GEOPHYSICAL STUDY

OF THE TECTONICS AND CRUSTAL STRUCTURE

OF THE GULF OF MAINE

by

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The Gulf of Maine is a major physiographic feature of the northeast continental shelf of North America. Up to the present, investigations of the Gulf region have been concerned primarily with the shallow sediments which overlie older and more-indurated basement rock. The purpose of this study is to delineate the gross lithology of the basement by means of magnetic and gravity surveys, and to examine the structure and tectonics of the Gulf relative to that of the adjoining Appalachians.

A critique of the gravity method is made as part of the interpretation procedure, and it is shown that the analytical properties of the method are closely related to the horizontal gradient of gravity. Conversely it is concluded that refined data analysis is not warranted if gravity measurements are so widely spaced that gravity gradients are not well-determined.

The aeromagnetic and gravity maps of the Gulf of Maine show a widespread presence of intense anomalies, and a regular pattern of regional zones and lineations. A comparison with anomaly-lithology correlations on land indicates that most anomalies arise from igneous plutonic and volcanic sources. The northwest margin of the Gulf appears to be underlain by a zone of gabbroic rocks which extends to land regions of Massachusetts on the southwest, and Maine and New Brunswick on the northeast. The central region of the Gulf is typified by a crystalline complex where igneous rocks are abundant; gravity data indicate that Carboniferous strata, probably in the form of rift deposits,

may also be present in this region. A regional correlation of gravity levels with gross age of bedrock in Maine and New Brunswick suggests that the crystalline bedrock of the central Gulf may be predominantly Precambrian in age. A discontinuity is inferred along the east margin of the Gulf opposite Nova Scotia although its precise nature is unclear. The transition from shallow bedrock of the interior Gulf to deep bedrock beneath the Banks region takes place over a narrow zone, which is probably a fault feature.

The dominant trend of structure in the Gulf of Maine is southwest, although east and southeast trends are discernible. In general this structural pattern is conformable with the overall structural grain of the northern Appalachians. In particular the analyses of the data support the continuation of Wilson's Cabot fault and associated structures within the Gulf. A composite of geophysical trends of the Gulf of Maine and the adjoining Appalachians shows that major structures on the cratonic side are conformable with the shape of the craton, whereas those on the oceanic side maintain a southwest trend throughout. The area where the two trends merge is the central zone of regional metamorphism. The geometry suggests east-west compression against a stable craton.

Analysis of regional gravity levels of Maine and the Gulf indicates an average crustal density of about 2.9 gm/cm^3 beginning at a depth of less than 8 km. This density is significantly higher than that proposed at this depth in most models of the crust.