PALAEOGEOGRAPHY OF SOUTHEASTEREN PART OF PANNONIAN BASIN DURING PLIOCENE AND QUATERNARY

M. RAKIC[1], P. STEJIC[2] and S. SIMONOVIC[3]

[1]*Srbija, Beograd, Karadjordjeva 48*
[2]*Srbija, Geozavod – Gemini, Beograd, Karadjordjeva 48*
[3] *Srbija, Beograd, Save Kovacevica 40*

Abstract: After the Upper Miocene, in southeastern parts of the Pannonian Basin three megalithogenetic complexes were deposited: marine, through Pontian and Middle Pliocene, lacustrine, in Upper Pliocene, and fluviatile, Quaternary. A casual chronological relation was established between the formation of these complexes, on one hand, and the effects of eustatic fluctuations, tectonic processes and climatic changes, on the other hand. The mentioned factors significantly controlled the paleogeography west of the Carpathians by changing with the time sedimentation areas, characeter and nature of deposition in the areas, hydrography, eco-systems, etc.

Key words: *Palaeogeography, Pliocene, Quaternary, Pannonian basin, Lithogenetic complexes.*

Geographical position of investigated area

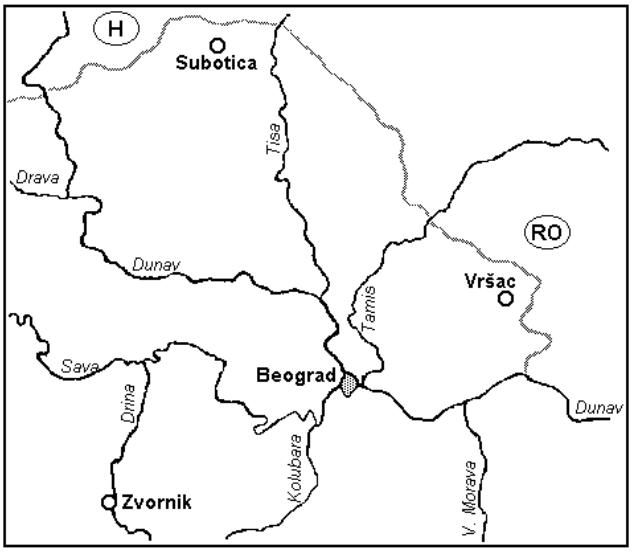


Figure 1

Without regard to different interpretations of the origin of sea level fluctuations, researches by Burkar (1953), Lundberg (1972), Velicko (1967), Fairbridge (1962) and other proved three large post-Miocene cycles; Pontian regression, Upper Pliocene transgression, and Villafranchian regression[1]. Each of the megacycles was followed by a number of flustuations, which are well studied, particularly those of the Pleistocene and the Holocene.

[1] Post-Villafranchian "transgressions and regressions", stated by the mentioned authors, are interpreted here as fluctuations within the same regression cycle (our remark).

Arguments presented in this work support the thesis that the basins east and west of the Carpathians were in direct communication during the Lower and Middle Pliocene via a strait in the region of Djerdap George. A general regression, when the sea level fell 300 metres, was sporadically interceded by minor regressions which in the Pannonian Basin led to slight rises of the sea level and in salinity. These slight and short, retrograde, processes were manifested in temporary submergence of river valleys and areal expansion of oligohaline fauna. For the same reason, unadepted freshwater organisms either expired or retreated to the areas of narrowed foreshore alluvial plains, or migrated even further - upstreat the river courses. Also, continuous retreat of coastlines resulted in much longer river courses and freshening of basins, and consequent extinction of marine and growing domination of freshwater fauna, especially at the end of the marine cycle.

