Gravity Survey in the Vicinity of Proposed COCORP Traverse
Across the Brevard Zone near Gainesville, Georgia

Final Technical Report

Prepared by

Anton M. Dainty
School of Geophysical Sciences
Georgia Institute of Technology
Atlanta, Georgia 30332

August, 1980
Introduction

The purpose of this study was to investigate the Brevard Zone along Georgia line 1 of the COCORP Appalachian Traverse using gravity data. A primary objective was to determine whether the Brevard Zone separated or offset rocks of substantial density contrasts and to determine any such offset. A secondary objective was to determine whether any gravity anomaly was caused by the Brevard Zone or any associated structure and to determine the cause of any such anomaly. This study was undertaken because of the prominence of the Brevard Zone in many published interpretations of Appalachian tectonics (e.g. Rankin, 1975, considered the Brevard Zone to be a suture).

Data and Data Reduction

1470 readings of the acceleration due to gravity were taken in the survey area using a Worden Educator gravity meter and a Lacoste Romberg gravity meter. Elevation was taken from United States Geological Survey Topographic Sheets, 1:24,000 series. The average spacing between points is 1 km, but a dense spacing of 1000-2000 feet was used along the COCORP Georgia Line 1 and in the central region of the study area, while a 2 km spacing was used in peripheral regions. Readings were reduced to Observed Gravity and Free Air and Simple Bouguer anomaly using the 1931 Standard Gravity Formula and a reduction density of 2.67 gm/cc for the Bouguer reduction. Figure 1 is a map of the Simple Bouguer anomaly values. The estimated error in the Free Air and Simple Bouguer anomaly is ±0.4 mgals, and is mainly due to uncertainty in the elevation. A larger scale map (1:125,000) and individual gravity values, either as a listing or as card images on computer tape, are available from the author on request. The card images are written in the Department of
Figure 1. Map of Simple Bouguer Gravity in the study area. Note: This figure has been reduced.
Discussion of the Simple Bouguer Anomalies

Figure 2 is a map of the Simple Bouguer anomaly field with geological formations of interest superposed. The COCORP Georgia Line 1 is also shown in Figure 2. Regional features seen on Figure 2 include a strong gravity gradient in the southeastern portion of the map and a gradient towards an intense gravity low in the northeastern corner of the map. The gradient in the southeastern part is a section of the Piedmont Gravity Gradient that runs from Georgia to Virginia and is associated with crustal thinning from northwest to southeast (Long, 1979). Recent structural interpretations based on COCORP data (Cook et al., 1979), indicate that it is unlikely this crustal thinning is associated with the Brevard Zone. The low to the northeast is part of an intense low associated with the highest part of the Appalachian mountains running from Georgia to Pennsylvania, and is presumably due to crustal thickening.

More local features can also be seen in Figure 2. The Brevard Zone of cataclasis is marked, as well as the Dahlonega Shear Zone. A positive Bouguer anomaly of \( \sim 5 \) mgals is associated with the Dahlonega Shear Zone, probably caused by the metamorphosed mafics present in the Zone. A small negative Bouguer anomaly of 0-2 mgals is associated with the surface trace of the Brevard Zone. Figure 3 shows a profile along the COCORP Georgia Line 1, crossing the Brevard Zone. There does not appear to be a correlation of topography and Bouguer anomaly, thus the Bouguer anomalies must be due to subsurface causes. Anomalies within the Brevard Zone fluctuate rapidly, suggesting a very near surface
Figure 2. Map of Simple Bouguer Gravity with geologic correlations. Note: This figure has been reduced.
Figure 3. Profile of Simple Bouguer Gravity and topography along COCORP Georgia Line 1.
source. The most likely explanation for the anomaly associated with the Brevard Zone is weathering to a greater depth relative to surrounding areas. Support for this hypothesis comes from the influence the Brevard Zone has on the course of the Chattahoochee River - this river is deflected to run southwest along the Brevard Zone over most of its length in Northern Georgia, and is the only major river to run in this direction. The proposed greater weathering depth in probably due to the fine grained nature of the rocks in the zone of cataclasis leading to greater chemical weathering. If a density contrast of 1 cm/cc is assumed between fresh and weathered rock, the observed anomaly can be explained by 0-50 m of extra weathered material in the Brevard Zone. This is entirely reasonable for this area. Part of the weathered material may be in the form of alluvium.

Apart from this minor, near surface anomaly, there is no appreciable anomaly associated with the Brevard Zone, indicating that the Brevard Zone does not offset and/or separate rocks of different density. Surface rocks in the study area are metamorphosed to a greater or lesser degree, and are frequently not differentiated on different sides of the Brevard Zone on the Geologic Map of Georgia (1976), even though the Brevard Zone is considered to be the boundary between two major divisions of the Appalachians, the Blue Ridge and the Inner Piedmont. A subsurface interpretation of the Brevard Zone based on COCORP reflection data (Cook et al., 1979) indicates that it is a splay off a sole thrust underlying both the Blue Ridge and the Inner Piedmont, rather than a primary structure. Our conclusions are compatible with this interpretation.
In addition to the anomalies discussed above, parts of anomalies superposed on the Piedmont Gravity Gradient are seen in the southeast portions of Figures 1, 2 and 3. These anomalies are believed to be associated with an area of metamorphosed mafic rocks in this area.

References:


Geologic Map of Georgia (1976). Georgia Department of Natural Resources, Atlanta, Georgia.
