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STRUCTURE CONTOUR MAP OF PRE-MESOZOIC BASEMENT, LANDWARD MARGIN OF BALTIMORE CANYON TROUGH

by
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DISCUSSION

The structure contour map of pre-Mesozoic basement indicates the structural complexity of the landward margin of the Baltimore Canyon trough, especially that shown by the buried rift basins of probable early Mesozoic age. Information on depth to basement is important in determining the economic limit of drilling through overlying rocks in the search for oil and gas.

Control for the Atlantic Coastal Plain portion of the map is provided by drill hole data (Anderson, 1948; Brown, Miller, and Swain, 1972; Jacobeen, 1972; Onuschak, 1972; Hansen, 1978, 1982; Hansen and Wilson, 1984; H. J. Hansen, Maryland Geological Survey, personal communication; E. K. Rader, Virginia Division of Mineral Resources, personal communication). Rocks identified by these authors as representative of the nonmarine Newark Supergroup (Cornet, 1977; Van Houten, 1977; Olsen *et al.*, 1982) are interpreted as indicating buried rift basins similar to the exposed Newark Supergroup basins shown on the map. The offshore buried basins shown by the structure contours probably contain Mesozoic age (Late Triassic-Early Jurassic) rocks similar to those of the Newark Supergroup. It is also possible that the offshore basins, in part, may contain marine rocks. In the COST G-2 well drilled in Georges Bank east of Nantucket Island, Cousminer *et al.* (1984) recognized intermittent marine sedimentation in rocks as old as Norian age (Late Triassic).

Offshore control is provided by multichannel common depth point (CDP) seismic reflection profiles, most of which were run under contract to the U. S. Geological Survey in the 1970's: lines with the prefix USGS by the Geologic Division and those with prefixes M, V, and D by the Conservation Division. In addition, the Delaware Geological Survey contracted for seismic reflection profiling in 1976 for lines DGS 1-3, DS 5, and GD 1-2, in 1983 for line DGS 001, and purchased rights to line T 5000.

On the seismic profiles the basement surface was interpreted as the base of the set of subparallel reflections that clearly represent post-Paleozoic age sedimentary rock. In most instances these are gently inclined and onlap the basement surface. Within basement itself, reflections generally are more chaotic, and its highly faulted nature produces many diffraction patterns. The base of the subparallel and often steeply inclined reflections clearly representing the sedimentary fill of the buried rift basins was interpreted conservatively; therefore, the deepest parts of the basins indicate minimum depths.

Two-way travel times to basement were converted to depths by using root mean square stacking velocity plots and the Dix equation (Dix, 1955). Interval velocities were determined for up to six sequences between the sea floor and basement surface. In order to smooth out some of the irregularities that result from depth determinations at isolated shot points, a moving average of the interval velocities was calculated for each seismic profile by using five adjacent shot points having velocity analyses.

The kind and density of offshore control provide more detailed structural configuration of the basement surface than does the sparse drill hole control of the Middle Atlantic Coastal Plain. If continuous seismic reflection profiles of the Coastal Plain were available at the same density of coverage as offshore, the basement surface beneath the Coastal Plain would be expected to have as complex a configuration as it has offshore, one that might well fit the pattern envisaged by Brown, Miller, and Swain (1972). Studies of selected small areas do indeed indicate complex basement structure beneath the Coastal Plain (Jacobeen, 1972; Spoljaric, 1973; Dames and Moore, 1974; Hansen, 1978).

The -2,000-meter contour approximately marks the first major increase in the regional seaward slope of the basement surface. Anderson (1948) first noted the change in slope from study of onshore exploratory oil wells of the Maryland Eastern Shore. Using the same drill hole data, Richards (1948) named this region of more steeply sloping basement the Salisbury Embayment. The map shows that this embayment is where the hinge zone of the Baltimore Canyon trough lies beneath the Coastal Plain rather than beneath the continental shelf to the north and south. It also is where the hinge zone changes strike from a northeasterly to a more northerly trend, approximately parallel with the changing trend of the Fall Line. Murray (1961, fig. 3.1, p. 92) referred to the bend in the Fall Line as marking the landward limit of the Chesapeake-Delaware basin, and the "Salisbury syncline" as an accentuated (basement) depression that is related to the Maryland-Pennsylvania structural salient of the Appalachian fold belt. Murray further suggested that large basement fractures may exercise control over these features. Hobbs (1904) and Brown, Miller, and Swain (1972), among others, also indicated this.

The offshore buried rift basins tend to align in a north-south direction. For comparison, I have shown the outlines of the exposed Newark Supergroup basins as they are shown on individual State geologic maps (Berg *et al.*, 1980; Cleaves *et al.*, 1968; Johnson, 1950; Milici *et al.*, 1963; Rodgers, 1982; and Stuckey, 1958) and named by Cornet (1977) and Robbins (1982). The exposed basins tend to follow the Appalachian structural grain. Trends of basins buried beneath the Coastal Plain are unknown, but for one area I have suggested by the pattern of the -500-meter contour east of the Culpeper Basin a trend similar to that of the Culpeper, Richmond, and Taylorsville basins.

The different trend of the offshore basins might reflect a slightly later time of development than that for the onshore basins (Doyle and Benson, 1984; Benson and Doyle, 1984). On the Long Island platform, where basement is shallow, the basins align with magnetic anomaly patterns mapped by Klitgord and Behrendt (1977). Hutchinson and Klitgord (1984, p. 26) have identified four grabens there from single-channel and multichannel seismic reflection data and also suggest that they may have "... formed during a different (later?) stage in the break-up evolution." Offshore the Delmarva Peninsula, where basement is deeper, the magnetic anomalies are of longer wave length. Because of this it is more difficult to recognize the trends of the offshore basins from magnetic data alone. The deepest part (>14,000 m) of the Baltimore Canyon trough, itself a large rift basin, does coincide with a very broad magnetic low.

Interpreted faults were placed on the map if they were indicated on seismic reflection profiles, or arbitrarily where sharp bending and displacement of structure contours suggest faulting. It is not always clear on the seismic profiles whether the borders of the the buried rift basins are unconformities or fault surfaces. The closely spaced contour lines bordering the basins indicate either or perhaps both.

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EXPLANATION

-2000 Structure contours (meters below sea level)

Interpreted faults

Coastal Plain drill holes:

▲ Newark Supergroup penetrated

● Pre-Mesozoic basement penetrated

USGS 2 Offshore multichannel CDP seismic reflection profile