GEOLOGICKÝ ZBORNÍK — GEOLOGICA CARPATICA 32, 1, BRATISLAVA, MARCH 1981 Pp. 135—142

MICHAL KOVÁČ*

GEODYNAMICAL DEVELOPMENT — CRITERIUM FOR THE SUBDIVISION OF THE WEST CARPATHIAN NEOGENE SEDIMENTATION AREAS

(Tab. 1, Figs, 1—3)

Abstract: This work contributes to discuss new opinions on the time and space division of the West Carpathian Neogene basins from the view-point of the theory of plate tectonics. Except for their recent geographical position, this division takes into consideration their geodynamical development and also their relation to larger interregional sedimention areas of the Alpine-Carpathian System in the diverse Neogene stages.

Резюме: В работе предоставлены для дискуссии новые взгляды на возрастное и пространственное деление неогеновых бассейнов Западных Карпат с точки зрения теории движения литосферических плит. Это деление принимает во внимание кроме их сегодняшнего географического положения их геодинамическое развитие, как и принадлежность к межрегиональным областям отложений осадков в рамках альпийско-карпатской системы в отдельных временах неогена.

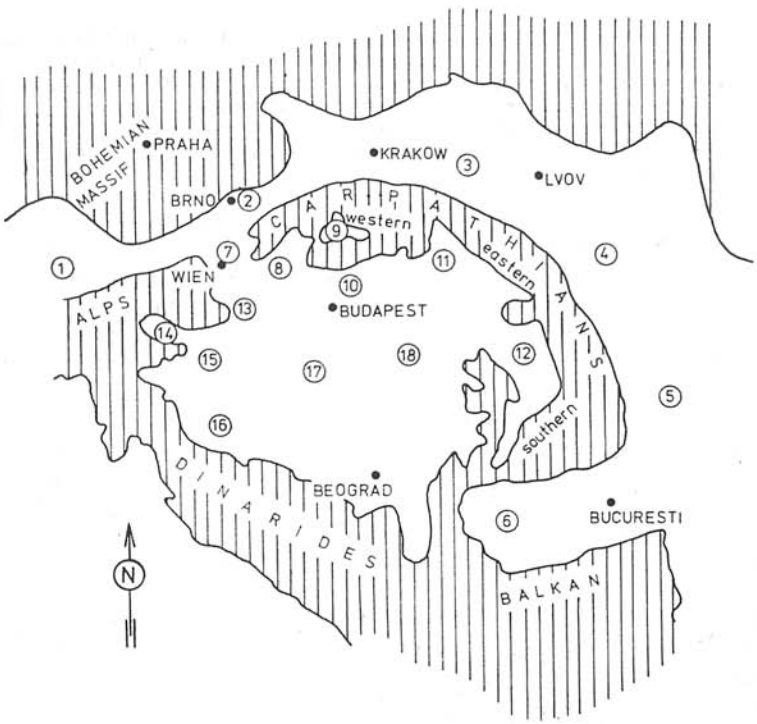
The sedimentation filling of the Neogene basins of the West Carpathians in their contemporary geographical position represents only denudation remains of the original sedimentation basin of differents stages. The basins differ from each other by their age and by their extent, especially because of the changeable position of the West Carpathian Block during the stages of the space reduction in the Neogene of the outer arc units. Therefore sediments of the different Neogene stages occurring nowadays in the same geographical region were naturally originated in geographically different areas (Fig. 2, which doccuments the movement of sedimentation areas in the East Slovakian Basin in dependence on the movement of the West Carpathian Block). The space reduction during the Neogene could be presupposed on 40 km in NW section and 80 — 100 km in NE section (Poland) of the West Carpathians (M. Kováč, 1980).

The geodynamics of the Neogene of the Alpine—Carpathian System appears by creation, destruction, also by migration of the interregional sedimentation areas. These ones demonstrate a common development of the West Carpathians with adjacent areas (the Eastern Alps, the Eastern Carpathians, the Pannonian Block etc.) during the Neogene stages. The common development of sedimentation areas could be also a recognition of the acceptance of conclusions of the plate tectonics theory (X. Le Pichon et al., 1973; M. Maheľ, 1979), especially of the existence of the time and space limited subduction in the outer arc units of the Alpine—Carpathian System (Z. Roth, 1977), the Neogene Block structure (O. Fusan et al., 1979) and the action of active mantel diapir (L. Stegena et al., 1975; D. Vass, 1979) in the inner arc (Intra—Carpathian area).

