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Paleogeography of the Berriasian–Barremian Ages of the Early Cretaceous

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Abstract—Global litholologic–paleogeographic maps are compiled for the Berriasian, Valanginian, Hauterivian, and Barremian ages of the Early Cretaceous. Main features of paleogeography, sedimentation environments in oceans, regularities in distribution of paleogeographic environments in continental margins, spatial position of arid and humid sedimentation settings in continents, and position of latitudinal climatic belts of the Neocomian time are considered. It is noted that clayey–calcareous hemipelagic and pelagic sedimentation prevailed in the Tethys; carbonate-free clayey–siliceous and calcareous pelagic sedimentation was characteristic of the Pacific, whereas hemipelagic terrigenous sediments were mainly accumulated in the Southern Ocean. Morphological–structural lateral series of deep-water trenches, turbidite fore-arc basins, and volcanic belts of island-arcs and continental margins are distinguished at the convergent boundaries between continental and oceanic plates. Five latitudinal climatic belts of the Neocomian time corresponded to the northern circumpolar humid zone with coal deposits, the northern midlatitudinal humid zone with coal–bauxite–kaolinite deposits, the intersubtropical arid zone with evaporites, the southern midlatitudinal humid zone with coal–kaolinite deposits, and the southern humid zone with coal-bearing sequences.

Key words: *paleogeography, Berriasian, Valanginian, Hauterivian, Barremian, hemipelagic and pelagic oceanic environments, continental margins, arid and humid climates, evaporite and coal-bearing basins, climatic belts.*

INTRODUCTION

This paper is the next in a series of publications devoted to characteristics of global lithologic–paleogeographic maps for subsequent Cretaceous ages compiled with the purpose to elucidate the evolution of paleogeographic and paleoclimatic peculiarities in the spatial distribution of sedimentation settings and volcanic belts during the epoch of the warm biosphere. This paper presents lithologic–paleogeographic maps for the Berriasian, Valanginian, Hauterivian, and Barremian ages of the Early Cretaceous (Figs. 1–4). They were compiled using the same method that was applied for previously published maps for the Middle Cretaceous (Zharkov *et al.*, 1995). By means of independent systems of symbols, arid and humid zones in continents, shelves, island arcs, and in the peripheral and central areas of the ocean are distinguished in these maps. The maps are sufficiently informative. They allow us to elucidate peculiarities of the spatial distribution of carbonate, terrigenous, glauconite-bearing, phosphorite-bearing, and chalk sedimentation environments in shelf and epicontinental seas; to demonstrate features of evaporite sedimentation and coal accumulation in continents; to derict patterns of turbidite and black-shale deposition; and to reconstruct the general distribution of hemipelagic and pelagic sediments in oceans. Simultaneously, they provide sufficiently complete information on the distribution of magmatic and sedimentary–volcanogenic rock complexes in the active continental margins, intracontinental areas, and oceans.

It is impossible to consider in one paper all peculiarities of paleogeographic and paleoclimatic confinement of the distinguished sedimentation and volcanism settings. Keeping this in mind, we paid the most attention to the following: (1) to principal paleogeographic features that existed during the first half of the Early Cretaceous and to paleoenvironments of oceanic sedimentation; (2) to the main regularities in distribution of paleogeographic settings in continental margins; and (3) to the spatial distribution of arid and humid sedimentogenesis in continents and to reconstruction of latitudinal climatic belts of the Neocomian time. The reference list includes only those publications that are essential for this paper. All other works that were used in compiling maps were listed in our previous article (Zharkov *et al.*, 1995).

