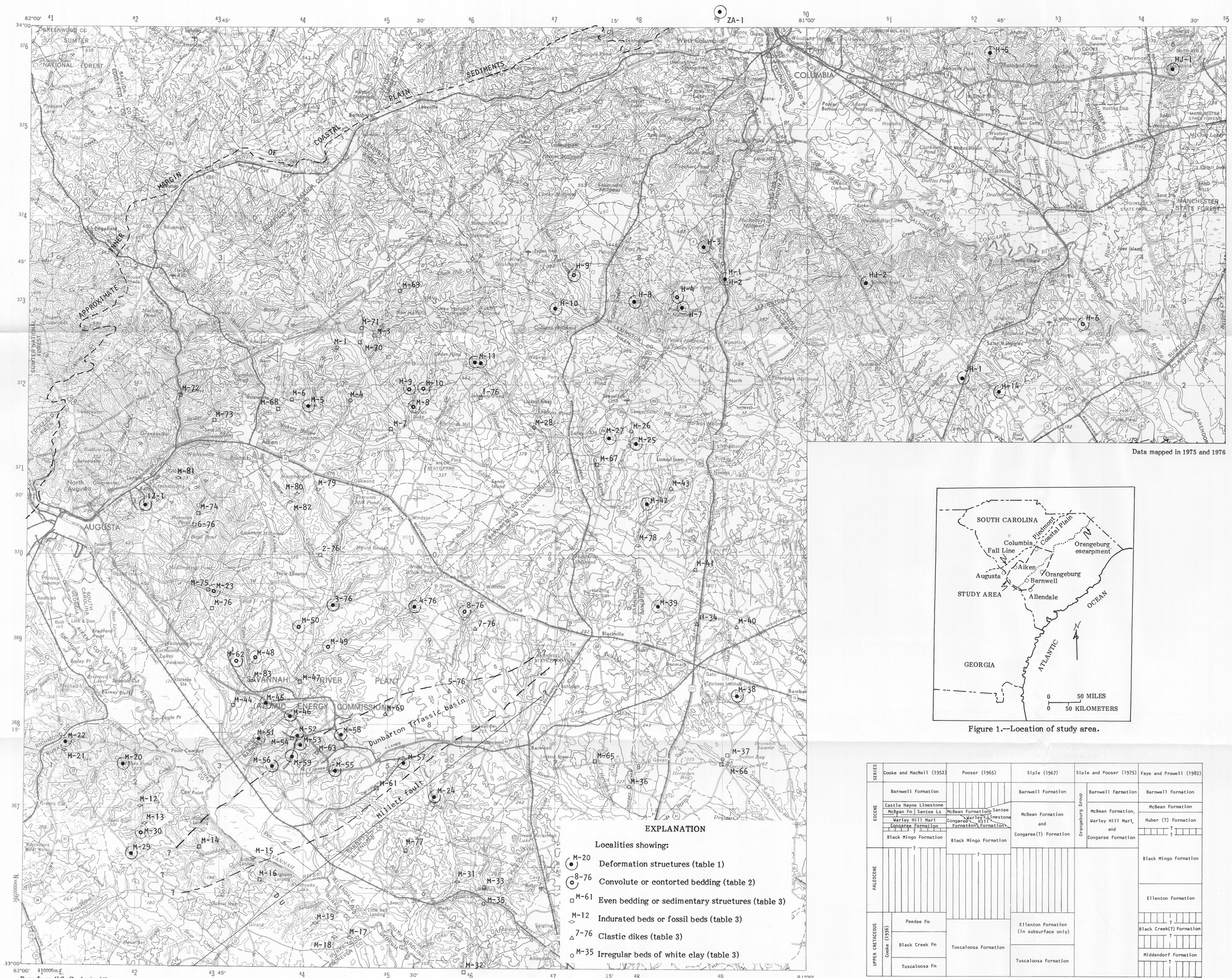


Data mapped in 1975 and 1976

Figure 1.—Location of study area.

Figure 2.—Stratigraphic nomenclature used in the study area.

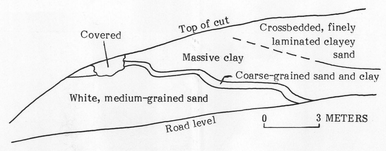


Figure 3.—Sketch of folding(?) at locality H-2.

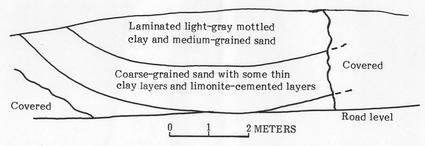


Figure 4.—Sketch of fold at locality H-3.

