COMMONWEALTH OF VIRGINIA
DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINERAL RESOURCES

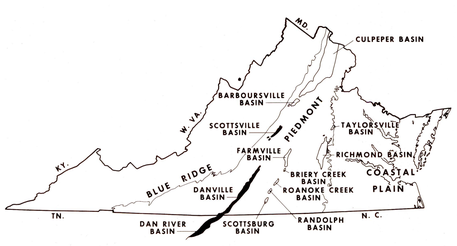
THIS MAP PREPARED IN COOPERATION WITH THE UNITED STATES
DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
AND THE
NORTH CAROLINA DEPARTMENT OF NATURAL
RESOURCES AND COMMUNITY DEVELOPMENT,
DIVISION OF LAND RESOURCES, GEOLOGICAL
SURVEY SECTION

PUBLICATION 58
SIMPLE BOUGUER GRAVITY ANOMALY MAP
OF THE DANVILLE—DAN RIVER BASIN
AND VICINITY, VIRGINIA—NORTH CAROLINA
AND
THE SCOTTSVILLE BASIN AND VICINITY, VIRGINIA

# SIMPLE BOUGUER GRAVITY ANOMALY MAP OF THE DANVILLE-DAN RIVER BASIN AND VICINITY, VIRGINIA-NORTH CAROLINA AND THE SCOTTSVILLE BASIN AND VICINITY, VIRGINIA

