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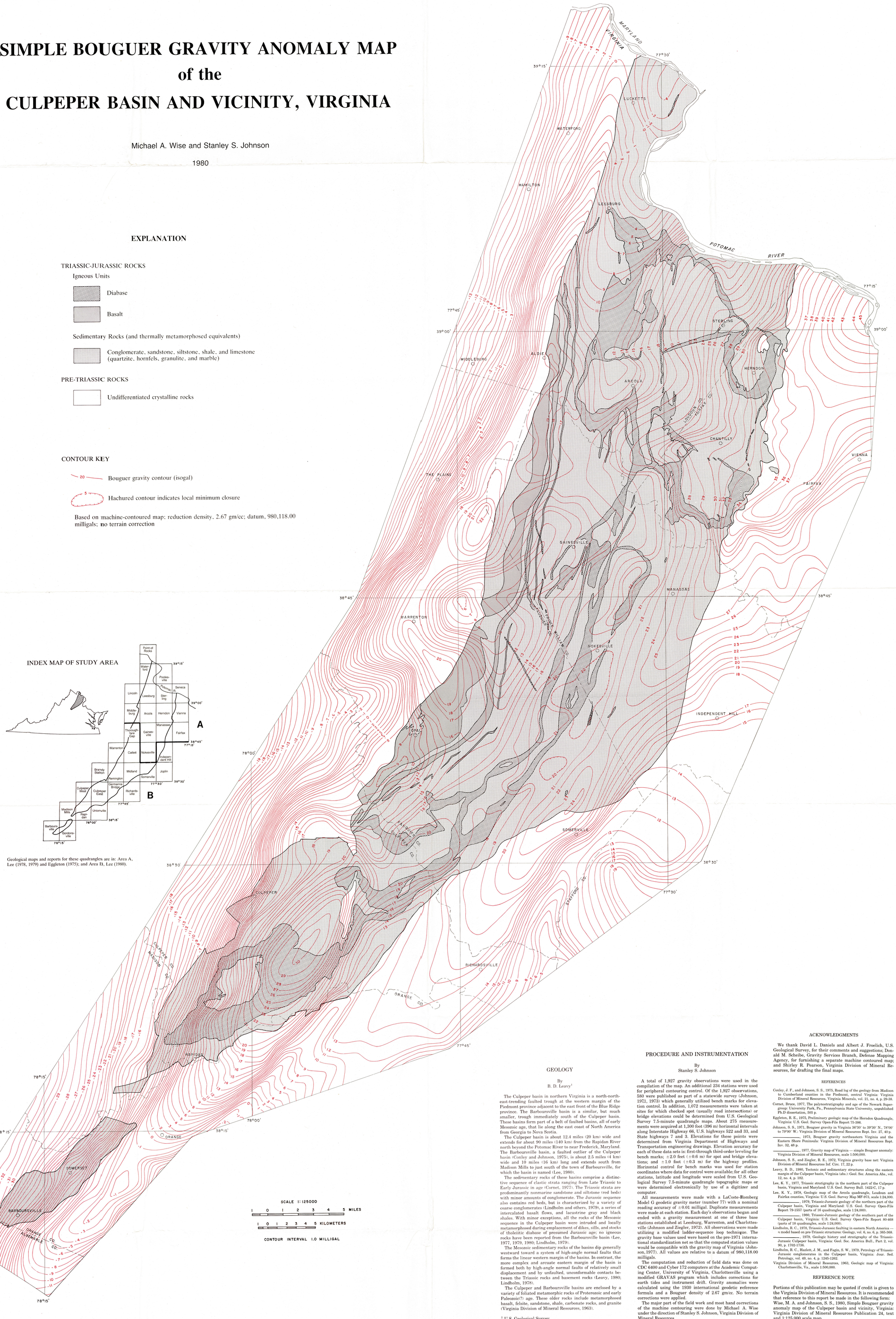
SIMPLE BOUGUER GRAVITY ANOMALY MAP
OF THE
CULPEPER BASIN AND VICINITY, VIRGINIA

# SIMPLE BOUGUER GRAVITY ANOMALY MAP of the CULPEPER BASIN AND VICINITY, VIRGINIA

Michael A. Wise and Stanley S. Johnson

1980




## EXPLANATION

TRIASSIC-JURASSIC ROCKS

Igneous Units

- Diabase
- Basalt

Sedimentary Rocks (and thermally metamorphosed equivalents)

- Conglomerate, sandstone, siltstone, shale, and limestone (quartzite, hornfels, granulite, and marble)

PRE-TRIASSIC ROCKS

- Undifferentiated crystalline rocks

## CONTOUR KEY

- 20 — Bouguer gravity contour (isogal)
- 5 — Hachured contour indicates local minimum closure

Based on machine-contoured map: reduction density, 2.67 gm/cc; datum, 980,118.00 milligals; no terrain correction

INDEX MAP OF STUDY AREA




Geological maps and reports for these quadrangles are in: Area A, Lee (1978, 1979) and Eggleton (1975); and Area B, Lee (1980).

