MAP GP-893

DEPARTMENT OF THE INTERIOR
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GEOLOGIC INTERPRETATION OF GEOPHYSICAL MAPS, CENTRAL SAVANNAH RIVER AREA, SOUTH CAROLINA AND GEORGIA

By David L. Daniels

GEOPHYSICAL INVESTIGATIONS
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DANIELS—CENTRAL SAVANNAH RIVER AREA, S. CAROLINA-GEORGIA MAP GP-893

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INTRODUCTION

SURVEY DESCRIPTION

A combined aeroradioactivity and aeromagnetic survey was conducted in 1958 by the U.S. Geological Survey for the U.S. Atomic Energy Commission, Division of Biology and Medicine, in a square area, 100 miles on a side centered on the Savannah River AEC plant (hereafter called the SRP Survey), Barnwell County, S.C. (fig. 1). The flight lines were 1 mile apart, 500 feet above ground, in northwest-southeast parallel traverses perpendicular to the average trend of the geologic structures in the Piedmont.

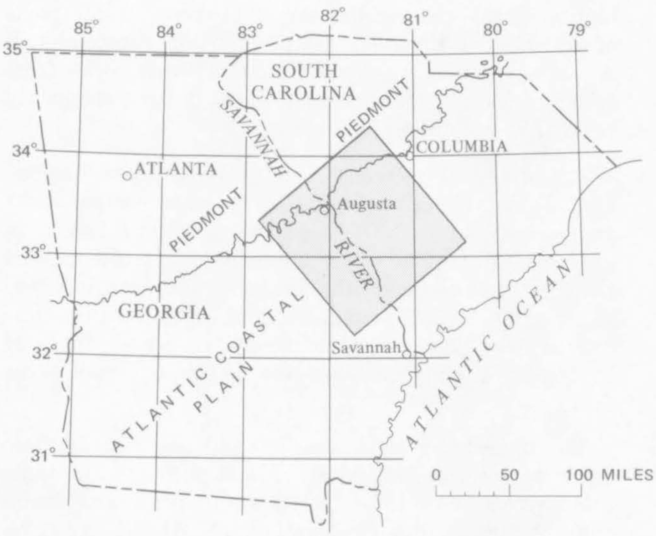

FIGURE 1.—Index map showing area of this report.

The radioactivity data were compiled as a radioactivity level map and analyzed by Schmidt (1961). Petty and others (1965) compiled the aeromagnetic map.

METHOD OF INVESTIGATION

This study is a geologic interpretation of the aeromagnetic map, the aeroradioactivity map, and other geophysical data, making use of available geologic data.

In order to aid the interpretation, I studied the geology of a small area that had not been previously mapped to determine the relationship between the geology and geophysical data. From the information gathered in the small area, the geologic data were extrapolated to the larger area using the geophysical maps and other geologic maps wherever possible. The Emory and Batesburg 7½ minute quadrangles in Saluda County, S.C. (fig. 2) were chosen because they include the southern half of the Carolina slate belt and the gneissic rocks to the southeast. Slate belt rocks are emphasized in this study because they have undergone the least metamorphism, deformation, and igneous intrusion, thereby making geophysical correlations simpler. Gamma-radiation was measured at outcrops and about 200 samples were taken for magnetic measurements in the laboratory.

ACKNOWLEDGMENTS

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GEOLOGY OF THE AREA

Piedmont crystalline rocks underlie approximately the northwestern quarter of the SRP survey area (fig. 1). The rest of the area is covered by Mesozoic and Tertiary sedimentary rocks of the Atlantic Coastal Plain province. Because the Coastal Plain rocks are mostly nonmagnetic, they contribute little to the anomaly pattern of the magnetic map. Their presence only increases the distance between the airborne detector and the anomaly-producing crystalline rocks.

The regional geology of the southern Piedmont has generally been discussed in terms of geologic belts that parallel the trend of the Appalachians. The belts are principally metamorphic zones (Overstreet and Bell, 1965a; Crickmay, 1952) but in some cases may also be tectonic provinces.

For a summary of geologic work in South Carolina and Georgia see Overstreet and Bell (1965a), Crickmay (1952), and Hurst (1970).

CAROLINA SLATE BELT

The Carolina slate belt in this region consists of lower greenschist facies metasedimentary and metavolcanic rocks intruded by granitic plutons (map *A*). Original rock types include argillite, siltstone, sandstone, and felsic to mafic tuffs, flows, and breccia (Overstreet and Bell, 1965a). Because of moderate deformation and limited recrystallization, original sedimentary and volcanic textures are commonly preserved.

In South Carolina, the geology of the region joining the northeast edge of the SRP Survey area was mapped by Secor and Wagener (1968). They differentiated the slate belt rocks into three major stratigraphic units: 1) the Wildhorse Branch Formation (oldest)—felsic and mafic metatuffs and graphitic phyllite; 2) the Persimmon Fork Formation—dacitic metatuffs; and 3) the Richtex Formation—largely metamudstones. They interpreted the sequence as folded into a synclinorium in the northwestern part of their area with an anticlinorium to the south.

Similar rocks are found 30 miles to the southwest in Edgefield and McCormick Counties (fig. 1) where preliminary geologic maps (McCutchen, 1970; Johnson, 1970) show three northeast-trending slate-belt units within the SRP Survey area; felsic metavolcanic rock to the northwest and a central 4-5-mile-wide band of meta-argillite which grades southeast into quartz-sericite-phyllite.

