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AEROMAGNETIC CONTOUR MAP
OF THE
CULPEPER BASIN AND VICINITY, VIRGINIA

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Stanley S. Johnson[1] and A. J. Froelich[2]

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The Culpeper and Barboursville basins in northern Virginia are north-northeast-trending, faulted troughs at the inner margin of the Piedmont geologic province along the east front of the Blue Ridge geologic province. These basins are parts of a belt of similar northeast-trending structures, all of Early Mesozoic age, in eastern North America.

The Virginia portion of the Culpeper basin is about 12.4 miles (20 km) wide and extends for about 90 miles (145 km) from the Rapidan River north beyond the Potomac River where it terminates just south of Frederick, Maryland. The Barboursville basin is a small faulted outlier immediately south of the Culpeper basin (Conley and Johnson, 1975) about 2.5 miles (4 km) wide and 10 miles (16 km) long, extending 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 ("Culpeper Group") which ranges in age from Late Triassic to Early Jurassic (Cornet, 1977). The Triassic section is predominantly non-marine sandstones and siltstones ("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 gray and black lacustrine shales. The entire "Culpeper Group" in the Culpeper basin is intruded and locally metamorphosed by dikes, sills, and stocks of tholeiitic diabase of Early Jurassic age (Lee, 1977, 1979, 1980; Lindholm, 1977; Lindholm and others, 1979). Igneous rocks have not been reported in the Barboursville basin (Lee, 1980).

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

The Culpeper and Barboursville basins are enclosed by a variety of foliated metamorphic rocks of Precambrian and Early Paleozoic age. These rocks underlie and crop out around the basin margins. These rocks include metabasalt with interlayered arkose, shale, quartzite, phyllite, schist, gneiss, felsic and mafic metavolcanic rocks and carbonate rocks (Virginia Division of Mineral Resources, 1963).

INSTRUMENTATION AND PROCEDURES

The 1981 aeromagnetic survey of the Culpeper basin and vicinity was performed by EG&G geoMetrics under contract to the Virginia Division of Mineral Resources. The magnetic survey was done concurrently with a radiometric survey (Leavy and others, 1982). The magnetometer used for the survey was a geoMetrics G-803 (¼ gamma sensitivity). The magnetometer (stinger assembly) and ancillary equipment was installed in a twin-engined Beechcraft Queen Aire. The magnetometer had a "noise envelope" of less than one gamma (sampling rate—one second) and was compensated for the effects of permanent and induced magnetism produced by the aircraft. A ground monitor was utilized to collect data on diurnal changes and magnetic storms.

The survey was flown in an east-west direction at a flight altitude of 500 feet (152 m), with flight lines spaced at 0.75 mile (1.21 km). Sufficient control lines were flown to cover the survey area adequately. The survey was flown with simultaneously operating analog and digital data acquisition systems.

The contour map is based on a machine contoured product that has been slightly modified by hand. The data values used for contouring were interpolated into a 0.5 kilometer grid using a minimum curvature gridding routine (search radius of 2 kilometers). A constant value of 55,000 gammas was removed from the data prior to processing. No gradients were removed.

Several aeromagnetic surveys have been flown over northern Virginia including the Culpeper basin, but these surveys provided only partial coverage at any one time. No single complete aeromagnetic map of the basin (Virginia portion) has been published at this contour interval previously; however, the U. S. Geological Survey map (1981) was based on old unpublished data and has a contour interval of 250 gammas. Data were not collected during this survey in Dulles International Airport airspace, because survey flights were not allowed in the area at the time of the 1981 survey. For the Dulles area, data from previous surveys were used; contours are dashed on the contour map for these data. (Zietz and others, 1977; Blanchett and others, 1963; U. S. Geological Survey, 1980).

INTERPRETATION

The principal magnetic anomalies are caused by pre-Mesozoic rocks that enclose and underlie the basin and by Jurassic igneous rocks within the Culpeper basin. Linear belts of pre-Mesozoic rocks (mainly Catoctin Formation, metamorphosed basalt) along the western margin of the northern half of the basin produce pronounced aeromagnetic highs and lows. The basin follows the regional trend of the older rocks in the north, but its southern part cuts westward across the regional strike. The northeast magnetic trend on the western edge of the northern basin changes abruptly near the Culpeper-Fauquier county line to a north trend. This trend and its associated anomalies apparently separates the Culpeper basin into two subbasins.

The Mesozoic sedimentary rocks within the Culpeper basin have little effect on the observed anomalies, except in areas where diabase bodies have intruded and metamorphosed the adjacent "red beds," producing hornfels that has a locally high magnetite content. Jurassic basalt flows and diabase intrusive rocks with the surrounding hornfels produce magnetic highs that are most apparent in the southern Culpeper subbasin where diabase constitutes most of the basin fill.

The Barboursville basin is indicated generally as a magnetic low, and the southeast flank of the basin is defined by the magnetic gradient associated with the Catoctin Formation.

