with the actual distribution. The results suggest that approximately half of the sediments existing today are younger than 600 million years (m.y.), whereas the remainder is distributed irregularly through a stratigraphic column representing 2,500 to 3,000 m.y. Such a distribution means that the total mass of sediments deposited during geologic time would have to be 4 to 6 times the existing mass and that sedimentary material is rapidly recycled forward in time. Thus, one may think of the half-mass age of all sedimentary rocks as approximately 600 m.y.; however, the half-mass age of carbonate rocks is less, about 300–400 m.y., and that of evaporites even less, about 200–300 m.y.

The relatively high percentage of carbonate rocks, and the almost complete restriction of evaporites to the post-Precambrian result from the fact that the components required to make these rocks are cycled forward at a rate 1.5 to 2 times the rock mass as a whole. Geochemical "uniformitarianism"—the concept that the total mass of sediments existing at any one time in the geologic past had about the same composition as observed today—should be considered when geological conclusions are drawn that are based on the proportions of sedimentary rock types in the geologic column.

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Mobility of Atlantic Coastal Plain and Shelf[1]

Although the Atlantic margin of the United States has been considered to have a similar but less mobile history than the Gulf margin, new data and reevaluation of existing data indicate quite different histories for the two areas. The Atlantic margin is a mobile area with sediment thicknesses approaching those of the Gulf margin, but most of the deposition along the Atlantic margin occurred during the Mesozoic whereas the Gulf received the largest amount of sediments during the Cenozoic. Mobility, however, continued in the Atlantic margin during the Cenozoic, but this mobility did not always parallel that occurring in the Gulf; times of transgression in the Gulf Coast may correspond to regressions in the Atlantic Coast and *vice versa*.

Cenozoic mobility of the Atlantic margin is illustrated by a consideration of Miocene paleoenvironments and stratigraphic data. Several basins existed along the Atlantic margin during the Miocene; some of the basins were open to the ocean, but others were restricted from open circulation. Among those basins, mobility was differential throughout the Miocene. Miocene deposition took place in water as deep as upper bathyal within the present coastal margin, and primary phosphorite is associated with the deeper parts of the basins.

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New Evidence for Dating Carboniferous Flysch Deposits of Ouachita Geosyncline, Arkansas and Oklahoma[1]

Ammonoids and other invertebrate fossils from the Stanley Shale, Jackfork Sandstone, and Johns Valley Shale provide new information on the ages and correlations of these three stratigraphic units. The Stanley Shale is Late Mississippian (Chesterian) in age through most of the Ouachita Mountains region, except for a basal part, approximately 75 ft thick, of probable Meramecian age. In Saline and Perry Counties, Arkansas, Pitkin Limestone fossils, most of them in reworked boulders, are present about 500 ft below the top of the Stanley. Near Little Rock, Arkansas, ammonoids in the upper part of the Stanley represent the *Reticuloceras tiro* zone of the lower Hale.

The Jackfork Sandstone is of Early Pennsylvanian (Morrowan) age in Arkansas, but near Talihina, Oklahoma, its basal plant-bearing beds are of Late Mississippian (Chesterian) age. *Cymoceras*, an early Morrowan ammonoid genus, has been recognized in the lower part of the Jackfork near Amity, Arkansas. The Game Refuge Formation of Harlton at the top of the Jackfork has yielded Morrowan brachiopods and trilobites in Atoka County, Oklahoma.

The Johns Valley Shale contains indigenous ammonoid assemblages representing the *Branneroceras branneri*, *Axinolobus modulus*, and *Diaboloceras neumeieri* zones. These three zones are present also in the type section of the Bloyd Shale, indicating a direct equivalence of the two formations. Masses of Caney Shale in the Johns Valley, some of them enormous, as well as boulders of Lower Ordovician to Lower Pennsylvanian rocks, were introduced largely by turbidity flow and gravity gliding.

[1] Publication authorized by the Director, U.S. Geol. Survey.

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Geology of Continental Margins: Introduction and Review

Continental margin is assumed here to include the continental shelf, the continental slope, the continental rise, and other equivalent features in less mature margins such as marginal troughs, marginal plateaus, outer ridges, and continental borderlands. Petroleum industry's interest in continental margins is based on the same factors that delineate oil provinces on land: (1) zones of thick fine-grained sediment deposition with high organic content (source rocks); (2) lenses, layers, and wedges of sandstone (reservoir rocks); and (3) active tectonism to produce the necessary structure and to provide driving forces for the migration of petroleum into reservoirs. These factors occur in an area that encompasses more than 20% of the earth's surface area. If the shelves are considered to be regions of erosion and transport, the slopes and rises still occupy 10–15% of the earth's surface; this is an area larger than that of major onshore oil production. Present technology makes it possible to drill about 35% of the continental margin areas. Such projects as JOIDES and similar projects being planned can provide at least preliminary data on the remaining 65%. The advent of deep submersibles makes it possible for geologists to see the surface of the entire area as other techniques are used to probe beneath the surface.

Historically, the investigation of the margins began when the first measurement of water depth was made as an aid to navigation in shallow coastal water. However, the major contribution of modern workers can be restricted to the last 30 years in which the expansion of knowledge has been exponential. It is no exaggeration to say that the time necessary for the publication of these abstracts is sufficient to include new basic discoveries and interpretations. Thus earth scientists are in