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HISTORY OF PARATETHYS

by

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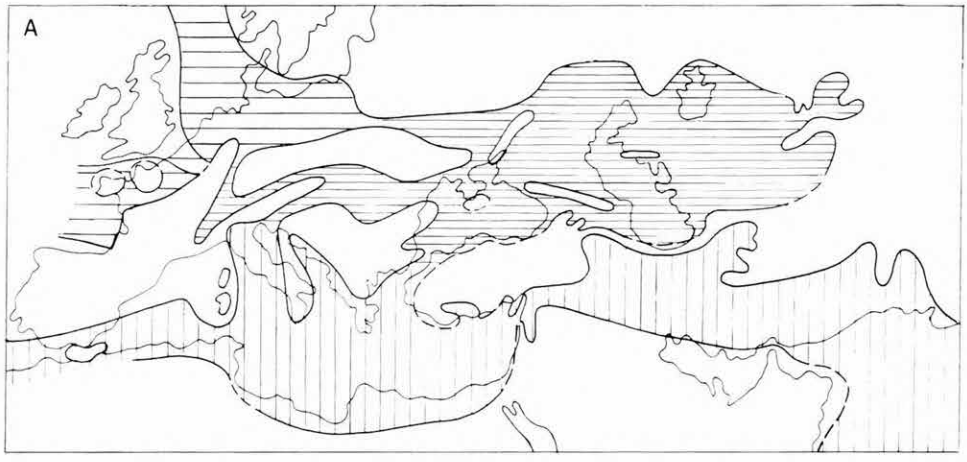
The largest innercontinental Paratethys sea appeared in Oligocene (Fig. 1, A) due to the isolation of the extreme northern part of Tethys as a result of orogenic movements of the Alpine belt, caused by the drawing of the continental plates of Africa, Arabia and Hindustan closer to Eurasia. The principal factors determining the history of Paratethys development were tectonic movements (alpine orogenesis), global changes of the ocean level and climatic variations.

From the end of Early Miocene Paratethys, for the first time since the beginning of its history, subdivides quite definitely into western and eastern parts (Fig. 1, C), its eastern (Euxino—Caspian) part was twice as large as its western (Pannonian) one. Further differentiation occurred later. At present exist two basins only—the Azov—Black sea and the Caspian sea, in the place of Paratethys.

Against the historical background of the process of Paratethys disintegration, connections both within Paratethys, in particular between its Western and Eastern basins, and between Paratethys as a whole and open marine basins appeared and disappeared repeatedly. This changed the character of the whole Paratethys and of its separate parts. On this basis N. I. ANDRUSOV singled out three cycles of development in the Eastern Paratethys (Tarchanian—Karaganian, Konkian—Sarmatian and Maeotian). Each of them started with the entering of saline waters of the world ocean into the basin and the penetration of marine organisms and finished with complete or partial closing of Paratethys and the formation of specific, usually brackish-water fauna. It caused the alternation of basins of various types. A number of cycles in the Western Paratethys have been introduced by J. SENEŠ.

The amount of data available at present makes it possible to single out in the Eastern Paratethys not less than seven cycles during Oligocene and Neogene (NEVESSKAJA et al., 1984). The *initial (I) cycle* (Early Oligocene—beginning of Late Oligocene) was characterized by a rather extensive connection with the Atlantic ocean (Fig. 1, A) and considerable hydrogen sulphide contamination. In the second half of the cycle (Solenovian time) the first closing of Paratethys took place. It was accompanied by the formation of endemic fauna of molluscs and ostracods.