In Georgia, the crystalline rocks were mapped by G. W. Crickmay for the State geologic map (Georgia Div. Mines, Mining and Geology, 1939). Slate, phyllite, schist, and metavolcanic rocks in the Savannah River region were mapped as the Little River Series, thought to be equivalent to rocks of the slate belt in South Carolina. LeGrand and Furcron (1956) provided more detailed mapping of the granites and gneisses but left the Little River Series undivided. Crawford (1968a-d) subdivided the Little River rocks within the SRP Survey area into five units without any stratigraphic or structural interpretation: (1) a fine-grained hornblende gneiss-biotite gneiss-amphibolite unit; (2) a phyllite-metavolcanic unit; (3) a phyllite-"knotty" sericite schist unit; (4) a muscovite schist-"knotty" sericite schist unit; and (5) a quartz-feldspar-sericite-muscovite schist unit. Elongate to oval bodies of granite and gneissic granite are fairly abundant.

CHARLOTTE AND KIOKEE BELTS

Quartz-microcline gneiss, migmatitic amphibolite interlayered with quartz-biotite gneiss, and granite-granodiorite plutons are the principal Charlotte belt rocks in Newberry County, S.C. (McCauley, 1961). Only the amphibolite-quartz-biotite gneiss is present within the SRP Survey area. Younger gabbro plutons, which are common west of this area, are absent here.

Crickmay's (1952) term Kiokee belt is used here for the similar rocks that border the Carolina slate belt on the south. The Kiokee belt comprises granite gneiss, hornblende gneiss, quartz-microcline gneiss, minor serpentine, and lenticular bodies of granite and porphyritic granite (Crawford, 1968 a–d; Overstreet and Bell, 1965b).

BEL AIR BELT

Southeast of the Kiokee belt, low-grade metasedimentary and metavolcanic rocks, called the Bel Air belt by Crickmay (1952), appear in discontinuous erosional openings in the Coastal Plain cover (Sandy and Crawford, 1968a, b; Crawford, 1968a, b, d). These rocks are lithologically very similar to the rocks of Crickmay's Little River Series. Moreover, Crickmay (Georgia Div. Mines, Mining and Geology, 1939) mapped a narrow connection between the Bel Air rocks and Little River rocks around the west end of the Kiokee belt.

THE EMORY AND BATESBURG QUADRANGLES

GEOLOGY

The rocks in the Emory and Batesburg 7½-minute quadrangles in west-central South Carolina were studied in reconaissance fashion in order to relate the geology to the aeromagnetic and aeroradioactivity data (fig. 2). The relations found between the geophysics and geology in this area were then used to extrapolate the geology to the remaining area of slate-belt rocks covered by the geophysical survey.

More than half the area of these two quadrangles is underlain by lower greenschist facies (chlorite and biotite zones) metasedimentary and metavolcanic rocks of the slate belt intruded by a porphyritic granite pluton. A narrow cataclastic zone separates these rocks from felsic gneisses to the southeast which in turn are partly covered by coastal-plain deposits.

The slate-belt metasedimentary rocks were mapped (fig. 2) as two units separated by metavolcanic rocks and given tentative stratigraphic position based on graded bedding. The upper metasiltstone, which crosses the northwest corner of the Emory quadrangle, is a tan-weathering metasiltstone. Bedding is defined by fine multicolored layers dipping mostly northwest distorted by steeply dipping cleavage and associated small shear folds.

The underlying metavolcanic rocks are derived from felsic to intermediate vitric-crystal tuffs, lapilli tuffs, and breccia with interlayered mafic flows and lapilli tuffs. A steeply dipping foliation, (N. 45° E., av.), resulting from flattening of volcanic clasts and planar orientation of micas and chlorite is the dominant structure which obscures any original stratification.

The lower metasiltstone is derived from a fairly well sorted arkosic siltstone with lesser shale and poorly sorted volcanic sandstone. Scattered volcanic clasts and lack of conglomerate and plutonic lithic fragments indicate that the metasedimentary rocks are probably reworked volcanic deposits.

Minor folds are rare in the Emory and Batesburg quadrangles but where observed have steep axial planes and nearly horizontal northeast-trending axes.