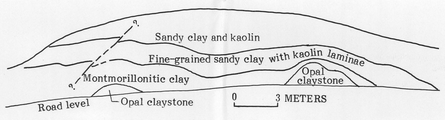


Figure 5.—Photograph of opal claystone (fuller's earth) body at locality H-5. Sketch shows collapse structures over opal claystone bodies. Shovel handle is about 50 cm long.

Figure 6.—Photograph and sketch showing high-angle faults at locality H-8. Hammer is about 30 cm long.

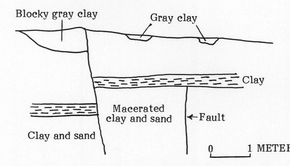


Figure 7.—Sketch of faults at locality 4-76.

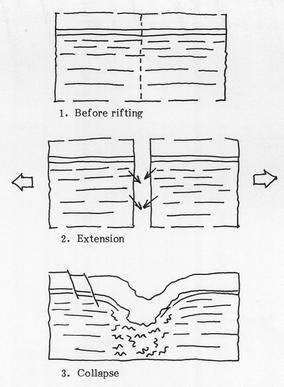


Figure 8.—Photograph and schematic interpretation of collapse(?) structure at locality M-5. Shovel blade is about 20 cm long.

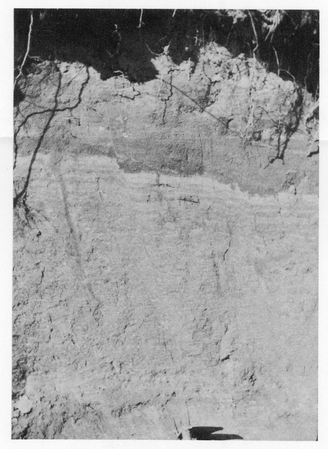
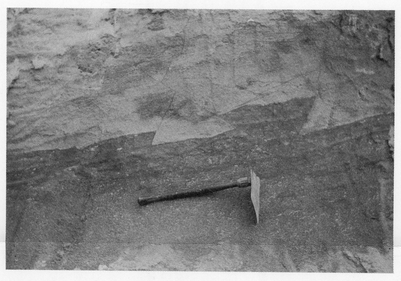


Figure 9.—Small faults at locality M-11. Shovel blade is about 20 cm long.



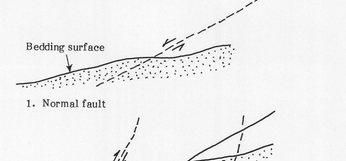


Figure 10.—Photograph and schematic interpretation of complex faulting at locality M-57. Shovel handle is about 50 cm long.

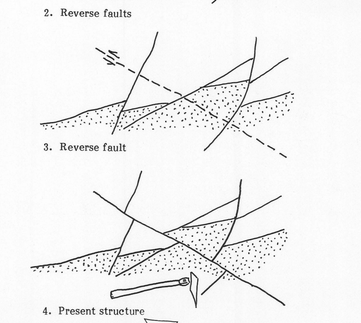


Figure 11.—Sketch of antecline(?) at locality M-58.

Figure 12.—Small graben at locality IZ-1. Photograph shows faults bounding southwest side of graben. Shovel handle is about 50 cm long.

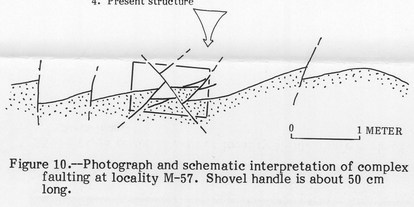


Figure 13.—Convolute beds at locality M-30. Knife is about 10 cm long.

INTRODUCTION

As a contribution to the assessment of neotectonics in the area of the Upper Coastal Plain of South Carolina, field traverses were made between Columbia, S.C., and Augusta, Ga., in 1975 and early 1976 in order to locate and describe small-scale deformation structures within exposed Coastal Plain rocks. The study covered most of the area between the Fall Line (northwest margin of the Coastal Plain) and the Orangeburg (Citronelle) escarpment (fig. 1).

Fieldwork was done principally by vehicle along roads, but also included railroad cuts and excavation sites, such as quarries and landfills. Natural exposures are rare and provided no examples of deformation structures for this study. The geologic units exposed in the area are chiefly clastic sediments deposited in nearshore marine to continental environments. They include semiconsolidated sand, silt, clay, and rare thin impure limestone beds of Late Cretaceous to Eocene age (fig. 2). These sedimentary beds generally have a gentle regional dip to the southeast (Faye and Prowell, 1982, p. 6).