Isolines of Quaternary deposits thickness

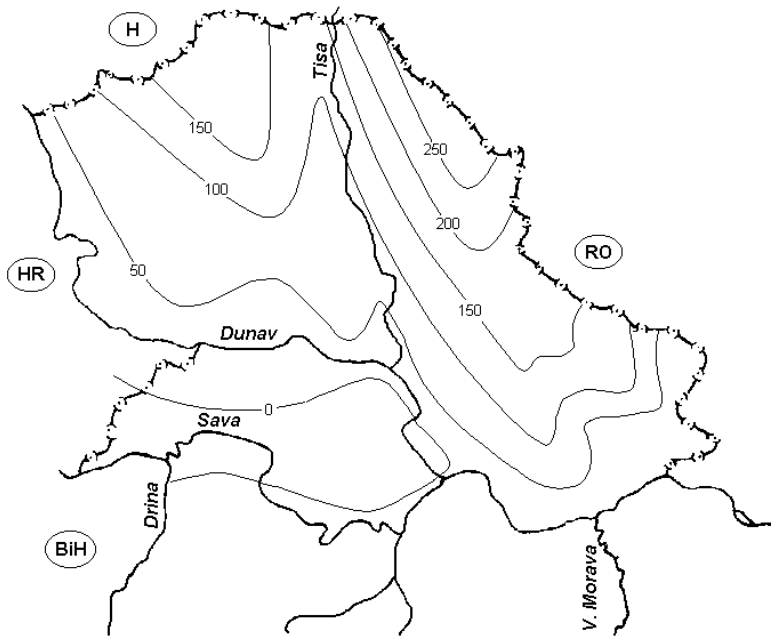


Figure 2

The given examples of variegated biofacies in the Pontian and multiple alternation of beds with caspibrackish and freshwater fauna in lower Paludina beds are a perfect evidence of the nature and the history of marine communication between the Pannonian and the Dacian basins.

The Danubian depression transformed in the Upper Pliocene into a large lake, and the former strait into an outlet. Transition from caspibrackish to lacustrine stage is not well defined. The unconformity of middle paludina beds (lower Upper Pliocene) in relation to the older Neogene sediments, which is well manifested in marginal parts of the basin, may be interpreted as a hiatus between the deposition of lacustrine and marine sediments. This basic assumption has not yet been confirmed in central parts of the basin.

An evidence of the Upper Pliocene transgression, east of the Carpathians, is the presence of Akchagylian cardids in a "freshwater series of Lower Levantian beds" (Rumanien after Ebersin et al., 1966, or Lower Villafranchian according to

Ghenea, 1972). As mentioned before, these deposits are equivalent to middle and partly upper Paludina beds in Yugoslavia.

In view of the Romanian authors' interpretation of the isolation of the Pannonian and the Valachian basins from the Middle Sarmatian ending with the Günz or Mindel, and of the fact that marine fauna of Akchagylian cardids has not been found westward from the central Kewatinian lake of Romania, the thesis of their communication through the Danube calls for an additional explanation.

A research in the effect of Upper Pliocene transgression on Euro-Asian freshwater basins (Lundberg, ibid.) proved in the former case that the rises in level and salinity of lakes directly depended on how high was the transgressive wave and how wide were the valleys conducting the transgression.

PALAEOGEOGRAPHICAL SKETCH OF SOUTHEASTEREN PART OF PANNONIAN BASIN
(PANNONIAN - MIDDLE PLIOCENE)

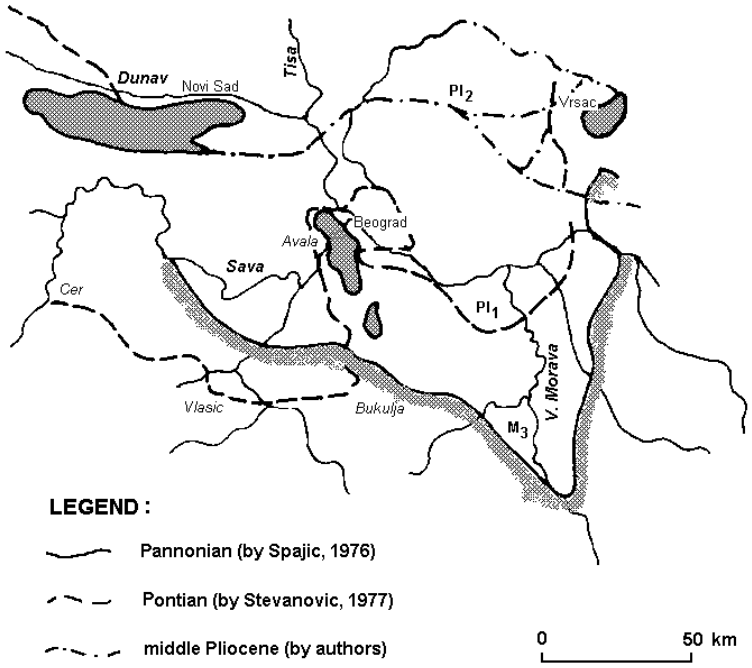


Figure 3

The presence of Akchagylian cardids in the central area of Dacian Basin is an evident example of a direct effect of transgression westward through a wide gulf.

In the examples of sea invasion through narrow valleys with gorges and canyons, the ingression wave retarded river flows that drowned upstream depressions and formed freshwater basins.

In our interpretation, the onrush of the westward moving transgression wave collided with the Danube flow at its exit form Djerdap Gorge that formed a natural barrier to a further rush of sea water to the west. For the same reason, powerful backwater indirectly added to the rise of the Pannonian lake which, in relation to the basin in Oltenia, must have lain at a higher altitude.

