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Docket Nos: 50-424
and 50-425

APPLICANT: Georgia Power Company

FACILITY: Vogtle, Units 1 and 2

SUBJECT: SUMMARY OF VISIT TO EXAMINE CLASTIC DIKES NEAR VOGTLE, JUNE 21-22, 1984

On June 21 and 22, 1984, a staff geologist, Ina Alterman, visited the vicinity of the Vogtle plant to examine clastic dikes. T. Crosby and D. Campbell of Bechtel acompanied her. Her trip summary is attached at Enclosure 1.

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Licensing Branch No. 4
Division of Licensing

Enclosure:
As stated

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Certified By Angela Hatton

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MEETING SUMMARY DISTRIBUTION

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Coastal Plain Clastic Dikes Field Trip Report

Introduction

Dike-like structures are common and widespread in the younger Tertiary sedimentary strata of the Miocene (24-5 million years before the present (mybp)). They are found in the upper Coastal Plain from Georgia to North Carolina in two upper Miocene formations, the Barnwell Formation and the overlying Hawthorne Formation.

The origin of the structures, primarily "clastic" dikes, but with associated faults and folds, is still not understood. They have been proposed, among other possible causes, to have had a seismic origin, possibly related to the Charleston 1886 earthquake (Seeber and Armbruster 1983), the result of subsidence, differential compaction, or infilled extension cracks in soil. The dikes have been studied by several authors (Heron, et al, 1975; Secor, 1979; McDowell and Houser, 1983) and referred to by several others (see accompanying references). None of these, however, was a long-term systematic study to attempt to relate all the features, to determine the age, extent, and geometry.

The following includes brief descriptions of observations of the first day, and a more detailed account of the exposure of the second day, along with photos of the described features.

The attached map of the vicinity of Vogtle (Fig. 1) locates the outcrops examined on this trip. Stop numbers prefixed with a numeral 1 were outcrops seen the first day. Stops 1-3 and 1-7 were omitted because of time constraints. On the second day, only Stops 2-6 and 2-7 were visited, again for reasons of time. Letter-number sets below the stop numbers on the map are the corresponding outcrop designations from the USGS Miscellaneous Field Studies Map (MacDowell and Houser, 1983). Note also that the first three stops visited were within the Savannah River Plant exclusion area, for which we were given permission and were accompanied by SRP staff geologist Wendell Marine.

Stop 1-1 - This was a roadcut about 8'-10' high consisting of crossbedded gray and red sandy clay beds with thin interbeds of gravel. There was a considerable amount of gravel float on the outcrop.

Yellow-buff dike-like projections about 1-2" thick from the bottom of the soil at the top of the outcrop were clearly visible. A weathered mottled zone at the top gradually changed to the narrow vertical to low dipping projections, some of which joined with others and ended abruptly and some, individual structures (Fig. 2a).

On close examination, the "dikes" showed no sharp boundaries or distinctive differences in texture or clast composition from the "host" layer (Fig. 2b).

According to the applicant's consultants, the composition of the clay in the dikes is the same as that of the host sediments, but the ratios of the two types of clay vary. The ratio of kaolin to vermiculite remains constant for all depths within the dikes but changes in the host strata downward from the weathering zone. The significance of these observations is not clear, but the applicant's response to Q's concerning the dikes may provide documentation and analysis of the clay relationships.

Stop 1-2 - A short walk into the woods along an old railroad track brought us to a large, low level exposure, at ground level and a few feet above. The strata were yellow and red weathered clayey sands with some gravel stringers. Cutting across in several directions were 4" wide dike-like structures, the borders of which stood up above the host rock due to differential weathering. For the most part the dikes consisted of thin white clay (kaolin) seams about ¼" thick bordered by yellow weathered sandy clay grading into a red to maroon rind or crust which stands out in relief on the weathered surface (Fig. 3).

Most dikes intersect others without offsetting them. Some dikes appeared to bifurcate, while some ended abruptly at the boundary with other such structures.

That the clay material appeared to be intruded into the host rock was indicated by one dike with 2" thick clay that cut across a gravel bed. No gravel could be found in the dike, indicating the gravel did not continue across the dike (Fig. 4).

One anomalous irregularly shaped dike of gray clay, about 3" wide, offset a series of yellow and red layers in a reverse or thrust displacement (Fig. 5) indicating some form of minor disturbance during opening of the fissure into which the injected material was emplaced.

Stop 1-4 - This was an unusual exposure offering a unique 3-dimensional view of relations between dikes. The top surface and two trenchlike ditches at right angles to each other provided an interesting perspective of two groups of dike sets (Fig. 6). One group consisted of the thin, yellow-buff dikes lacking sharp boundaries, like those seen at Stop 1-1. Some are remarkably linear in geometry and cross each other in a regular fashion (Fig. 7).

The other group are similar to those seen at Stop 1-2, with red rinds standing up in relief from the surrounding sedimentary material. These crossed each other, in places following the yellow-buff dikes and in other places diverging from these or cutting across (Figs. 8 and 9). The red-crusted dikes are mixtures of sand, silt and clay, with a larger proportion of clay in the dikes then in the host strata, according to the consultants.

An unusual feature of this exposure was the circular "blob"-like appearance of some of the red-crusted material, suggesting that in the third dimension these are pipe-like structures (Fig. 6, near hammer handle; Figs. 7 and 8, near hammer head; Fig. 9, at lower left corner of photo).

An observation that may have some significance in determining the history of the dikes is that the north-south oriented, vertical, red-crusted dikes exhibited crude planar or anastomosing shears within the dike boundaries. A nonsystematic sampling showed occasional pebbles within the dikes were sheared across parallel with these planar features (Figs. 10 and 11). The east-west oriented red-crust dikes and the buff colored dikes did not show this structure within them.

Stop 1-5 - The outcrop here was a roadcut up to about 6-8 ft above road level. The outcrop was in a yellow sand member of the Barnwell Formation. The dikes were 1-2 in thick, consisting of yellowish clay with sand and silt and red rinds. They appear to end upwards at a weathered soil boundary, but close inspection indicated that they continue across the weathered zone but are faded, probably due to chemical weathering (Fig. 12, to right above hammer head).

Stop 1-5a- This stop had some instructive features that a systematic study of the dikes could no doubt use in understanding their origin. The outcrop is about 3m high and consisted of three distinctively weathered units (Fig. 13).

The strata were bowed down into a broad open syncline with a wave length of about 8m. In the axis of the synclinal trough, the upper yellow layer was down-faulted in a graben, bounded by vertical faults (Fig. 15) along which several dikes were concentrated.

These observations support an interpretation of a sag into a subsurface void with a small section of the sag (synform) dropping still further along vertical faults. The relationship of the dikes to this structure is not obvious. The dikes are not confined to the faults but show a concentration there.

