INTRODUCTION

The information in this report was collected between 1974 and 1982 as part of the Reactor Hazards Program of the U.S. Geological Survey (USGS). This program was initiated to delineate and assess geologic hazards that could be particularly detrimental to major constructions, especially nuclear reactors. Faults are of principal interest to the program because earthquakes associated with them can cause major damage in short periods of time.

Prior to 1970, very little was known about Cenozoic faulting in the eastern United States. The most abundant data were available in the western Gulf Coastal Plain where oil exploration had generated a considerable amount of subsurface stratigraphic information. The Atlantic Coastal Plain was considered to be generally devoid of faults, although scientists such as McGee (1888) and Darton (1891, 1951) had proposed major faulting or uplift along the Fall Line. The Piedmont and Blue Ridge Provinces of the eastern United States contained numerous mapped faults, but the recency of fault movement was unknown because of the absence of Cenozoic strata.

One of the initial efforts of the Reactor Hazards Program was a compilation and evaluation of Cretaceous and younger faults in the East. Topical studies were initiated in areas of particular interest, and these studies in turn generated a broader scientific interest in the problem of Cenozoic deformation. A preliminary literature investigation of Cretaceous and younger faulting was published by York and Oliver (1976), and was followed by an interpretive map of young faults by Howard and others (1978).

The data in this report represent the presently available knowledge of fault characteristics and distribution. Clearly, as current investigations progress and as geologists become more aware of the evidence for Cenozoic faulting, the number of known Cenozoic faults will increase substantially. Until such time, the data that are shown here must be viewed conservatively because I believe they are not a totally representative collection of information at this scale. The data are useful in characterizing basic fault patterns in the region, but certain factors limit the usefulness of the map. Limitations of this information are discussed in the following text, and the reader should give them major consideration when using the map and fault table.

DATA LIMITATIONS

Geologic Conditions

The identification of Cretaceous and younger faults in the eastern United States is probably most greatly affected by the distribution of geologic units of that age. Cretaceous and younger rocks and strata are predominantly restricted to the Coastal Plain Province on the outer margin of the continent. The geologic provinces characterized by crystalline rocks (i.e., the Piedmont and Blue Ridge) contain minor amounts of upper Tertiary strata in the form of fluvial terrace deposits and thin surficial veneers derived from weathering of older rocks. In general, such deposits cannot be dated accurately although most are probably Miocene or younger. The identification of Cretaceous and younger faulting is based generally on a recognized displacement of paleontologically or radiometrically dated sediment. It is readily apparent that areas lacking the appropriate stratigraphy will be relatively devoid of observed Cretaceous and younger faults; however, this does not preclude their existence. Therefore, one must consider known fault localities as positive data points, and similarly must realize that the lack of observed faulting does not denote the absence of Cenozoic deformation, but rather reflects a lack of critical information.

Fault Distribution

The distribution of faults is directly related to tectonic framework and opportunity for geologic observation. The Fall Line along the Atlantic Coast is an excellent example of the latter situation. Along this natural boundary, the Coastal Plain strata are so thin that faults commonly juxtapose the sediments with crystalline rocks of the basement complex. A contact of this sort is readily recognized and is generally assigned a high degree of significance by most geologists. If this same fault were exposed entirely in crystalline rocks, it would typically be attributed to minor Paleozoic deformation. If, on the other hand, it were exposed entirely in the sedimentary section, it could be difficult to see and might be attributed to a non-tectonic origin (for example, slump faulting).

The linearity of the Fall Line along the Atlantic Coast has been suggested as evidence of Cenozoic tectonism by numerous workers since McGee (1891). Data in this report finally provide evidence supporting earlier speculation about faulting; however, one major question remains. Similar styles of Cenozoic faulting have been reported in the Piedmont far west of the Fall Line (White, 1952), and significantly east of the Fall Line (Jacobeen, 1972). Therefore, is the Atlantic Coast Fall Line a center of late Mesozoic and Cenozoic tectonic activity, or simply an area where conditions for geologic observation of faulting are unusually favorable? This question is critical to the assessment of the distribution of Cretaceous and younger faults across the entire eastern United States.

