Sea-floor spreading caused the subsequent widening of the basin, and allowed the first marine transgression that formed a long and narrow embayment—the primitive South Atlantic Ocean. Here, due to restrictive conditions, an evaporitic section was deposited.

The combined effect of the enlargement of this embryonic ocean by eastward migration of the Mid-Oceanic Ridge since Late Cretaceous time, and basin tilting due to detumescence of the pre-rift arching, determined the deposition of a thick, predominantly marine section with deltaic sedimentation near the Doce River area, and of shallow-platform carbonates in the central and eastern parts of the basin.

This upper marine section, although only weakly structured by the progressively decreasing reactivation of the Early Cretaceous faulting, underwent adiastrophic movements by growth faulting and halokinesis.

Late Cretaceous to middle Eocene submarine volcanic activity built up the framework of a 30,000-sq km accretion to the preexisting continental shelf.

The process of origin and evolution, and the structural and stratigraphic characteristics of the Espírito Santo basin, cause consideration of the basin as potentially petroliferous, and warrant the exploration program that is being carried out.

The accumulated knowledge of the Espírito Santo basin, that reflects the regional situation of the whole Brazilian continental margin, affords an important clue to the study of continental drift of South America and Africa.

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SEDIMENTARY MODELS, CYCLES, AND DELTAS, UPPER CRETACEOUS, WYOMING

Sedimentary models developed from modern sedimentation alone are of limited usefulness to the petroleum geologist because of (1) lack of variation resulting from deposition during a consistent trend of sea-level change; (2) poor control in the vertical dimension, particularly in intermediate and deeper water environments; and (3) the lack of direct association with petroleum accumulation. More widely useful models can be derived from certain ancient rock sequences, utilizing principles based on modern sedimentation. Good outcrops, abundant well control, bentonite marker beds, and dominantly stratigraphic oil and gas production make the Upper Cretaceous formations of Wyoming particularly useful in providing models pertinent to both industry and academic needs.

The Ericson Sandstone of southwestern Wyoming and its nonmarine and marginal-marine equivalents can be combined with marine elements of the model from eastern Wyoming to produce a complete, wide-shelf model consisting of fluvial, paludal, barrier-island, shelf, slope, and basinal facies. Significant differences between the resulting model and previously proposed models are the podlike configuration, the presence of thick slope deposits, and the significant submarine topography present at the epicontinental slope. A narrow-shelf model can be derived from the Lewis Shale, Fox Hills Sandstone, and Lance Formation of the Red Desert basin.

The complete sedimentary cycle consists of the same units as the complete model. Only regressive sedimentary cycles have been recognized. The maximum marine transgressive shift recognized is reflected in a basinal facies directly overlying the paludal facies of the Parkman in southwestern Powder River basin.

The complete model includes a distinct fluvial facies deposited at the mouth of a river and, by definition, a delta. An incomplete sequence consisting of paludal, barrier-island, and a thin shelf facies is interpreted to be interdeltaic. Several deltas can be delineated on this basis from the Ericson and time-equivalent rocks of Wyoming and adjacent states. When related to sequences interpreted as deltaic in older and younger Upper Cretaceous rocks of the area, a shifting pattern of deltaic sedimentation similar to that of the modern delta complex is suggested. If this pattern of shifting loci of deposition is correct, some stratigraphic concepts may require reexamination.

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A METHOD OF FINDING OIL—UNORTHODOX THINKING

Orthodox thinking proceeds in patterns established by past experience and is principally useful in solving the problem of why "other" people discover all the oil. Unorthodox thinking (as here used) is a deliberate pattern of denying (or doubting) the validity of each accepted basic concept and seeking new alternatives. In this sense unorthodox thinking is a method of generating new ideas in a regular and continuing stream.

The unorthodox approach challenges accepted ideas of oil generation and migration, suggesting new and untested trends for major oil accumulation. Similar trends, discovered largely by accident, already have produced vast quantities of hydrocarbons. Such accumulations, although a mystery to orthodox thinkers, are a challenge and an education to the unorthodox. Unorthodox thinking (a method of finding oil) is also a method of organizing and perpetuating creative energy.

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CONCEPTS OF MICROPALEONTOLOGY APPLIED TO PETROLEUM GEOLOGY

Micropaleontologic correlations by means of planktonic microfossil zones, defined on either an evolutionary or paleoceanographic basis, show that there are major time-transgressive features for paleontologic zones based upon benthic forams. This problem is especially acute in tectonically active basins where rapid sedimentation is combined with differential subsidence rates. Stage boundaries based on benthic species may occur progressively down-section toward submarine fans; conversely, such boundaries are progressively higher in the section toward deep-water depositional areas that are far from sediment sources. Thus, the misidentification of stratigraphic objectives can lead to drilling errors of many hundreds of meters in exploring different depositional centers within a basin. This aspect of correlation precision is especially acute in areas of continental margins.

Paleoenvironmental logging of sections and wells, employing primarily benthic foram faunas, makes possible (1) definition of paleobathymetric cycles, (2) detection of areas with truncated cycles, (3) definition of principal depositional centers and their migration in time, (4) proper evaluation of sediment bodies such as turbidites and submarine landslides, and (5) definition of paleotectonic rates which lead to the definition of structural trends developing within a basin.

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BASIC DISPOSAL-WELL DESIGN