Stop 1-6 The exposure was a large clay pit opening of Barnwell red silt. The exposed wall was about 3m high and had a few yellow clay dikes about 2-3 in wide. Two of these dikes were cut by low angle faults which offset them (Fig. 16) in a reverse sense. The faults dip in opposite directions (Fig. 17) and bear a similar relationship as faults at the Barnwell Low Level waste repository which were evaluated by USGS geologists. Their opinion was that these faults probably represented a possible subsurface subsidence into a depression, causing the overlying material to appear to shift upward (John B. Robertson memo dated Nov. 12, 1979 in Allied General, 1980). The cause of the void that could result in such collapse may be a solution cavity in an underlying soluble carbonate unit, or removal of material by liquefaction. This could not be determined from the field observations.

Stop TRENCH - Because of time limitations, it was decided to visit the most extensive exposure available for the second day's trip. This was a waste disposal trench, about 300m long, 10-15m high and 25m wide, dug on the Vogtle site about 2 km ~~south~~ north of the plant (Fig. 18).

This was the largest, most continuous exposure available on this trip. It showed several types of features and certain consistent relationships of dikes and structures that may provide clues to an eventual understanding of the dikes.

The strata exposed in the trench were reported to be the Barnwell red beds. The overall structure was of a series of antiformal/synformal features (Fig. 18) that were noncylindrical in longitudinal shape, as determined by their variation in crosssectional shape on either side of the trench. That these were not classic-type folds formed by compression was indicated by two observations: (1) the axes of the various fold-like structures, measured by extending in imaginary line from identical points on the "fold" hinges on each sidewall of the trench, were at high angles to each other, roughly N45E and N45W for two successive antiforms, and (2) numerous small normal faults and graben-like structures are associated with the synforms, indicating extension, rather than compression (Figs. 19-26). Note the similarity of Photo 21 to Photo 15 of Stop 1-5a, both showing a small graben in the trough of the synform bounded by vertical normal faults. These two exposures are 25 km apart, and the folds are oriented at about 90° from each other indicating that regional compression was not the cause of these folds.

As with the structures at Stop 1-5a, these features indicate a sag-like mechanism of strata sinking into subsurface voids.

Other features observed in the trench that may be useful in understanding the origin of the dikes include the common occurrence of dikes along faults (Figs. 20 and 23), narrow dikes in one type of layer branching out in another stratigraphic unit (Figs. 20, 23 and 27), arch-like structures over the synforms, similar in orientation to the opposite-dipping faults at Stop 1-6 (Fig. 20, 21, and 28), some small thrust-like faults that may indicate underthrusting (Figs. 29 and 30), and a set of unusual intrastratal diapirs less than .5m in amplitude (Fig. 26), associated with a series of normal faults.

Stop 2-6 - This roadcut, about 5m high, exposed the contact between the Barnwell massive red sand and the Altamaha facies of the Hawthorne Formation, of a mottled red color.

At the southern end of the outcrop, vertical dikes in the upper unit, the Hawthorne, terminated in a clay bed at the base of the Altamaha stratum and did not appear to cut the underlying Barnwell red sand.

Because of time constraints, only a cursory look at this large exposure was possible.


AIKEN
BARNWELL
S R P
STOP 1-1 M-47
STOP 1-2
STOP 1-3 M-60
STOP-1-5 S-76
SRP BOUNDARY
STOP 1-4
Stop 1-5A M-24
STOP 1-6
STOP 1-7
Point Comfort
STOP 2-1 M-20
STOP 2-2
STOP 2-3 M-30
STOP 2-4 M-29
Vogtle
PLANT SITE
SAVANNAH RIVER
STOP 2-7
STOP 2-6 M-16
STOP 2-5
Duncan USGS Hole 1060'
SCALE IN MILES
5 0 5
KILOMETERS
5 0

