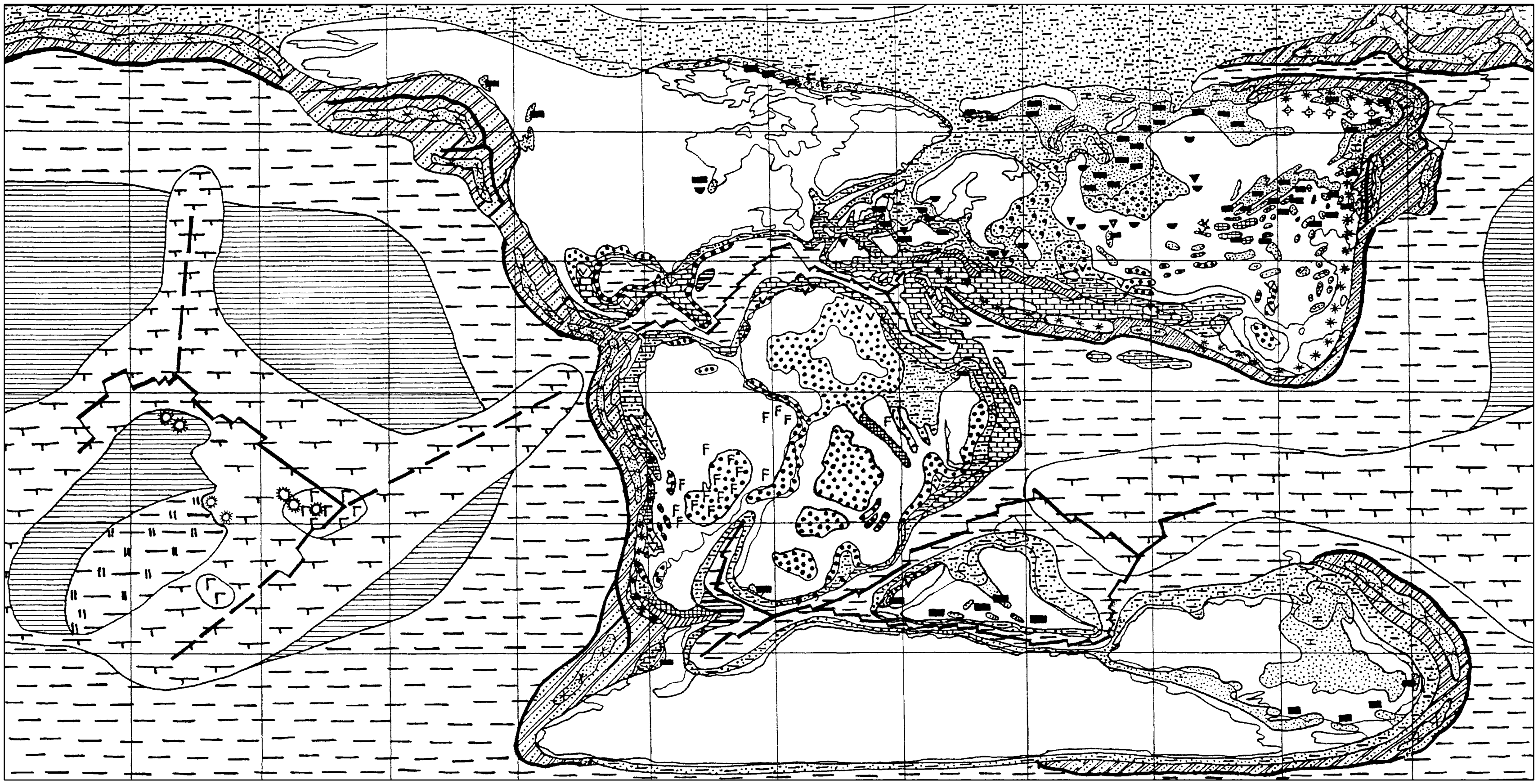


Fig. 4. The lithologic–paleogeographic map for the Barremian age of the Cretaceous (symbols as in Fig. 1).

