитовая тектоника Болгарской части Мизийской платформы во время юры. В ранней и средней юре Мизийская платформа была сложена из нескольких блоковых структур — грабенов и горстов. Она медленно погружалась, в результате чего осуществлялась постепенная морская трансгрессия. Первоначально море заполнило негативные структуры, а к концу средней юры оно завладело и наиболее возвышенными горстами. Повсюду осуществлялась мелководная терригенная и терригенно-карбонатная седиментация. Во время поздней юры наступила существенная перестройка платформы. Обособились три больших блока — Западномизийская и Восточномизийская карбонатные платформы, разделенные между собой Центральномизийским бассейном, который стал поприщем пелагической седиментации. Батиметрическая дифференциация между карбонатными платформами и бассейном была значительна. Перимизийская зона, прилежащая с юга, характеризовалась более тонкой континентальной корой. Во время ранней и средней юры в ее восточной части оформился флишевый трог (Маториды), а в поздней юре по всей длине Перимизийской зоны обособился Ниш-Троянский трог. Основной питающей сушей для Мизийской юрской платформы был Фракийский массив.

Abstract. The Moesian Platform was built during the Early and Middle Jurassic by few block structures — grabens and horsts. It subsided slowly, which controlled a progressive marine transgression. In the beginning the sea ingressed in the negative structures, and at the end of the Middle Jurassic it covered even the highest horsts. Shallow water terrigenous and terrigenous-carbonate sedimentation was ubiquitous. During the Late Callovian and the Late Jurassic a considerable reorganisation in the structure of the platform began. Three big blocks were differentiated, and namely, the West and East Moesian Carbonate Platforms, separated by the Central Moesian Basin (with pelagic carbonate sedimentation). The bathymetric differentiation between the carbonate platforms and the basin was considerable. The Perimoesian Zone in the South was characterized by thinner continental crust. During the Early and the Middle Jurassic, its eastern part was occupied by a flysch trough (the Matorids), and the Nis-Troyan Flysch Trough was differentiated in the Perimoesian Zone. The principal source of allimentation was the Thracian Massif.

Introduction

The tectonic structure of the Moesian Jurassic Platform was discussed in few publications in the period between 1983 and 1993. They concerned different parts: in the SW (Сапунов et al., 1983; 1985; Додикова et al., 1984); the NW (Сапунов et al., 1988); the Central (Сапунов et al., 1991) and the eastern parts (Сапунов, Чумаченко, 1987). The Early-Middle Jurassic tectonic development of the Perimoesian Zone was discussed by Чумаченко, Чернявска (1990), and Tchoumatchenco et al. (1992).

A first attempt to draw a general picture of the tectonic development of the Moesian Jurassic Platform was made (Tchoumatchenko et al., 1989; Sapunov, Tchoumatchenko, 1990).

The aim of the present paper is to draw a more detail summary of the tectonic evolution of the Bulgarian part of Moesian Jurassic Platform. It is based on all available data obtained from the study of the well and outcrop sections. We try to establish the liaison between the Late Triassic structures existed on the platform and their significance for its Early-Middle Jurassic evolution.

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Tectonic structure and relief of the Moesian Platform in the beginning of the Hettangian (fig. 1)

Jubitz (1960) and Трошков (1963) were the first to establish and describe the Early Cimmerian structures in the western part of the Moesian Platform. The first generalisation of the tectonic structures at the end of the Triassic was done by Hachev (1972), who established 17 positive structures, defined as upswellings; he characterized in detail their structure and named them after a geographic eponyme. They are shown on his Pre-Hettangian palaeogeological map.

For the present study, we compiled a similar palaeogeologic map (fig. 1). It is based on our proper data on sections from wells and outcrops. We confirmed a part of the positive structures of Hachev (1972), and we found that some of them participated into bigger units. As we shall see later, the outcrops of Paleozoic and/or Lower Triassic rocks, in some cases, are not cores of high elevated structures.

In the beginning of the Hettangian time the Moesian Platform represented a dry land. Marine conditions existed probably in the area situated south of it, in the Peri-moesian Zone.

Two big Early Cimmerian upswellings were differentiated in the Bulgarian part of the Moesian Jurassic Platform. They possessed a complicated structure and were composed of positive units of lower rank. The western structure is designated (Hachev, 1972) Belogradčik Early Cimmerian Upswelling, and for the eastern one we use the name North Bulgarian Early Cimmerian Upswelling. The Belogradčik Upswelling was elongated in NW-SE direction, and in the central part (in the region of the town of Kula and the hill of Vraška Čuka) the pre-Jurassic erosion denudated Paleozoic rocks. The North Bulgarian Upswelling was much bigger and flatter structure, with complicated configuration. The general direction was ENE-WSW. It was composed by few upswellings of lower rank. In its western parts, in the region of the town of Veliko Târnovo, the Jurassic sediments covered transgressively Lower Triassic sandstones of the Petrohan Group, and in some places — clastic Permian rocks. The upswelling was more elevated in north-eastern direction, and in many regions in south Dobrogea the Jurassic sediments cover directly Silurian and Devonian rocks.

Apart from these two big upswellings, there are also two smaller ones. One of them, the Gigen Upswelling (Hachev, 1972) was situated east of the town of Orjahovo. Lower Triassic sandstones of the Petrohan Group crop out in its core. In comparison with the upswellings cored by Paleozoic rocks, the Gigen Upswelling, probably, was lesser elevated. The second of them, the Radova Upswelling (Динкова et al., 1987) was situated in the SW region of the Moesian Platform. It was also highly elevated, and cored by Paleozoic rocks.

The Belogradčik and the Radova Upswellings at the south were separated from the North Bulgarian Upswelling at the NE and the Gigen Upswelling at the north by

the Sevlievo Early Cimmerian Depression. Its filling consisted predominantly of various terrigenous sediments belonging to the Upper Triassic Moesian Group. The Sevlievo Early Cimmerian Depression represented a relatively narrow graben structure with NW-SE (150°) direction.