FIG. 2a

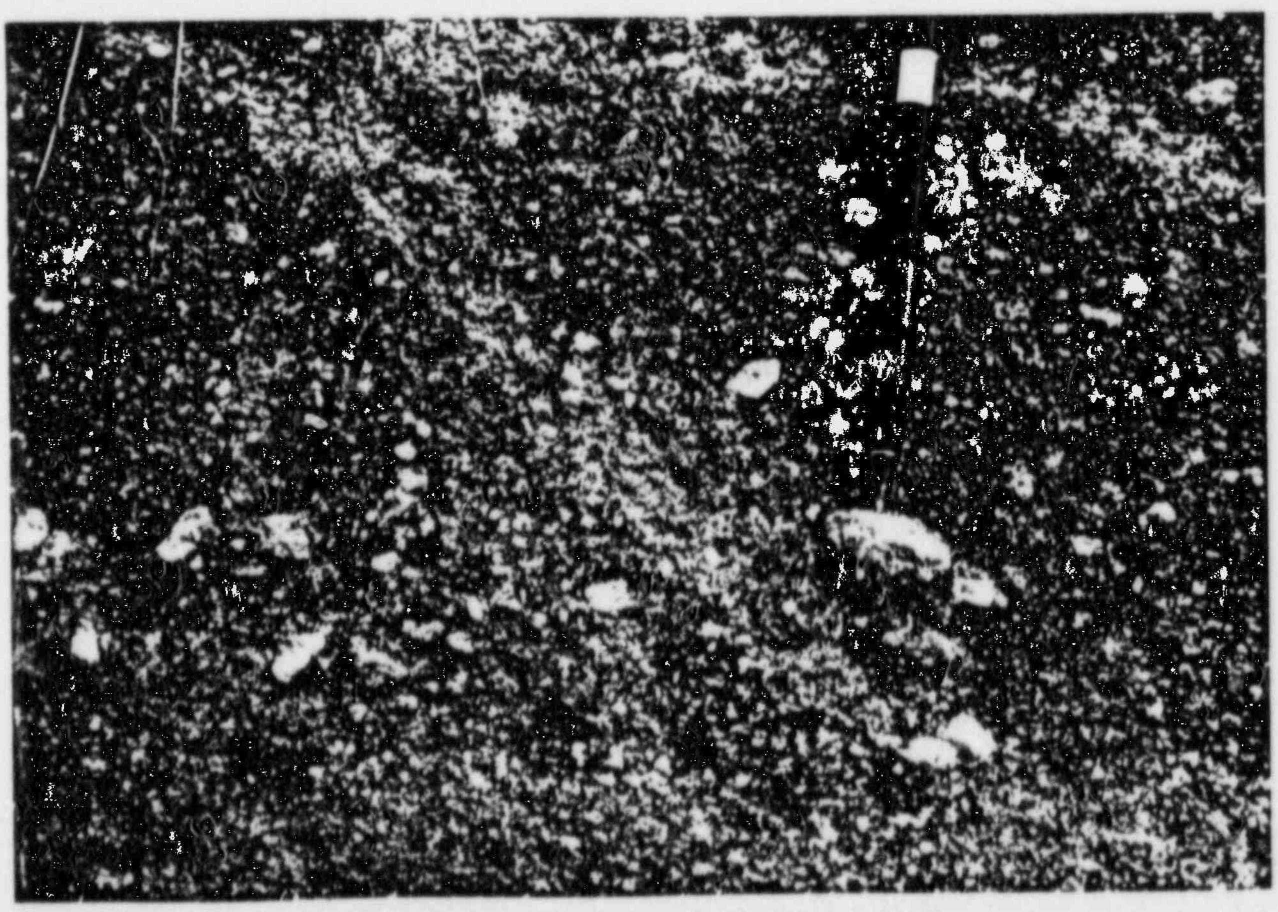

FIG. 2b

FIG. 3

FIG. 4

FIG. 5

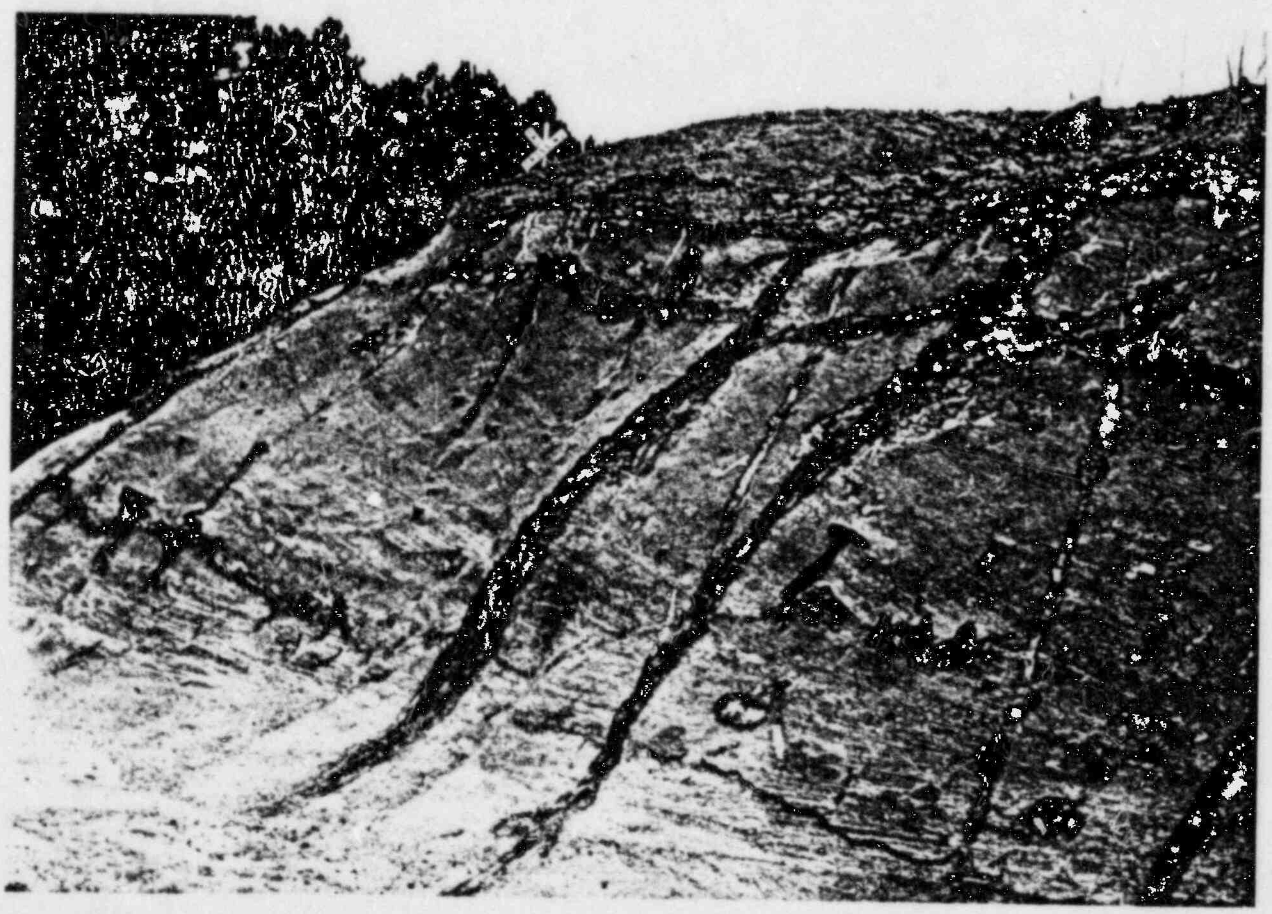

