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# INVESTIGATION OF SELECTED LINEAR FEATURES IN THE NORTHERN ADIRONDACK MOUNTAINS, NEW YORK

Final Report
July 1977 - June 1978

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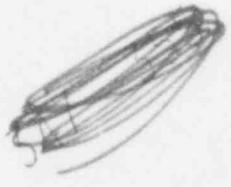
ABSTRACT

Five, prominent (13 to 35 km long), sub-parallel, ENE-trending linear features located along the northern flank of the Adirondack uplift were investigated as to nature and origin by selective detailed mapping. These features had been first observed on Landsat images. Outcrop mapping at 1:24,000 of the Proterozoic (Helikian), granulite-facies rocks involved, revealed only eight critical locations where bedrock is exposed along or near (within 75 m) the five linear features. One linear feature (∿14 km long) is considered to be entirely fault controlled. Another (∿23 km long) could not be evaluated due to lack of outcrop along its trace. The remaining three linear features appear to be the result of selective erosion along one or a combination of the following features: layering or foliation of bedrock, fractures and joints, less resistent rock units. No marked aeromagnetic discontinuities are associated with any of the five linear features.



FIGURES





# INVESTIGATION OF SELECTED LINEAR FEATURES IN THE NORTHERN ADIRONDACK MOUNTAINS, NEW YORK

## Introduction and Previous Work

The purpose of this study was to investigate the nature of prominant ENE linear features observed on Landsat images along the northern flank of the Adirondack domical uplift. A major reason for studying these lineaments is their prominence and the fact that their trends contrast sharply with those of the predominant NNE to NE lineaments which are so characteristic of the eastern half of the Adirondack region (Fig. 1). The ENE lineaments represent a new, large-scale tectonic element in the northern Adirondacks.

When transferred to topographic maps at 1:24,000, the ENE linear segments are seen to correspond, in the main, with valleys or straight breaks in slope, as will be discussed in more detail later. As a group, these topographic lines extend for a distance of ∿70 km, from Sylvan Falls on the West Branch of the St. Regis River eastward to a point north of Upper Chateaugay Lake (Figs. 2 and 3). The longest individual linear feature is ∿35 km long, extending from west of Lake Ozonia Outlet to east of Titusville Mountain (Figs. 2 and 3, linear feature A). The area studied involves parts of the following six 15' quadrangles: Nicholville, Santa Clara, Loon Lake, Malone, Chateaugay, and Churubusco.

The first quadrangle geologic mapping in this area was done by A. F. Buddington (1937) who mapped the Santa Clara 15' quadrangle. A. W. Postel (1952) later mapped the Churubusco 15' quadrangle. The Loon Lake, Malone, Chateaugay, and Nicholville 15' quadrangles were mapped, respectively, by Postel, Dodson, and Carswell (1956); Postel, Wiesnet, and Nelson (1956); Nelson and others (1956); and Postel and others (1959). At only one location did any of these workers recognize a fault along any of the linear features examined in this study. Postel and others (1959) noted a small fault on the western bank of the West Branch of the St. Regis River at Sylvan Falls. This outcrop is located near the western edge of Figure 2, beneath the "B" of linear feature B. It occurs west of the point at which the linear feature loses topographic expression. This small fault can be traced for ∿20m and strikes east, with a dip of 75° to the north. The horizontal displacement given by Postel is ∿0.75m, relative movement not specified.

## Present Study

### Method of Investigation

Bedrock mapping at a scale of 1:24,000 was done along those portions of the linear features which were considered the most likely to have exposed bedrock, i.e., along steep slopes, and in streams which intersect the linear features. Special attention was given to the search for evidences

