Paper G 29

LINEAMENTS IN COASTAL PLAIN SEDIMENTS AS SEEN IN ERTS IMAGERY

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ABSTRACT

Examination of satellite imagery over the Atlantic Coastal Plain near Washington, D. C. shows numerous lineaments, which cannot be accounted for by any known cultural or natural features. At least some of these lineaments represent the surface expression of faults, for one of them has been correlated with the outcrop of a fault that had been traced for several miles in southern Prince Georges County, Maryland. If a substantial number of these lineaments do indeed represent fault traces, the fact that they show on the surface suggests that the geologic history of the Coastal Plain is much more complex than has previously been recognized, and that faulting may have occurred in the Holocene, much later than has generally been recognized. The importance that such recent movements could have on future development of the Coastal Plain should be emphasized.

Earthquake prediction is becoming increasingly important in planning for the future development of the country, especially near the rapidly-growing urban centers. Even in relatively stable seismic areas, such as the Atlantic Coastal Plain, the importance of determining the potential for earthquakes is being recognized in planning for such major structures as nuclear power plants, which must be designed to withstand the earth movements that can reasonably be expected to occur. Unfortunately, the earthquake potential of much of the country is relatively unknown. Only in those areas of repeated seismic activity, such as in California, can some interpretation be made of the extent and magnitude of earthquakes. Even here, however, the location of all the active faults is not known.

The seismic potential of the Atlantic Coastal Plain is, perhaps, the least known of any area in the country, for although earthquakes have occurred here, some of them strong enough to do considerable damage, little is known of either their source, or of the location of the surface expression of the faults that caused them.

With the advent of satellite photography a new tool is available to aid in the seismic study of the country, for lineaments can be recognized that undoubtedly represent the surface traces of hitherto unmapped faults. For this paper, studies were made of the lineaments that can be seen on ERTS image 1062-15190, taken September 23, 1972, of the Atlantic Coastal Plain in the vicinity of Washington, D. C.

This image shows the area of the contact of the Coastal Plain and the Piedmont, the Fall Line, extending diagonally southwestward from the upper right center of the image to the lower left center. Two major cities, Baltimore (near the upper center) and Washington, (just left of center) lie astride the Fall Line. The Chespeake Bay, which covers much of the right side of the image lies entirely within the Coastal Plain.

To understand implications of the lineaments that can be seen on the surface of the Coastal Plain, a brief description of the area is necessary. The Atlantic Coastal Plain, extending along the coast from New Jersey southward to Florida, is underlain by poorly consolidated sediments that range in age from Cretaceous to Holocene. These sediments thicken from the western edge of the Coastal Plain where they pinch out against the crystalline rocks of the Piedmont Province, to as much as 10,000 feet at the Atlantic Ocean. The Coastal Plain has generally been considered an area of few geologic structures; those that have been reported are broad regional features such as the Cape Fear Arch and the Salisbury Embayment. Although a considerable number of minor structures have been postulated, few have been found because the poorly consolidated nature and the homogeneity of the sediments have tended to mask any surface or near surface evidence of folding or faulting.

Examination of the ERTS image shows three types of lineaments are present: those that are obviously man made, such as power lines, roads and railroads; those that are a single natural feature, such as a beach or strand line, and a third type that cannot be accounted for by any single natural or cultural feature. The latter are marked by a combination of factors, such as drainage patterns, shorelines and vegetation and other land use patterns. Only lineations of the third type are considered in the remainder of this discussion. These are difficult to pick out on the image unless one is looking for them. The best way to see them is to hold the image at about a 45° angle away from you and look at the image from the edge. Lineations trending in the direction of the 'look' will be most easily found, so to see other lineaments, rotate the image. These alignments can best be seen on band 5 or on the color additive view, but it is anticipated that when a winter scene is available and the minor drainages better exposed, the lineations will show to good advantage also on the near infrared bands 6 and 7.

The lineations fall into three major trends: N 40° E, a direction that roughly parallels the Fall Line; N 05° W and N 35° W. Other minor trends are also seen. Each of the lineaments can be traced 30 miles or more; many disappear off the edge of the photograph, so no maximum lengths are available. Some of the lineaments can be traced at least 10 miles across the Fall Line into the Piedmont.

A significant number of these lineations may well represent the surface traces of zones of faulting that control the location of the drainages and the shorelines. Fault traces form zones of weakness in unconsolidated sediments, making them more subject to erosion. These zones of weakness are not readily apparent from examination of the surface or of topographic maps or even of high altitude photographs, indicating that a weak and discontinuous character of the alignments makes them too subtle to be seen in large scale, highly detailed view. It is a case of not being able to see the forest for the trees. When a lineament seen on the satellite image is plotted on a map, a relationship between it and some of the map features, such as anomalous drainage patterns, can be recognized. In fact, a fault system, originally described by Jacobeen, (1972), was originally found by observing anomalous drainage patterns. By study of the ERTS image it has been possible to show that this fault system extends more than 30 miles, a distance far longer than was previously recognized.

The time of movement is not certain. Jacobeen was able to tell that the movement of this one fault was intermittent from Cretaceous at least through the early Miocene. The unconsolidated nature of the Coastal Plain sediments and the homogeneity of the surface formation, however, precludes finding any evidence of movement within about 200 feet of the surface.