FIG. 6

FIG. 7

FIG. 8

FIG. 9

FIG. 10

FIG. 11

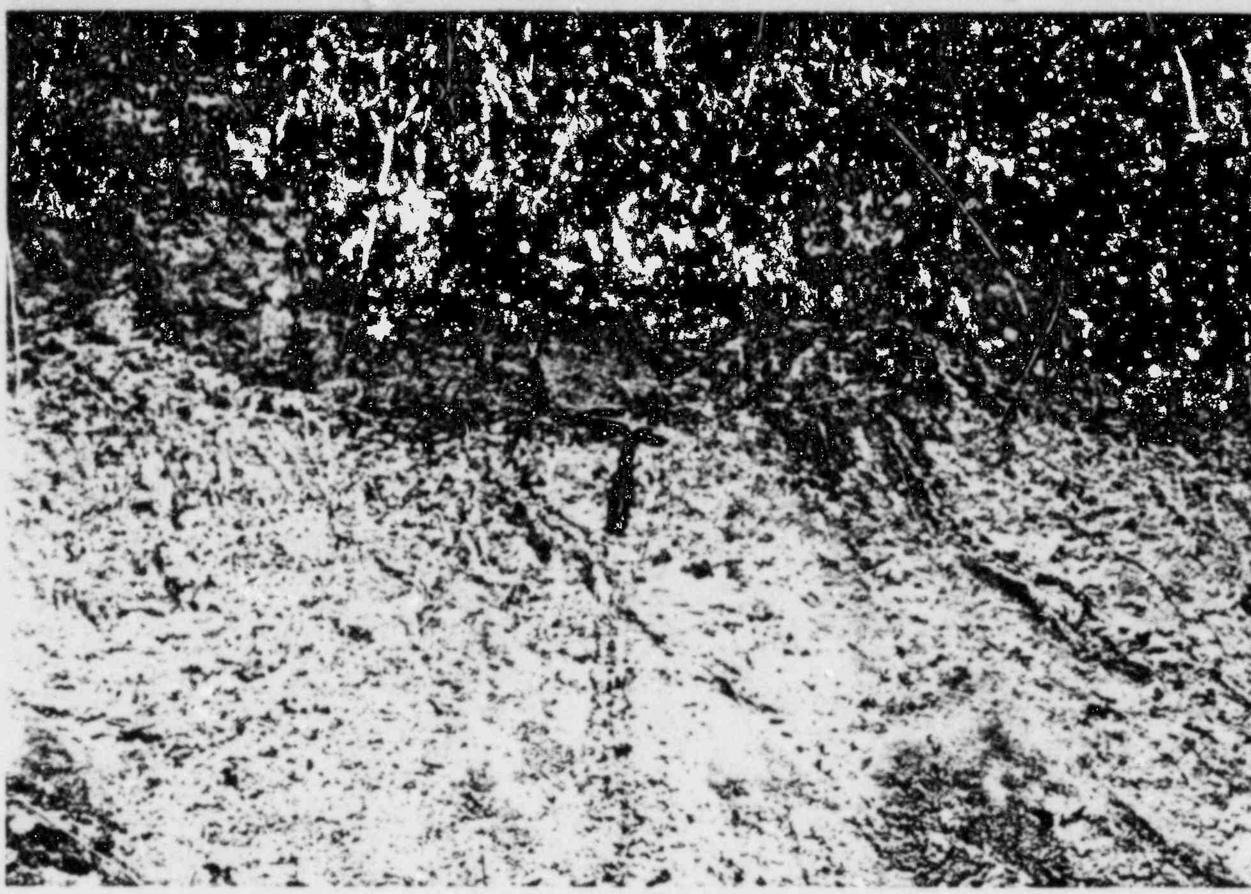

FIG. 12

FIG. 13