* RNDr. Michal Kováč, CSc., Geological Institute of the Slovak Academy of Sciences, Dúbravská cesta 9, 886 25 Bratislava, Czechoslovakia.

The contemporary geographical position of the Neogene basins represents the final phase of an orogenetic process. This position of the Neogene basins in the outer and innner sides of the West Carpathians arc, also in its own mountain chain, was one of the main criteria for their division in the past. However, this division did not express the genetic relations of their origin and creation (except for those ones, pointed out by D. Andrusov, 1958; T. Buday, I. Cicha, J. Seneš, 1965).

The division of basins was traditionally as follows:
— outer (foredeeps)
— basins in the mountain arc (e.g. the Vienna Basin)
— inner (the Danubian basins)



1 — the Subalpine Molasse and the Oligocene and Miocene flysch zones, 2 — the Subcarpathian Miocene Foredeep in Czechoslovakia and the Subcarpathian Oligocene and Miocene flysch zone, 3 — the Subcarpathian Miocene Foredeep in Poland and the Subcarpathian Oligocene and Miocene flysch zones, 4 — the Subcarpathian Miocene Foredeep in the USSR and the Subcarpathian Oligocene and Miocene flysch zones, 5 — the Subcarpathian Miocene Foredeep in Romania, 6 — the Dacian Basin, 7 — the Vienna Basin, 8 — the Danubian Lowland, 9 — the tnner arc bassins of the West Carpathians, 10 — the South Slovakian — North Hungarian sedimentation area, 11 — the East Slovakian Basin, 12 — the Transsylvanian Basin, 13 — the Eisenstadt-West Hungarian Sedimentation area, 14 — the Lavantal Basin, 15 — the Styrian Basin, 16 — the Drava-Sava Basin, 17 — the Pannonian Basin, 18 — Hungarian Alföld.