River communication between the Pannonian and the Dacian basins in the Upper Pliocene easily explains the identical, and largely, endemic biofacies, lake

level fluctuations, their effluent regimen, formation of a delta at the exit from Djerdap Gorge, and morphological incongruity of central lake planes, used by Romanian authors as an evidence of isolation of the lakes.

Tectonically, the entire pliocene is characterized by a balance between a slow subsidence in the areas of sedimentation and rising of the adjacent mountains. The same trend through a few millions of years resulted in thick deposition of dominantly shallow-water lithofacies. The thickness of deposits is as high as 2000 metres in depressions along the outer Carpathians. Basins were rapidly filled, by the "delta system", from periphery to central areas.

Pontian biofacies, at the onset of the marine cycle, illustrate submediterranean conditions. A trend of gradual decline in mean annual temperatures, and increasing freshening at the end of the regression stage, led to a rapid development of endemic fauna, with scanty marine relics and the dominance of freshwater, predominantly fluvial species.

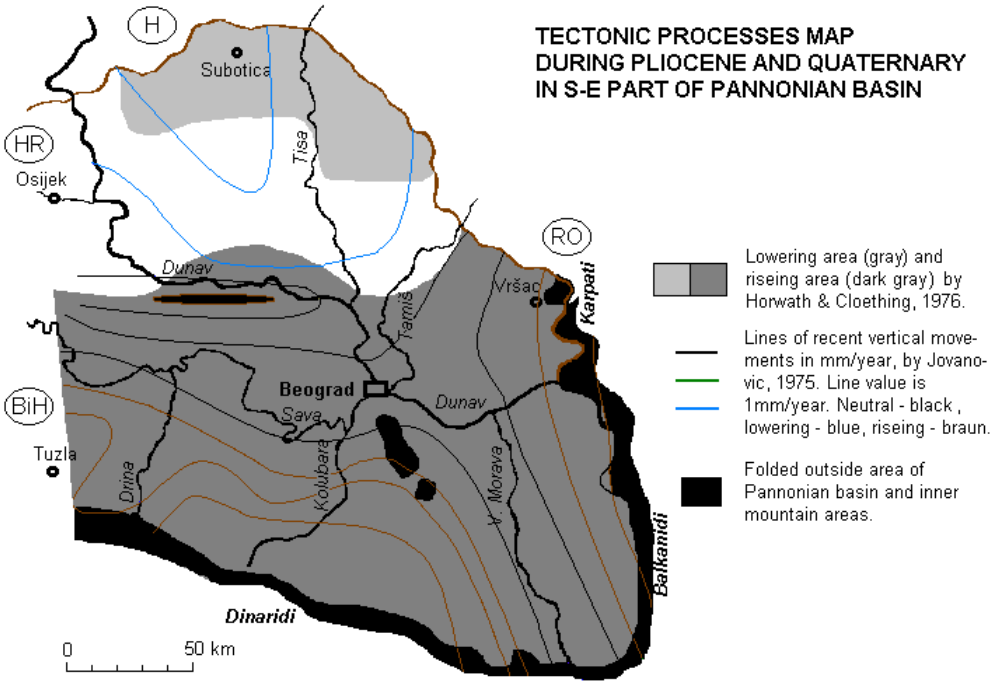


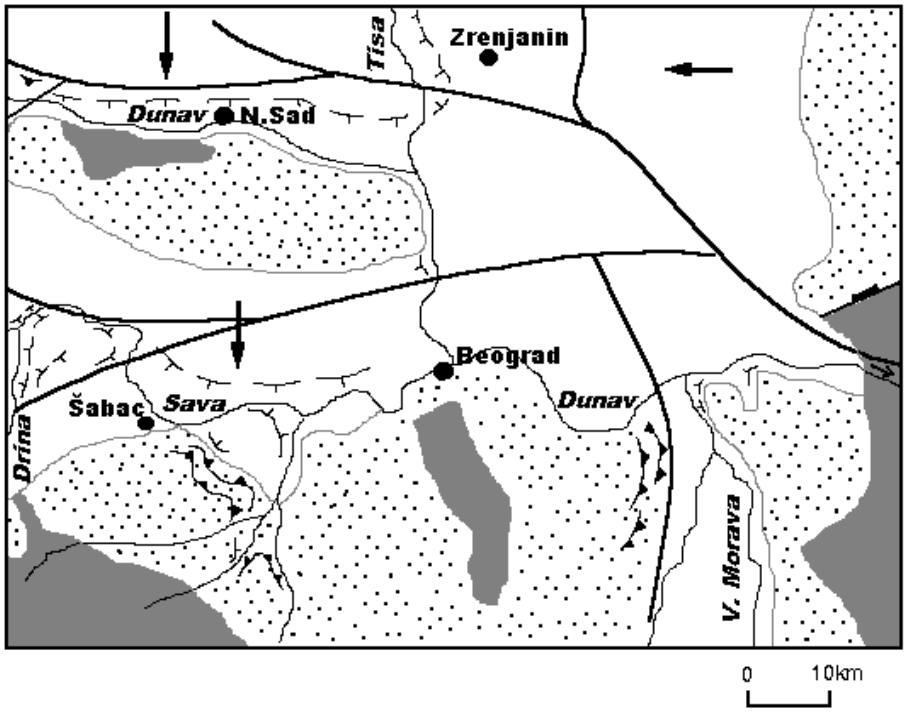
Figure 4

The lacustrine stage is definitely characterized by warm continental climate with arid sequences at the end of the Pliocene. Changed environments are manifested in the absence of marine organisms and strong development of genera of sculptured unionids, viviparae, neritids, and melanids. This fauna resembles the most the "porata" (Akchagylian) faunal complex, including all three of its subcomplexes.

The sea level fell about 200 metres in the latest Pliocene and the early Quaternary. The regression effect is manifested in a sea retreat from Dobrogea some 150 km southward. This led to a sudden emptying of the Pannonian lake and the formation of a new fluvial denudation system, with the Danube as the main drainage river.

In the earlier stage of the fluviatile cycle, Pannonian rivers formed a complex intermontane flowing basin, in which were laid "alluvial deposits of

increasing thickness" (constructive reservoir type after Schanzer, 1951, and Allen, 1965). These very thick deposits in multiple vertical alternation of gravel, sand, silt, and clay are referred to in the national literature as "river-lake" or "polycyclic-fluvial" deposits.



Geomorphological sketch of S-E part of Pannonian Basin

LEGEND:

- Primary river basin during Quaternary, with marked direction of river valley
- Slopes on Neogene sediments, partly or fully covered by loess and under loess Quaternary beds
- Underlaying Neogene sediments
- Erosion direction and river valley widening after Mindel
- Older Quaternary river terraces (50-60 m and 80-110 m relative height levels)
- Younger Qauternary river terraces (25-35, 7-12 and 3-5 m relative height levels)