iterranean Tethys, where they crossed almost the entire basin in the meridional direction and thus created a barrier to westerly surface currents in the tropical belt of the northern hemisphere. Isolated carbonate platforms (Apennines, Apulian, Gavrovo, Taurus, Midian, Bahamas, Mayan, and others) were separated from each other and from pericratonic carbonate platforms by narrow and deep basins, which accumulated either marly–calcareous sediments enriched in planktonogenic organic matter and enclosing the pelagic ammonite fauna or the hemipelagic and pelagic limestones of the Majolica facies and turbidites (Bernoulli, 1972; Bourbon, 1978; Emery and Uchupi, 1984; Dercourt *et al.*, 1985; Dercourt *et al.*, 1993). Because of their small dimensions, some pericratonic and isolated carbonate platforms and the deep basin separating them are not shown in lithologic–paleogeographic maps. All these areas are arbitrarily defined as settings of the shallow-water shelf calcareous sedimentation demonstrating the principal location of the carbonate platform areas.

In the Central Atlantic, Gulf of Mexico, and Caribbean areas, deep-water sedimentation prevailed throughout the Berriasian–Barremian time of the Early Cretaceous. Gray thin-bedded micritic limestones and marls, calcareous hemipelagic sediments, and pelagic limestones were accumulated in these areas (Lancelot *et al.*, 1978; Murdmaa *et al.*, 1979; Tucholke *et al.*, 1979; Owens, 1983; Emery and Uchupi, 1984; Tucholke and McCoy, 1986; Schlee *et al.*, 1988; Stephan *et al.*, 1990; Salvador, 1991; Dercourt *et al.*, 1993). Judging from the difference between modern hypsometric positions of deep-water facies and coeval shallow-water limestones (Blake Plateau), these basins were up to 3–3.5 km deep (Sclater *et al.*, 1977; Murdmaa *et al.*, 1979; Emery and Uchupi, 1984). Clayey–calcareous sediments enriched in organic matter, the deposition of which was most intense during the Valanginian and Hauterivian (Weissert, 1981; Cotillon and Rio, 1984; Emery and Uchupi, 1984; Arthur and Dean, 1986), were characteristic of some areas in the northwestern Atlantic Tethys, Gulf of Mexico, and several limited areas in the Mediterranean Tethys. One of such areas (the northwestern Atlantic Tethys) is arbitrary defined in maps as a basin of black-shale sedimentation.

It was presumed that deep-water hemipelagic facies of clayey–calcareous sediments were also widespread in the eastern part of the Tethys (Dercourt *et al.*, 1993), though geological records about this spacious oceanic basin were almost wholly destroyed by subsequent subduction and collision between Hindustan and Asia. The hypothetical belt of pelagic calcareous sediments is also shown along the reconstructed spreading ridge in the central part of the eastern Tethys.

During the Berriasian–Barremian, the gradual opening of the Southern Ocean and sea-floor spreading advancing southwestward separated Gondwana into two major western and eastern continental blocks. At the initiatial opening stage, the South Atlantic represented a narrow gulf of the Southern Ocean (Rabinowitz and La Brecque, 1979; Scotese *et al.*, 1987, 1988; Patriat and Segoufin, 1988). Mainly terrigenous and calcareous–terrigenous hemipelagic sediments accumulated in the narrow though relatively deep Southern Ocean. In the Hauterivian and Barremian, black shales enriched in organic matter were deposited along its western margin (Malumian *et al.*, 1983; Thomson, 1983; Krasheninnikov and Basov, 1985; Kavun and Vinnikovskaya, 1993).