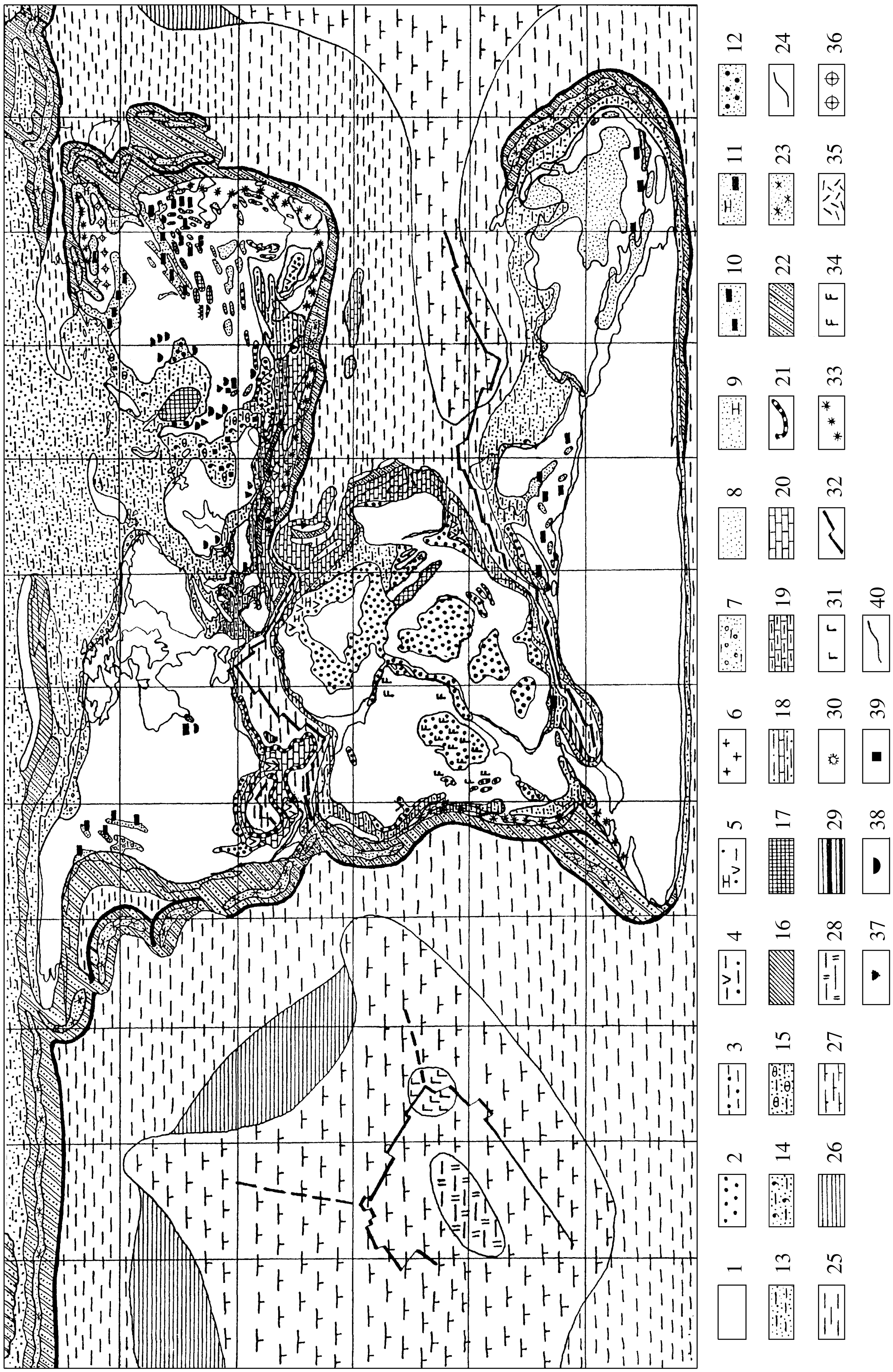

Fig. 1.

THE PRINCIPAL PALEOGEOGRAPHIC FEATURES AND SEDIMENTATION ENVIRONMENTS IN OCEANS

Paleogeographic peculiarities of the first half of the Early Cretaceous were controlled by the existence of three major continental blocks—Laurasia, Western Gondwana, and Eastern Gondwana, whose position was relatively stable throughout almost the entire Neocomian (Ziegler *et al.*, 1982; Zonenshain *et al.*, 1984; Barron, 1987; Scotese *et al.*, 1987, 1988; Funnell, 1990; Dercourt *et al.*, 1993). Laurasia was located in the northern hemisphere extending from 20°–30° N to the northern polar areas. Western Gondwana, comprising South America and Africa, was mainly situated within the subtropical–tropical belt between 25°–28° N and 35°–40° S. Eastern Gondwana, including Australia, Antarctica, and India, was located in the southern hemisphere south of 35°–40° S and occupied large areas in the southern polar region. In the Berriasian, Eastern Gondwana represented a single continent. In the Valanginian, India started to separate from Australia and later from Antarctica to finally become an isolated continental block in the Barremian (Veevers, 1984; Scotese *et al.*, 1987, 1988; Patriat and Segoufin, 1988). These major continental masses composed the continental hemisphere of the Earth, which opposed the oceanic hemisphere occupied by the Pacific.

Paleogeography of oceanic basins was controlled in the Neocomian by geodynamic processes initiated in the Middle–Late Jurassic. The Tethys, which extended over almost 20 000 km between Laurasia and Gondwana continents from the Caribbean region in the west to the southeast Asian margin and the Australia–Guinea region of Eastern Gondwana in the east continued to open and advance westward. It comprised the eastern Tethys encompassing the area between the Asian part of Laurasia in the north and India and Australia in the south; central (or Mediterranean) Tethys; and western Tethys; where the Central Atlantic (Atlantic Tethys), Gulf of Mexico, and Caribbean regions can be distinguished (Dercourt *et al.*, 1993). At the beginning of the Early Cretaceous, the seaway between North and South America appeared and resulted in formation of the global western current in the Tethyan and Pacific tropical latitudes of the northern hemisphere (Luyendyk *et al.*, 1972; Berggren and Hollister, 1974).