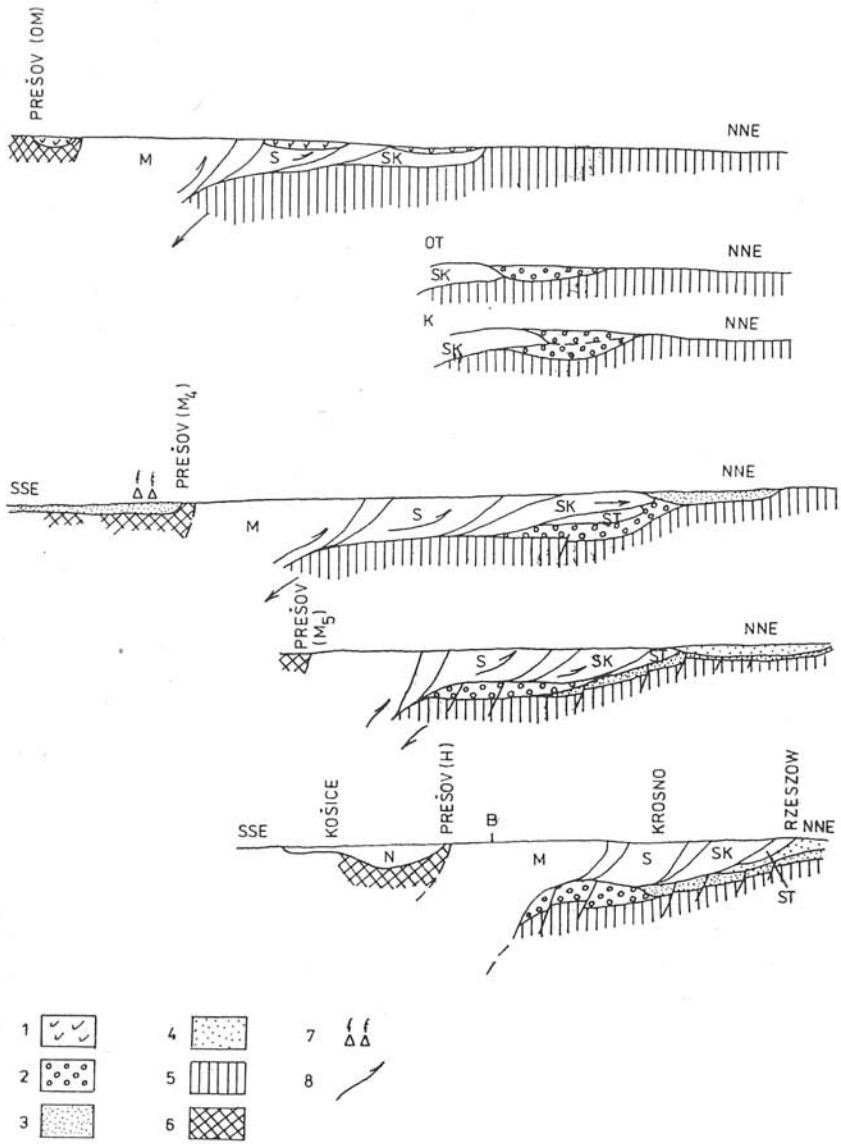


Fig. 2. The schematic outline of the Neogene movement of sedimentation areas in the East Slovakian Basin in dependence on the movement of the West Carpathian Block appearing by the space reduction of the outer arc unitc. *Explanations:* 1 — Egerian sediments, 2 — Ottnangian and Karpatian sediments, 3 — Badenian sediments, 4 — Sarmatian sediments, 5 — the North European Platform, 6 — the Carpathian-Pannonian Block, 7 — volcanism, 8 — direction of the movement B — clippen zone, M — the Magura unit, S — the Silezic unit, SK — the Scolian unit, ST — the Stebnica unit, N — the Neogene, OT — Ottnangian, K — Karpatian, OM — Egerian, M_4 — Badenian, M_5 — Sarmatian, H — recent geographical position (Prešov$_H$).

A more recent division (T. Buday, I. Cicha, J. Seneš, 1965) took in consideration not only the nowadays position but also their development in the stage before so called „Tortonian" (the regional stage Badenian now). As an example the basins are mentioned in the inner part of the West Carpathian arc which show many differences and they can not be considered as salients from the Sarmatian more or less of the uniform, so called „Pannonian Basin". These basins joined with the units of the inner Carpathians are therefore divided into:

a) basins, created before the Neogene, whose subsidence had finished in the Badenian
b) basins, created in the Badenian, their subsidence has begun in the Badenian and the maximum reached in the Pannonian, Pontian and Pliocene (the Danubian Lowland in South Slovakia).

On the basis of geodynamical considerations, analysis of movements inside the filling of the Neogene basins (M. Kováč, 1980), related to the interregional sedimentation areas within the Alpine—Carpathian System, it is possible to propose a more exact division of the Neogene basins of the West Carpathians:

1. *The Neogene basins of the „East-Alpine — West Carpathian origin" (Egerian, Eggenburgian, Ottnangian)*

The stages Egerian, Eggenburgian, Ottnangian are characterized by the end of movements in the outer arc units of the Alps and their uplift from the end of Ottanangian (S. Prey, 1978). By the East Alpine influences the sedimentation area is originated which passed from the area of the outer arc Alpine Molasse in the Eggenburgian to the area of the Subcarpathian Miocene Foredeep in Moravia to some WE directed parts, the Vienna Basin and farther, to the area of the inner depressions of the West Carpathians. The Pre—Neogene basement of the Eisenstadt — West Hungarian sedimentation area and the Pre—Neogene basement of the Danubian Lowland created probably a genetic continuation of the Eastern Alps in these stages. We are lead to this presumption also by development of the common inner arc (so called Intra Carpathian) sedimentation area of the Eastern Alps and the West Carpathians which overlapped from the Drava — Sava Depression on SW to the South Slovakian — Nort Hungarian sedimentation area on NE (Fig. 3, tab. 1). The uplift of the Eastern Alps in the end of the Ottnangian can be one of the causes of sedimentation changement of the West Carpathians. Terefore, according to my opinion a subdivision of sedimentation areas of the West Carpathians in the Egerian, Eggenburgian, Ottnangian should be as follows:

a_1) in continuation of the Eastern Alpine Molasse, the Eggenburgian sediments of the Subcarpathian Miocene Foredeep in Moravia, sedimentation in the Egerian and Eggenburgian of the nappe of the Pouzdřany and Waschberg — Ždánice units, the Vienna Basin (Eggenburgian, Ottnangian), Eggenburgian sediments in the intramountain depressions of the West Carpathians

a_2) the inner basin of the Subcarpathian Miocene Foredeep in Poland, the unit of the Scolian nappe, Egerian and Eggenburgian sediments of the

East Slovakian Basin as a result of the transgression from the North region of the Subcarpathian Miocene foredeep (R. Rudinec, 1978).

b) the east margin of the Danubian Lowland and the South Slovakian Basin as the NW salient of the uniform inner arc sedimentation area of the Eastern Alps and the West Carpathians.

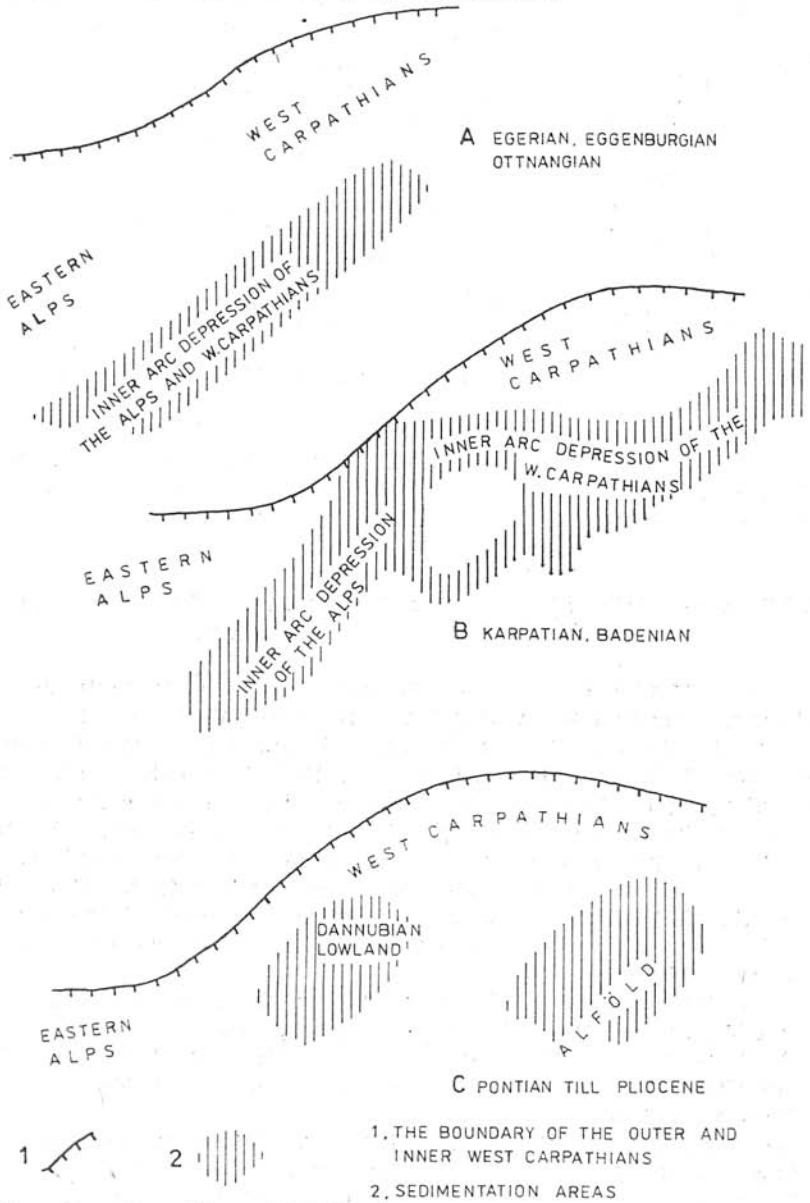


Fig. 3. The schematic outline of the development of the inner arc (Intra Carpathian) sedimentation area of the West Carpathians in the Neogene.