Other regions with outcrops of ancient rocks (Paleozoic and Lower Triassic), covered directly by Hettangian marine sediments are shown in the palaeogeologic map. Thus, in the band Loveč-Cerven Brjag - Bojčinovci, in the lowermost part of the Sevlievo Early Cimmerian Depression an elongated zone with direction NW-SE (150°) has existed; there Hettangian and Sinemurian sediments cover directly predominantly Middle Triassic carbonate rocks of the Iskâr Group and partially on the terrigenous sediments of the Lower Triassic Petrohan Group. We suppose, that the outcrop of Middle and Lower Triassic rocks in the Sevlievo Depression is controlled by the erosion of a river, that flowed in its lowermost subsided parts. This river eroded and transported away the terrigenous Upper Triassic sediments of the Moesian Group. The other possibility (outcrop of Middle and Lower Triassic rocks connected with the existence of a narrow and long horst, which has been completely eroded) is less probably. To the south of the town of Teteven, the outcrop of Paleozoic rocks and Lower Triassic terrigenous sediments was designated by H a ч e в (1972) as Nešov Upswelling. We suppose that this was not an upswelling, but in these parts of the Moesian Platform have existed a large river valley, directed west-eastward in which ingressed marine waters since Hettangian times. The river erosion in these places controlled the outcropping of Middle and Lower Triassic and Palaeozoic rocks. The described cases give us grounds to suppose, that in the end of the Triassic two types of outcrops of Lower Triassic and Paleozoic rocks had existed. They had different positions in the Late Triassic palaeorelief. The first group is represented by the outcrops of Paleozoic and Lower Triassic rocks that were connected with the high elevated parts of upswellings. They were the field of marine transgression only in the end of Early and predominantly during the Middle Jurassic. These are all of the described Early Cimmerian Upswellings. The second group of outcrops of Paleozoic and Lower Triassic rocks were located in the lowermost parts of the palaeorelief and probably were controlled by river erosion in the end of the Triassic and the very beginning of the Hettangian times. The river valleys, existing before the marine transgression, were, probably, formed in old graben systems. It seems, that besides the Sevlievo Early Cimmerian Graben at least two other Early Cimmerian grabens existed. The Mihajlovgrad and the Izdremec grabens (they are not shown on the palaeogeological map) (fig. 1). The three of them constructed the lowermost part of the palaeorelief and where the sites of the Hettangian marine ingression on the Moesian Platform (fig. 2).

Tectonics during the Early Jurassic (fig. 2, 5)

These principal large structures of the Moesian Late Triassic Platform played an important role during its Early-Middle Jurassic development.

The tectonic situation in the Bulgarian part of the Moesian Platform during the Early Jurassic inherited this of the end of the Triassic. Since the beginning of the Hettangian the whole platform begun to subside slowly. This subsidence was accompanied by a progressive disintegration of the principal upswellings. All these tectonic movements caused a gradual marine ingression coming from south-east. In some places, the marine ingression was preceded by local continental accumulation, and sometimes, the ingression was realised with oscillation. In result of this, an alternation of marine and continental sediments can be often established. During the Hettangian times, the sea occupied the Sevlievo, Mihajlovgrad and Izdremec Grabens, and later, during the Sinemurian it partially enter in the Veliko Târnovo and Provadija Grabens. The Vidin,

Vraca, Pleven, Dobrogea and East-Balkan Horsts, situated between them together with the Thracian Massif at the south, were the source dry lands for the sea gulfs.

During the Pliensbachian and the Toarcian times, the sea enlarged its area on the Moesian Jurassic Platform and gradually begun to occupy the peripheral parts of some of the horsts. On its south-western parts two new grabens were differentiated — the Breznik and the Svetlja Grabens. The last one was formed over the Radova Upswelling. After a short interval with continental lacustrine-paludial sedimentation, in the very beginning of the Early Pliensbachian, an Early Pliensbachian marine ingression took place.

Terrigenous-carbonate sediments were deposited in the biggest parts of the marine basin. Only in the eastern part of the Veliko Tarnovo and the Provadija Grabens an alternation of terrigenous, clastic and pelitic rocks was deposited. All these sediments were deposited predominantly in the conditions of the inner shelf. Only some toarcian marine deposits were sedimented in the environment of the outer shelf.

During the Early Jurassic, three general fault sets delimited the horsts and the grabens of the Moesian Platform; they possessed the following directions: (1) NW-SE; (2) NE-SW and (3) E-W. The Sevlievo, Svetlja and later Razgrad Grabens were formed on the NW-SE set. These three grabens were fan-shaped around the general NW-SE direction. The Mihajlovgrad and the Breznik Grabens followed the NE-SW set. The third direction (E-W) has been sub-parallel to the southern edge of the Moesian Platform and predestinated the formation of the Vraca Complex Horst and the Izdremec Graben, situated to south of it. The last, in eastern direction, passed into the Veliko Tarnovo and in the Provadija Grabens. The high elevated East-Balkan Horst had the same direction and has represented a dry land during the Early Jurassic.

The thickness of the Lower Jurassic sediments in the Moesian Platform changes in large limites — from few centimeters (near the village of Gložene, NW of Teteven — on the periphery of the Vraca Horst) up to some hundred meters (in the Sevlievo, Mihajlovgrad and Izdremec Grabens) (the maximum thickness is 775 m and is situated in the Sevlievo Graben).

Tectonics during the Middle Jurassic (fig. 3, 6)

During the mid Jurassic times, in result of the continuation of the slow subsidence of the Moesian Platform, the marine transgression occupied many new regions. At the end of this epoch the sea covered the whole Bulgarian part of the Moesian Platform. The Early Jurassic structures continued their existence and during the Middle Jurassic. Nevertheless, in some regions (predominantly in north-western and north-eastern parts of the platform) isolated satellite structures of lower rank were formed as steps of some complex horsts or some isolated new grabens (the two small grabens sub-parallel to the Svetlja Grabens in the south-western Bulgaria, for example). The general tendency was in the limitation of the horst area and the enlargement of the grabens.