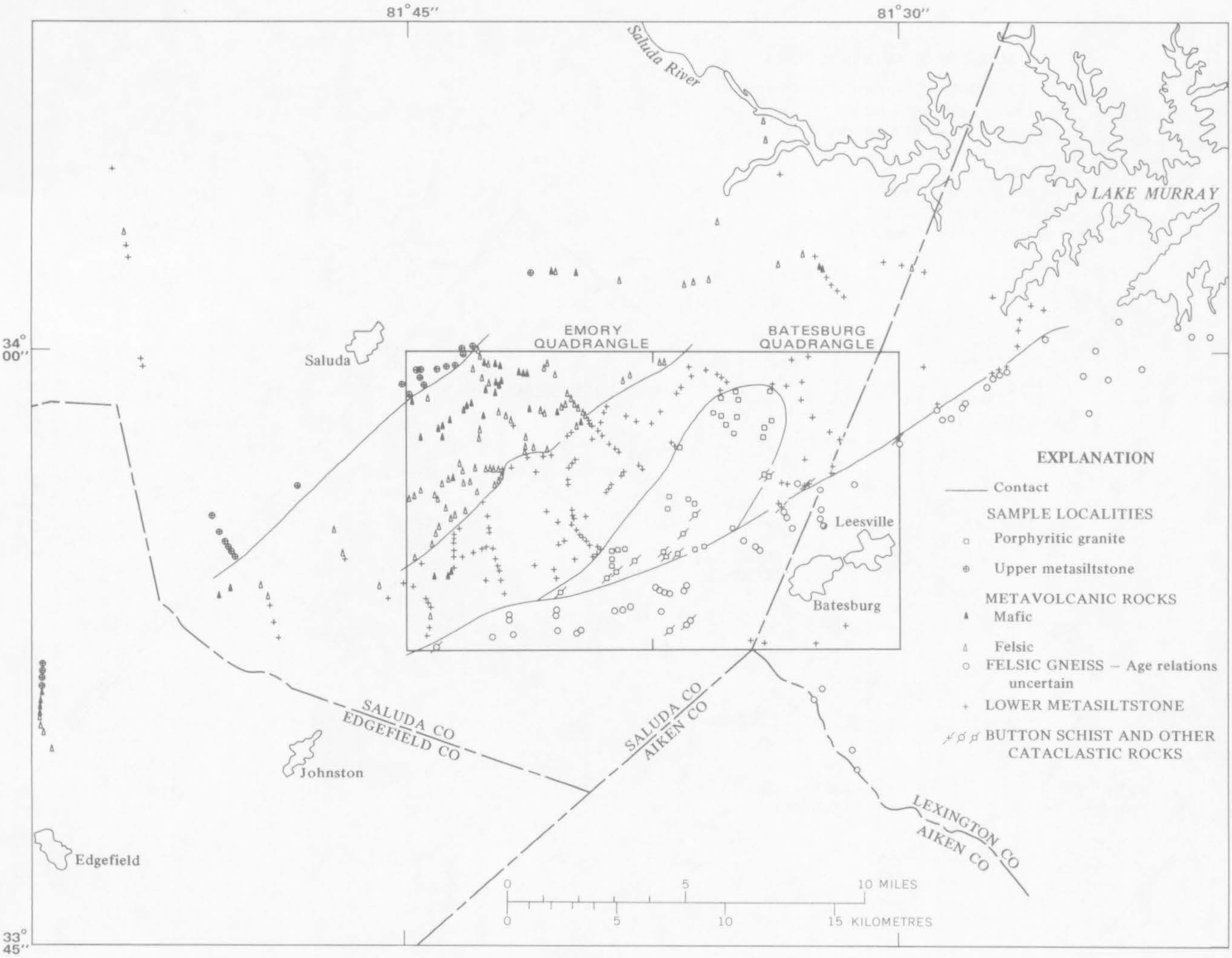

FIGURE 2.—Lithologic map of the Emory and Batesburg quadrangles, South Carolina. Geology by D. L. Daniels, 1969.

The rocks found in the Emory and Batesburg quadrangles resemble the rocks described by Secor and Wagener (1968) (fig. 3) to the northeast and the rocks mapped by McCutchen (1970) and Johnson (1970) in Edgefield and McCormick Counties to the west. Correlations based upon lithologic similarities and trend are shown in table 1.

TABLE 1. *Correlation of slate-belt rocks in South Carolina.*

Edgefield County (McCutchen, 1970) and McCormick County (Johnson, 1970)	Emory and Batesburg quadrangles—this report	Lexington, Newberry, Richland Counties (Secor and Wagener, 1968)
Bedded (meta) argillite	Upper metasiltstone	Richtex Formation
Quartz-sericite phyllite	Metavolcanic rocks	Persimmon Fork Formation
	Lower metasiltstone	Wildhorse Branch Formation

A porphyritic granite pluton described by Sloan (1908, p. 191), Watson (1910, p. 200), Schmidt (1962, p. 35), and Overstreet and Bell (1965b, p. 31), intrudes metasedimentary rocks in the Emory and Batesburg quadrangles (fig. 2). Evidence of intrusive origin includes closely spaced fractures in metasiltstones on the northwest edge of the pluton and an aureole of granoblastic spotted metasandstone on the northeast edge. The granite is massive and unfoliated in its northern part but becomes increasingly foliated and cataclastic toward the southern edge where it is a blastomylonite.

Felsic gneisses border the slate-belt rocks on the southeast. The dominant variety is a porphyroblastic quartz-microcline gneiss with lesser biotite gneiss, hornblende-biotite gneiss, quartzite, and unfoliated rocks of granitic appearance.

GEOPHYSICAL MEASUREMENTS

Magnetic measurements were made on rock samples from the Emory and Batesburg quadrangles and vicinity to provide control for the interpretation of the aeromag-

