that continental crust contains more radioactive minerals than does oceanic crust. Such inhomogeneities also may be caused by the presence of convection currents in the mantle. Bott (1971) believed that the global gravity-anomaly field may be a result of lateral variations in the depth of the olivine-spinel transition and other phase transitions caused by temperature fluctuations in the mantle. Such temperature fluctuations may be caused by the same processes that cause sea-floor spreading.

Kaula (1969, 1970) showed that free-air anomalies obtained from satellite observations are similar to those obtained from shipboard measurements: a negative belt in the western Atlantic and a positive one over the Mid-Atlantic Ridge (the zone in the eastern Atlantic is generally positive). The gravity field indicates that the midocean ridges are sites of mass excess, with the marginal ocean basins having mass deficiencies. These variations in mass were related by Kaula (1970) to the behavior of the lithosphere in response to asthenospheric flow. Although most of the North American continent is characterized by positive gravity anomalies, much of Canada and the New England region that were glaciated during the Pleistocene have negative values—an indication that these regions have not yet reached equilibrium from their former crustal depression by ice loading.

SEDIMENTARY FRAMEWORK INFERRED LARGELY FROM SEISMIC REFLECTION PROFILES

General

The oceanic basement (layer 2) of the deepsea floor is overlain by a thin sedimentary apron (layer 1) that has the form of a giant prism thinning against the Paleozoic terrane toward the land and against the oceanic basement toward the Mid-Atlantic Ridge. The greatest thickness of layer 1 is under the outer continental shelf and the upper continental rise. North of Cape Hatteras and in the western Gulf of Mexico, the sediments of the apron are predominantly terrigenous; but, south of Cape Hatteras, in the Bahamas, and in the eastern Gulf of Mexico, they are chiefly biogenie carbonate debris. Broad warping, diapiric salt intrusions, faulting, and folding have greatly altered the morphology of the continental margin in many areas. Details of the nature of the internal morphology of the sedimentary apron have come from seismic-refraction, oblique-reflection, and seismic-reflection measurements made during the past 3 decades (Figs. 120, 121). On the basis of these data, plus information from outcrops and wells on land and the ocean floor, 19 structural sections have been compiled for the Atlantic continental margin, the Bahamas, and the Gulf of Mexico (Fig. 122).

Continental Margin North of Cape Hatteras

The most prominent topographic features of the Labrador and the Northeast Newfoundland shelves are a continuous trough parallel with the coast and several channels at right angles to it (Fig. 37—see color insert; Fig. 123). Recent seismic-reflection and refraction studies (A. C. Grant, 1966, 1970; Mayhew, Drake, and Nafe, 1970) on the shelf off Labrador (Fig. 124) verify Shepard's (1931a, 1931b) interpretation that the coastal trough is a glacial erosion feature that separates crystalline Precambrian rocks on the inner shelf from sedimentary strata on the outer shelf. The trough and outer banks are simply a lowland and cuesta carved from the shelf strata, remnants of the fluvial valleys of a former drainage system. Analysis of glacial erratics from the sedimentary prism beneath the banks indicates that the strata are coastal-plain deposits ranging in age from Jurassic to middle-Tertiary (McMillan, 1971). The rocks appear to become progressively older northward; the mid-Tertiary rocks are in the south, mid-Tertiary to Late Cretaceous in the central part, and Early Cretaceous in the northern reaches of the Labrador shelf. Later, the region was glaciated (Fig. 12), and the channels across the shelf served as routes along which ice reached the ocean. The seismic-profile recordings show pronounced warping in the sedimentary strata beneath the outer banks.

A. C. Grant (1970) described this warping as a result of isostatic adjustment following removal of material by glacial erosion; however, as O. Holtedahl (1970) explained, such isostatic adjustment probably does not occur along such a narrow zone, and the upwarp is more likely the result of an epeirogenic movement during late Tertiary or early Pleistocene time. Because this type of topography can be traced as far southwest as Long Island, the epeirogenic movement probably affected much of northeastern North America.

The cuestas and lowlands carved by fluvial erosion after the uplift and modified by glaciation now are the islands and sounds south of New England, the Gulf of Maine–Georges Bank complex, the banks and islands on the Scotian shelf, the Grand Banks, and the com-