In the beginning of the Middle Jurassic times the marine ingression occupied the last grabens and progressively begun to cover the horsts. The marine transgression was locally preceded by a continental accumulation of short duration. Shallow water terrigenous, clastic and pelitic sedimentation, and in more restricted quantity, terrigenous-carbonate deposition took place in the basin in general. In the grabens, where during the Early Jurassic times existed a marine regime of sedimentation, during the Middle Jurassic were deposited pelitic and clastic sediments and in limited quantity — terrigenous-carbonate sediments in relatively deeper conditions, corresponding to the environment of the outer shelf. The Middle Jurassic sediments, which were deposited on the horsts, are represented predominantly by clastic, and to a lesser degree, by pelitic, as well as by terrigenous-carbonate sediments. They were formed in shallow water environments, which corresponded to the inner shelf conditions.

The three principal fault sets, inherited since the Early Jurassic, persisted during the Middle Jurassic times: (1) NW-SE; (2) NE-SW; (3) E-W.

The thickness of the Middle Jurassic rocks varies in large limits — from few centimeters in the regions, where the Jurassic succession began with the Upper Callovian sediments up to few hundred meters in certain parts of the Sevlievo, Mihajlovgrad and Izdremec Grabens (the zone with maximum thickness is situated in the axial area of the Sevlievo Graben, where it reach up to 800-1095 m).

Tectonics during the Late Callovian and the Late Jurassic (fig. 4, 7)

A fundamental reconstruction in the tectonic structures of the Moesian Platform during the Callovian times took place. Three big blocks — western, central and eastern were differentiated. The western and the eastern blocks were highly elevated, with a permanent tendency to positive movements. They are known as West and East Moesian Carbonate Platforms (P a t r u l i u s et al., 1976, fig. 4; S a p u n o v, T c h o - u m a t c h e n c o in L e f e l d et al., 1986, fig. 2). These blocks were the site of shallow water carbonate sedimentation, connected with the shallower sublittoral. The central block, called by those authors Central Moesian Basin, was situated in a lower bathymetric position with a permanent tendency to subsidence. It was the area of pelagic carbonate sedimentation with the predominant deposition of micritic limestones, showing often some similarities with the Alpine Majolica facies and of nodular limestones of the facies of Ammonitico Rosso. The biggest part of the West Moesian Carbonate Platform is situated in Romania and eastern Serbia. In east direction, on Bulgarian territory, the West Moesian Platform is interfingered in a complicated manner with the Central Moesian Basin through three big tongues, known as Dragoman, Vraca and Gomotarci Horsts (C a n y n o v et al., 1988, fig. 33). The principal fault set delimited the Central Moesian Basin from the two platforms was NW-SE. Besides them, during the mid Kimmeridgian times, the Central Moesian Basin spread out to south of the platforms. Later on, these regions of the basin were also incorporated into the Niš-Troyan Flysch Trough.

The maximal bathymetric difference between the areas of the platforms and the basin was 500-600 m.

The thicknesses of the Upper Callovian — Upper Jurassic vary in large limits. In the East and the West Carbonate Platforms there some regularities in the distribution of the maximum thicknesses of the sediments. On the East Moesian Platform two zones with maximum thicknesses orientated east-westward existed. The first one is situated south of the town of Pleven, and the maximum thickness reaches up to 459 m. The next one is situated between the town of Ruse and the southern edge of the Platform, where the thickness is 320 m. The two thicknes maxima are delimited from the inner areas of the platform, as well as from its southern edge with zones of decreasing thicknesses. The thinner carbonates in the southern edge of the platform were probably formed in conditions of barrier reefs, and the zones with maximum thicknesses correspond to narrow, elongated in east-west direction lagoons. In the north and north-east direction another decrease of the thickness of the carbonates is recorded, being probably connected with the slow, but uninterrupted upswarding of the East Moesian Platform in this direction.

The transitional shelf zone between the East Moesian Platform and the Niš-Troyan Trough is relatively narrow, with a fast increase of the value of the thicknesses in south direction. The transitional zone is irregular, with few centres with decreasing thicknesses.

In the three horsts of the West Moesian Platform the zones with maximum thicknesses also correspond to lagoons which are by the same manner delimited from the

basins by zones of barrier reefs with coral buildups. The maximum thicknesses for the East and the West Moesian Platform are up to 400-450 m.

In the Central Moesian Basin, the maximum thicknesses of the sediments are aligned in its axial area, where the average values are about 300 m, to up to 750 m in the transitional zone between the Basin and the Niš-Troyan Trough.

The thicknesses of the flysch sediments also vary in large limits. An important increase of the thicknesses up to 2300-2500m exists in direction to the source provinces.

Correlations of the Jurassic Fault Sets

As already noted, during the Early and the Middle Jurassic three principal fault sets existed in the Moesian Platform: (1) NW-SE; (2) NE-SW; (3) E-W. During the Late Jurassic the NW-SE and E-W fault sets were inherited from the Early-Middle Jurassic sets.

The NW-SE set coincided with the general direction which existed in the west part of the Tethys, in the so-called Domain 1 (D e r c o u r t et al., 1990). According to these authors, "during the Early Jurassic Period, started a new stress regime that characterized the Jurassic Period" which has the direction 130° - 140° .

Almost the same (120° to 150°) is the direction of the big fault sets in north Dobrogea: Galati-Sf. Gheorghe, Peceneaga-Camena, Capadiva-Ovidiu and the Inframoesian Faults (G r ä d i n a r u, 1984; 1988). After M. S ă n d u l e s c u (oral communication, 1 October, 1993) they represent the SE prolongation of the Tornquist Line.