- Enterance part of Djerdap george

Figure 5

As a result of the Carpathians high rising and an intensified erosion, on one hand, and concurrent multiple susbsidence of the depression floor, on the other, lower levels of polycyclic-fluvial deposits (the Donau phase, Günz) consist of clastic materials in well differentiated lithofacies of river channels, flood plains, and oxbow lakes. A principal characteristic of fauna is the appearance of new genera and species (Vivipara böcki, Unio sturi, Corbicula apsheronica, etc.) and the complete disappearance of Levantian sculptured forms, which allows its correlation with the apsheronica faunal complex.

Controlled by inland ice and glacierization in adjacent mountainous areas, pannonian basin transformed in the upper earlier stage of the fluviatile cycle (Mindel) into a wet steppe. The Danube and other pannonian rivers had shallow

channels and low transport capacity, had hot perennial streams, but spread, particularly after late summer storms, into a number of flood lakes, forelands, and marshes of dufferent duration. Sporadic alternation of sediments with terrestrial or combined terrestrial-marsh faunal forms indicates their multiple partly or complete desiccation. An abundance of turbidity currents from marginal areas into the basin added to a great diversity of lithofacies, dominantly of silt and clay and subordinately of sands and small gravels. Apart form Corbicula fluminalis, which does not occur in deposits of the later fluviatile cycle, the fossil fauna largely consists of the species allied to Recent genera: Unio, Viviparus, Lithoglyphys, Fagotia, Valvata, Bithinia, etc., making the biofacies correlative with the Tiraspolan faunal complex.

Valleys of all Pannonian rivers, in the later stage of the fluviatile cycle (Riss, Würm, Holocene), are distinctly outlined and marked by terrace risers of 20-25 m, 7-12 m, and 3-5 m relative heights, the earliest one cut down into Mindel deposits, its tread covered by loess and eolian sand. All valley floors show vertically well graded material. At the base of each level lie grey sands of channel facies, overlain by silts of fluvial facies, locally of loessoid habitus. Lateral equivalents are sporadic oxbow facies, represented by organogenic-marsh clay, silt and peat. Faunal assemblages form the above-stream terraces (levels 20-25 m and 7-12 m rel. hgt.) correspond to the late Pleistocene faunal complex of two subtypes; cold and humid with Elephas trogontherii during the Riss, and cold and dry with E. primigenius during the Würm. The post-Mindel fluviatile stage is characterized by differentiation of valleys, their cutting down into the upper levels of polycyclic-fluvial deposits, and formation of above-stream and stream terraces at relative heights of 25-35 m (Riss), 7-12 m (Würm), 3-5 m (lower Holocene), and 0-3 m (Recent).

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