Cycle II (Late Oligocene—Early Miocene) started with the immigration of marine fauna from the Atlantic area. Later (Sakaraulian, Eggenburgian) the joining with Tethys happened. In the first part of the cycle hydrogen sulphide contamination was the strongest, due to which fauna at the end of Oligocene—beginning of Miocene is practically unknown. It brings about special difficulties in the determination of the Oligocene—Miocene boundary and basin reconstruction (Fig. 2, IIa). The Sakaraulian basin contained diverse, very warm-water mollusc fauna with a great number of species and genera common with Eggenburgian basin of Western Paratethys. However, there are here many species known neither in Western Paratethys nor in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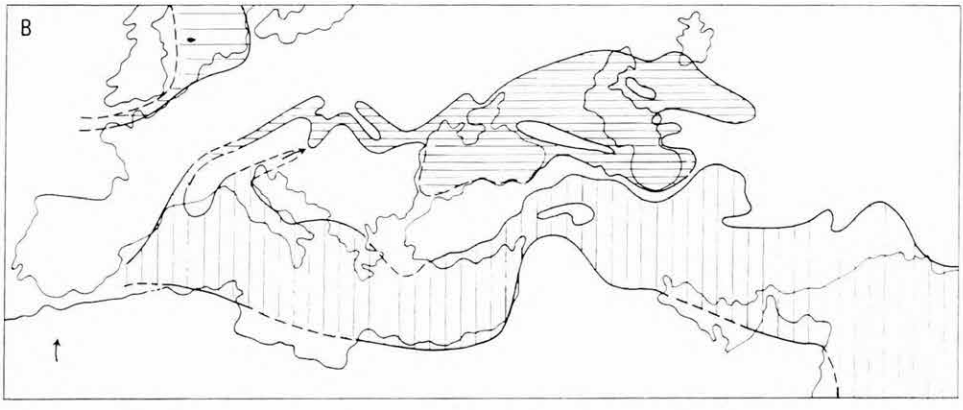
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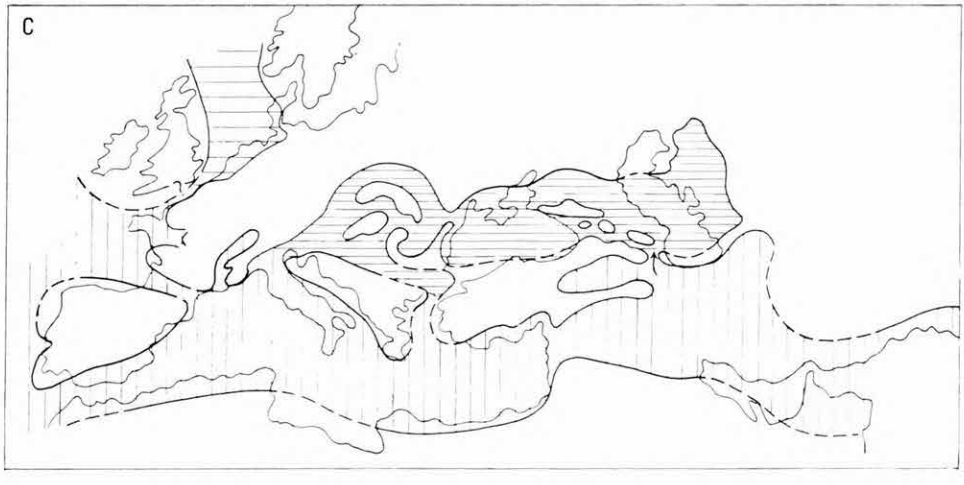
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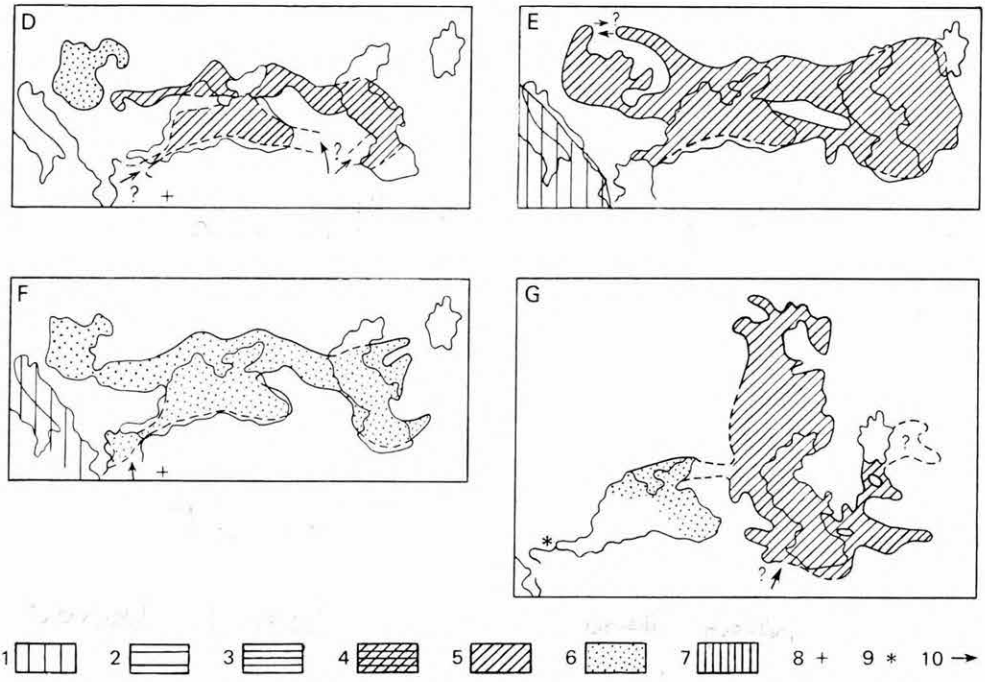