Notes on the Jurassic tectonic units situated south of the Moesian Platform

Immediately south of the Moesian Platform the Perimoesian Zone was situated. It is characterized by a thinner continental crust. During the Early Jurassic, in its eastern part existed a trough with turbidite (flysch) sedimentation, known as Matorides (Ч у м а ч е н к о, Ч е р н я в с к а, 1989; 1990). Probably this flysch trough began its formation during the Late Triassic but the transition between the Upper Triassic and the Lower Jurassic flyschs is not proved until now. The existence of this flysch trough is proven only since the Early Jurassic time and it is closed at the end of the Bathonian. By this closure the territory of East Stara Planina Mountains was accreted to the East-Balkan Horst and to the Thracian Massif. We suppose that the Matorides represented the west prolongation of the Paleo-Tethys coming from Crimea and the Caucasus. The western prolongation of the Matorides is uncertain. Until now we considered (T c h o u m a t c h e n c o et al., 1989; С а п у н о в et al., 1991; T c h o u m a t c h e n c o et al., 1992) the region of the Elena-Tvârdica Pass as being the east termination of the Matorides Basin, and of the Paleo-Tethys. But it is possibly that, after a diagonal swelling in the area of the Tundža Tilted Basin, it is prolonged to west in the Perithracian Oceanic Zone. We consider that the Jurassic sediments of the Trek-ljano Group (З а г о р ч е в, Т и х о м и р о в а, 1988), and those of the Eastern Rodopes (Z a g o r č e v et al., 1989) were connected directly with the Jurassic sediments of the Matorides, now shifted; they represented the peripheric parts of the Perithracian Ocean.

The next stage in the evolution of the Perimoesian Zone is connected with a new opening during the Late Callovian time on the territory of eastern Bulgaria, where the differentiation of the Niš-Troyan Trough began, with an intensive turbidite (flysch) sedimentation. Later on, during the mid-and the late-Kimmeridgian times the trough expanded quickly to the west at the account of the partial shortening of the Central Moesian Basin. The Niš-Troyan Trough was formed along the sub-equatorial fault

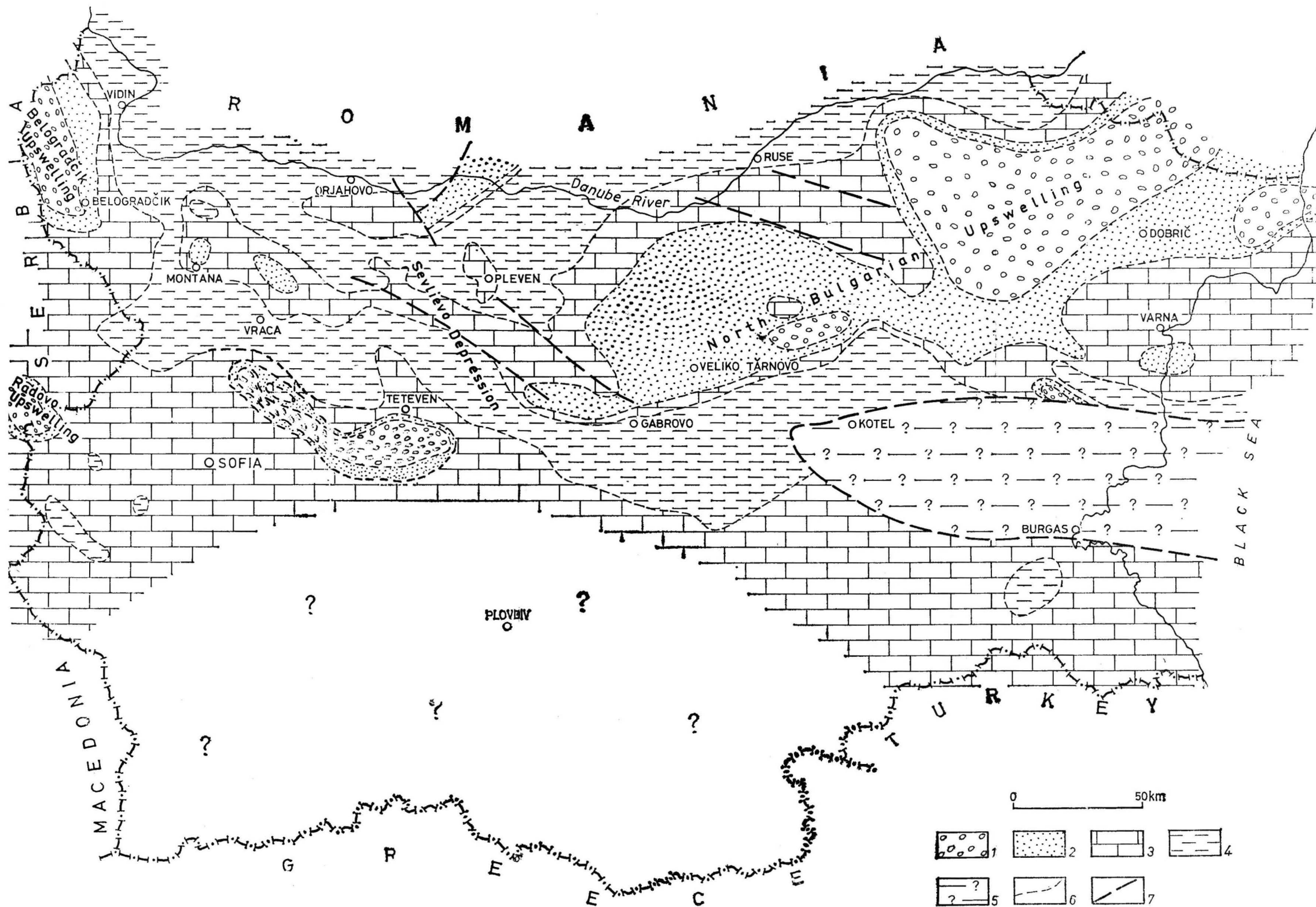
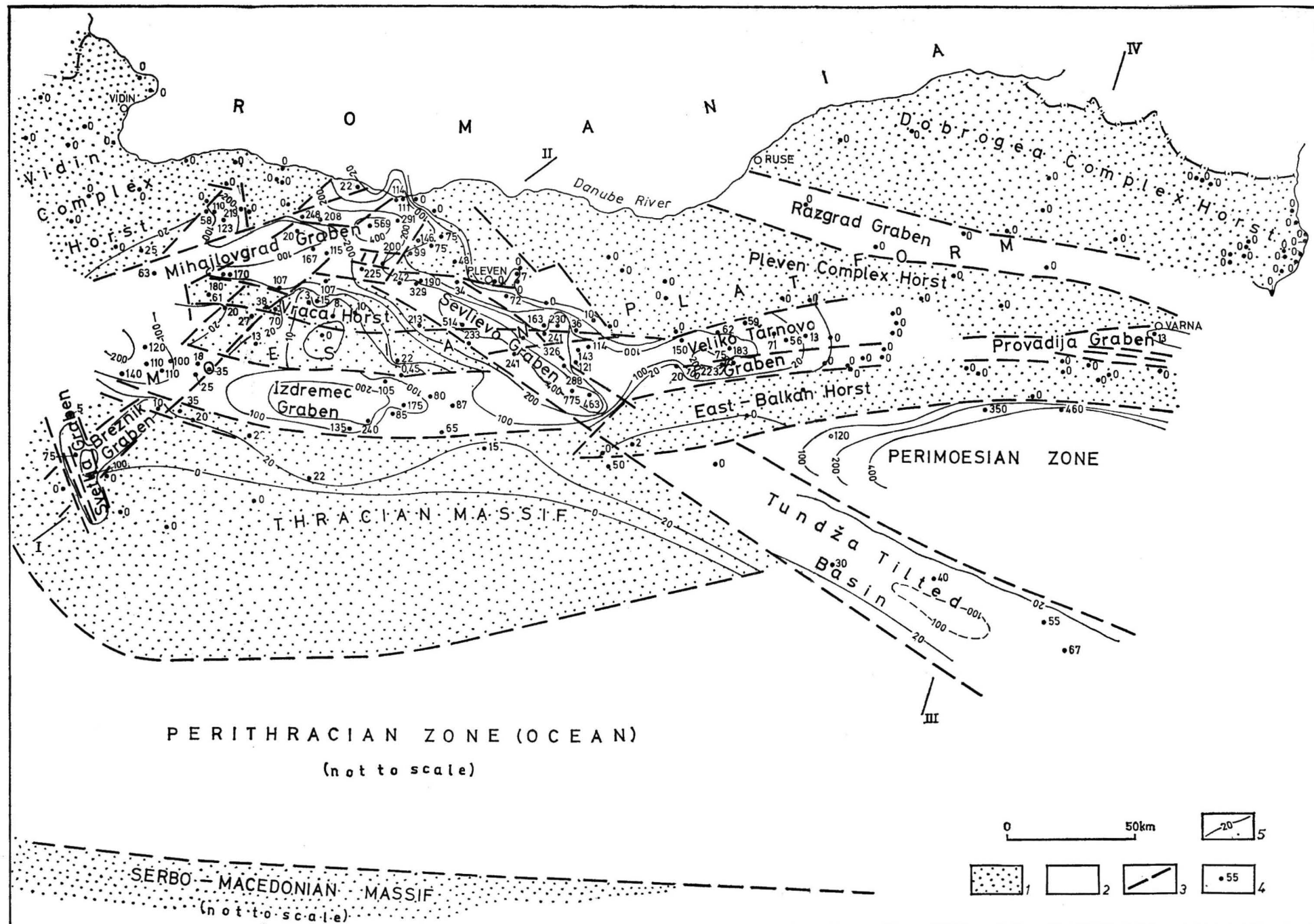