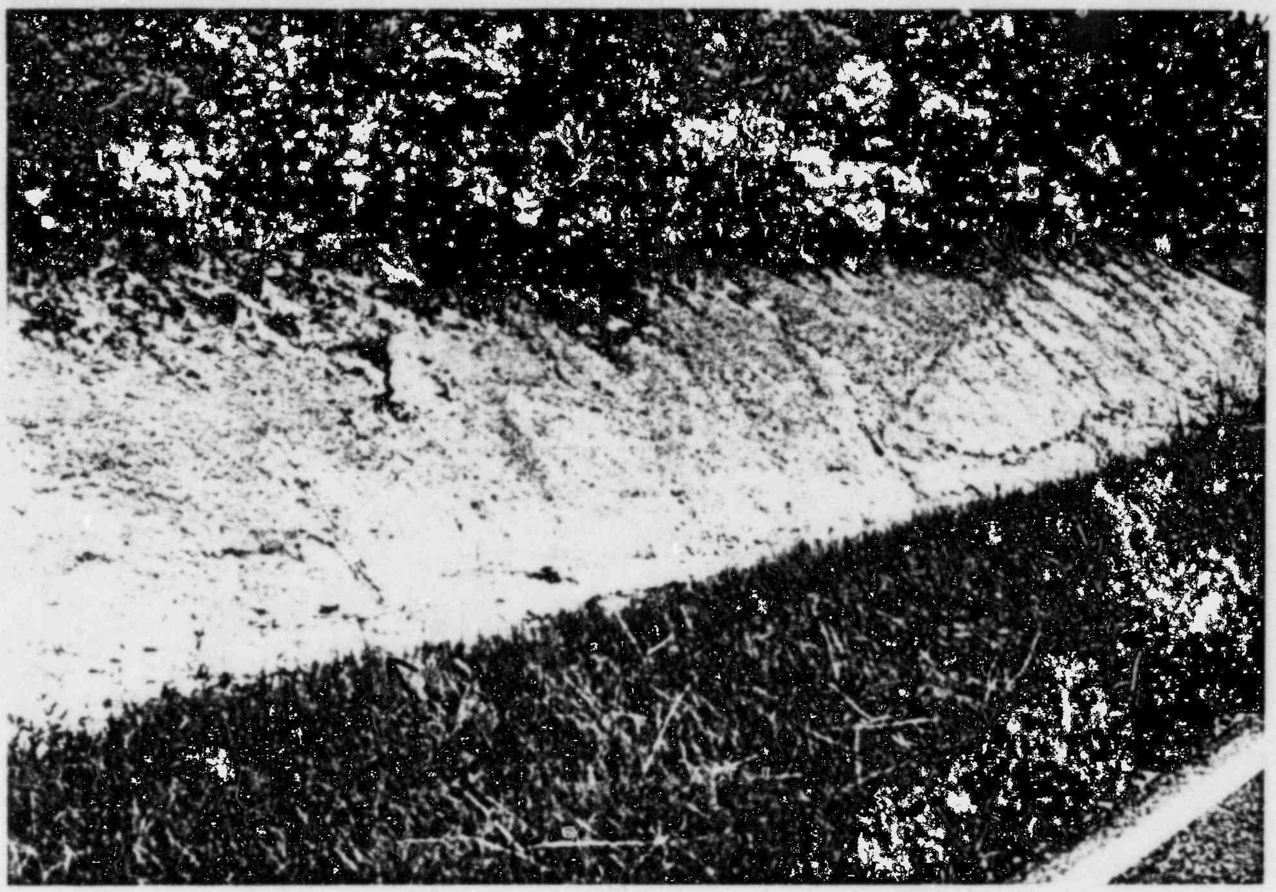

FIG. 14

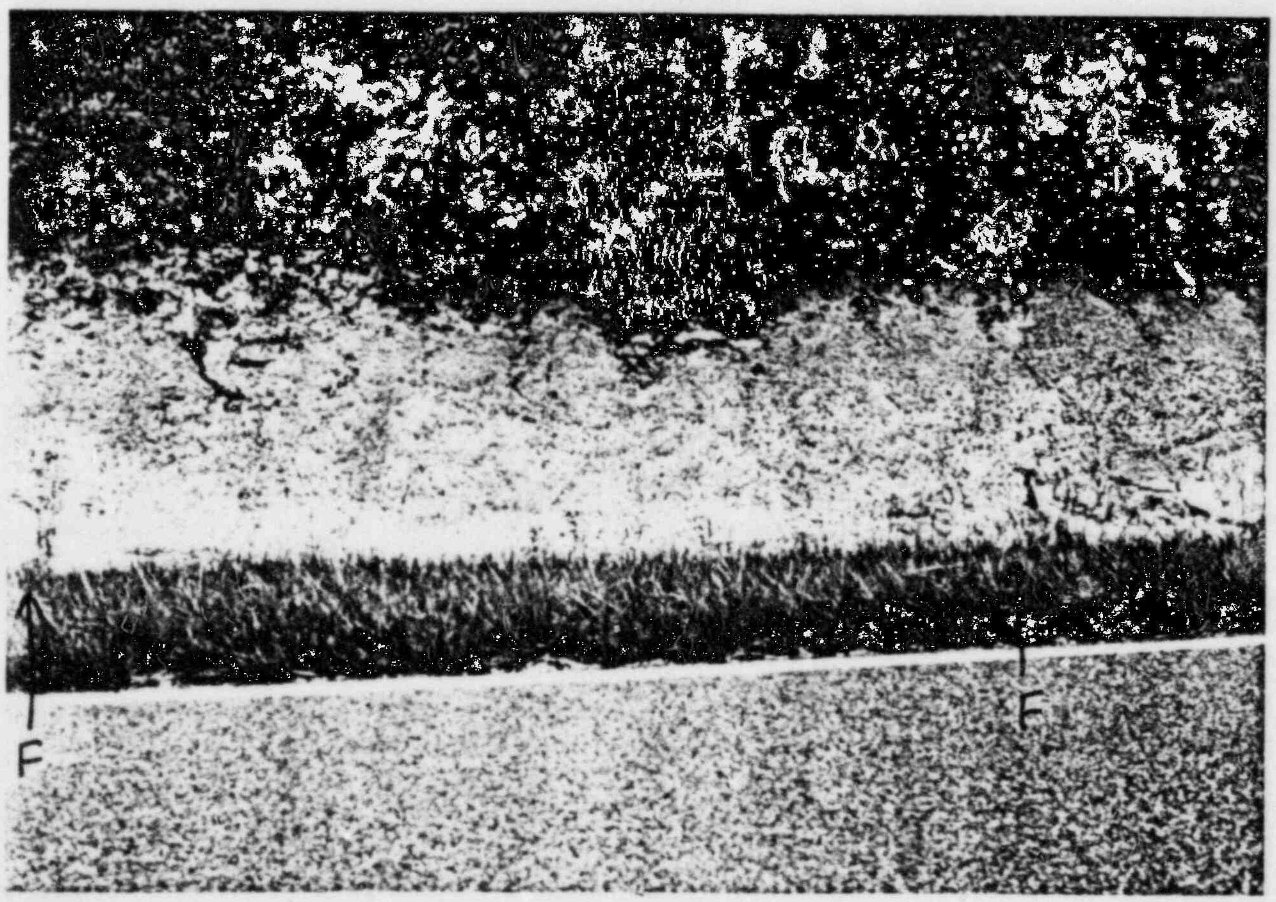

FIG. 15

FIG. 16

FIG. 17

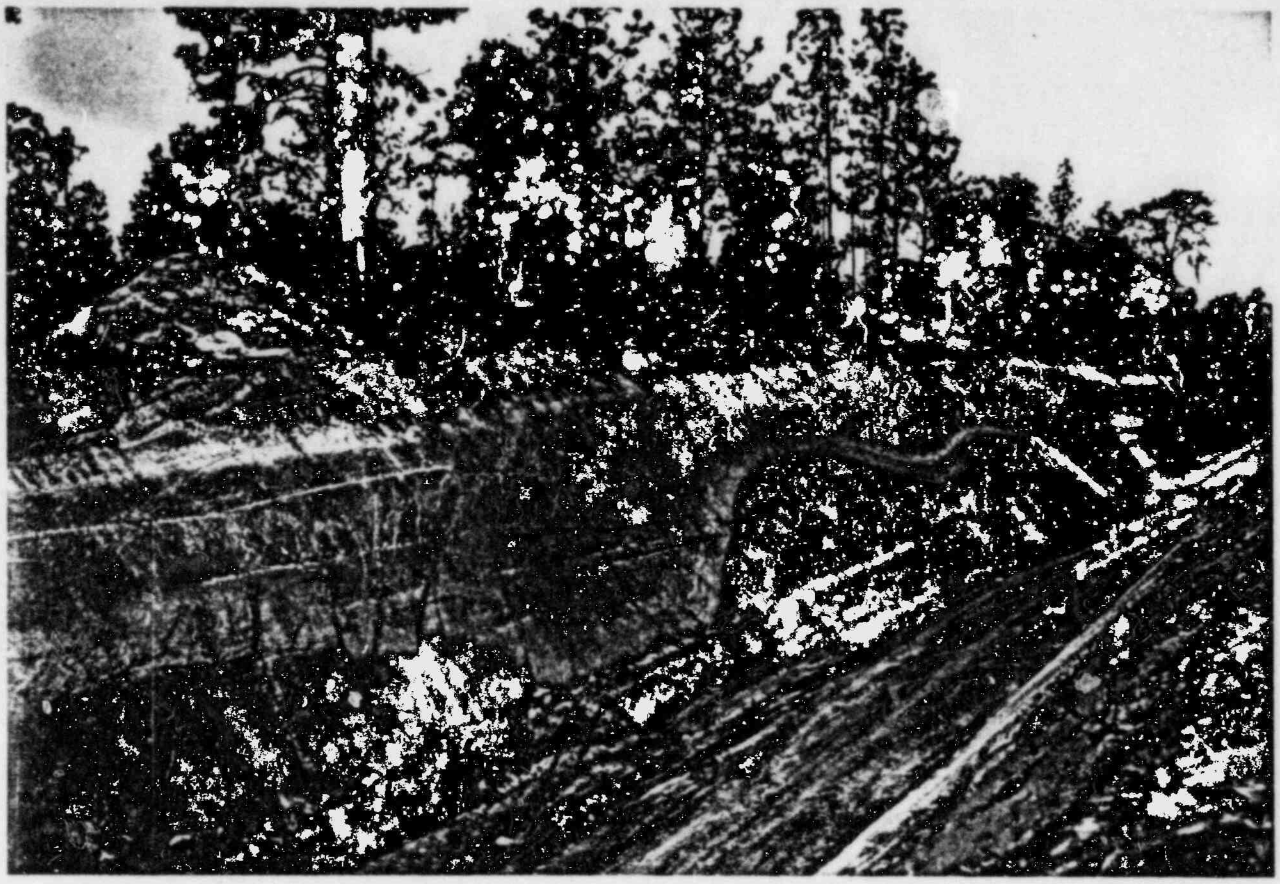