Data Collection

The preliminary report on young faulting by Howard and others (1978), in which I compiled the fault data for the eastern United States, emphasized recency of faulting and showed regions having similar fault style. The publication incorporated geophysical data on the location and recency of faulting. Because of problems with scale and map clarity, faults with minor offsets were commonly omitted.

This report, unlike that of Howard and others (1978), emphasizes the geologic criteria proving the existence of Cretaceous and younger faulting. The fault table gives geologic evidence for the presence and recency of movement of reported faults. Geophysical surveys were used to delineate the extent of several faults, but in these instances, drill-hole data were used to substantiate the findings.

The entries in the fault table are largely from published sources, although there are considerable data from active research projects. In most cases, I made an attempt to personally investigate the fault outcrop localities to verify the existence of the structures and to determine the nature of their origin. Where applicable, I also attempted to date the youngest displaced materials using modern methods (for example, palynology), to revise the conclusions of previous workers. In the case of Conley and Drummond (1965) (entries 63 and 65), Conley and Toewe (1968) (entries 39 and 40), and York and Oliver (1976) (entry 64), I question the authors' assertion that the reported structures have tectonic origins. The geometry of these faults and the physical characteristics of the displacements indicate instead that the faults have been generated by slumping. Although by general definition slump surfaces are faults, it is important to distinguish such features from true tectonic structures. I included these references in this study because they are reported in the literature as Cenozoic faults; nevertheless, they must be differentiated from true tectonic faults.

The faults shown in southern Georgia and in Florida are known largely as a result of subsurface water and petroleum exploration. Some of the structures have not yet been recognized at the surface, probably because of poor exposure and inadequate surface mapping. They are postulated primarily upon drill-hole data and upon structure contouring of known subsurface horizons. This sort of fault identification yields excellent age control and displacement information, although it reveals little about fault geometry. Faults are shown vertically in cross section by most authors, but they could dip steeply in either direction. Such structures are included in the table because they do reflect geologic evidence of Cenozoic tectonism. To maintain the reliability of this index, I included only those faults that are defined on a substantial amount of drill-hole data or that have some surface outcrop expression. It is important to note that variations in paleontologic interpretation from place to place may alter the age and correlation of lithologic units, thereby seriously affecting the continuity of structure-contoured surfaces that delineate postulated faults (for example, see Moore, 1955, p. v and vi).

Numerous faults and folds have been recognized in the eastern Gulf region, and have been particularly well catalogued in Alabama (Self and Neathery, 1975). Unfortunately, the fault zones are so extensive and so complex that their detailed geometries are still largely uninvestigated. Hence most reports of faults in the eastern Gulf region lack accurate description of the observed fault planes. Many of the faults shown in Alabama are defined on the same basis as those discussed in the preceding paragraph, except that subsurface work has been supplemented by outcrop information. However, the outcrop data generally do not yield direct evidence of faulting (such as shearing), but rather delineate anomalous variations in the position of stratigraphic units.

For the eastern Gulf region, I compiled only the most important regional data and pertinent local information. In the fault table I had to approximate the orientations of curvilinear structures and their locations; however, the assigned references might offer significant additional descriptions of specific localities.

Folds, arches, and other warps are omitted from this compilation because (1) their limits cannot be precisely defined by present stratigraphic mapping, and (2) the age range of deformation is uncertain because of sedimentological and paleontological variations. Postulated warps such as the Ocala Arch, the Cape Fear Arch, and the Salisbury Embayment have been discussed in the literature for many years, but little has been done to further outline their geologic significance.

Extent of Structures

Generally, the faults shown in the table have a known minimum extent, but in most cases do not have a known maximum extent. A standard bar and ball symbol is used to denote faults less than 16 km (10 mi) in length, whereas longer faults are shown by lines whose lengths are approximately scaled to known extent. Most of the faults shown with the standard symbol are largely uninvestigated, and their total lengths are probably significantly greater than presently known.