Fig. 1. (A—G) Palaeogeographic sketches of the Paratethys and adjacent basins

Tethys: *1*, *2* boreal basins; Paratethys: *3* marine, *4* marine with a somewhat abberrant salinity, *5* semimarine, *6* brackish-water, *7* freshwater.—*8* The location of molluscs of Pontian type (TANNER, 1974), *9* the location of molluscs of Akchagylian type (TANNER, 1982), *10* probable communication of Paratethys with open marine basins

the Mediterranean Tethys at that time. This permits us to assume the possibility of connection of the Eastern Paratethys not only with the Mediterranean Tethys but with also Indo-Pacific region of Tethys (Fig. 1, B). The end of this cycle (Kozachurian, Ottnangian) was marked by the closing of Paratethys and the formation of brackish-water fauna of molluscs and other groups. At that time there were episodical connections between the Western and the Eastern Paratethys owing to which some specific brakish-water species penetrated from the Western Paratethys into the Eastern and vice versa (POPOV, VORONINA, 1983). Cycle II corresponds to Eoparatethys according to SENEŠ. This cycle was characterized by still faint differentiation of the Eastern and the Western Paratethys and by presence of hydrogen sulphide contamination.

Cycle III (Mesoparatethys according to SENEŠ) was characterized by precise division into the Eastern and the Western Paratethys (Fig. 1, C). At the beginning of the cycle (Tarchanian) the Eastern Paratethys had communications both with the Eastern Paratethys (Carpathian basin) and the Indo-Pacific regions of Tethys. Early Tarchanian fauna included polyhaline molluscs and foraminifera, echinoids and others. In the second part of Tarchanian the salinity slightqlitly decreased, though the basin has been still marine.

The salinity of the Tschokrakian basin following the Tarchanian was probably high enough but deviated from the normal to a certain extent. This basin had close

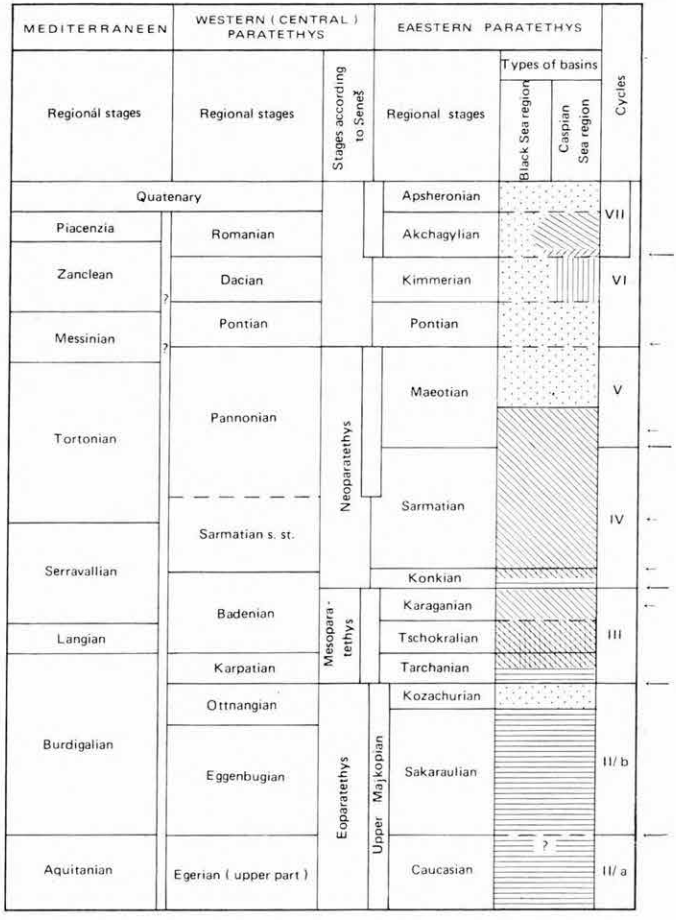

Fig. 2. Geological time table

connections with Tethys. This communication must have taken place in the southeastern part of the Eastern Paratethys, as it is here that the most diverse fauna is observed. In Late Tschokrakian and Karaganian times the Eastern Paratethys began closing up and freshening. This caused extinction of the overwhelming majority of marine species and the evolution of endemic forms. Only in the second half of Karaganian time the episodical communication with Tethys waters was marked in the southeast of Paratethys. This caused a brief appearance of some marine species. Gypsum formation was characteristic of the Karaganian time. This stage may correspond to the stage of gypso- and salt accumulation of Middle Badenian. The Western Paratethys at the beginning and at the end of cycle III (Early and Late Badenian) had rather extensive communications with the Tethys (RÖGL et al., 1978).