FIG. 18

FIG. 19

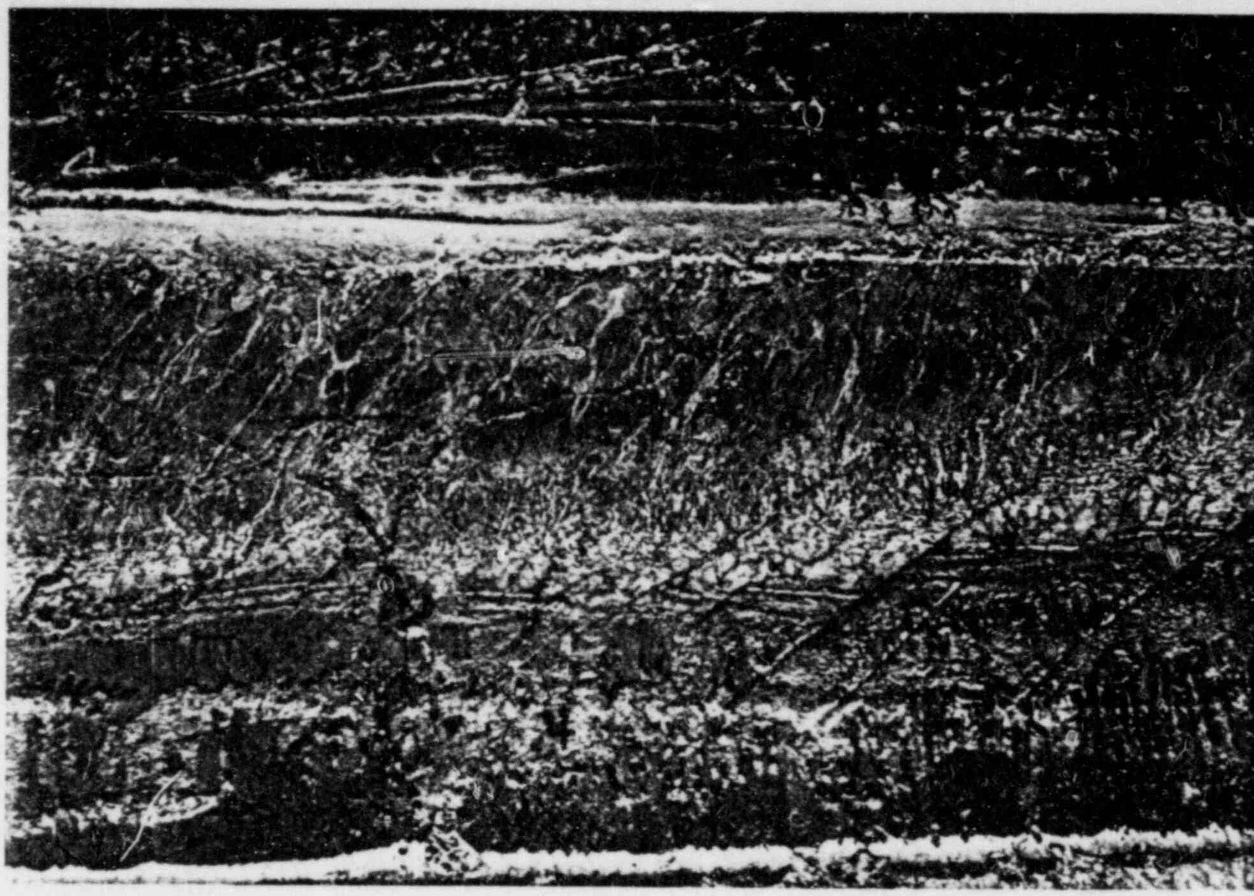

FIG. 20

FIG. 21

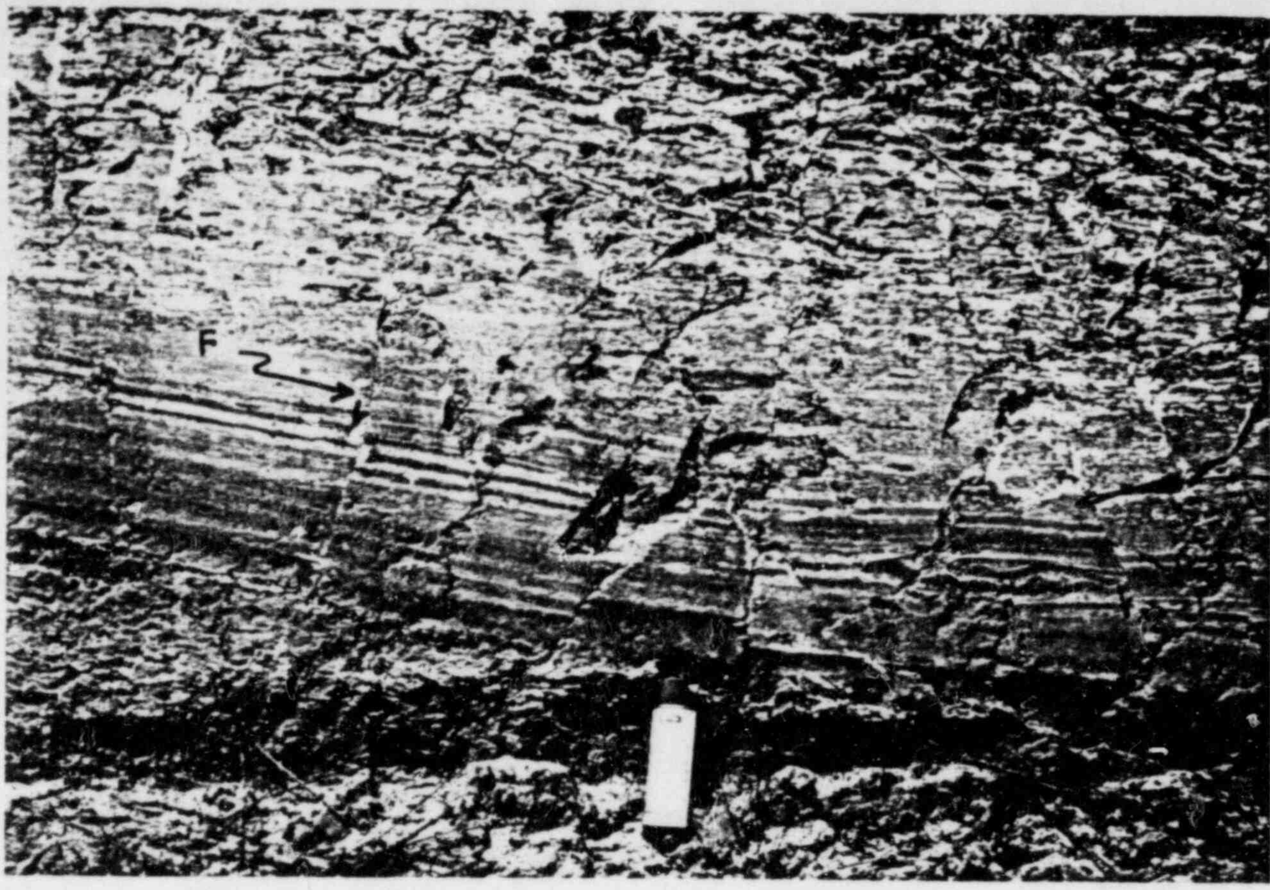