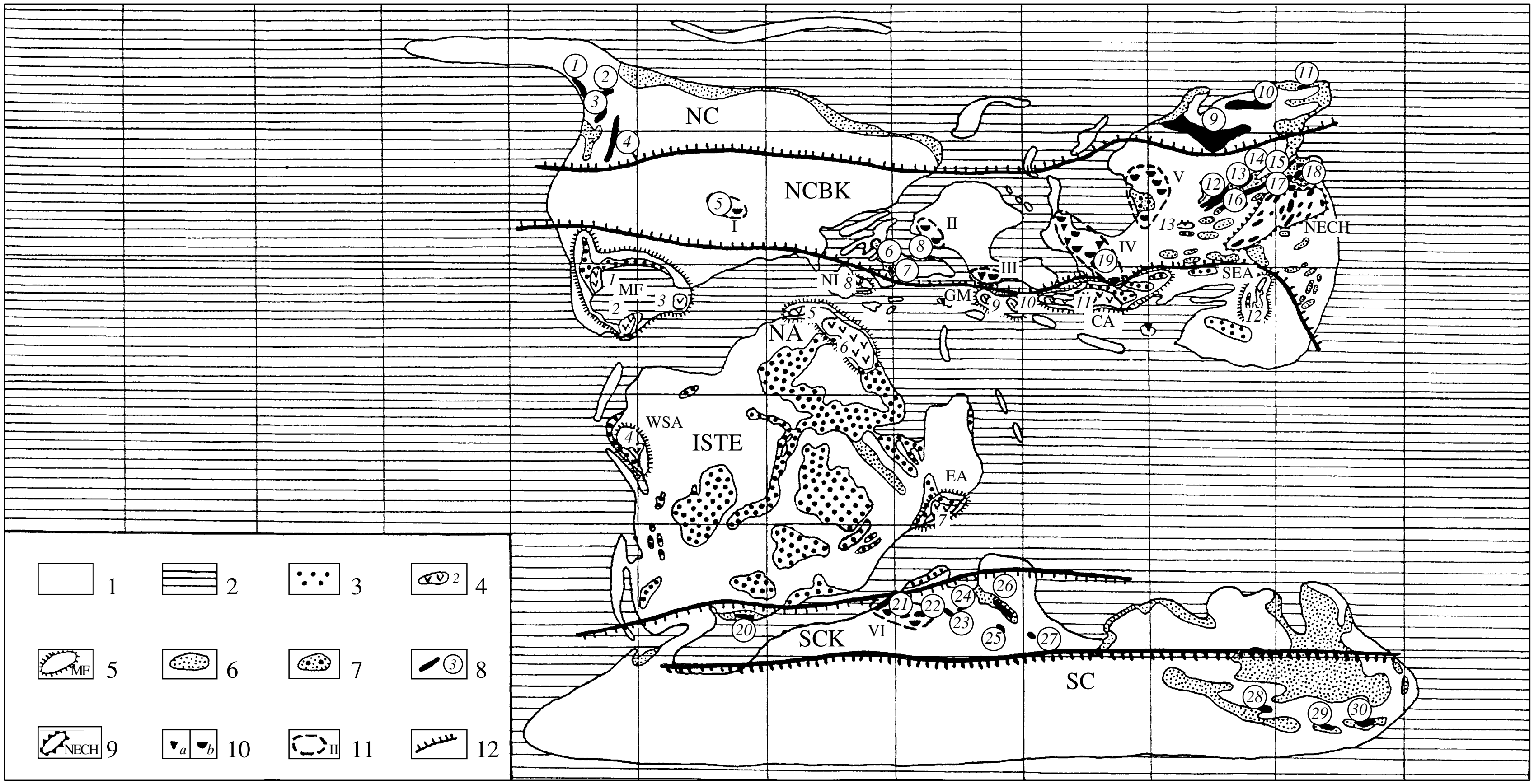
Beginning in the Barremian, Hindustan started to move away from Antarctica, because a spreading zone appeared between them and created the deep-water seaway. This event marked the initial opening of the Indian Ocean, and its floor became a new area of hemipelagic terrigenous deposition (Patriat and Segoufin, 1988).

