SIMPLE BOUGUER AND RESIDUAL BOUGUER GRAVITY MAPS

OF

NORTH CAROLINA

(OF-87-1 AND OF-87-2)

by

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SOURCE OF THE DATA

Most of the 21,016 gravity stations used in this study were obtained from the files of the DSAG, Aerospace Center, Defense Mapping Agency, St. Louis, MO (USAF). Original sources for the data obtained from the USAF are listed at the end of this report.

Additional data includes data collected from stations in the vicinity of Chapel Hill, from a northeast trending strip of stations through the Deep River Triassic Basin which were collected by students at the University of North Carolina at Chapel Hill during the 1970's, from stations in the vicinity of Randolph County which were collected by the author for a study in the Carolina Slate Belt, and from a strip of stations from Lexington, North Carolina, toward Glenola which were collected for Best, Geddies, and Watkins (1973) and contributed to this study by Dr. David M. Best of Northern Arizona State University. These other data have been reported to the DSAG. Other than a proprietary study by Marathon Oil which includes portions of the North Carolina Coastal Plain, no significant quantity of data known to the author has been omitted.

CREATION OF THE GRID

The map grids were created using SURFACE II. The two large maps were gridded using 250 columns (E-W) and 100 rows (N-S) which produced nearly equal sized cells of about 0.05 units/inch, or a grid node spacing of approximately 2.5 km. This can be considered the effective resolution of the map. The number of grid nodes (25,000) was just greater than the 21,016 stations plotted, 867 "replicate stations" were averaged.

These maps are a significant improvement over Mann (1962) which used only about 2,000 stations, statewide. A further significant improvement, such as a resolution of about 1 km, would require about 150,000 stations.

Grid nodes were calculated using a search strategy based on an inverse distance squared weighted average of the 8 "nearest neighbor" stations. A relatively large search radius was permitted for the 8 "nearest neighbors" which resulted in a grid with no missing node values, but consequently increased the error in sparesly controlled sections. Experiments with scaling showed that a factor of 0.2 produced a plot of 1:500,000 which overlies the *Geologic Map of North Carolina* (1985) with a good fit.

The small **4th Order Trend Surface Map** (scale 1:2,000,000) inset on the **Residual Bouguer Map** was gridded at 100 by 80 utilizing the full set of data. The 4th order trend surface is similar to the regional "drift" surface produced by the Universal Kriging algorithm. Similar surfaces were obtained for several other orders. Thus, the 4th order surface map may be considered to represent "deep crustal" features. The number of inflections in the surface portrayed is controlled by the order and may represent a forced solution.

CORRECTION OF DATA

Each station's value was corrected for the effects of elevation and latitude. Free-air values for stations at sea were substituted for the Bouguer value. All USAF data was obtained corrected to the 1971 Datum. The data not contributed by the USAF was corrected to the 1971 Datum by utilizing revised station values obtained from the USAF.

Corrections:

- Free-air correction = 0.9406 x elevation
- Bouguer correction = 2.67 x 0.01276 x elevation
- Theoretical G = 978.049 x {1 + 5.2884 x 10^{-3} x $\sin(\phi)^2$ - 5.9 x 10^{-6} x $\sin(2\phi)^2$} where ϕ is the latitude.

GENERATION OF MAPS

Inasmuch as the *Geologic Map of North Carolina* (1985) is a Lambert projection, the latitude and longitude of the gravity data were transformed to arbitrarily scaled Lambert values utilizing the GEOPROJ procedure of the SASGRAPH package with intersepts set at 33 and 41 degrees. The small mismatch between the gravity maps and the geologic map, noticable in the mismatch of county outlines, is probably the result of the different methods used to produce the Lambert projections. The projection for the gravity maps was developed by a mathematical routine while that utilized on the geologic map was not. The gravity maps were contoured using the SURFACE II package and an IBM 3033U computer at Akron University.

The graphical output of SURFACE II was transferred to a PRIME 850 computer and then written onto a MEDUSA cad/cam sheet. MEDUSA was used to add scaled, transformed county outlines (from SASGRAPH), to add stations locations, and to add titles. Some offshore, contoured areas were deleted because of poor control or conflicting data. The **Simple Bouguer Map of North Carolina and Vicinity** was contoured using a 5 milligal (mg) interval from the corrected Bouguer values of all 21,016 stations.

The **Residual Bouguer Map of North Carolina and Vicinity** was created in several steps. The Lambert transformed dataset was passed into a trend surface procedure (Davis, 1973; Program 6.3) to produce a **4th Order Trend Surface** contoured at an interval of 10 mg (inset on the **Residual Bouguer Map of North Carolina and Vicinity**). Fourth order values were interpolated and subtracted from the simple Bouguer values to produce the residual Bouguer values at each station. The residual values were gridded and contoured by SURFACE II at an interval of 5 mg to produce the **Residual Bouguer Map of North Carolina and Vicinity.**

DATA LISTING

Data obtained from the USAF were contributed by many individuals and institutions (Table 1). Studies are listed by USAF Source Number and by contributor, more often an institution than the author. It is not feasible to provide a location map of each source's extent.

TABLE 1 - Data listing.

Alabama Geological Survey:	2552
David M. Best:	6271
Delaware Geological Survey:	6363
DMAH, TC, NOAA, NGS:	576, 1083, 2094, 2733, 2752, 3029, 3032, 3033, 3034, 3039, 3132, 3328, 3413, 3680, 4099, 5275, 5278, 6167, 6583, 6624, 6691
Georgia Institute of Technology:	4487, 6210
G.R. Keller:	4563, 4795
Los Alamos Labs:	5648
South Carolina Geological Survey:	5791
TVA:	4476
University of N.C. at Chapel Hill:	1105, 3511, 3760, 3877,4470, 6018
NAVOCEAN and NOAA (at sea):	3078, 3080, 3086, 3095, 3096, 3104, 3109, 3243, 3699, 3982, 5559
U.S. Geological Survey (on land and sea):	392, 928, 929, 2226, 4382, 392, 928, 5488, 5490, 5494, 5498, 6253, 6910, 6913
Va. Division of Mineral Resources:	5502, 6556, 6624

TABLE 1 - Data listing (continued).

G.P. Wollard:
2016, 2052, 3500, 3546, 3548, 3549, 3582, 3583, 3584, 3586, 3588, 4054

J. L. Worzel: 2728

REFERENCES CITED

Best, D.M., Geddes, W.H., and Watkins, J.S., 1973, Gravity investigation of the depth of source of the Piedmont gravity gradient in Davidson County, North Carolina: *Geological Society of America Bulletin*, v. 84, pp. 1213-1216.

Davis, J. C., 1973, *Statistics and Data Analysis in Geology*: New York, John Wiley & Sons, pp. 332-333.

Mann, V.I., 1962, Bouguer gravity map of North Carolina: *Southeastern Geology*, v. 3, pp. 207-220.

North Carolina Geological Survey, 1985, *Geologic Map of North Carolina*: North Carolina Department of Natural Resources and Community Development, Raleigh, North Carolina, 1 sheet, colored geologic map 1:500,000.