LOCALITIES SHOWN ON MAP

This reconnaissance study reports a total of 105 localities, of which nearly half have examples of various types of deformation structures. The localities are grouped into categories as listed in tables 1 to 3, and their distribution is shown on the map.

Table 1 gives 36 localities, five of which have been reported previously by other workers, with structures that are mainly faults and folds with displacements or amplitudes that measure several centimeters to several meters. Those that are queried could not be positively identified as deformation structures, in most cases because of extensive weathering; some may indeed be weathering features that resemble structures.

Tables 2 and 3 contain features of other types. Table 2 lists 13 localities that show convolute bedding. The 56 localities in table 3 are exposures of normally bedded sedimentary sequences or sequences with distinctive features other than deformation structures, including fossils, sedimentary structures, and clastic dikes. The localities in these two tables represent the best exposures of their types and include only a fraction of the outcrops examined during the study. They are included as a source of data for further investigations and to illustrate the distribution and abundance of these features. Thus, deformation structures are known to be absent in the beds listed in table 3 (and in about 75 outcrops not listed), leading to an observed ratio of outcrops with deformation structures to outcrops without such structures of about 1:12.

DISCUSSION

The structures listed in table 1 are of three types: folds, faults, and collapse structures that are related to opal claystone bodies. All of these structures, which are described below and illustrated in figures 3–12, were produced by gravity-induced deformation as a result of loading, compaction, slump, sliding, or in some cases possibly by tectonic deformation. Depth of deformation is not known; in none of the localities were undeformed rocks exposed below the observed structures. Stratigraphic control in the study area is poor, and no definite assignment of the structures to stratigraphic units can be made at present.

Opal claystone (fuller's earth) forms a number of small domal bodies over which sedimentary beds are draped and faulted (localities H-5, M-52, JH-1, HJ-1, HJ-2; fig. 5). The position and attitude of deformation structures exposed in trenches at locality H-5, excavated as a part of this study, tend to support the hypothesis of Heron and Johnson (1963) that these are collapse structures which formed as a result of dissolution of the opaline sediment and consequent letdown of overlying beds.

Folds observed in this study are small monoclines (fig. 3) or broad, open synclines or anticlines (figs. 4, 11), commonly cut by small faults (for example, localities 4-76, M-22, M-24, and JH-1, table 1). All faults are probably normal or extensional except at locality ZA-1 and at locality M-57, where two stages of reverse faulting are shown to have taken place after normal faulting (fig. 10). Most of the normal faults are very steeply dipping to vertical (figs. 6-9, 12). At locality IZ-1 such faults bound a small graben (fig. 12), and at locality M-5, they bound an extensional collapse structure (fig. 8).

Some structures suggest a nontectonic origin, such as the numerous closely spaced faults at locality M-11 (fig. 9) which closely resemble "microfaulting of compactional origin" as illustrated by Pettijohn and Potter (1964, pl. 111-B). Others are less clear as to origin. Johnson and Heron (1965) suggested a solution origin for the structures at locality JH-1, but Owens and others (1976) proposed a tectonic origin for this and other structures reported herein. Zupan and Abbott (1975) cited the faults at locality ZA-1 as evidence for post-Eocene tectonic activity. Map-scale structures within and near the study area offer additional evidence of tectonic activity. The buried Dunbarton Triassic basin (Marine and Siple, 1974), which is apparently overlain by undisturbed Cretaceous rocks, is located in the southern part of the area (see map). The Belair fault zone, just west of the map area, is a series of en echelon, northeast-trending oblique-slip reverse faults which offset Coastal Plain sediments of Late Cretaceous and late Eocene age (Prowell and O'Connor, 1978). On the basis of a series of test wells along the Savannah River, Faye and Prowell (1982) postulated two northeast-trending subsurface faults in Coastal Plain sediments as young as late Eocene: the Millett fault, in the southern part of the area (shown on the map), and the Statesboro fault, just southeast of the area. Inasmuch as the presence of the Millett fault is based largely on the wells along the Savannah River, its northeastern extent is unknown. All of the structures observed during this study lie near the trace of this presumed fault or its northeastern projection, or to the northwest of the fault. Further study might clarify the relationship, if any, between minor surface structures, such as those described in this report, and deep-seated fault zones.

Convolute bedding noted in table 2 appears to have resulted from liquefaction of the sediments under load from overburden, perhaps in response to seismic shaking (Sims, 1973). An example of convolute bedding is shown in figure 13.