FIG. 22

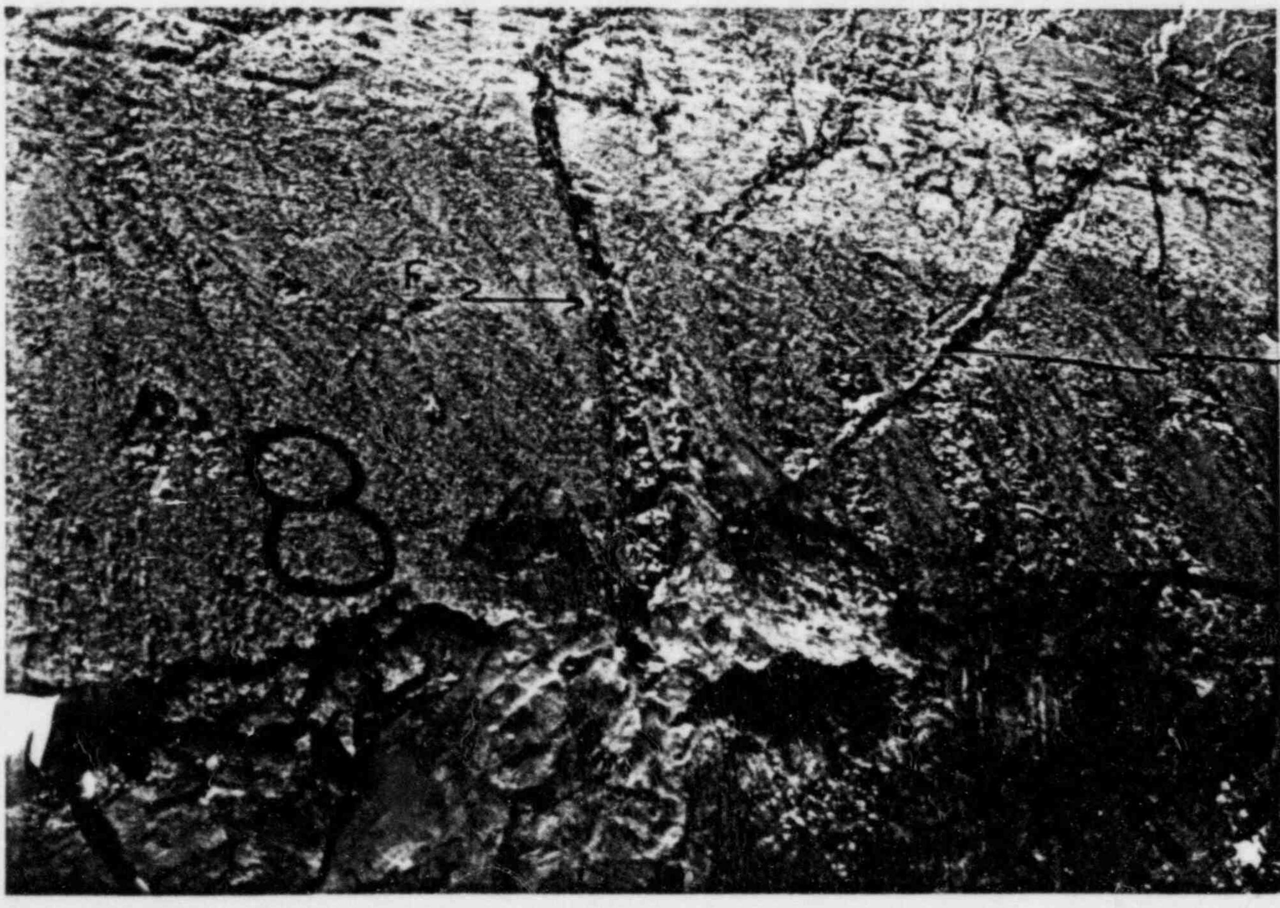

FIG. 23

FIG. 24

FIG. 25

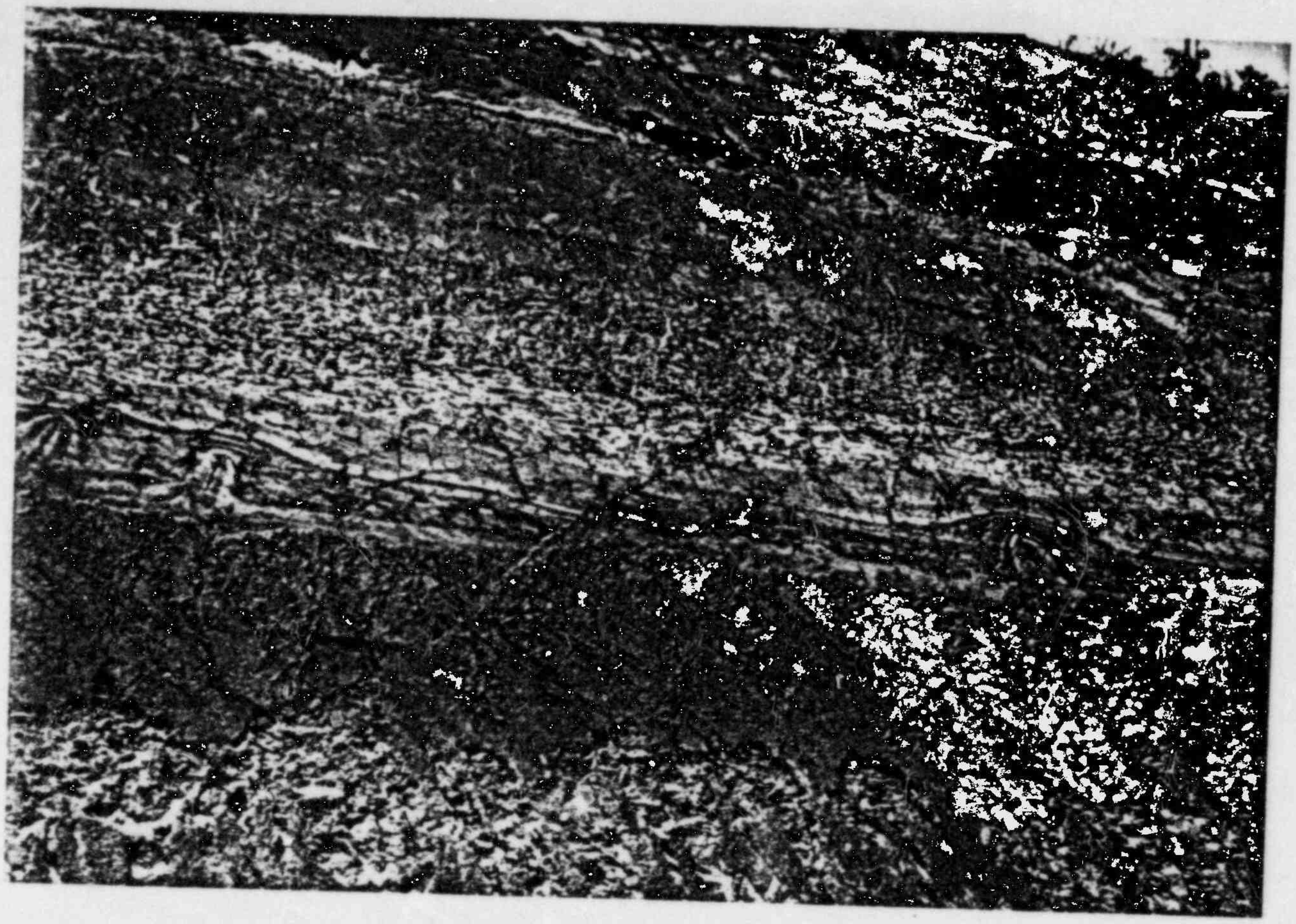