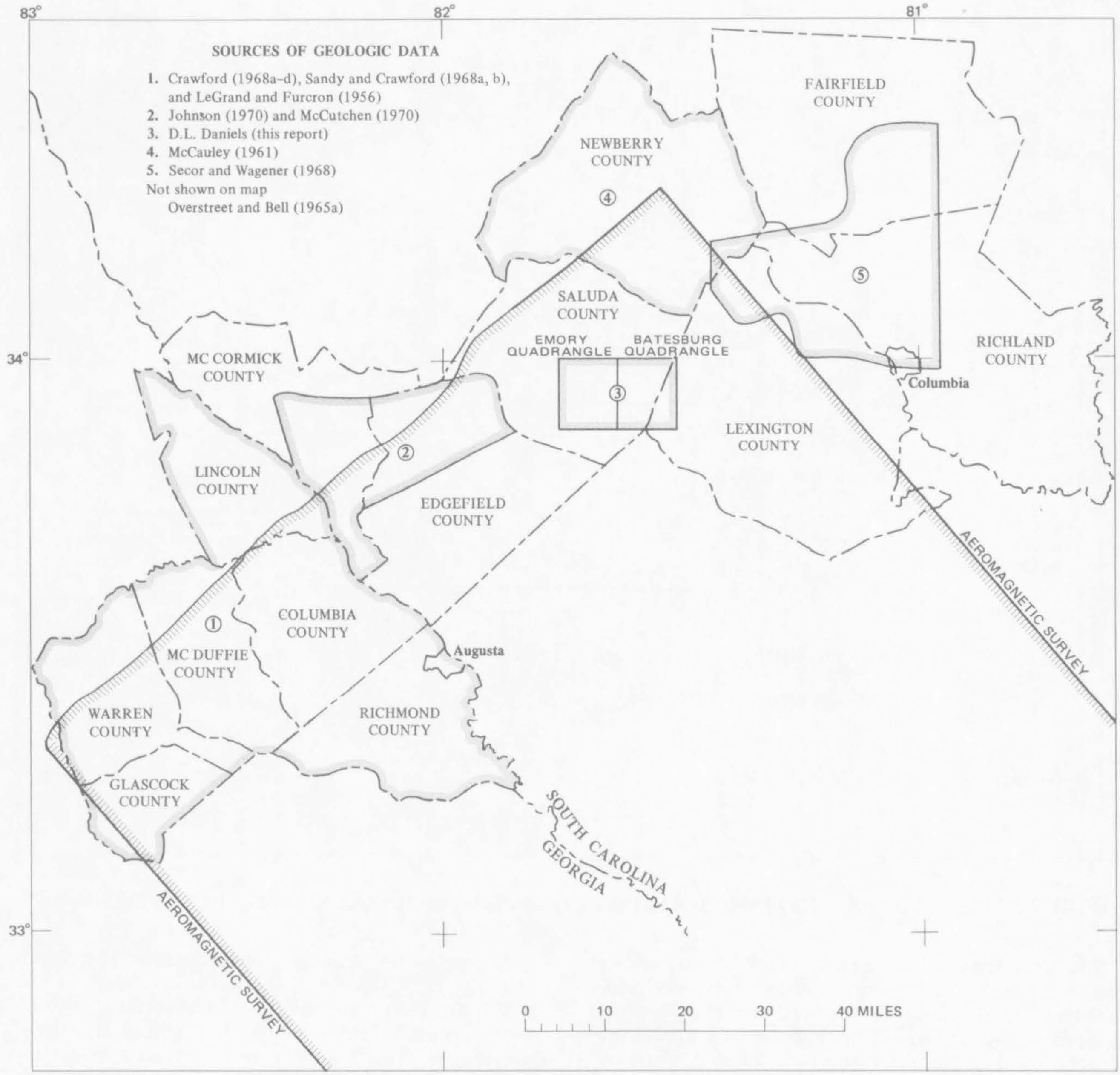

FIGURE 3.—Index showing sources of geologic data.

netic map. Magnetic susceptibility and remanent magnetization measurements were made on one-inch cores drilled from about 100 of the fresher rock samples. Additional susceptibility measurements were made on small cubes sawed from more weathered rocks. Magnetic susceptibility was measured with an A-C bridge instrument—model MS-2 manufactured by Geophysical Specialities Co. Remanent magnetization was measured with a U.S. Geological Survey spinner magnetometer of the type described by Doell and Cox (1965). Magnetic susceptibility data, in the form of histograms, (fig. 4 *A-E*) show the following: the porphyritic granite has a uniformly low susceptibility; the felsic gneiss has a uniform, moderate susceptibility; and although most slate-belt rocks have a low susceptibility, some have a highly variable susceptibility with only a small fraction that could be classified as anomaly-producing (fig. 4 *A-C*). The upper metasiltstone was not sampled because of limited area and poor exposures.

Remanent magnetization, which contributes to the total magnetization, is weak and less than the induced magnetization in the porphyritic granite and the felsic gneiss but again is highly variable in the slate-belt rocks where it often exceeds the induced component. Although there is a wide scatter in the direction of magnetization, most vectors are normally polarized and therefore add to the induced component.