Numerous earthquakes in the Coastal Plain have been recorded since the coming of the Europeans some 350 years ago. The worst of these quakes are those that damaged Charleston, South Carolina in 1886. In addition, minor earth tremors occur approximately every four years in the vicinity of Richmond. A lack of visible surface evidence of faulting from these and other earthquakes had led to the general belief that the sediments were little affected by the seismic activity in the Coastal Plain. If, as it indeed seems probable, that most, if not all of the lineaments observed in ERTS data can be shown to be the surface traces of faults, a new appreciation of the importance of earth movement in the area should be made. In as much as these traces show up on the surface, movement must have taken place in comparatively recent time. This is an important factor in determining the extent of possible future faulting in the area.

To determine the extent of the faulting in the Coastal Plain, much yet needs to be done. The first step would be to plot all the lineations that can be seen on ERTS imagery for the entire Coastal Plain. The relative movements of these faults must also be determined. Only after these studies are completed can a detailed and certain knowledge of the geologic history of the Coastal Plain be understood. The results would provide information of potentially great economic and environmental importance to the planning and construction of the future development of the Coastal Plain.

Reference cited

Jacobeen, F. H., Jr., 1972, Seismic evidence for high angle reverse faulting in the Coastal Plain of Prince Georges and Charles Counties, Maryland: Md. Geol. Survey Information Circular #13, 21 p.

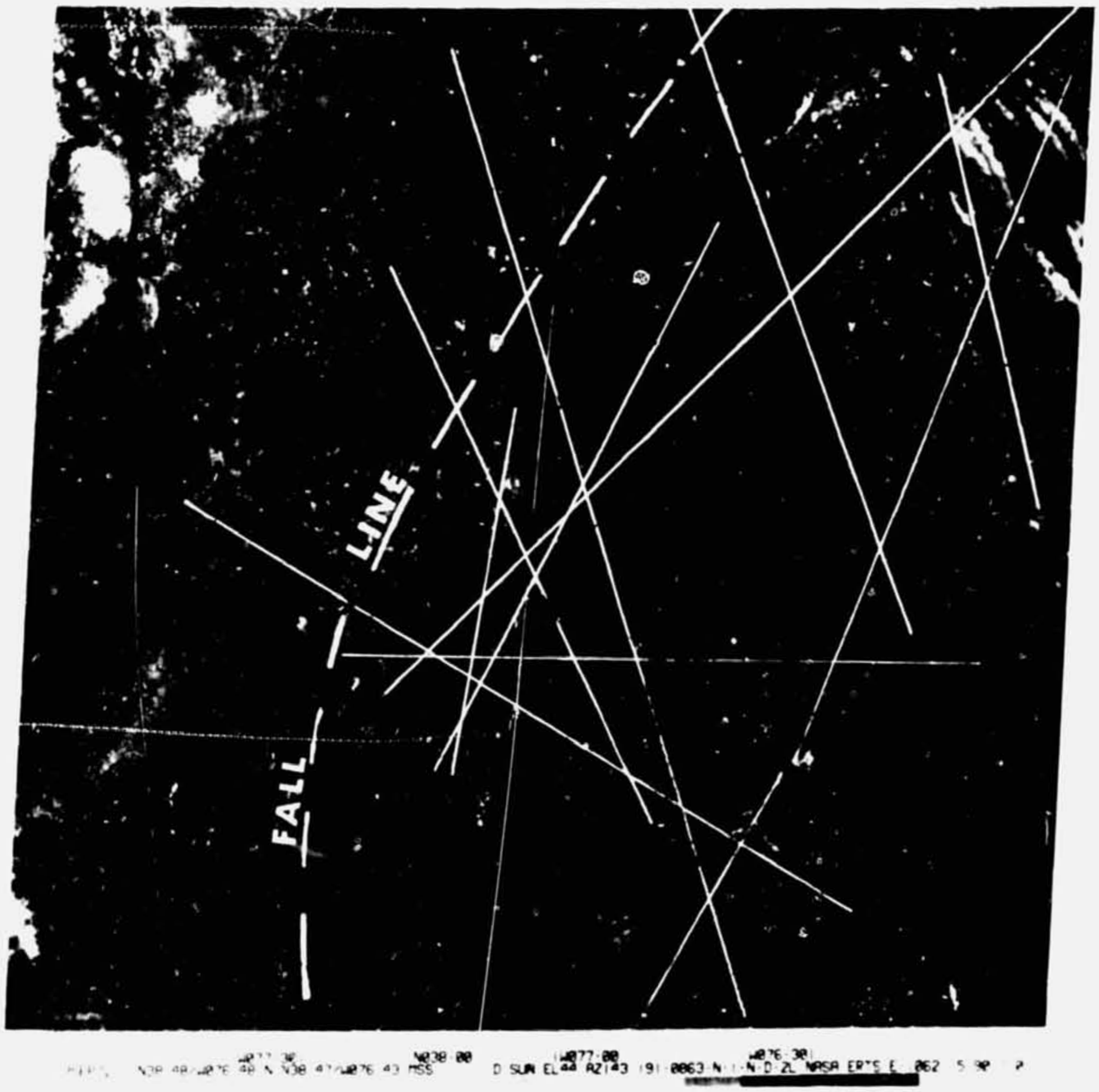

Figure 1:-- Some of the lineaments in the Coastal Plain sediments near Washington D. C. that can be seen in ERTS imagery. At least some of these lineaments are traces of faults.