FIG. 26

FIG. 27

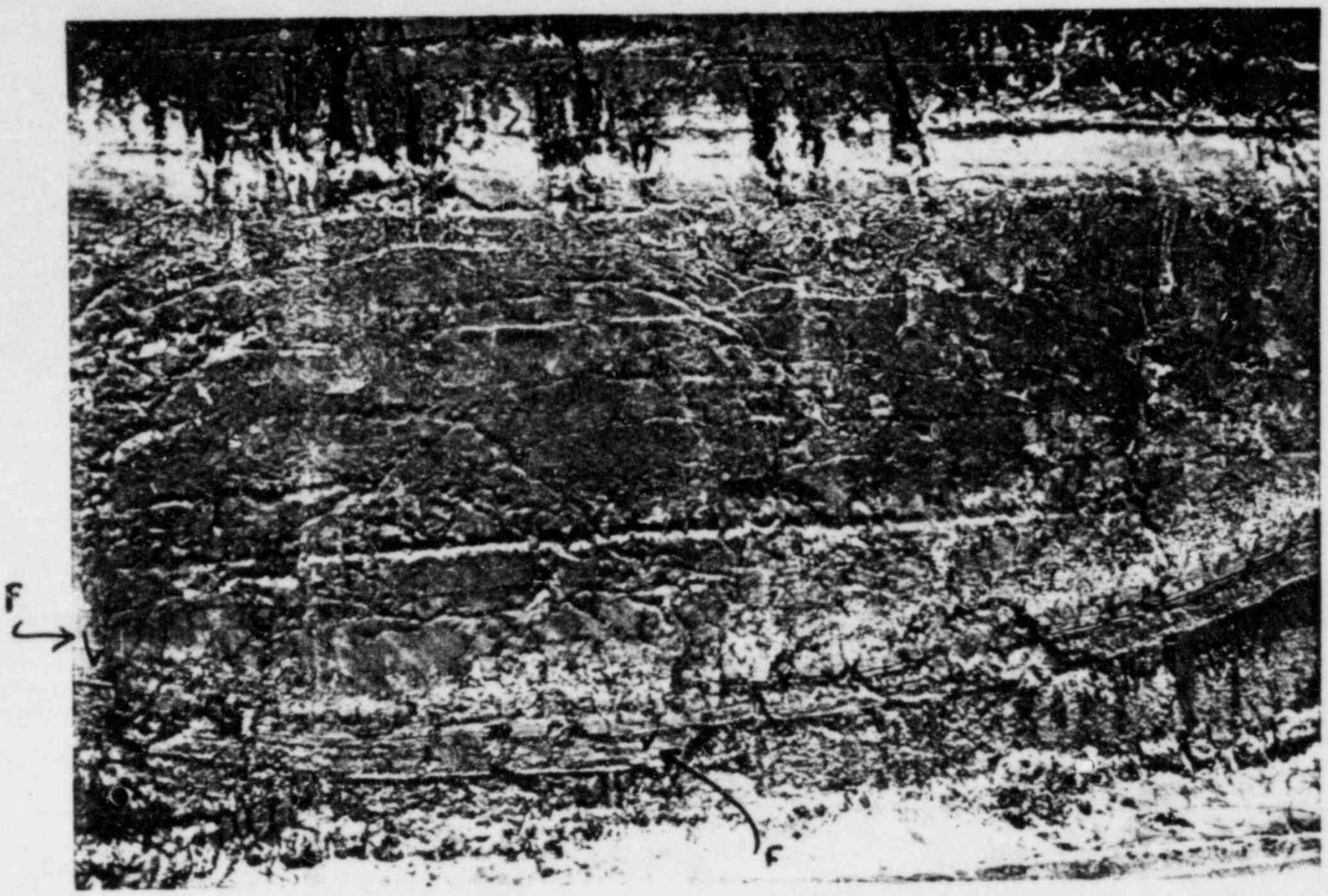

FIG. 28

FIG. 29

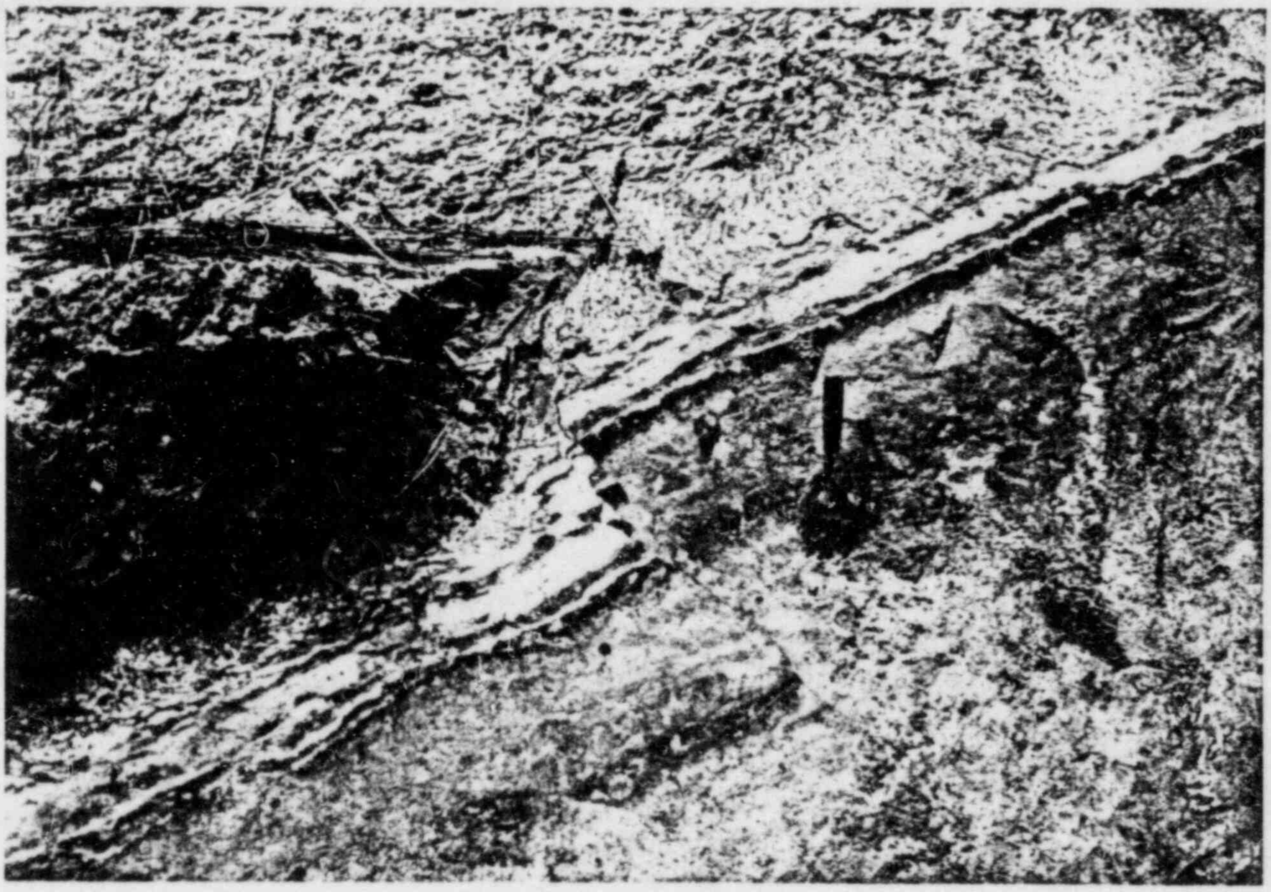

FIG. 30