Cycle IV of the Eastern Paratethys began with the Konkian time and lasted till the end of Sarmatian, i.e. it enveloped the second half of Middle and the beginning of the Late Miocene. This cycle corresponds to Neoparatethys according to SENEŠ. At the beginning of the cycle rather broad communication elisted with the Tethys.

The salinity became close to normal marine one, and the basin got inhabited by polyhaline species of molluscs, Bryozoa, Echinodermata, Foraminifera and others. The communication with the Tethys was probably in the southeast of Paratethys supported by the presence of most polyhaline assemblages in these regions (Transcaspian and Eastern Georgia). Some connection might also have existed between the Konkian basin and the Late Badenian Western Paratethys. During the first half of Sarmatian time Paratethys was again a unique basin (Fig. 1, D), and then complete isolation of the Western Paratethys from Eastern one occurred. In comparison with the previous time in Early Sarmatian there was impoverishment of all groups of organisms (ILJINA et al., 1976; PARAMONOVA et al., 1979) as a result of the extinction of a large number of polyhaline genera, caused by the reduction of salinity. In such situation few euryhaline species of molluscs, ostracods, foraminifera and other groups because widespread. In the course of time some of them gave birth to numerous endemic species. The character of the Middle and Late Sarmatian fauna in general points to the continuing decrease of salinity, though in the first half of Middle Sarmatian episodical communications with the Mediterranean probably still appeared. Absolute dating (ILJINA et al., 1976; VASS, 1979; CHUMAKOV et al., 1984) points to the possibility of correlation of Lower Sarmatian to Upper Serravallian and of Middle and Upper Sarmatian to Lower Tortonian. Beginning with the second half of Middle Sarmatian the Pannonian brackish-water basin was formed as a result of the isolation Western Paratethys from the Eastern one. Fully endemic mollusc fauna appeared there during Pannonian time.

In the post-Sarmatian time in the Eastern Paratethys *cycle V* — (Maeotic)-began whereas in the western part of Paratethys the previous cycle continued (Fig. 1, E; Fig. 2). The Early Maeotian transgression was accompanied by the coming of marine species from some basin which was communicating with the Mediterranean basin. This connection might probably take place in the southeast but might have passed through southwestern regions of the Eastern Paratethys (ILJINA et al., 1976; ILJINA, 1980; STEVANOVIĆ, ILJINA, 1982). It is possible that the maximum of the Maeotian transgression reflects the maximum of Tortonian transgression. By the end of Early Maeotian isolation of the Eastern Paratethys began, salinity decreased and a brackish-water fauna replaced marine one.

Cycle VI of the development of the whole of Paratethys began in post-Pannonian time in Western Paratethys and in post-Maeotian in the Eastern Paratethys. The vast Early Pontian basin was formed, Paratethys again becoming united (Fig. 1, F). In the Eastern Paratethys this cycle began with the coming of brackish-water fauna, alien to the previous late Maeotian one, as well as some marine elements. This factor makes it possible to single out this cycle as an independent one (Fig. 2). The majority of Early Pontian molluscs of the Eastern Paratethys is of Aegean origin. Here were only single common species which had genetic ties with the Pannonian fauna and inhabited the Western Paratethys. Consequently, the communication between the Western and Eastern Paratethys in Early Pontian was complicated (NEVESSKAJA, STEVANOVIĆ, 1985). Beginning with the second half of Pontian Paratethys started to skrink thus by the end of Pontian time the Pannonian basin disappeared and the Eastern Paratethys was devided into the Euxinian and Caspian basins.

In the euxinian region cycle VI lasted till the end of Pliocene (Tchaudian time), whereas in the Caspian region it continued to the end of Kimmerian.