2. *The Neogene basins of the „West Carpathian origin". (Karpatian, Lower Badenian)*

The Karpatian and the Lower Badenian stages are characterized by the independence of the Carpathian development of the Eastern Alps. The creation of a large Subcarpathian Miocene Foredeep begins, the individual West Carpathian inner arc sedimentation area is created, represented by the region of the Danubian Lowland (as the whole — flooded from the Lower, Middle Badenian), the South Slovakian — North Hungarian sedimentation area and the East Slovakian Basin (fig. 3, tab.1).

The inner arc sedimentation area of the Eastern Alps is characteristic by transgression in the region to the Styrian, Lavantallian basins, the Eisenstadt — West Hungarian sedimentation area. From here, the marine connection to the Vienna Basin overlapped, and farther, with the foredeeps of the West Carpahians. A division of the sedimentation areas of the West Carpathians in the Karpathian and Lower Badenian is revealed:

a) Subsarpathian Miocene Foredeep of the West Carpathian (transgression on the Pouzdřany and Ždánice nappe units)
b) the inner arc sedimentation area of the Alps — in its continuation sediments of the Vienna Basin and the NW margin of the Danubian Lowland (in Karpatian — the Trnava and Topoľčany bays)
c) the inner arc sedimentation area of the West Carpathians: the South Slovakian Basin, the East Slovakian Basin; the Badenian transgression crosses the margin of the Danubian Lowland.

3. *The Neogene basins of the „West Carpathian — East Carpathian origin" (Middle Badenian till Sarmatian)*

The stages Middle Badenian — Sarmatian can be characterized by the end of movements in the SW and NW part of the West Carpathians (overthrust of the foredeep of the flysch nappes in the end of the Karpatian and in the Lower Badenian) (I. Cicha et al., 1965, Z. Roth et al., 1962) and by gradual uplift of the area after the Lower Badenian. The East Carpathian part remains the active one of the Carpathian arc, including the NE part of the West Carpathians where the flysch nappes were overthrust to the external basin of the Subcarpathian Miocene Foredeep in the Sarmatian (R. Ney et al., 1974). The subsident area of the Tisa part of the East Slovakian Basin represents a continuation of the inner arc area of the East Carpathians (tab. 1).

The following subdivision of the West Carpathian sedimentation areas in the stages Middle Badenian till Sarmatian is proposed:

a) the Subcarpathian Miocene Foredeep — NE part of the West Carpathian (Poland) continuation of the East Subcapathian Miocene Foredeep
b_1) the Vienna Basin
b_2) the inner sedimentation area of the West Carpathians, the Danubian Lowland, the North Hungarian sedimentation area, the East Slovakian Basin — as continuaton of the inner arc (Intra Carpathian) sedimentation area of the East Carpathians.

4. *The Neogene basins of the West Carpathians in the area of the „Pannonian Basin" (Pannonian, Pontian and Pliocene)*

Sedimentation areas of the stages Pannonian, Pontian and Pliocene were connected with two significant subsident regions. On the West it is the sedimentation basin with the centre of sedimentation in the Kolárovo region (1000 m) with SW continuation from the Danubian Lowland in direction to the inner sedimentation area of the Eastern Alps. On the East or in the centre of the inner arc basin it is subsident region of the Hungarian Alföld — „Pannonian Basin" by older transcription. This is represented by depression of NE — SW orientation with the centre East from the Danube—Tisa tectonic line. Overlap of these subsident regions could point at the finish of activity of mantle diapir and following subsidence under influences of erosion of the earth crust (L. Stegena et al., 1975, D. Vass, 1979). This is assigned by the fact that: the MOHO boundary in direction to the East from the Eastern Alps raises from 50 km to 27 km (M. Miller, 1976), in the region of the Hungarian Alföld the MOHO boundary it still 23 km (L. Stegena et al., 1975).

Division of the sedimentation areas of the West Carpathians in the Pannonian, Pontian and Pliocene:

a) the final subsidence in the region of the Danubian Lowland in South Slovakia
b) the Košice Depression as a North salient of the Hungarian Alföld
c) the young filling of the inner depressions of the West Carpathians — accompanied by the uplift of the central units of the West Carpathians.