East-west magnetic profiles outside and across the basins show three to six major north-trending magnetic (high or low) belts that correlate with major basement rock types. These can be traced discontinuously beneath and across the Culpeper and Barboursville basins, even where the magnetic contours are locally disturbed by extensive diabase bodies. Steep north-trending gradients within and flanking the basins apparently correspond to contacts between basement lithologic units, concealed faults, igneous and metamorphic rocks, or combinations of these features.

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[1]Virginia Division of Mineral Resources, Charlottesville, VA 22903
[2]U. S. Geological Survey, Reston, VA 22092

EXPLANATION

TRIASSIC AND JURASSIC ROCKS

Igneous units

- Diabase
- Basalt

Sedimentary rocks (and thermally metamorphosed equivalents)

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

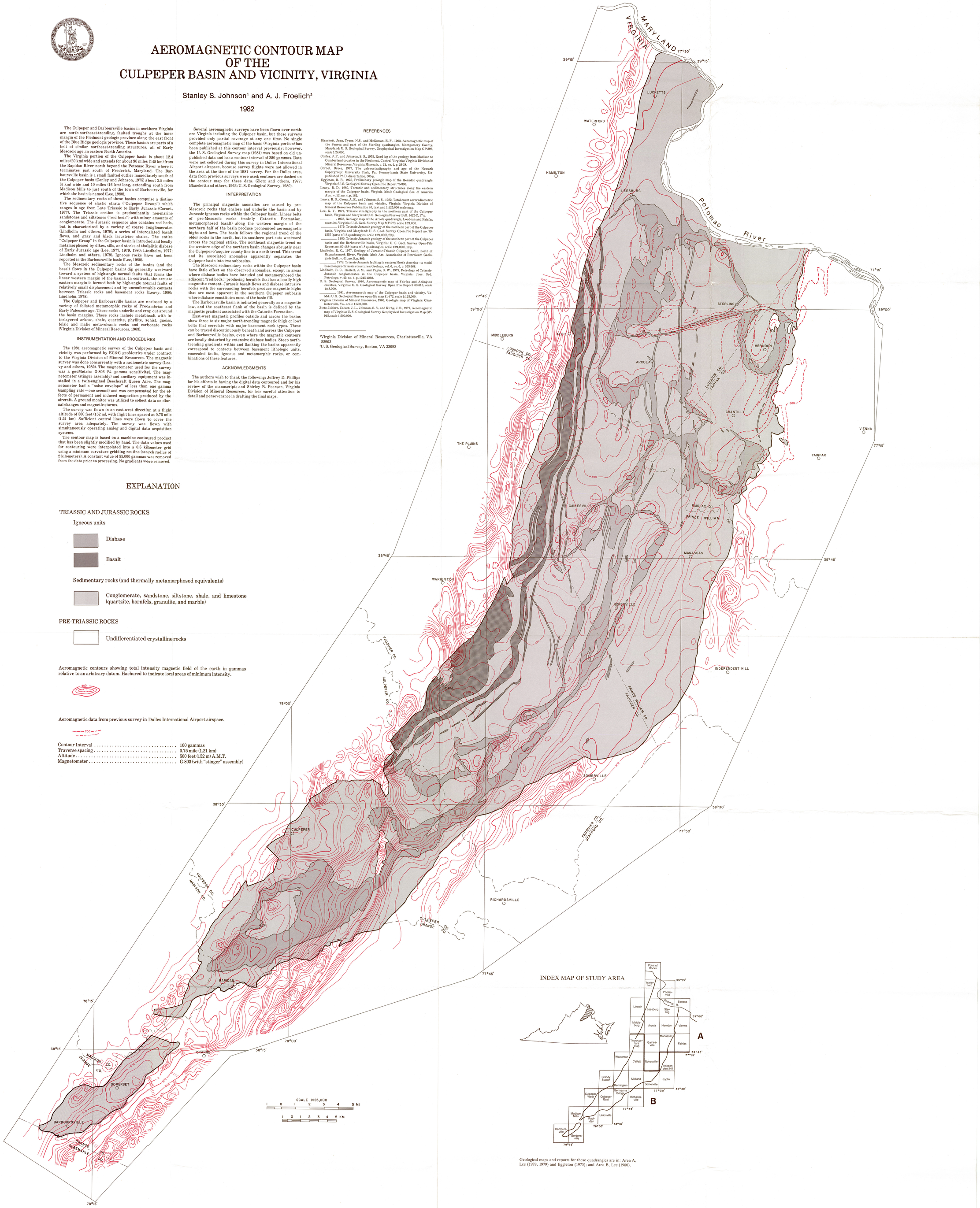
PRE-TRIASSIC ROCKS

- Undifferentiated crystalline rocks

Aeromagnetic contours showing total intensity magnetic field of the earth in gammas relative to an arbitrary datum. Hachured to indicate local areas of minimum intensity.

Aeromagnetic data from previous survey in Dulles International Airport airspace.

Contour Interval	100 gammas
Traverse spacing	0.75 mile (1.21 km)
Altitude	500 feet (152 m) A.M.T.
Magnetometer	G-803 (with "stinger" assembly)



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).