In post-Kimmerian time the new *cycle VII* began in this area (Fig. 2). It lasted till the end of the Pliocene (Akchagylian—Apsheronian). Its was marked by the coming of the marine Akchagylian fauna which had been evidently caused by the

communication of the Eastern Paratethys with the Mediterranean (NEVESSKAJA, TRUBIKHIN, 1984) which had reappeared somewhere in the southeast (Fig. 1, G). The Akchagylian molluscs are definitely of mediterranean origin and have no genetic ties with the Sarmatian ones (PARAMONOVA, 1977). The Akchagylian basin in the Caspian area of the Eastern Paratethys replaced by the brackish-water Apsheronian basin and later by the also brackish-water Baku, Khazarian, Khvalynian and Neocaspian basins so that cycle VII which started at the beginning of Akchagylian continued in the Pleistocene, too.

In the euxinian region the last Neogene Ponto-Tschaudian cycle (VI) was replaced by the Quaternary cycles reflecting interchanges of brackish-water (ancient euxinian and neo-euxinian) and marine (Uzunlarian, Karangatian and Black Sea proper) basins.

REFERENCES

CHUMAKOV I. S., GANZEJ S. S., BYZOBA S. L., DOBRYNINA V. JA., PARAMONOVA N. P. 1984: Geokhronologija sarmata Vostochnogo Paratetisa. — Dokl. AN SSSR 276. (5): 1189—1193.

ILJINA L. B. 1980: O svjazjakh meoticheskogo morja s Vostochnym Tetisom. — Izv. AN SSSR, ser. geol. 7.:138—142.

ILJINA L. B., NEVESSKAJA L. A., PARAMONOVA N. P. 1976: Zakonomernosti razvitija molluskov v opresnennykh bassejnakn neogena Evrazii (pozdnij miotsen-rannij pliotsen). — Tr. Paleontol. in-ta. 155.:1—288.

NEVESSKAJA L. A., STEVANOVIĆ P. M. 1985: Ponticheskij etap razvitija Paretetisa. — Izv. AN. SSSR. ser. geol. 9.:36—51.

NEVESSKAJA L. A., TRUBIKHIN V. M. 1984: Istorija Kaspijskogo bassejna i ego fauny molluskov v pozdnem pliotsene i rannem plejstotsene. — V kn.: Antropogen Evrazii. M.: Nauka.:19—27.

NEVESSKAJA L. A., VORONINA A. A., GONCHAROVA I. A., ILJINA L. B., PARAMONOVA N. P., POPOV S. V., CHEPALYGA A. L., BABAK E. V. 1984: Istorija Paratetisa. — 27 Mezhd. geol. kongr. Paleookeanologija. Koll. 03. Dokl. 3.:91—101.

PARAMONOVA N. P. 1977: K sistematike sarmatskikh i akchagylskikh kardiid (Bivalvia). — Paleontol. sb., 3.:65—74.

PARAMONOVA N. P., ANANOVA E. N., ANDREEVA-GRIGOROVIC A. S., BELOKRYS L. S., GABUNIA L. K., GRUSINSKAJA K. F., HONDKARIAN S. O., CARMISCHINA G. I., KOZIRENCO T. F., MAJSURADZE L. S., MOVLAZADE-ATAEVA E. Z., NEVESSKAJA L. A., PONOMAREVA L. D., ROSHKA V. H., TSHEPALYGA A. L. 1979: Paleontological characteristics of the Sarmatian s. l. and Maeotian of the Ponto-Caspian area and possibilities of correlation to the Sarmatian s. str. and Pannonian of the central Paratethys. — Ann. Géol. pays hellén. (Hors sér.) 2.: 961—971.

POPOV S. V., VORONINA A. A. 1983: Kotsakhurskij etap razvitija Vostochnogo Paratetisa. — Izv. AN SSSR, ser. geol. 1.:58—67.

RÖGL F., STEININGER F. F., MÜLLER C. 1978: Middle miocene salinity crisis and paleogeography of the Paratethys (Middle and Eastern Europe). In Initial Reports of the Deep Sea Drilling Project, Washington. 42. (1):985—990.

STEVANOVIĆ P. M., ILJINA L. B. 1982: Stratigrafija meotisa Vostochnoj Serbii i sosednikh regionov po molluskam. — Bull. Acad. serbe sciences et Arts, t. 82, Cl. Sci. nat. et math. Sci. nat. 23.:105—136.

VASS D. 1979: Review of activity-working group for radiometric age and paleomagnetism (1975—1978). — Ann. Géol. pays hellén. (Hors sér.) 3.:1427—1441.

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