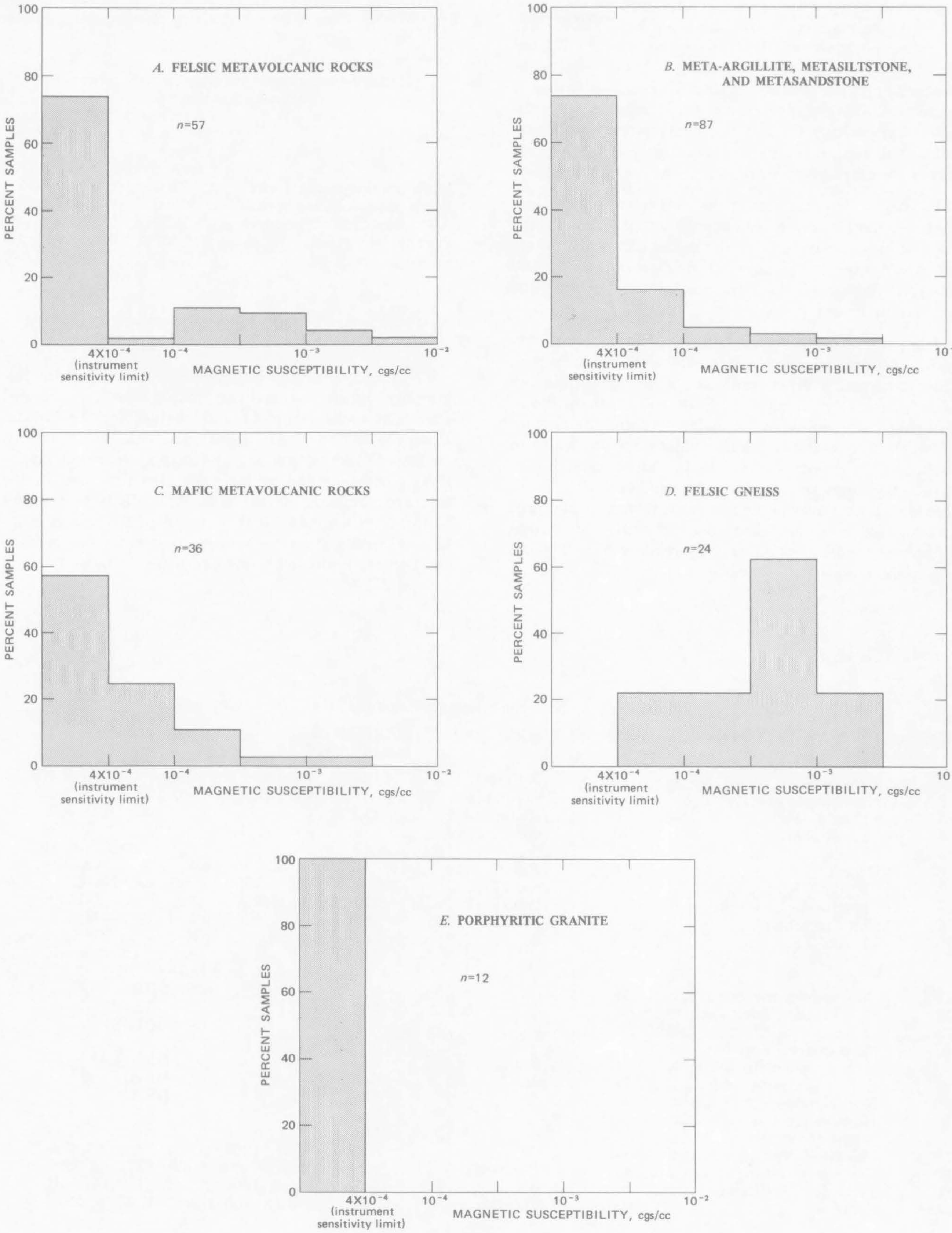

FIGURE 4.—Histograms showing magnetic susceptibility of selected Piedmont rocks from the Emory and Batesburg quadrangles and vicinity, South Carolina (see fig. 2).

Because of weathering, some adjustments should be made in the magnetic data. The slate-belt samples are all noticeably more weathered than the felsic gneiss and porphyritic granite samples. One of the effects of weathering in the southern Piedmont is the oxidation of magnetite, thereby decreasing the magnetic susceptibility and perhaps the remanent magnetization. Therefore, a higher proportion of slate-belt rocks are probably more magnetic than found by the measurements.

The magnetic properties of the metavolcanic rocks and the lower metasiltstone are not sufficiently different that they could be separated on the magnetic map. However, one would expect the magnetic field to be smooth and relatively high over the felsic gneiss and low over the porphyritic granite.

The gamma radiation was measured at nearly all exposures examined using a portable scintillation meter. The range and average radiation levels, in counts per second, are shown in table 2. Even though these radiation values are unique to the instrument and the manner in which it is used, the relative values are applicable to the aeroradioactivity survey. In the Emory and Batesburg quadrangles, therefore, aeroradioactivity levels should be lowest over mafic and felsic metavolcanic rocks and highest over the felsic gneiss. Further, the metasedimentary rocks should be high relative to both felsic and mafic metavolcanic rocks.

TABLE 2. *Gamma radiation levels of rocks in the Emory and Batesburg Quadrangles, South Carolina.*

[Measurements made at outcrops with a portable scintillation meter]

	Average (Counts per second)	Range (Counts per second)
Mafic metavolcanic rocks	3700	2000–6000
Felsic metavolcanic rocks	6500	4500–12,000
All metasedimentary rocks	7800	4000–12,000
Porphyritic granite	12,000	10,000–15,000
Felsic gneisses	17,000	8000–35,000

INTERPRETATION OF GEOPHYSICAL DATA

The geophysical and geologic interpretations that follow are illustrated on two maps; one for exposed Piedmont rocks (map *A*) and another for the Coastal Plain region (sheet 3). Geophysical data are presented on map *B* (aeromagnetic) and map *C* (aeroradioactivity). Anomalies and geologic features discussed in the text are numbered on the maps (i.e. *A*5 in text refers to loc. 5 on map *A*). Sources for the lithologic descriptions recorded from wells pentrating basement beneath the Coastal Plain sediments are listed in table 3.