Stanley S. Johnson, Leonard S. Wiener[1], and James F. Conley

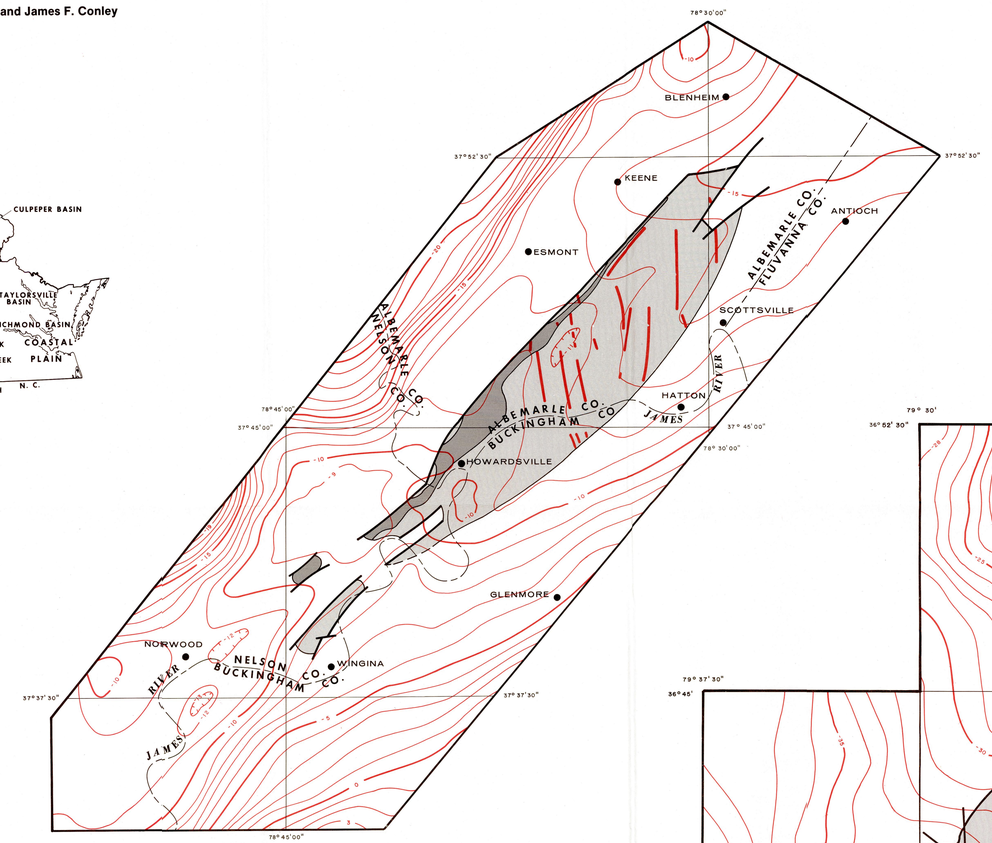
1985

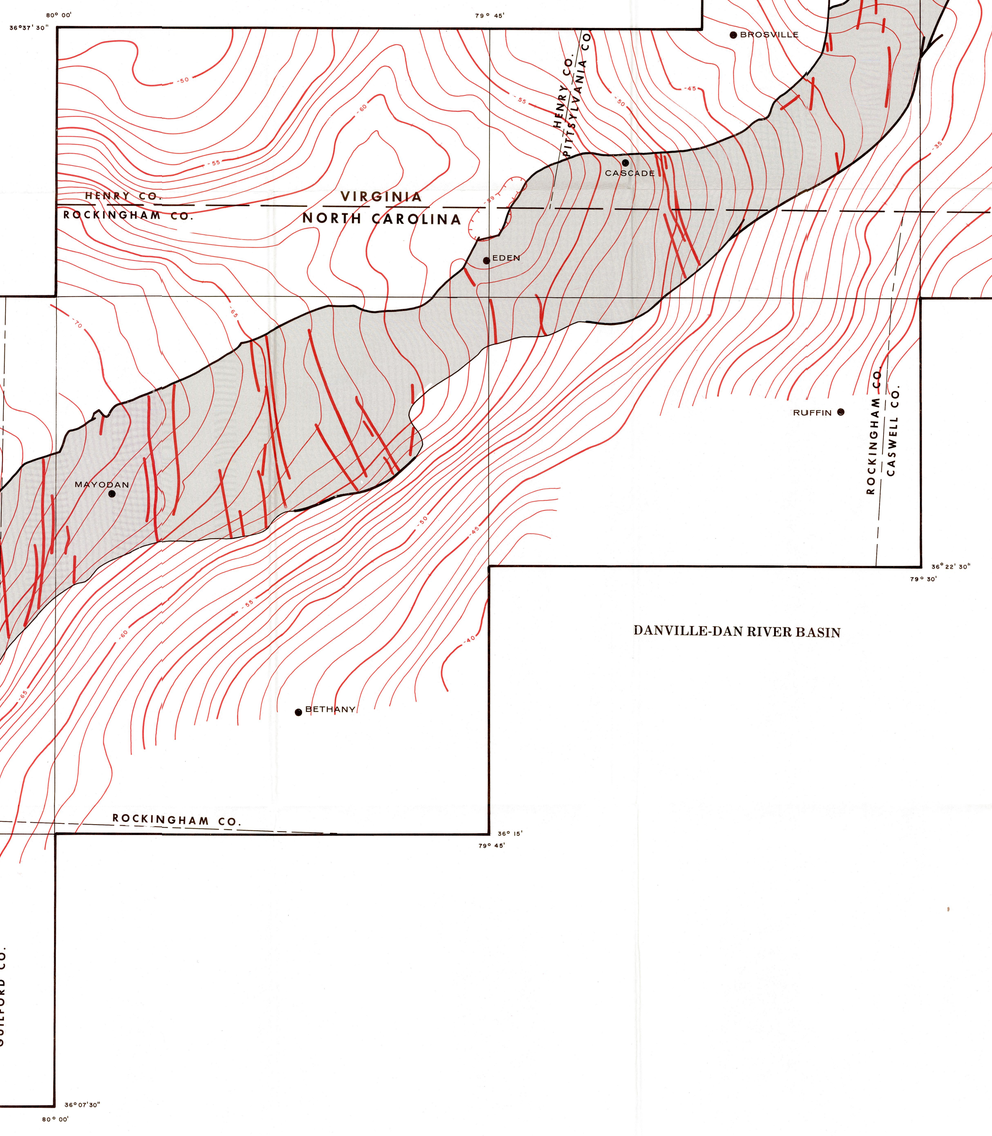


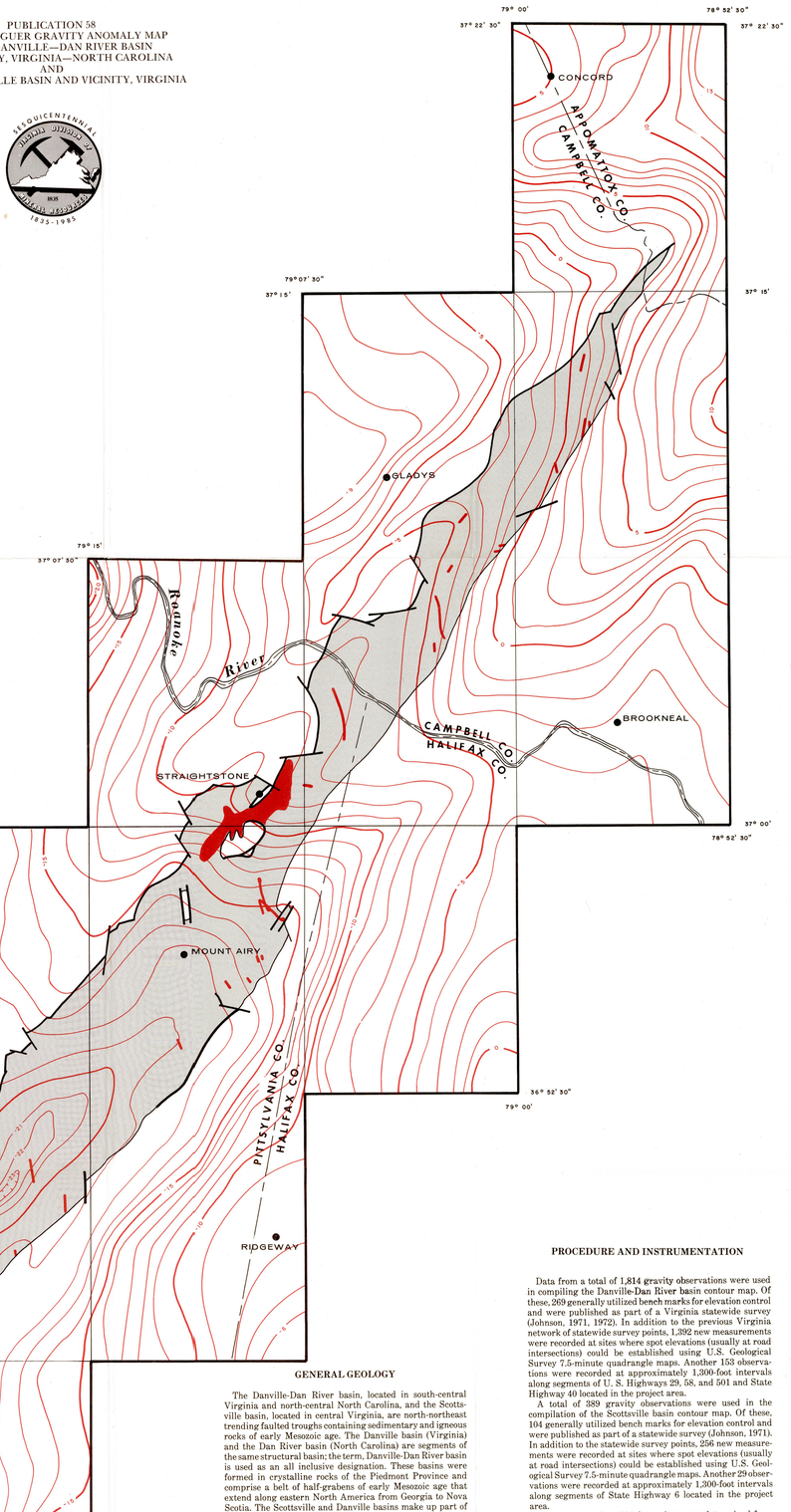

SCOTTSVILLE BASIN

SCALE 1:125000
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 KILOMETERS






## EXPLANATION

Jurassic (?) igneous rocks
diabase

Triassic sedimentary rocks
sandstone, siltstone, shale, conglomerate

Pre-Triassic (?)/Triassic (?) rocks
lithic breccia and conglomerate, greenstone (slightly metamorphosed)

Pre-Mesozoic igneous and metamorphic rocks (includes Jurassic (?) dikes outside basin)
undifferentiated crystalline rocks

## KEY

Contacts—exposed, approximate, or inferred

Faults—exposed, approximate, or inferred

Bouguer gravity contour

Hachured contour indicates local minimum closure

Contour interval 1.0 milligal

Contours based on machine-contoured map; reduction density 2.67 g/cm³; datum 980,118.00 milligals; no terrain correction

Base map from the U. S. Geological Survey

## PROCEDURE AND INSTRUMENTATION

Data from a total of 1,814 gravity observations were used in compiling the Danville-Dan River basin contour map. Of these, 269 generally utilized bench marks for elevation control and were published as part of a Virginia statewide survey (Johnson, 1971, 1972). In addition to the previous Virginia network of statewide survey points, 1,392 new measurements were recorded at sites where spot elevations (usually at road intersections) could be established using U.S. Geological Survey 7.5-minute quadrangle maps. Another 153 observations were recorded at approximately 1,300-foot intervals along segments of U. S. Highways 29, 58, and 501 and State Highway 40 located in the project area.