Fig. 1. Palaeogeological map of Bulgaria at the very beginning of the Hettangian
 1 - Paleozoic rocks; 2 - Low Lower Triassic sandstones and conglomerates (Petrohan Group); 3 - Middle and Upper Triassic carbonate rocks (Iskar Group); 4 - Upper Triassic terrigenous rocks (Moesian Group); 5 - Upper Triassic carbonate turbidites(?)



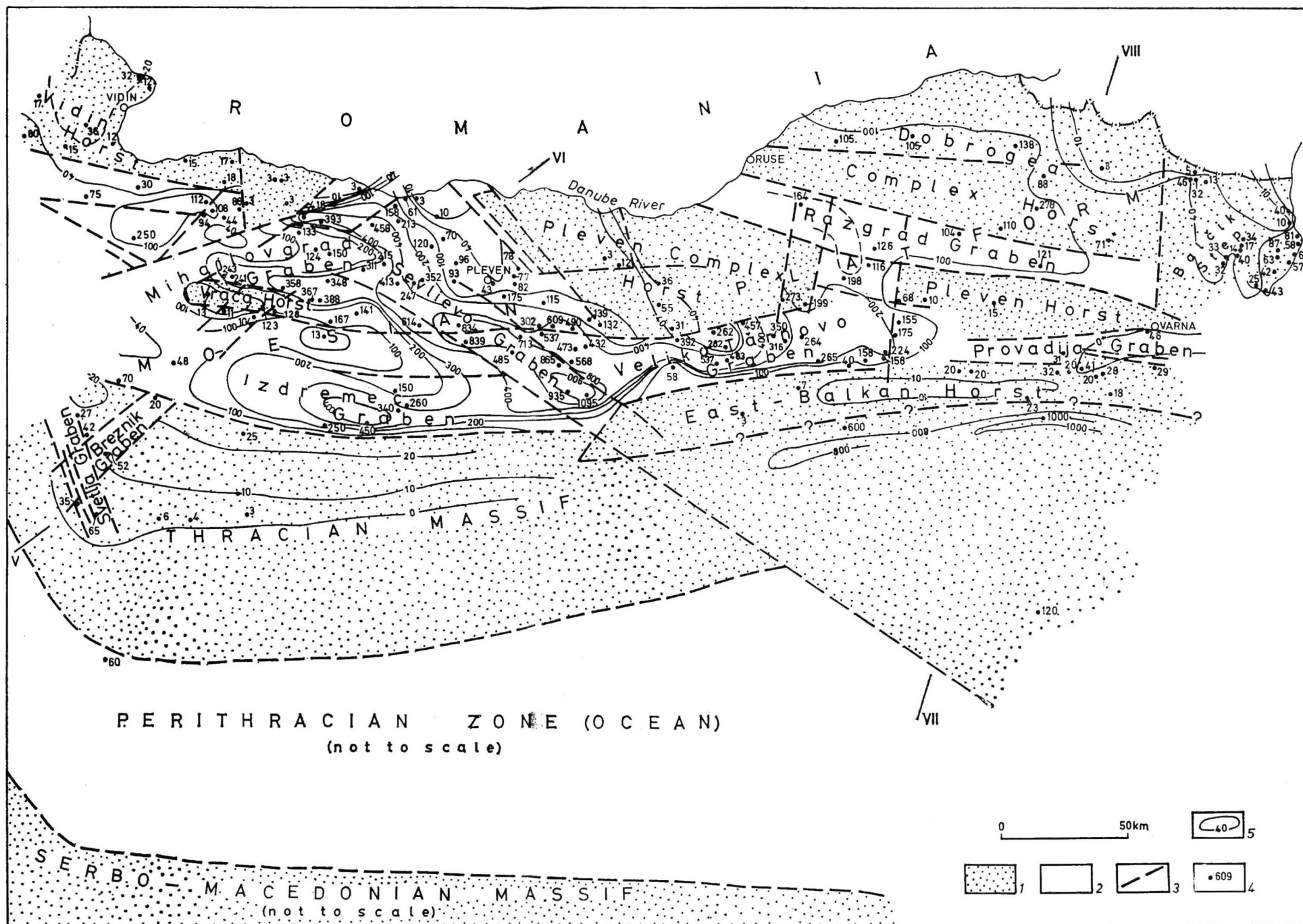


Fig. 3. Tectonics at the end of the Middle Jurassic (Early-Middle Callovian)
 1 — horsts and/or other elevated zones; 2 — grabens and/or other subsided zones; 3 — palaeofaults; 4 — thickness in meters

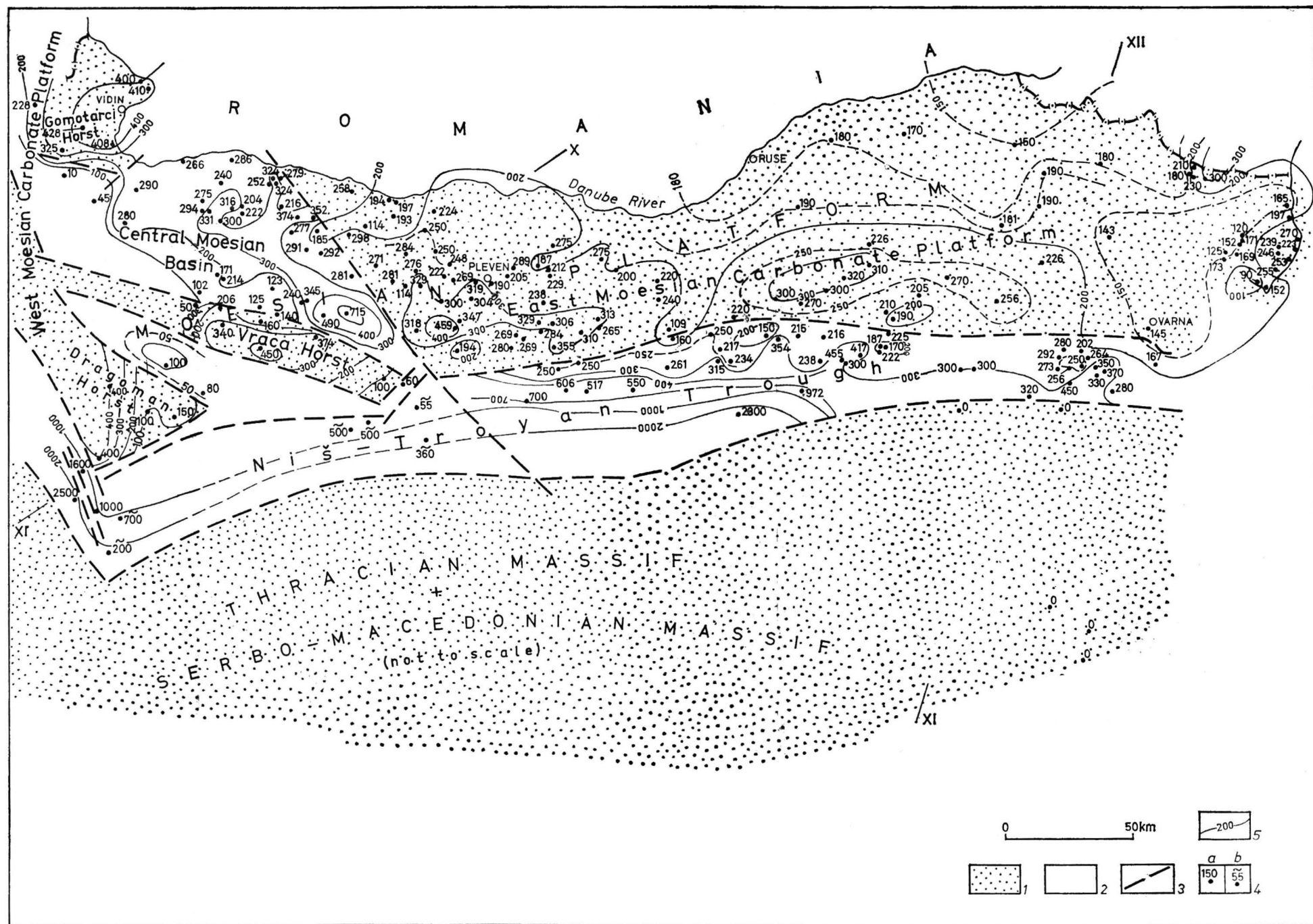


Fig. 4. Tectonics at the end of the Late Jurassic (end of Tithonian)
 1 — horsts and/or other elevated zones; 2 — grabens and/or other subsided zones; 3 — palaeofaults; 4a — thickness in meters, 4b — actual thickness of subsequently eroded sediments

