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A Synthesis of Marine Geological/Geophysical Data for Ocean Crustal Drilling on Mid-Atlantic Ridge

We have recently completed a synthesis of all available marine geological/geophysical data in the Mid-Atlantic Ridge area of the central Atlantic Ocean. The synthesis was undertaken to evaluate future scientific drill sites. The final product is a set of maps on Mercator projection for the following areas: Area VIII-1, 33° to 38°N, 30° to 44°W; Area VIII-2, 28° to 33°N, 34° to 48°W; Area VIII-3, 22° to 28°N, 39° to 50°W. For each area the data synthesized includes: contours of bathymetry at a 500-m (1,640-ft) contour interval, contours of free-air gravity at a 10 mgal contour interval, total intensity magnetic anomaly profiles and identifications along ships' tracks, locations and thicknesses of sediment ponds from seismic reflection data, seismic crustal structure from sonobuoy and other refraction measurements, surface sediment core locations, sediment types and ages, locations of available rock dredges, heat flow measurements, seismicity and regional tectonics. In addition, detailed maps showing near bottom observations at the Mid-Atlantic Ridge in the vicinity of the Kane Fracture Zone (24°N), TAG area (26°N), Oceanographer transform (35°N), and the Famous Area (37°N) are included.

The segmental nature of the Mid-Atlantic Ridge crest is clearly shown. It is interpreted as a succession of relatively short spreading centers separated and offset by, in general, small offset transform zones. The average spacing between the transform zones is less than 50 km (31 mi) and rather uniform. The fracture zones may be traced away from the ridge transform section, but not necessarily as a continuous bathymetric feature.

The gravity anomalies present a smoothed (low-pass filtered) version of the bathymetry. In some places (e.g., the eastern extension of fracture zone B at 36.5°N), the gravity anomalies display the continuation of fracture zones where the bathymetry does not.

The magnetic anomaly identifications show the variable behavior of the North Atlantic accreting boundary through time. Consistent asymmetric spreading is found south of the Kane Fracture Zone (24°N), indicating continuous eastward migration of the accreting boundary. Variable asymmetric spreading is documented farther to the north. We find that the asymmetry is preserved in the individual magnetic anomalies, suggesting that the emplacement of the magnetic source has occurred in a relatively narrow zone. Further, we believe that the extreme variability of magnetic anomaly shapes in the North Atlantic may be caused by variable asymmetric behavior of the individual spreading centers.

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Lower Cretaceous Wabiskaw Tar Sands: Shallow Shelf Reworking of Submarine Fans

The Wabiskaw Sands consist of 3 units, each of which is a mappable submarine fan complex. They prograded westward into a shallow basin, 50 to 60 m (164 to 200 ft) deep, that existed during the early part of the Lower Cretaceous transgression. Each fan complex was fed by a different submarine canyon. These canyons were drainage valleys on the Paleozoic erosion surface before they were drowned by the marine transgression. Each fan complex covers 6,000 to 7,000 km^2 (2,300 to 2,700 mi^2) and each was probably related to a progressively higher sea level stand.

Once on the basin floor, the sand was reworked by storms and possibly tides, and now has the characteristics of a shallow shelf bar similar to the Upper Cretaceous Hygiene Sand of Colorado or Sussex Sand of Wyoming. Each of the three Wabiskaw sequences coarsen upward. They are strongly bioturbated at the base, decreasing to only slight bioturbation in the upper sandy facies, in which *Asterosoma* is the most common trace fossil. These glauconitic sands are dominated by tabular bedding or large, shallow, trough cross-bedding when physical structures are visible; otherwise the sands appear massive.

A bar morphology is apparent from data from closely spaced (215 m; 700 ft) wells, and reservoir parameters such as porosity and permeability broadly reflect this pattern.

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Discovery Functions of Oil and Gas by Depth Zones Throughout U.S. Basins

This paper presents the key results concerning oil and gas discovery functions derived from comprehensive computer-supported analyses of the exploration histories of the main producing provinces of the conterminous U.S. To permit meaningful comparison between different geologic regions and/or horizons, the discovery functions are expressed as relationships between exploratory drilling density (in ft/mi^3 of sediment) and hydrocarbon content (in bbl discovered/mi^3 of sediment). The discovery functions obtained for each basin as a whole are compared to those of the individual depth zones in the basin (the depth zones being defined on the basis of uniform levels of drilling density and/or stratigraphic characteristics). The striking finding of these comparisons is that the discovery functions of the individual (homogeneously explored) depth zones are inherently much more angular or "flat shaped" than those obtained for each basin as a whole. The implications of this finding are discussed in relation to: (a) the theoretical considerations underlying the concept of (negative-exponential-type) discovery functions; and (b) the practical application of discovery functions to the projection of future oil and gas discoveries.

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TEM as a Tool in Study of Carbonate Crystal Chemistry

All natural carbonate minerals exhibit crystal defects, either in terms of nonstoichoimetry or structural imperfections. These defects represent a record of the crystallization (or in some places post-crystallization) process and thus provide direct evidence concerning various diagenetic reactions. The characterization of these defects is facilitated in many ways by use of the transmission electron microscope (TEM) and its various modifications.

The diffraction contrast mechanism allows certain defects not visible in other microscopes (e.g., domain structures, stacking faults, modulated structures, etc) to be imaged with very high resolution (approximately 20 A). High-resolution electron microscopy (HREM) utilizes a phase contrast mechanism and is capable of imaging individual lattice planes with a resolution better than 2 A. Depending on the particular planes imaged, information about local ordering and stacking defects is obtained, aspects