Features listed in table 3 are not known to be associated with deformation; however, the origin of clastic dikes (table 3) is not clear. Johnson and Heron (1965, p. 41) reported that at locality JH-1 one dike fills a fault, but most fill slump fractures or result from soil-forming processes. Siple (1967, p. 59) attributed dikes to (1) shrinkage from weathering, (2) seismic shaking, or (3) relief of compressional stress by injection from below. Zupan and Abbott (1975) suggested that clastic dikes, along with associated reverse faulting, demonstrate tectonic compressional forces at locality ZA-1. The dikes, which are generally composed of sandy clay and occur within coarse sand (Siple, 1967, p. 58-59), are common in much of the study area; only particularly good exposures are noted herein.

REFERENCES CITED

Cooke, C. W., 1936, Geology of the Coastal Plain of South Carolina: U.S. Geological Survey Bulletin 867, pl. 2.

Cooke, C. W., and MacNeil, F. S., 1952, Tertiary stratigraphy of South Carolina: U.S. Geological Survey Professional Paper 243-B, p. 19-29.

Faye, R. E., and Prowell, D. C., 1982, Effects of Late Cretaceous and Cenozoic faulting on the geology and hydrology of the Coastal Plain near the Savannah River, Georgia, and South Carolina; U.S. Geological Survey Open-File Report 82-156, 70 p.

Heron, S. D., Jr., and Johnson, H. S., Jr., 1963, Nature and origin of the slump structures in the Black Mingo Formation of South Carolina: Southeastern Geology, v. 4, p. 199-212.

Inden, R. F., and Zupan, A.-J. W., 1975, Normal faulting of upper coastal plain sediments, Ideal kaolin mine, Langley, South Carolina: South Carolina State Development Board Geologic Notes, v. 19, n. 4, p. 159-165.

Johnson, H. S., Jr., and Heron, S. D., Jr., 1965, Slump features in the McBean Formation and younger beds, Riley cut, Calhoun County, South Carolina: South Carolina State Development Board, Division of Geology Geologic Notes, v. 9, n. 3, p. 37-44.

Marine, I. W., and Siple, G. E., 1974, Buried Triassic basin in the central Savannah River area, South Carolina and Georgia: Geological Society of American Bulletin, v. 85, p. 311-320.

Owens, J. P., Prowell, D. C., and Higgins, B. B., 1976, Tectonic origin of deformed strata in the upper coastal plain of South Carolina: Geological Society of America Abstracts with Programs, v. 8, n. 2, p. 240.

Pettijohn, F. J., and Potter, P. E., 1964, Atlas and glossary of primary sedimentary structures: New York, Springer-Verlag, 370 p.

Pooser, W. K., 1965, Biostratigraphy of Cenozoic Ostracoda from South Carolina: University of Kansas, Paleontological Contributions, Arthropoda, art. 8, 80 p.

Prowell, D. C., and O'Connor, B. J., 1978, Belair fault zone; evidence of Tertiary fault displacement in eastern Georgia: Geology, v. 6, p. 681-684.

Sims, J. D., 1973, Earthquake induced structures in sediments of Van Norman Lake, San Fernando, California: Science, v. 182, p. 161-163.

Siple, G. E., 1967, Geology and groundwater of the Savannah River Plant and vicinity, South Carolina: U.S. Geological Survey Water-Supply Paper 1841, 113 p.

Siple, G. E., and Pooser, W. K., 1975, Proposal of the name Orangeburg Group for outeropping beds of Eocene age in Orangeburg County and vicinity, South Carolina, in Cohee, G. V., and Wright, W. B., Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1973: U.S. Geological Survey Bulletin 1395-A, p. A55.

Zupan, A.-J. W., and Abbott, W. H., 1975, Clastic dikes: evidence for post-Eocene(?) tectonics in the Upper Coastal Plain of South Carolina: South Carolina State Development Board Geologic Notes, v. 19, n. 1, p. 14-23.