A total of 389 gravity observations were used in the compilation of the Scottsville basin contour map. Of these, 104 generally utilized bench marks for elevation control and were published as part of a statewide survey (Johnson, 1971). In addition to the statewide survey points, 256 new measurements were recorded at sites where spot elevations (usually at road intersections) could be established using U.S. Geological Survey 7.5-minute quadrangle maps. Another 29 observations were recorded at approximately 1,300-foot intervals along segments of State Highway 6 located in the project area.

Elevations for the 1,300-foot points were determined from Virginia Department of Highways and Transportation engineering drawings. Elevation accuracy for each of the data sets is: first- through third-order leveling for bench marks; ±2.0 feet for spot-determined and bridge elevations; ±1.0 foot for the highway profiles. Horizontal control for bench marks was established for station coordinates where data for control were available; for all other stations, latitude and longitude were scaled (manually) from U.S. Geological Survey 7.5-minute quadrangle topographic maps.

All measurements were recorded using a LaCoste-Romberg Model G geodetic gravity meter (number 77) with a nominal reading accuracy of ±0.01 milligal. Duplicate measurements were made at each station. Each day's observations for the Virginia part of the basin began and ended with a gravity measurement at one of three base stations established at Charlottesville, Appomattox, and Chatham (Johnson and Ziegler, 1972). The North Carolina part of the basin began and ended with a gravity measurement at one of two base stations that were established at Reidsville and Winston-Salem (979,788.200 and 979,721.010 milligals respectively). These two base stations were established by four tie-loops to the Virginia Gravity Base net station at Chatham. The base station loops were made utilizing the ladder-sequence loop technique. All field observations were made utilizing a modified ladder-sequence loop technique. The gravity-base values used were referenced on the pre-1971 international standardization net in order that the computed station values would be compatible with the gravity map of Virginia (Johnson, 1977). All values are relative to a datum of 980,118.00 milligals.

The computation and reduction of field data was done on computers at the University of Virginia, Charlottesville, using a modified GRAVAS program which includes corrections for earth tides and instrument drift. Gravity anomalies were calculated using the 1930 international geodetic reference formula and a Bouguer density of 2.67 g/cm³. No terrane corrections were applied.

The gravity values were machine contoured by the Defense Mapping Agency, Aerospace Center, St. Louis Air Force Station, Missouri. The computer contour map was manually checked, and where deemed necessary, hand corrections were made.

## GENERAL GEOLOGY

The Danville-Dan River basin, located in south-central Virginia and north-central North Carolina, and the Scottsville basin, located in central Virginia, are north-northeast trending faulted troughs containing sedimentary and igneous rocks of early Mesozoic age. The Danville basin (Virginia) and the Dan River basin (North Carolina) are segments of the same structural basin; the term, Danville-Dan River basin is used as an all inclusive designation. These basins were formed in crystalline rocks of the Piedmont Province and comprise a belt of half-grabens of early Mesozoic age that extend along eastern North America from Georgia to Nova Scotia. The Scottsville and Danville basins make up part of a western segment or belt of graben terrane in Virginia, of which the boundary fault lies on the west. Other basins that comprise the western segment are the Barboursville and Culpeper basins of Virginia, and the Davie County basin of North Carolina (Wise and Johnson, 1980). The Farmville basin and four smaller basins (Johnson, et al., 1985) are included in the central segment. The eastern segment consists of the Taylorsville and Richmond basins, and five small subsidiary outlying basins in east-central Virginia (Johnson, et al., 1985). The Durham-Sanford (Deep River)-Wadesboro subbasins comprise an eastern segment of exposed basins in North Carolina, of which the normal boundary fault forms the eastern margin.

### Danville-Dan River Basin

The Danville-Dan River basin is approximately 110 miles in length with a maximum width of about eight miles. It extends from southern Appomattox County, Virginia, to within 10 miles of Winston-Salem, North Carolina. The basin has an areal extent of approximately 460 square miles (Weems, 1980).

