zoic faunas were distributed widely throughout this basin and interconnecting seaways. Zoogeographic distinctions were few, and seem attributable chiefly to isolation in restricted seaways rather than by oceanographic dissimilarities within the basin. Currents in the basin were slow and water mass distinctions poorly developed. As the assembled continents drifted apart in the early middle Mesozoic, faunal endemism increased in response to the development of different water masses through increased circulation and a restricted basin. Since the late Mesozoic, water mass distributions and current patterns have been analogous to modern ones although not as sharply defined. By the beginning of the Tertiary the configuation, but not the size of the basin, was established. This basin configuration, together with an increasing climatic gradient, intensified oceanic and atmospheric circulation, upwelling, and biotic provinciality and speciation. Imposed on this trend were periods of climatic amelioration (early Paleocene and Oligocene) that allowed planktonic biotas to disperse widely, suggesting decreased circulation and weakened water mass boundaries. Upwelling intensity and primary production decreased, the calcium-carbonate compensation depth increased, and extinction occurred among pelagic organisms as habitats and nutrient supplies to which they were adapted disappeared. Provincialism of plankton and shelf benthos increased during the later Tertiary as circulation intensified in response to cooling high-latitude marine climates.

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PETROLOGY AND STRATIGRAPHY OF EARP FORMATION, PIMA AND COCHISE COUNTIES, ARIZONA

Stratigraphic and petrologic studies show that the Earp Formation of Pennsylvanian and Permian ages in southeastern Arizona and southwestern New Mexico consists of fluvial clastic rocks that interfinger with supratidal, intertidal, and subtidal marine carbonate rocks. The clastics encroached initially from the northwest into the shallow Earp sea during Missourian time and continued migrating eastward during Virgilian and Wolfcampian time.

Clastic-ratio and isopach maps, a convex-upward geometry shown by a thinning of the overlying Colina Limestone, and primary sedimentary structures indicate that the clastic-dominated part of the Earp Formation was deposited as a delta.

In the carbonate lithologies, 3 environments of deposition are recognizable: supratidal, intertidal, and subtidal. The supratidal environment is characterized by pelmicrites filled with sparry calcite surrounded by a micrite envelope; desiccated, interlaminated carbonates of algal origin (biomicrites); the absence of fossils; evidence of dedolomitization; and "bird's-eye" structure (dismicrite). The intertidal environment is composed of pelmicrites, biomicrites, micrites, and biosparites. Fusulinid biomicrites and biomicrites that have delicate tests preserved are characteristic of the subtidal environment.

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QUANTITATIVE BASIN ANALYSIS OF PERMO-CARBONIFEROUS DUNKARD GROUP IN OHIO, PENNSYLVANIA, AND WEST VIRGINIA

It long has been known that the depositional strikes of some facies variables in ancient fluvial regimes are generally perpendicular to the inferred paleoslope. We propose that this is an effective criterion for selecting facies components whose regional distributions were primarily slope induced. A statistical model based on the postulated geometric relation between the paleocurrent pattern and the regional facies trends provides a means of identifying the trend components that were controlled by the depositional slope.

On the basis of 134 measured sections in the Permo-Carboniferous Dunkard Group, paleoslope response components of 5 facies variables were selected using this model. Examination of these trends in conjunction with crossbed readings made at 389 localities reveals (1) a high concentration of clastics on the southeast, consisting primarily of thick belt sandstones (subgraywackes) and red mudstones, (2) a northern drainage outlet characterized by abundant freshwater limestone, coal, sheet sandstone, and gray-green shales, and (3) a second drainage basin to the west with sheet sandstones, red mudstones, and few limestones or coals. Analysis of the slope-induced facies trends indicates that sandstone geometry and distribution were controlled by the configuration of the paleoslope whereas the formation of limestone, coal, red mudstone, and nonred shale depended primarily on the relative positions of the groundwater table and the depositional surface. The Dunkard Group was deposited on a northward to westward sloping alluvial plain from which distributaries emptied into seas on the northeast and southwest of the present Dunkard basin.

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SEA-FLOOR SPREADING AND STRUCTURAL EVOLUTION OF SOUTHERN RED SEA

The Red Sea is in the early to intermediate stages of continental breakup, and its structural evolution has been fundamentally the rifting and breaching of continental lithosphere by normal faulting attendant to the process of sea-floor spreading. In Oligocene time, the continental lithosphere of the Red Sea area was bowed into a large regional arch with normal faults across the crest. Subsequently, rifting by normal faults that propagated upward from the base of the lithosphere caused strong subsidence on horst and graben and tilted blocks; this rifting led to an extensive marine incursion, and a thick evaporite sequence was deposited in the restricted, hot, arid, low-latitude setting of the Miocene Red Sea trough. A second rift westward of the earlier central or axial Miocene rift originated in the southern Red Sea area in Pliocene time, and the 2 features are now evolving concurrently over a distance of at least 400 km. An evaporite section of very shallow marine origin accumulated in the western rift during the Quaternary; it constitutes a modern example of salt accumulating in a narrow, restricted, rifted trough which is forming as a consequence of continental breakup.

The present opposing coastlines of the Red Sea were never in contact, because the fragmentation of continental lithosphere was attained very largely by normal faulting. Only if a vertical fault surface cut the entire thickness of lithosphere could points on opposite coastlines ever have been contiguous.