TABLE 3. *Wells striking basement beneath Coastal Plain sedimentary rocks.*

Well no. (sheet 3)	Rock type	State	County	Altitude of basement (ft)	Reference
1	Metavolcanic rock	Ga.	Jefferson	−100	Woollard and others, 1957, well No. 27
2	Hornblende gneiss	do.	Columbia	+344	Herrick, 1961, p. 133, GGS–264.
3	Chlorite schist	do.	Richmond	+172	p. 339, GGS–309.
4	Talcose schist	do.	do.	−189	Applin, 1951, p. 19, well No. 14.
5	do.	do.	do.	−19	well No. 15.
6	Granite	S.C.	Aiken	−15	Siple, 1967, pls. 1, 3, 4, AK–10
7	do.	do.	do.	+67	1958, p. 62, well No. 2.
8	Chlorite-sericite schist	Ga.	Burke	−473	Herrick, 1961, p. 49, GGS–131.
9	Chlorite schist	S.C.	Aiken	−357	Siple, 1967, pls. 1, 3, 20–M.
10	do.	do.	do.	−585	pls. 3, 4, and written commun., 1967, P–4R.
11	Quartz-feldspar gneiss	do.	do.	−615	Diment, and others 1965, 1965, p. 5637, DRB 1.
12	Hornblende-chlorite schist	do.	do.	−690	DRB 2.
13	do.	do.	do.	−649	DRB 3.
14	Mica quartzite and chlorite-biotite schist	do.	do.	−673	DRB 4.
15	Epidote-chlorite schist	do.	do.	−643	DRB 5.
16	Hornblende-chlorite schist	do.	do.	−631	DRB 6.
17	Hornblende-chlorite schist and quartzite	do.	do.	−682	DRB 7.
18	Chlorite-hornblende schist	do.	do.	−696	Siple, 1967, p. 18–19, pl. 4, 35–H.
19	Triassic (?) fanglomerate	do.	Barnwell		Marine and Siple, 1971, p. 328
20	Triassic (?) siltstone	do.	do.	−1045	Siple, 1967, p. 22, pl. 4, P–5–R.
21	Granite	Ga.	Screven	about −2550	Milton and Hurst, 1965, p. 18.

CAROLINA SLATE BELT

The highly regular character of the magnetic anomalies over the slate belt suggests continuity of the rock units. Linear anomalies connecting physically separated mapped units indicate that the units are geologically linked.

The most prominent magnetic feature is the smooth, broad low on the northwest edge of the survey which connects the (meta)argillite in Edgefield and McCormick Counties (Johnson, 1970; McCutchen, 1970) with the upper metasiltstone in the Emory quadrangle, thus strengthening the geologic correlation proposed in (table 1). The low narrows in Georgia and lies mostly over the phyllite and metavolcanic unit mapped by Crawford (1968c) along the southern edge of Lincoln County. The low seems to identify the metasedimentary part of that unit. The region under the low is shown as upper metasiltstone on map *A*.

Linear magnetic highs over the metavolcanic unit in the Emory quadrangle extend for 50 miles to the southwest and connect with the quartz-sericite phyllite in Edgefield County (McCutchen, 1970) and with the phyllite-"knotty" sericite schist and the hornblende gneiss-biotite gneiss-amphibolite unit (Crawford, 1968b) in Columbia County, Ga. This suggests that these units are all metavolcanic rocks; they are interpreted as such on map *A*. As expected from the data in table 2, a subtle aeroradioactivity low coincides with the metavolcanic rocks in the Emory quadrangle and follows the linear magnetic anomalies to the Georgia state line.

The aeroradioactivity data, however, are not useful in the vicinity of Clark Hill Reservoir or Lake Murray because of the shielding effect of water. Therefore, only magnetic trends were used in these areas.

The lower metasiltstone was extended (map *A*) beyond the Emory and Batesburg quadrangles on the basis of a magnetic pattern similar to that over the metavolcanic rocks but distinguished from the metavolcanic rocks by its higher radioactivity level. A possible correlative unit in McDuffie and Warren Counties, Georgia, is the "quartz-feldspathic-sericite-muscovite rock" unit of Crawford (1968a, d).

The very linear magnetic anomalies suggest regional cylindrical folding about horizontal axes. The northwest dips in the Emory quadrangle and the symmetrical disposition of metavolcanic units bordering the upper metasiltstone belt (McCutchen, 1970; Johnson, 1970) further suggest a synclinal axis along this unit. To the north and east of the Batesburg quadrangle, magnetic anomalies are less regular and may indicate the hinge areas of folded magnetic layers.

Cataclastic porphyritic granite and "button" schist in several locations along the south edge of the slate belt (fig. 2) suggest a fault as proposed by Overstreet and Bell (1965a, p. 117). Crawford (1968a-d) mapped two "knotty" schist units (equivalent to "button" schist) along the south edge of the slate belt in Georgia. One of these mapped units, along with the South Carolina cataclastic rocks, lies along a narrow linear magnetic low (*B*4) 50 miles long that is interpreted as the trace of this fault zone (*A*4).