In the Neocomian, the Pacific represented a spacious and deep oceanic basin exceeding in size its modern area. According to reconstructions (Zonenshain *et al.*, 1984; Kononov, 1989) and available new data, four major lithospheric plates (Kula, Farallon, Phoenix, and Pacific) continued to evolve here along the system of spreading ridges with two triple-junctions. Reliable data on sedimentation environments are obtained (from deep-sea drilling) only for the Pacific plate, whereas three other plates are completely eliminated by subduction, and their history can be depicted only from isolated blocks (terranes) incorporated into accretionary structures of surrounding continents. The sediment distribution in these vanished plates is shown hypothetically by analogy with the Pacific plate and on the basis of general regularities of oceanic sedimentation.

During the Neocomian, the small Pacific plate born in the Jurassic was located in the southern hemisphere, in the center of the oceanic pelagic area far from the continents, and this resulted in accumulation of typical pelagic facies, whose characteristic features are red coloration, prevalence of biogenic and authigenic components, absence of terrigenous material (except for the finest clay), insignificant thicknesses, and a low sedimentation rate (Murdmaa, 1987).

In the central part of the Pacific plate most distant from the spreading axis, an oceanic area below the carbonate compensation depth (CCD) existed from the Berriasian through the Barremian. Red carbonate-free clayey–siliceous (radiolarian) sediments were accumulated in this part of the basin. This area of abyssal pelagic facies gradually widened during the indicated period of time. In the Barremian, typical pelagic clays including zeolite varieties were accumulated together with radiolarites.

Pelagic calcareous (nannofossil–foraminiferal) oozes were accumulated above the CCD along the mid-oceanic ridges and on submarine rises existing from the Jurassic. On the Schatsky Rise, the Berriasian–Valanginian(?) was marked by the accumulation of black siliceous sediments enriched in organic matter.


NC
NCBK
I
II
III
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4
5
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8
9
10
11
12
a
b
NECH
MF
II

Fig. 5.

There were several areas of active intraplate volcanism, the largest of which—the Darwin Rise—was situated during the Neocomian near the spreading axis, probably in an area of triple-junction at the eastern corner of the Pacific plate. Volcanic edifices that appeared there in the Hauterivian–Barremian now compose the constituents of the Mid-Pacific Mountains. Volcanoes of the Japanese guyot group in the northern part of the plate, as well as those of the Schatsky Rise, were probably active in earlier epochs as well. As a result of intraplate volcanism, the Ontong-Java and Hess rises were formed in the Barremian. Many volcanic islands rose above the sea level and were subsequently (beginning in the Hauterivian–Barremian) transformed into atolls (Sager *et al.*, 1993).

MAIN DISTRIBUTION PATTERNS OF PALEOGEOGRAPHIC ENVIRONMENTS IN CONTINENTAL MARGINS

This section is dedicated to characteristics of paleogeographic environments in active continental margins of the western, eastern, and southern parts of Laurasia and in marginal areas of Gondwana, except for those adjacent to the Central Atlantic, Tethys, and Southern Ocean (Figs. 1–4).

As was mentioned previously (Zharkov *et al.*, 1995), the method of compiling paleogeographic and paleogeodynamic maps of the ocean–continent transition zone for successive ages of the Early Cretaceous included the analysis of Mesozoic orogenic belts, which fringe continents and are composed of tectonically imbricated nappes and thrust sheets of heterogeneous and heterochronous rock complexes—the terranes of oceanic (sedimentary, ophiolitic, island-arc) and marginal continental formations. The main purpose of this analysis was to determine the primary nature of allochtonous terranes occurring in modern orogenic belts as highly dislocated structural units.

The ocean–continent transition zones considered below encompass peripheral parts of oceanic basins (often comprising chains of volcanic island arcs) and marginal areas of continents. Interaction of oceanic and continental plates along convergent boundaries was responsible for the conformable spatial distribution of paleogeographic settings in the ocean–continent transition zone. As a result, lithologic complexes of different genesis in the peripheral oceanic zones and continental margins show the lenticular–banded distribution in the plan (Figs. 1–4).