With regard to the genetic heterogeneity of sedimentary filling of the West Carpathian Neogene basins in their recent geographical position as also the alochtonous position of the Neogene nappe units, submitted are to discussion the upper mentioned divisions of sedimentation areas of the West Carpathians of all Neogene stages based on contemporary situation of knowledge about geodynamics of the orogenetic process. The division pays attention to the original position of sedimentation basins in time and space and also their relation to large interregional sedimentation areas of the Alpine — Carpathian System.

Translated by Ľ. Lehotská-Halmová

REFERENCES

ANDRUSOV, D., 1958: Geológia československých Karpát. Zv. 1., SAV, Bratislava, 303p.
BUDAY, T. — CÍCHA, I. — SENEŠ, J., 1965: Miozän der West Karpaten. GUDŠ, Bratislava, 295p.
CÍCHA, I. — CHMELÍK, F. — PÍCHA, F. — STRÁNÍK, Z., — 1965: Eine neue tektonische Einheit der Äusseren Karpaten in Südmähren. Geol. práce, Zprávy, (Bratislava), 36, p. 85—104.
FUSÁN, O. — IBRMAJER, J. — PLANČÁR, J., 1979: Neotectonic Blocks of the West Carpathians. Geodynamic investigations Czechoslovakia. Final Report. Veda, Bratislava, p. 187—193.
KOVÁČ, M., 1980: Kvalitatívna analýza pohybov v neogénnych panvách Západných Karpát. Kandidátska dizertačná práca. Archív GU SAV, Bratislava, 152p.
MAHEĽ, M., 1979: Development and structure of the Czechoslovak Carpathians in the

light of principles of Global tectonic. p. 9—27., in: MAHEĽ, M. — REICHWALDER, P., edit. Czechoslovak Geology and Global Tectonic. Veda, Bratislava, 285p.
MILLER, M., 1976: A Lithospheric Seismic Profile along the Axis of the Alps 1975. First Results., Paleogeographysics, (Basel), 114, p. 1109—1130.
NEY, R. — BURZEWSKI, W. — BACHLEDA, T. — GÓRECKI, W. — JAKÓBCZAK, K. — SLUPCZYNSKI, K., 1974: Zarys paleogeografii i rozvoju litologiczno — facialnego utwórov miocenu Zapadliska Przedkarpackiego. Prace Geologiczne, (Warszava), 18, p. 7—64.
LE PICHON, X., — FRANCHETEAU, J. — BONNIN, J., 1973: Plate Tectonics. Elsevier (Amsterdam) p. 300.
PREY, S., 1978: Rekonstruktionsversuch der alpidischen Entwicklung der Ostalpen. Mitt. Österr. geol. Ges., (Wien), 69, 1, p. 1—25.
ROTH, Z., et al. 1962: Vysvětlivky k přehledné geol. mapě ČSSR 1:200 000 M-33-XIX Ostrava, Praha, p. 292.
ROTH, Z., et al. 1962: Vysvětlivky k přehledné geol. mapě ČSSR 1:200 000 M-33-XXIV Olomouc, Praha, p. 226
ROTH, Z., 1977: Structure of the North European Platform below the Carpathian Foredeep and the Carpathians in the ČSSR. Věstník ÚÚG, (Praha), 52, 3, p. 129—135.
RUDINEC, R., 1978: Paleogeographical, lithofacial and tectogenetic development of the neogene in Eastern Slovakia and its relation to volcanism and deep tectonics. Geol. zborn Geologica Carpathica (Bratislava), 29, 2, p. 225—240.
STEGENA, L. — GECZY, B. — HORVÁT. F., 1975: A Pannon medence kesökainozós fejlödese. Földtani közlöny, (Budapest), 105, 1, p. 101—123.
VASS, D., 1979: Genesis of inner — molasse basins in West Carpathians in light of leading function of mantle in Earths crust development p. 183 — 199 in: MAHEĽ, M. — REICHWALDER, P., edit. Czechoslovak Geology and Global Tectonics, Veda, Bratislava, p. 285.

Review by J. SENEŠ (Manuscript received September 12, 1980