A narrow belt of highly radioactive felsic gneiss of the Kiokee belt (the quartz-microcline gneiss of Overstreet and Bell, 1965b) extends from Batesburg, S.C., northeast to the dam at Lake Murray, just beyond the report area (*A*5, *B*5, *C*5). A pair of parallel linear magnetic anomalies (*B*6) border the gneiss but lie entirely over the adjacent metasiltstone on the northwest side, even though the gneiss has a higher average magnetic susceptibility than the average slate-belt rock (compare figs. 5*A–C* to 5*D*). The contact between felsic gneiss and slate-belt rocks on map *A* is shown, therefore, just inside the magnetic anomalies (*B*6).

Heron and Johnson (1958) suggested a sedimentary origin for the felsic gneiss at Lake Murray because it contains 44 percent modal quartz. Tewhey (in Secor and Wagener, 1968, p. 74) suggested that the felsic gneiss is a metasedimentary rock diapirically injected into the limb of an anticline of slate-belt rocks. The bordering magnetic anomalies lend some support to Tewhey's theory because they probably originate in the same magnetic metasiltstone layer that has been repeated by folding around a gneiss core.

CHARLOTTE AND KIOKEE BELTS

In the small part of the Charlotte belt that is covered by the SRP Survey, the aeroradioactivity level is higher than over the adjacent slate-belt rocks. This does not support McCauley's (1961) conclusion that the Charlotte belt gneisses are more mafic.

The Kiokee belt is characterized by abundant sharp linear magnetic anomalies that are shorter and less regular than those in the slate belt. The average magnetic intensity is lower and, like the Charlotte belt, the radioactivity level is higher suggesting that the bulk composition of the belt is more felsic. Generally, comparison of the aeromagnetic map with available geologic maps for the Georgia area shows little correlation between anomalies and mapped units. Individual anomalies cross mapped bodies of granite, hornblende gneiss, and ultramafic rock. One porphyritic granite pluton (*A*7), near Appling, Ga., however, is matched closely by a radioactivity high (*C*7) (Schmidt, 1962, p. 32). Trends of magnetic anomalies in the vicinity of this pluton are deflected (*B*8), suggesting that the country rocks have been shouldered aside during instrusion of the granite.

A zone of gneissic granite lenses extends southwest from Edgefield, S.C., into the slate belt and produces a corresponding radioactivity high *A*9, *C*9 (Schmidt, 1962, p. 32). Radioactivity highs mark other tabular bodies of felsic gneiss along the edge of the slate belt: a porphyroblastic granite gneiss (*A*10, *C*10) in Warren and McDuffie Counties (Crawford, 1968a, d); porphyroblastic gneissic granite (*A*11, *C*11) in Columbia County, Ga. (Crawford and others, 1966, p. 30), and the porphyroblastic felsic gneiss (fig. 2 and *A*5, *B*5, *C*5) in the Emory and Batesburg quadrangles, South Carolina. These tabular bodies of porphyroblastic gneiss may be either stratigraphically related paragneisses or genetically related orthogneisses.

The Kiokee belt is bounded on the southeast in Georgia by low-grade metamorphic rocks of the Bel Air belt. Silicified breccia separates the two belts on both sides of the Savannah River north of Augusta, Ga. (*A*13), indicating the boundary is faulted. In South Carolina, the southern boundary of the Kiokee belt is obscured by the covering Coastal Plain rocks. The predominantly sharp linear anomalies of the Kiokee belt in South Carolina change southward to a smooth less regular magnetic pattern (*B*12). This change in magnetic character is interpreted as the southeast boundary of the Kiokee belt (*A*12, *B*12).

BEL AIR BELT

The exposed rocks of the Bel Air belt are marked by a large magnetically high area that extends south into the Coastal Plain province. Low-grade metamorphic rocks have been recovered from four wells that penetrate basement in this area (wells 1, 3, 4, 5 on map *A* and table 3). I therefore infer that the area of magnetic highs bounded on the south by a narrow arcuate low (*A*14, *B*14), defines the subsurface extent of the Bel Air belt. The broad oval magnetic high (*B*15) along the north edge of the belt may be caused by a mafic pluton at shallow depths.

OTHER ROCKS BENEATH THE ATLANTIC COASTAL PLAIN

In the vicinity of Aiken, S.C., granitic rocks are found in wells striking basement (sheet 3, wells 6 and 7) and in stream valleys that cut through the Coastal Plain. The relatively smooth magnetic field of this area (sheet 3, area 1) suggests that granite is the predominant rock type in the region. Farther south, mafic metamorphic rocks have been recovered from wells striking basement at the Savannah River Plant (sheet 3, area 2a). The magnetic character of this region differs from area 1—the anomalies have larger amplitude and a bifurcating linear habit. A prominent V-shaped magnetic high occurs within area 2 (sheet 3, area 2b). The Atomic Energy Commission has been conducting a program of deep drilling at the Savannah River Plant to test the feasibility of storing radioactive wastes in caverns excavated in basement rocks (Christl, 1964). Cores of basement rock have been taken from a cluster of eight wells located on or close to the V-shaped anomaly (sheet 3). Hornblende-chlorite schist and similar mafic rocks were cored in seven wells drilled on the magnetic high. Quartz-feldspar gneiss was cored in the one well (Diment and others, 1965, p. 5637) located on a magnetic low. The magnetic susceptibility of three samples of felsic gneiss from this well (sheet 3, well 11) average 1.1×10^{-3} cgs/cc; three samples of chlorite-epidote-hornblende schist from wells 15–17 (sheet 3) average 2.1×10^{-3} cgs/cc; remanent magnetization is negligible in both sample groups. Though this is a sparse sampling, comparison with the aeromagnetic map (sheet 3) indicates that the hornblende schist is the magnetic unit. It is likely, therefore, that the V-shaped magnetic high is produced by hornblende schist; its shape suggests a large, gently plunging fold (sheet 3).