The Mediterranean and western Tethys represented a system of deep basins fringed by shallow pericratonic carbonate platforms and terrigenous shelves; the basins were also separated in some areas by groups of relatively small isolated carbonate platforms (Dercourt *et al.*, 1985; Dercourt *et al.*, 1993; Bogdanov *et al.*, 1994). Pericratonic and isolated carbonate platforms were areas of intense accumulation of biogenic carbonates; from the outer side, they were usually bounded by reefal carbonate buildups (Wilson, 1975; Masse and Philip, 1981; Wilson *et al.*, 1984; Frazier and Schwimmer, 1987; Schlager and Philip, 1990; Masse, 1992). Such carbonate platforms are often referred to the Urgonian type (Masse, 1992). Pericratonic carbonate platforms extended along the eastern margin of Africa, eastern and northern Arabia, and the northern and northwestern coast of Africa. In the southern periphery of Laurasia, they are traceable along the North American margin, in the southern and southwestern coast of the Gulf of Mexico near Baltimore Canyon and in the Blake Plateau, and also in the northern Tethyan margin around Iberia and from the Pyrenees platform to the Carpathian–Balkan region and further eastward to Elbrus and Central Afghanistan (Viniegra, 1981; Seibold, 1982; Young, 1983; Wilson *et al.*, 1984; Dercourt *et al.*, 1985; Tucholke and McCoy, 1986; Zonenshain *et al.*, 1987; Schwimmer, 1987; Schlee *et al.*, 1988; Rakus *et al.*, 1988, 1989, 1990; Watts and Blome, 1990; Masse, 1992; Dercourt *et al.*, 1993). Isolated carbonate platforms were mainly concentrated in two areas, in the Caribbean basin of the western Tethys and in the Mediterranean Tethys. Particularly remarkable were compact groups of isolated carbonate platforms in the Bahamas zone and near the eastern margin of the Med-

Fig. 1. The lithologic–paleogeographic map for the Berriasian age of the Cretaceous.

(1) land; (2–6) deposits of alluvial–proluvial plains, intermontane depressions, lakes, sebkhas, and lagoons in arid zones: (2) red-bed conglomerates, gritstones, and sandstones; (3) red-bed and variegated sandstones, siltstones, and clays; (4) sandstones, siltstones, and clays with gypsum; (5) gypsiferous calcareous, and terrigenous–calcareous sediments; (6) salt-bearing sediments; (7–12) deposits of alluvial and lacustrine–palustrine plains, intermontane depressions, coastal plains intermittently flooded by the sea, and lagoons: (7) gray conglomerates, gritstones, and sandstones; (8) gray sandstones, siltstones, and clays; (9) calcareous–terrigenous sediments; (10) terrigenous coal-bearing (intracontinental) sequences; (11) calcareous–terrigenous coal-bearing (maritime) sequences; (12) terrigenous red-bed carbonate-free sediments; (13–21) deposits of shelf and epicontinental seas: (13) sandstones, siltstones, and clays; (14) glauconite-bearing sediments; (15) phosphorite-bearing sediments; (16) turbidites of shelf slopes and back-arc basins; (17) carbonaceous clayey, clayey–calcareous, and calcareous–siliceous sediments (black shales); (18) siltstones, clays, and limestones; (19) clayey limestones and marls; (20) carbonate platforms; (21) reefs; (22–25) deposits of the continental and island-arc slope and peripheral zones of oceans: (22) turbidites; (23) calc-alkaline and tholeitic basalts and also island-arc terrigenous–volcanogenic rock complexes; (24) deep-sea trenches; (25) hemipelagic clayey, calcareous–clayey, calcareous sediments; (26) pelagic (red) clays; (27) pelagic calcareous and siliceous–calcareous sediments; (28) pelagic siliceous sediments; (29) carbonaceous clayey, calcareous–clayey, calcareous–siliceous, and siliceous sediments (black shales); (30) carbonate atolls; (31) intraplate alkalic and tholeitic basalts; (32) midocean ridges with tholeitic lavas; (33) calc-alkaline magmatic rocks of volcanic–plutonic associations in continental margins; (34) intraplate alkalic, tholeitic, and bimodal volcanic series of continents; (35) distal ash belts; (36) belts of S-granitoid massifs in the collision sutures; (37) bauxites; (38) kaolinite clays, kaolin-bearing rocks; (39) iron ores; (40) boundaries between lithologic complexes and paleogeographic regions.