Base modified from U.S. Geological Survey, 1980

## GEOLOGY

By
B. D. Leavy[1]

The Culpeper basin in northern Virginia is a north-northeast-trending faulted trough at the western margin of the Piedmont province adjacent to the east front of the Blue Ridge province. The Barboursville basin is a similar, but much smaller, trough immediately south of the Culpeper basin. These basins form part of a belt of faulted basins, all of early Mesozoic age, that lie along the east coast of North America from Georgia to Nova Scotia.

The Culpeper basin is about 12.4 miles (20 km) wide and extends for about 90 miles (140 km) from the Rapidan River north beyond the Potomac River to near Frederick, Maryland. The Barboursville basin, a faulted outlier of the Culpeper basin (Conley and Johnson, 1975), is about 2.5 miles (4 km) wide and 10 miles (16 km) long and extends south from Madison Mills to just south of the town of Barboursville, for which the basin is named (Lee, 1980).

The sedimentary rocks of these basins comprise a distinctive sequence of clastic strata ranging from Late Triassic to Early Jurassic in age (Cornet, 1977). The Triassic strata are predominantly nonmarine sandstone and siltstone (red beds) with minor amounts of conglomerate. The Jurassic sequence also contains red beds, but is characterized by a variety of coarse conglomerates (Lindholm and others, 1979), a series of intercalated basalt flows, and lacustrine gray and black shales. With minor exceptions, all the rocks of the Mesozoic sequence in the Culpeper basin were intruded and locally metamorphosed during emplacement of dikes, sills, and stocks of tholeiitic diabase of presumed Jurassic age; no igneous rocks have been reported from the Barboursville basin (Lee, 1977, 1979, 1980; Lindholm, 1979).

The Mesozoic sedimentary rocks of the basins dip generally westward toward a system of high-angle normal faults that forms the linear western margin of the basins. In contrast, the more complex and arcuate eastern margin of the basin is formed both by high-angle normal faults of relatively small displacement and by unfaulted, unconformable contacts between the Triassic rocks and basement rocks (Leavy, 1980; Lindholm, 1978).

The Culpeper and Barboursville basins are enclosed by a variety of foliated metamorphic rocks of Proterozoic and early Paleozoic(?) age. These older rocks include metamorphosed basalt, felsite, sandstone, shale, carbonate rocks, and granite (Virginia Division of Mineral Resources, 1963).

[1] U.S. Geological Survey

## PROCEDURE AND INSTRUMENTATION

By
Stanley S. Johnson

A total of 1,927 gravity observations were used in the compilation of the map. An additional 234 stations were used for peripheral contouring control. Of the 1,927 observations, 580 were published as part of a statewide survey (Johnson, 1971, 1973) which generally utilized bench marks for elevation control. In addition, 1,072 measurements were taken at sites for which checked spot (usually road intersections) or bridge elevations could be determined from U.S. Geological Survey 7.5-minute quadrangle maps. About 275 measurements were acquired at 1,300 foot (396 m) horizontal intervals along Interstate Highway 66, U.S. highways 522 and 33, and State highways 7 and 3. Elevations for these points were determined from Virginia Department of Highways and Transportation engineering drawings. Elevation accuracy for each of these data sets is: first-through third-order leveling for bench marks; ±2.0 feet (±0.6 m) for spot and bridge elevations; and ±1.0 foot (±0.3 m) for the highway profiles. Horizontal control for bench marks was used for station coordinates where data for control were available; for all other stations, latitude and longitude were scaled from U.S. Geological Survey 7.5-minute quadrangle topographic maps or were determined electronically by use of a digitizer and computer.

All measurements were made with 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 began and ended with a gravity measurement at one of three base stations established at Leesburg, Warrenton, and Charlottesville (Johnson and Ziegler, 1972). All observations were made utilizing a modified ladder-sequence loop technique. The gravity base values used were based on the pre-1971 international standardization net so 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 CDC 6400 and Cyber 172 computers at the Academic Computing Center, 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 gm/cc. No terrain corrections were applied.

The major part of the field work and most hand corrections of the machine contouring were done by Michael A. Wise under the direction of Stanley S. Johnson, Virginia Division of Mineral Resources.

## ACKNOWLEDGMENTS

We thank David L. Daniels and Albert J. Froelich, U.S. Geological Survey, for their comments and suggestions; Donald M. Scheibe, Gravity Services Branch, Defense Mapping Agency, for furnishing a separate machine contoured map; and Shirley R. Pearson, Virginia Division of Mineral Resources, for drafting the final maps.

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## REFERENCE NOTE

Portions of this publication may be quoted if credit is given to the Virginia Division of Mineral Resources. It is recommended that reference to this report be made in the following form: Wise, M. A. and Johnson, S. S., 1980, Simple Bouguer gravity anomaly map of the Culpeper basin and vicinity, Virginia: Virginia Division of Mineral Resources Publication 24, text and 1:125,000 scale map.