The mineral assemblages found in the cores (Diment and others, 1965) indicate the greenschist-amphibolite transition facies (Turner, 1968). The rocks are most like Charlotte and Kiokee-belt rocks because of their metamorphic grade, coarse grain size, extensive cataclasis, and absence of relict textures.

A seismic refraction survey of the Atlantic Coastal Plain, shows a series of low basement velocities in a line across South Carolina (Woollard and others, 1957) which were interpreted as slate series by Bonini and Woollard (1960, p. 305). Siple (1967, p. 22) however, reported that sedimentary basement rock of probable Triassic age was cored in a well (sheet 3, well 20) near Steel Creek in Barnwell County, less than a mile from one of the seismic stations (station 58, sheet 3). This well is on the southern edge of a broad, smooth, magnetic low near the center of the aeromagnetic map. Siple (1967) inferred that the magnetic low is caused by a thick accumulation of nonmagnetic Triassic(?) sedimentary rock and drew an estimated boundary for this basin coincident with the edge of the low. The interpretation was strengthened by later drilling.

Marine and Siple (1971) described a new well in Barnwell County, about 6 miles northwest of the Steel Creek well (sheet 3, well 19). This well was drilled through 1590 feet of red Triassic(?) fanglomerate into the crystalline basement. Marine and Siple inferred from the abundance of large angular clasts in the drill core that the well is close to a normal fault that forms the northwest boundary of the basin. A similar fault was assumed to bound the southeast edge of the basin because of the steep, linear, magnetic gradient in that area.

A sharp northeast-trending linear magnetic anomaly close to well 19 (sheet 3) contrasts with the smooth magnetic field near well 20 (sheet 3). As no diabase sills were found in the drill core from this well, the anomaly is probably related to the crystalline rocks beneath the Triassic(?) basin. The thickness, therefore, of the basin rocks at Steel Creek is many times greater than the 1590 feet found on the northwest edge.

Because the low basement velocity at the Steel Creek seismic station 58 (sheet 3) is probably due to the Triassic(?) sedimentary rocks, it is reasonable to infer similar basement geology for station 51 (sheet 3) 11 miles northeast of Orangeburg, S.C., where a nearly identical low basement velocity was recorded (Bonini and Woollard, 1960). Although this station is 6 miles beyond the edge of the aeromagnetic survey, the generally low magnetic intensity of the adjacent area suggests that if a basin exists, it extends into the survey area (sheet 3, area 3b).

The anomalies with the largest amplitude and size on the magnetic map are grouped in a northeast-trending belt just south of the two inferred Triassic(?) basins (sheet 3). High basement velocities were recorded at two seismic refraction stations (Bonini and Woollard, 1960) that coincide with these magnetic highs (sheet 3, stations 54 and 55) and average basement velocities are found at stations that coincide with nearby magnetic lows (sheet 3, stations 59 and 60). Gravity values are generally high in the region of the magnetic highs although station spacing is wide (Am. Geophys. Union, Special Commission for Geophys. and Geol. Study of Continents, 1964). The correlation between magnetic, gravity, and seismic measurements is unusually good and suggests the area is underlain by mafic rock. Proximity to a Triassic basin might suggest diabase sills or basalt flows as the source; however, anomalies of this amplitude are not generally caused by horizontal slabs of magnetic rock. The amplitude and elliptical shape of the magnetic anomalies instead favor gabbroic plutons. Four areas coincident with these anomalies are designated mafic intrusive complexes on sheet 3.

A narrow, linear, nearly east-west magnetic low (sheet 3, feature 16) divides two of the larger inferred mafic areas. This lineament is possibly a fault zone and may be related to a branch of the Goat Rock fault zone that extends under the Coastal Plain near Macon, Ga., on an alined course with the lineament (U.S. Geol. Survey and Am. Assoc. Petroleum Geologists, 1961). Other prominent magnetic lineaments that may be faults are shown on sheet 3 (feature 17).

An area with a relatively smooth magnetic field, but without the usual strong northeast grain, extends along the southeast edge of the survey (area 5, sheet 3). The field is smoothest in the southernmost corner, where depth to basement is greatest and where the only basement well penetrated granite (Milton and Hurst, 1965, p. 18). This is part of a larger magnetically featureless area that Taylor and others (1968, p. 776) felt was underlain by granitic basement.

Other nonmagnetic rocks, which could make up the basement in this magnetically featureless area, include:

1) Triassic sedimentary rocks—A basement well at Summerville, S.C., 13 miles southeast of the edge of the survey area, penetrated red shale and sandstone containing diabase sills (Cook, 1936, p. 177). These rocks may extend into the survey area. Diabase intrusions could be the source of several low-amplitude northwest-trending anomalies near long. 81°W., lat. 33°N.
2) Pre-Cretaceous arkose and felsic volcanic rock of unknown thickness found in basement wells in southern Georgia (Milton and Hurst, 1965) may be present here also.
3) High-grade metasedimentary rocks and concordant granite present in the inner piedmont belt in Georgia produce similar featureless magnetic patterns (Philbin and others, 1964), and could be present here also.

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