In the Berriasian through the Barremian, almost the entire periphery of the paleo-Pacific was fringed by systems of volcanic island arcs, which were connected along the strike with volcanic belts of continental margins in some regions. The lateral succession of structures in the ocean–continent transition zone commonly included a deep-sea trench, a fore-arc basin with turbidite deposits, a volcanic island arc with volcanic rocks of the calc-alkaline and tholeitic series and also with terrigenous–volcanogenic deposits, and a back-arc basin filled with turbidites. Continental margins adjacent to the peripheral oceanic zones were different in their paleogeographic environments. Land areas alternated with shelf seas, which accumulated sandy–clayey and, less commonly, terrigenous–calcareous sediments. In addition, some segments of the circum-Pacific belt were occupied by chains of land volcanoes of marginal continental volcanic chains. These volcanic belts were accompanied by fore-arc depressions filled with turbidite or sandy–clayey sediments.

The small back-arcs occupied by basins were the accumulation areas of red-bed molasses and gray-colored terrigenous and calcareous deposits often in combinations with alkalic basaltic rocks of the intraplate type. In rare cases, such basins were transformed into marginal seas where turbidites and tholeitic basalts that were similar to MORB lavas accumulated.

Characterizing more thoroughly paleogeographic environments in the transition zone from the past

Fig. 5. Belts and provinces of arid and humid sedimentation of the Berriasian Age of the Early Cretaceous.

(1) land; (2) oceans, shelves, and epicontinental seas; (3) provinces and basins of the red-bed arid sedimentation; (4) evaporite basins (*1*, Sabians; *2*, Yucatan; *3*, South Floridan; *4*, Acre; *5*, Moroccan; *6*, Algerian–Tunisian; *7*, Mandera; *8*, Soria; *9*, Moesian; *10*, Georgian; *11*, Central Asian; *12*, Lanpang–Simao; *13*, Dzabhan, Banernur); (5) evaporite provinces and their indices (MF, Mexico–Floridan; WSA, Western South American; NA, North African; EA, East African; NI, North Iberian; GM, Georgian–Moesian; CA, Central Asian; SEA, Southeast Asian); (6) provinces, areas, and basins of terrigenous humid sedimentation (gray beds); (7) humid provinces and areas of variegated and red-bed sedimentation; (8) coal-bearing basins: *1*, Saint Elias; *2*, Whitehorse; *3*, Bowser, Sastus, Skeena; *4*, Foothills and Front Ranges of Rocky Mountains; *5*, Moose River; *6*, Celtic, Bristol, Wild, and Channel; *7*, Parisian; *8*, Western Netherlands, Lower Saxonian, and Altmark–Branderburg; *9*, Lena; *10*, Zyryanka; *11*, Pegtymel'; *12*, West Transbaikalian (Gusinoe Ozero, Uda, Khilok–Chikoi, Eravnoe, and others); *13*, Olekma–Vitim (Ukshum, Vitim, and others); *14*, Southern Yakutia; *15*, Udsk; *16*, East Transbaikalian (Chikoi, Chita–Ingoda, and others); *17*, Amur–Zeya; *18*, Bureya; *19*, Karakamys; *20*, Algoa; *21*, Sakoa; *22*, Palar and others; *23*, Eluri, Ongole, and others; *24*, Wardha, Nagpur, and others; *25*, Talcher; *26*, Narmada (Satpura and others); *27*, Damodor and others; *28*, Otway; *29*, Bass; *30*, Gippsland, Strzelecki; (9) Northeastern Chinese (NECH) coal-bearing province (Songliao, Hailar, Erlian, and other basins); (10) areas of bauxite formation (*a*) and kaolinite-formation (*b*); (11) provinces of kaolinite or kaolinite–bauxite formation: I, Moose River; II, Western Baltic; III, Northern Black Sea; IV, Central Asian–Western Siberian; V, Eastern Siberian; VI, Southern Madagascar–Southern Hindustan; (12) boundary between climatic belts. Climatic belts: NC, northern coal-bearing of the circumpolar humid zone; NCBK, northern coal–bauxite–kaolinite belt of the humid zone in middle latitudes; ISTE, intersubtropical evaporite belt of the arid zone; SCK, southern coal–kaolinite belt of the humid zone in middle latitudes; SC, southern coal-bearing belts of the humid zone.