Table 1.--*Localities showing deformation structures*

Locality	Description	Comments
H-1	Fold, strike N.60°-65°W., plunge SE.	Roadcut, S. Spring St., Swansea
H-2	Fold(?)	Fig. 3, roadcut
H-3	Syncline	Fig. 4, roadcut, State Rte. 6
H-5	Collapse structures over opal claystone	Fig. 5, roadcut, State Rte. 40-1691
H-7	Folds and fault(?)	Roadcut, State Rte. 32-100
H-8	High-angle faults, 1/2-m displacement	Fig. 6, roadcut, State Rte. 32-55
H-10	Fold, strike N.85°E.	Roadcut, County road S32-99
H-14	No data	
3-76	Monocline(?)	Roadcut
4-76	Syncline and steeply dipping faults	Fig. 7, roadcut
M-5	Collapse(?) structure	Fig. 8, roadcut
M-11	Normal faults and folds(?)	Fig. 9, roadcut
M-20	Folds, strike N.75°E., plunge NE.	Roadcut
M-22	Anticline and normal fault, 1-m displacement	McBean, Ga., roadcut
M-24	Syncline and normal fault, 30-cm displacement	Highly weathered; roadcut
M-25	Anticline(?) and faults(?)	Roadcut
M-27	Syncline(?)	Roadcut
M-29	Anticline(?)	Roadcut
M-38	Gentle folds	Bamburg County Landfill
M-39	Gentle syncline(?)	Roadcut
M-42	Minor faults(?) and folds(?)	Roadcut
M-45	Normal fault, strike N-S, dip 60°E., and folds	Quarry pit
M-46	Anticline(?)	Roadcut
M-51	Steeply dipping beds	Probable fold, but may be foreset beds; roadcut
M-52	Claystone body?	Railroad cut
M-53	Anticline(?)	Roadcut
M-55	Fault(?)	Roadcut
M-56	Anticline(?)	Roadcut
M-57	Anticlines, normal and reverse faults	Fig. 10, railroad cut
M-58	Anticline(?)	Fig. 11, roadcut
M-59	Anticlines(?)	Railroad cut
	Previously reported	
IZ-1	Small graben	Inden and Zupan (1975); fig. 12
JH-1	Folds and small faults	Johnson and Heron (1965); "Riley cut"
ZA-1	Reverse faults, clastic dikes	Zupan and Abbott (1975)
HJ-1	Collapse structures over opal claystone	Heron and Johnson (1963)
HJ-2	Collapse structures over opal claystone	Heron and Johnson (1963)

Table 2.--*Localities showing convolute bedding*

Locality	Description
H-4	Convolute white clay and orange sand beds
H-6	Convolute sand beds
H-9	Convolute red and white clay laminae
8-76	Deformed burrows
M-8	Highly convolute red and yellow sand and white clayey sand
M-9	White clay beds 1 m thick with projections on upper surface 15-30 cm high
M-10	White clay laminae set 10-15 cm thick
M-23	Yellow clay lens 15 cm thick injected downward 30 cm into red sand
M-30	Convolute bedding of sand and white fossil beds; fig. 13
M-48	Convolute bedding in sand
M-49	Convolute white clay bed within red sand
M-50	Convolute white clayey sand within red gravelly sand
M-62	Convolute beds in stream cut

Table 3.--*Localities with well-exposed sedimentary features*

Sediments evenly bedded or with sedimentary structures		**Indurated beds or fossil beds**		**Clastic dikes**	**Irregular beds of white clay**
Locality	Type of exposure	Locality	Type of bed	Locality	Locality
1-76	Landfill	M-12	Oyster shell bed	5-76	M-1
2-76	Borrow pit	M-13	Gastropodal bed	7-76	M-4
6-76	Sand pit	M-15	Oyster shell bed	M-34	M-26
M-3	Roadcut	M-17	Chert bed	M-40	M-28
M-6	Roadcut	M-18	Chert bed	M-60	M-35
M-7	Roadcut	M-19	Chert bed		M-36
M-14	Borrow pit	M-21	Siliceous bed		M-41
M-16	Roadcut	M-31	Sandstone		M-43
M-32	Roadcut	M-78	"Buhrstone"		M-63
M-33	Roadcuts	M-79	Siliceous bed		
M-37	Roadcut	M-80	Siliceous bed		
M-44	Roadcut	M-81	Siliceous bed		
M-47	Roadcut	M-82	Siliceous bed		
M-54	Railroad cut	M-83	Conglomerate		
M-61	Railroad cut				
M-65	Roadcut				
M-66	Roadcut				
M-67	Roadcut				
M-68	Clay pit				
M-69	Roadcut				
M-70	Roadcut				
M-71	Roadcut				
M-72	Railroad cut				
M-73	Roadcut				
M-74	Roadcut				
M-75	Roadcut				
M-76	Roadcut				
M-77	Roadcuts				

MAP SHOWING DISTRIBUTION OF SMALL-SCALE DEFORMATION STRUCTURES IN A PART OF THE UPPER COASTAL PLAIN OF SOUTH CAROLINA AND ADJACENT GEORGIA

By
Robert C. McDowell and Brenda B. Houser

1983

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