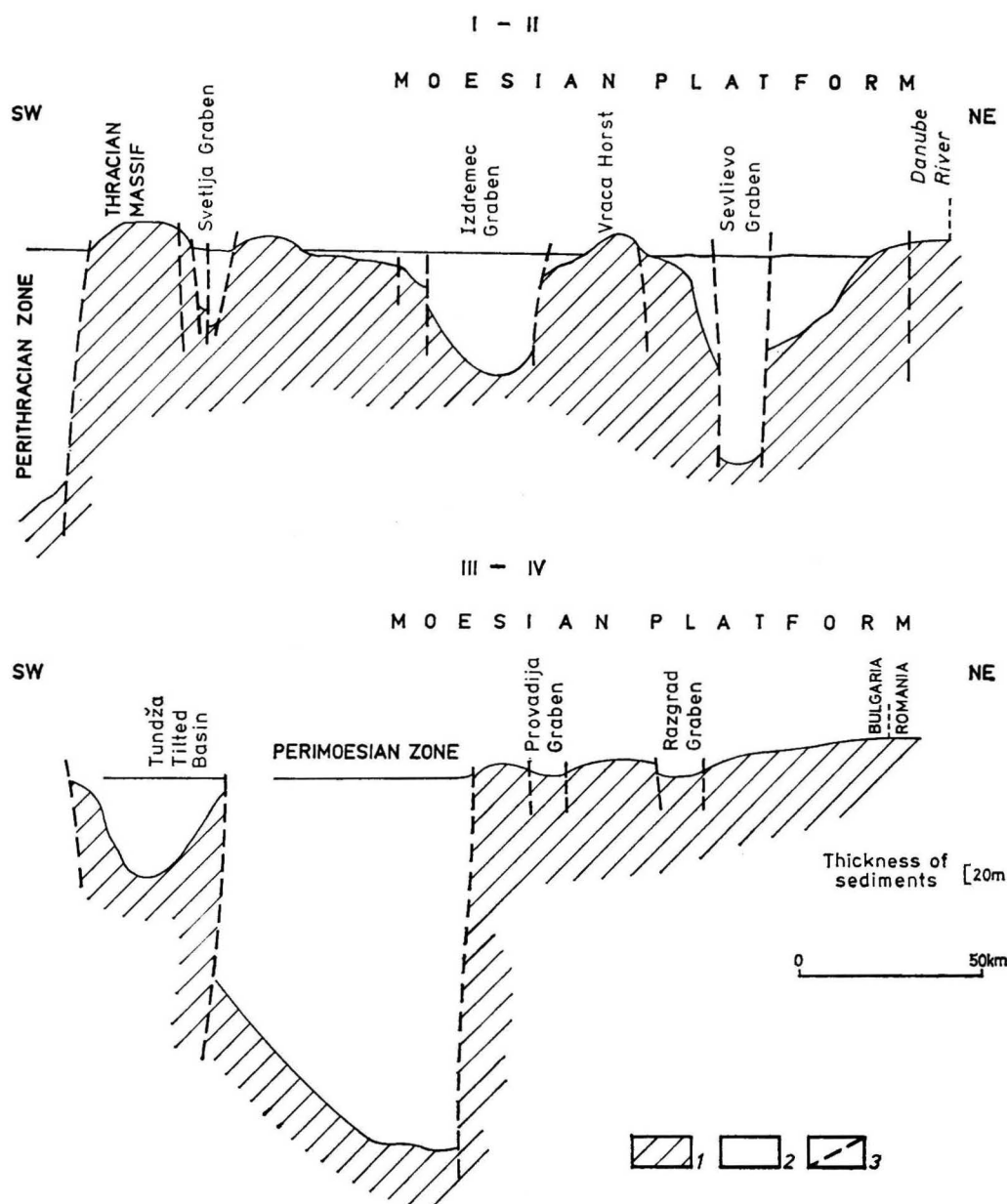


Fig. 5. Palaeotectonic transversal sections through the Moesian Platform at the end of the Early Jurassic
 1 — substratum; 2 — Lower Jurassic sediments; 3 — palaeofault

system — its direction, in general, is E-W. In south-western Bulgaria the trough turned to NW-SE, following this general direction. This is the cause for some geologists to consider this western part of the trough as an independent trough — Lužnica or Lužnica-Konjovo Trough (Бончев, 1986; etc). The Niš-Troyan Trough continued its existence also during the beginning of the Early Cretaceous.