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EXPLANATION

- Study area boundary
- Geologic province boundary

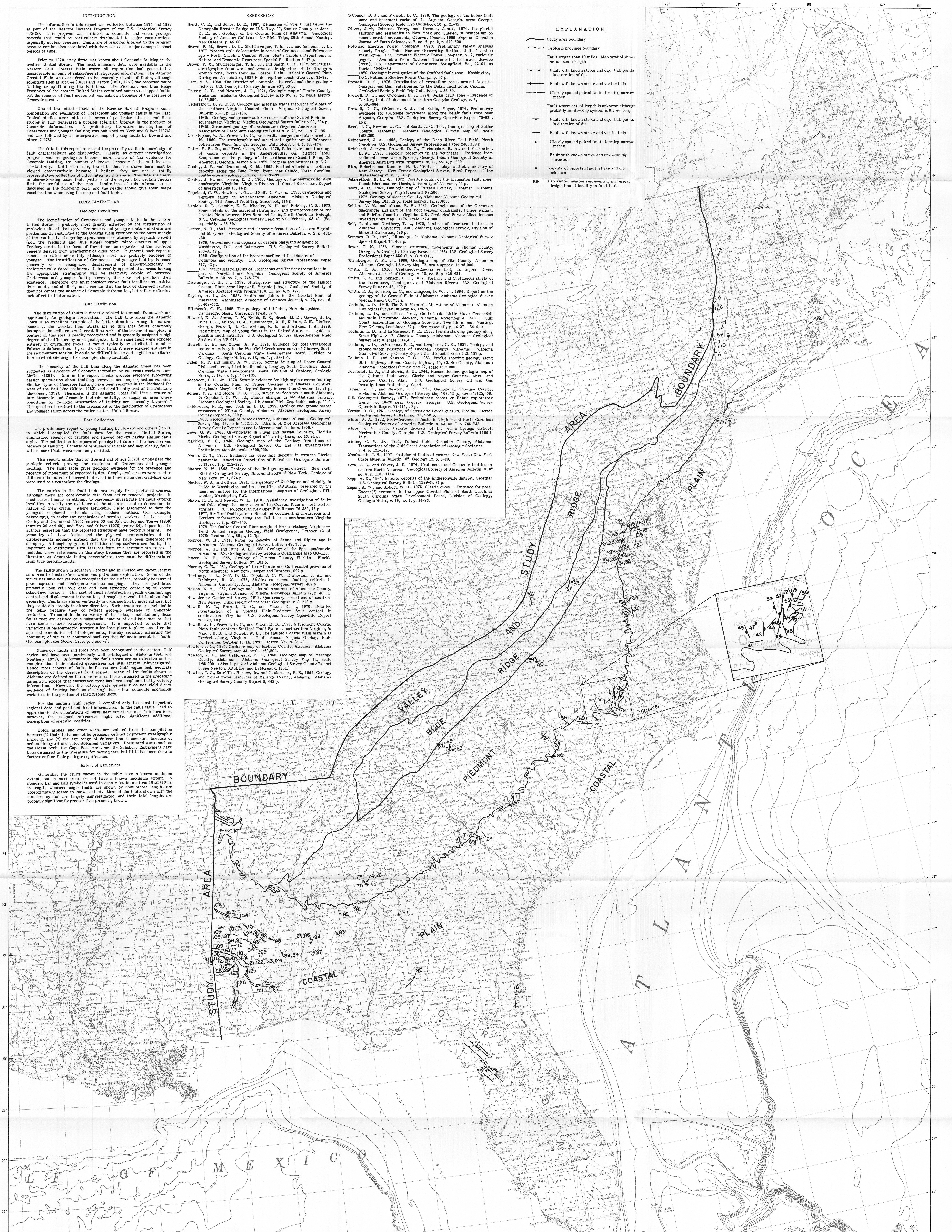
Fault longer than 10 miles--Map symbol shows actual scale length

- Fault with known strike and dip. Ball points in direction of dip
- Fault with known strike and vertical dip
- G — Closely spaced paired faults forming narrow graben

Fault whose actual length is unknown although probably small—Map symbol is 0.6 cm long

- Fault with known strike and dip. Ball points in direction of dip
- Fault with known strike and vertical dip
- G — Closely spaced paired faults forming narrow graben
- Fault with known strike and unknown dip direction
- Locality of reported fault; strike and dip unknown

69 Map symbol number representing numerical designation of locality in fault table



Base from U.S. Geological Survey, 1974

Data compiled 1974-1982

SCALE 1:2 500 000

INDEX OF FAULTS OF CRETACEOUS AND CENOZOIC AGE IN THE EASTERN UNITED STATES

By
David C. Prowell
1983