The upper Triassic sedimentary rocks in the Danville-Dan River basin include conglomerate, sandstone, carbonaceous siltstone, claystone, shale, mudrock, and thin coals. Microbreccia and cataclasite occur along major border faults. The sediments were deposited in fluvial and lacustrine environments. Most of the conglomerates and coarse-grained clastic rocks were derived from erosion of nearby source areas and were transported only a relatively short distance before being deposited. The depositional environments extent at any one time were controlled by local changes in rates of sediment input versus trough subsidence brought about by differential movements within the trough and along its boundaries.

Meyertons (1963) and Thayer (1970) identify approximately 100 diabase dikes within the basin, many of which extend discontinuously into the adjacent Piedmont and Blue Ridge areas. In the northern segment of the Danville basin, poorly exposed sheets or sills of diabase are present in a geologically complex area.

The sedimentary rocks of the Danville-Dan River basin occupy an asymmetrical graben. In general the strata dip to the northwest toward major southeast-dipping high-angle normal border faults that are locally cut by cross faults. Along the fault zone that comprises the western border of the basin, the principal faults (Chatham fault in Virginia; Dan River fault in North Carolina) form the contact between Triassic and pre-Mesozoic metamorphic rocks. The fault zone along the western border probably consists of a "series of down-to-the-basin steps" along its entire 110-mile length. It has been estimated that total cumulative vertical displacement along the fault zone may be as great as 15,000 feet, a figure which may also represent the cumulative thickness of the sedimentary units in the basin (Meyertons, 1963; Thayer, 1970).

The eastern margin of the Danville-Dan River basin has both unconformable and fault contact relationships with the adjacent crystalline rocks. Faulting is minor and discontinuous. In general, faults mapped along the eastern border of the basin are shorter in length and exhibit less displacement than those along the western border, and they generally dip steeply to the west instead of to the southeast.

### Scottsville Basin

The Scottsville basin, approximately 21 miles in length with a maximum width of about 3.5 miles, is located in southern Albemarle, northwestern Buckingham, and southeastern Nelson counties, Virginia. It has an areal extent of about 50 square miles.

The sedimentary units in the Scottsville basin comprise sandstone, siltstone, shale, and conglomerate. They lie nonconformably on pre-Mesozoic schists, phyllites, and slates along the eastern margin of the basin and generally dip westward. The coarse-grained clastic sediments of Triassic age, deposited in the basin, were derived from a source area external to the normal fault along the western boundary of the basin. A few northwest trending dikes have been mapped within the basin.

A slightly-metamorphosed sequence of lithic breccias and conglomerates, composed primarily of greenstone fragments and containing interlayers of greenstone, occurs along the western edge of the Scottsville basin. In some areas this unit is directly in contact with pre-Mesozoic metamorphic rocks. In other areas Triassic red shales and siltstones lie between the greenstone and lithic breccias and these underlying metamorphic rocks. Previously, the age of the metamorphosed unit has been interpreted by various authors as being either Mesozoic or pre-Mesozoic. Most have accepted the greenstone breccias and conglomerates as being border fanglomerates and conglomerates of Triassic age. Other authors have considered the interlayered metamorphosed greenstones to be of pre-Mesozoic age. Roberts (1928) mapped this metamorphosed sequence as undifferentiated Cambrian schists. Furcron (1935) mapped some areas of this unit as greenstone flows within the Precambrian Wissahickon formation. Nelson (1962) considered part of this unit as the Catoctin Formation. Kingery (1954, p. 21 and 24) describes a gabbro dike "body" as "a medium-grained, highly epidotized and chloritized green metagabbro. The intrusion of this body into the fanglomerate facies and between the fanglomerate and the rocks of the western facies has metamorphosed locally the fanglomerate and western facies to low grade chlorite, sericite, epidote, quartz contact rock, . . . , the highly altered metagabbro acts as a cement in much of the fanglomerate." Kingery (1954) and Sunderman (1957) considered this entire greenstone unit to be Triassic.

From the foregoing review of the literature, the metamorphosed sequence continues to be a geologic enigma. Even considering recent field studies, the age of this unit remains indefinite.

[1]North Carolina Department of Natural Resources and Community Development, Division of Land Resources, Geological Survey Section, Raleigh, N. C.

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