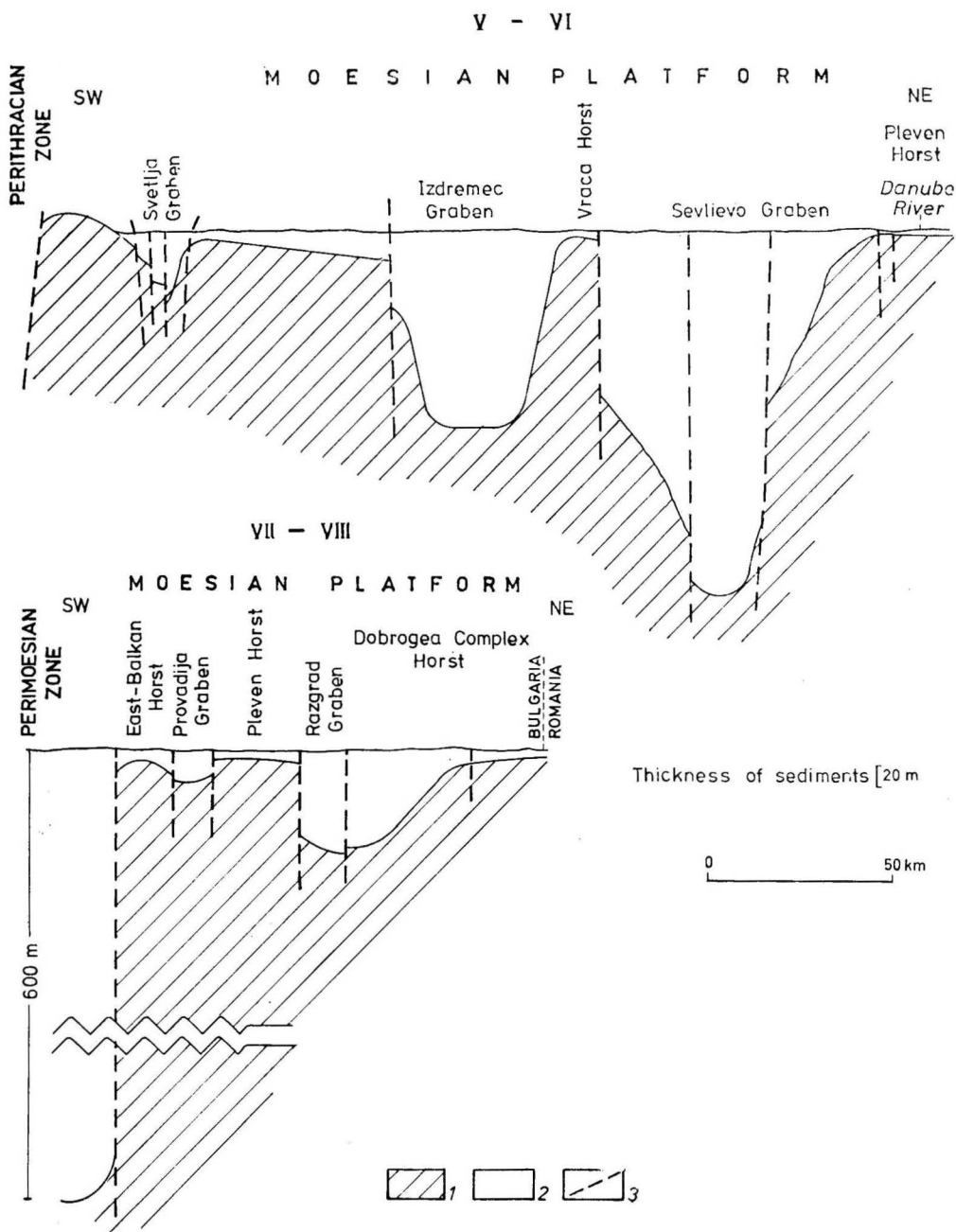


Fig. 6. Palaeotectonic transversal sections through the Moesian Platform at the end of the Middle Callovian
 1 — substratum; 2 — Middle Jurassic (Aalenian — Middle Callovian) sediments; 3 — palaeofault

During the Early and the Middle Jurassic, to the north of the Perithracian Zone and to south of the Moesian Platform was situated the Thracian Massif (fig. 2, 3). In NW direction it was prolonged, probably, into the Getikum.

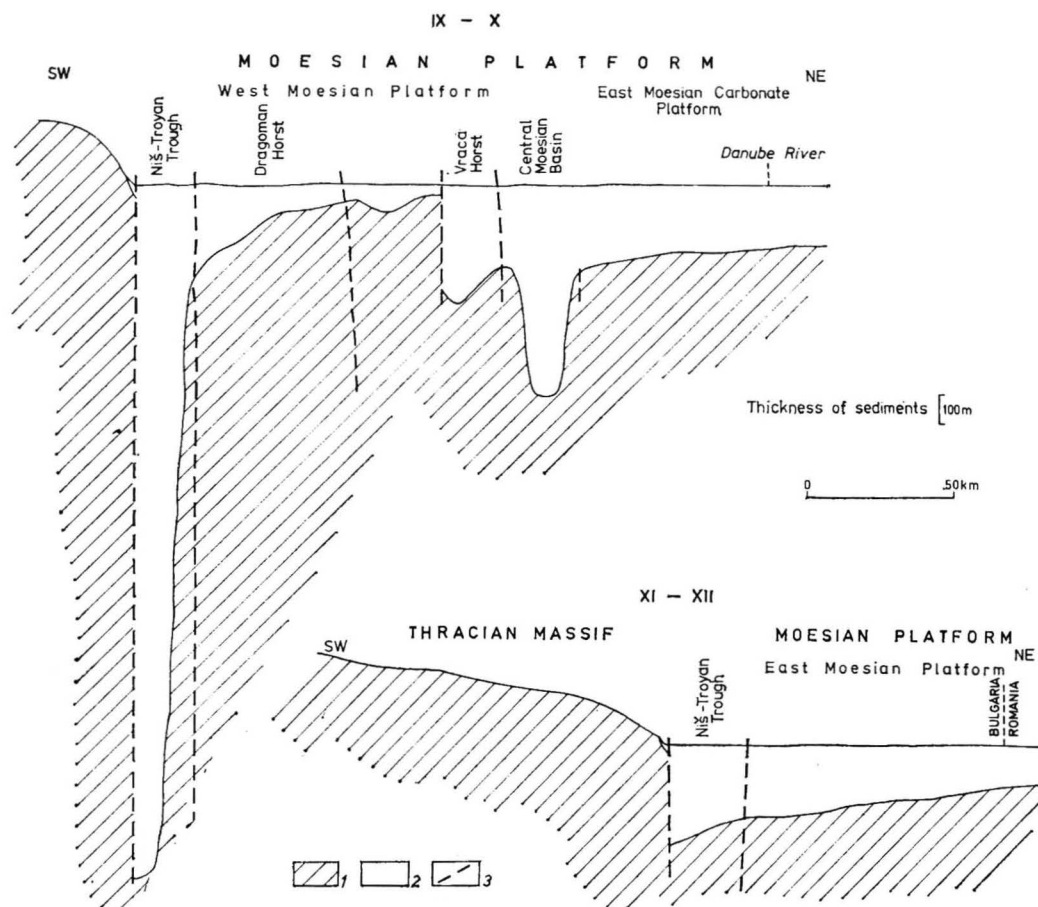


Fig. 7. Palaeotectonic transversal sections through the Moesian Platform at the end of the Tithonian
 1 — substratum; 2 — Upper Callovian-Upper Jurassic sediments; 3 — palaeofault

South of the Perithracian Zone the Serbo-Macedonian Massif was started.

The zone of the Perithracian Ocean was closed definitely on Bulgarian territory at the end of the Kimmeridgian, during which closure the Thracian Massif was united with the Serbo-Macedonian Massif to represent the principal province of allimentation of the Niš-Troyan Trough since the Tithonian to the Valanginian.

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