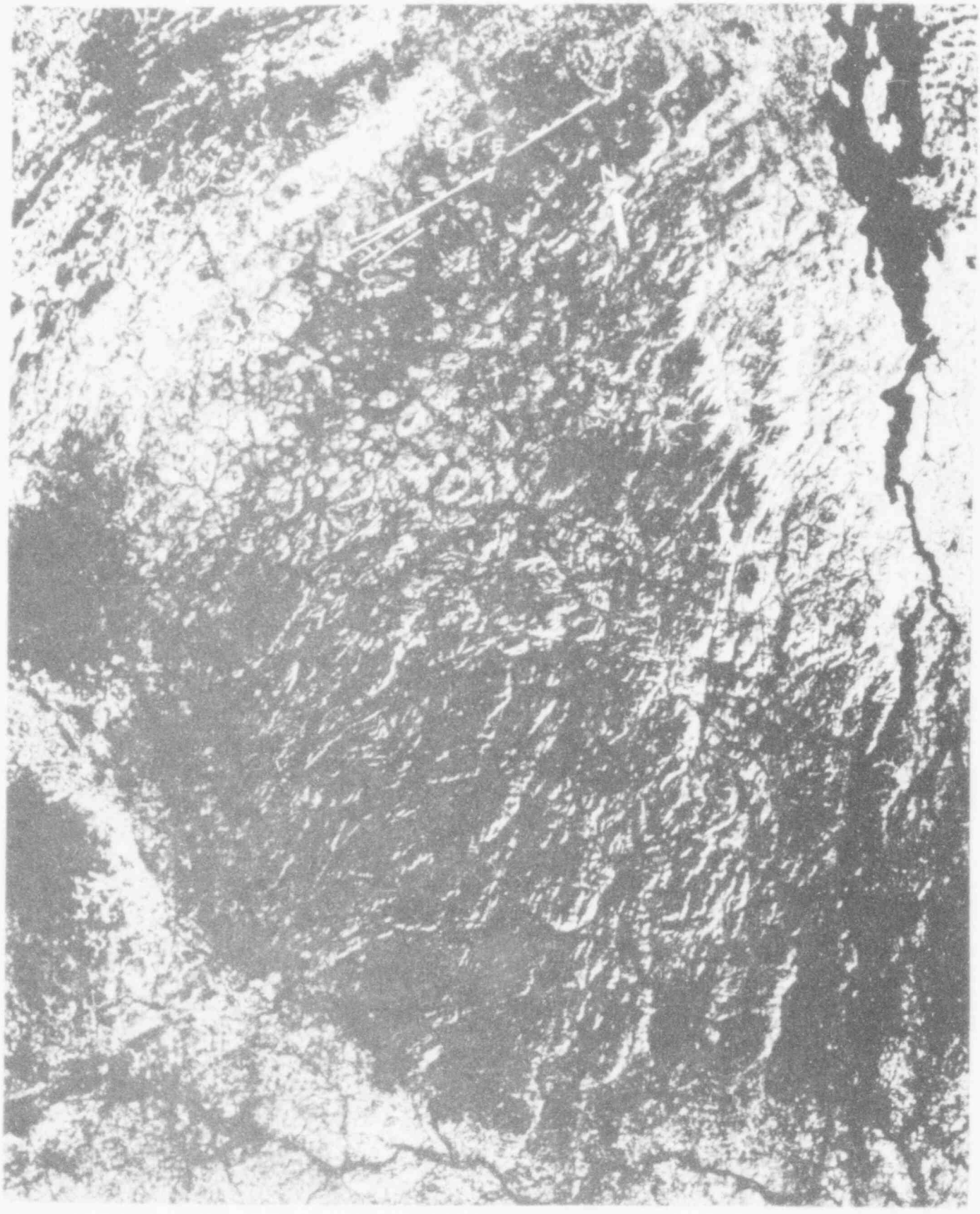
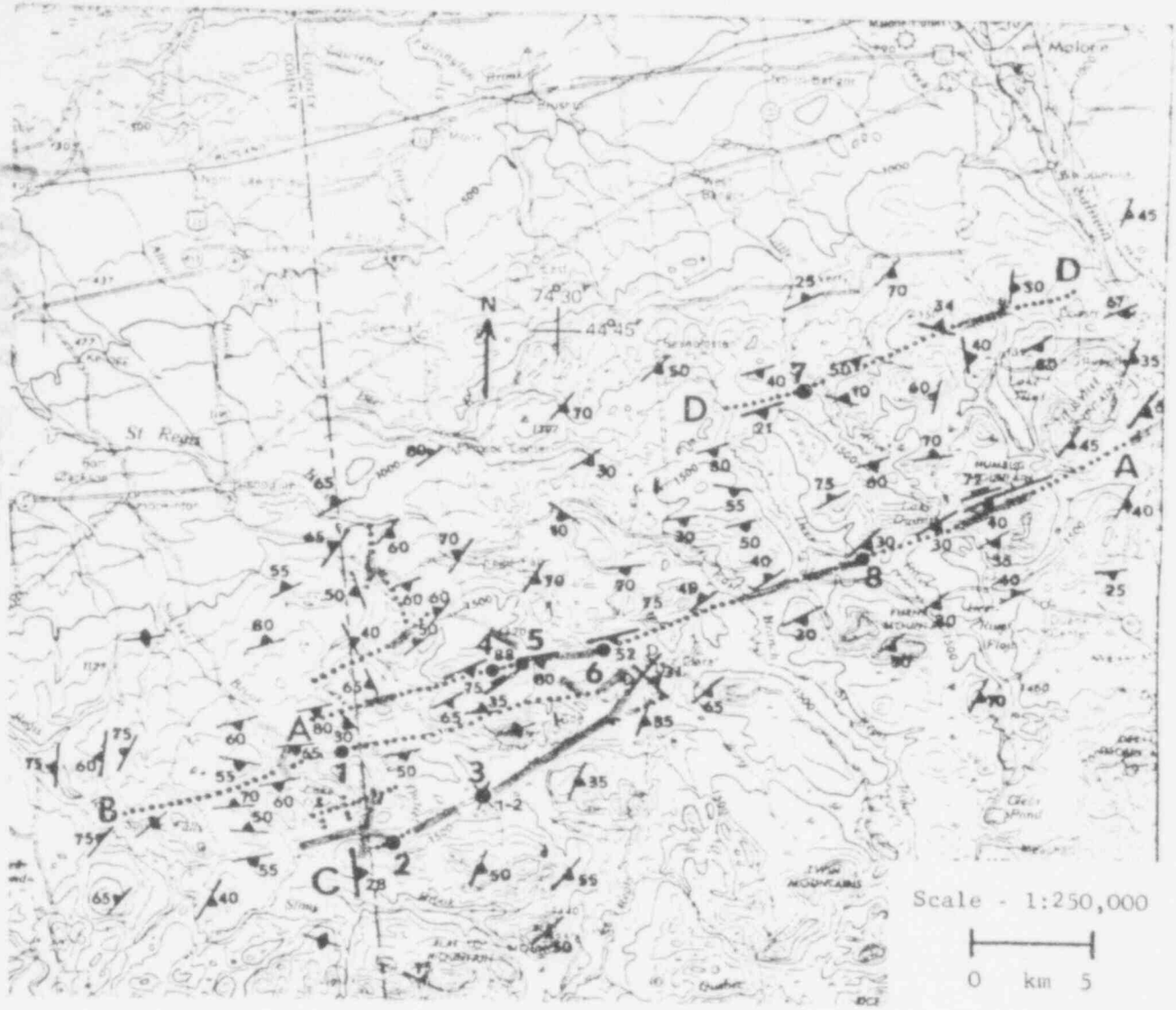




Figure 1 - Landsat - 1 monaic of the Adirondack Mountains region, made from the imagery of October 10 and 11, 1972, band 7. East-northeast-trending linear features in the northern Adirondacks which are discussed in this report are labeled A-E.




EXPLANATION

2 — Landsat topographic line; dotted where not visited because outcrop considered unlikely, screened pattern indicates areas visited but exposures lacking. Large, numbered dots indicate outcrop locations discussed in text. Other outcrops are indicated by symbols for strike-dip, breccia, fault, and dike.

75 — Strike and dip of layering and foliation (this study).

40 — Strike and dip of foliation compiled from sources cited in text.

81 — Strike and dip of dike.

D / U — Strike and dip direction of small fault; relative displacement direction shown.

X — Location of fault breccia.

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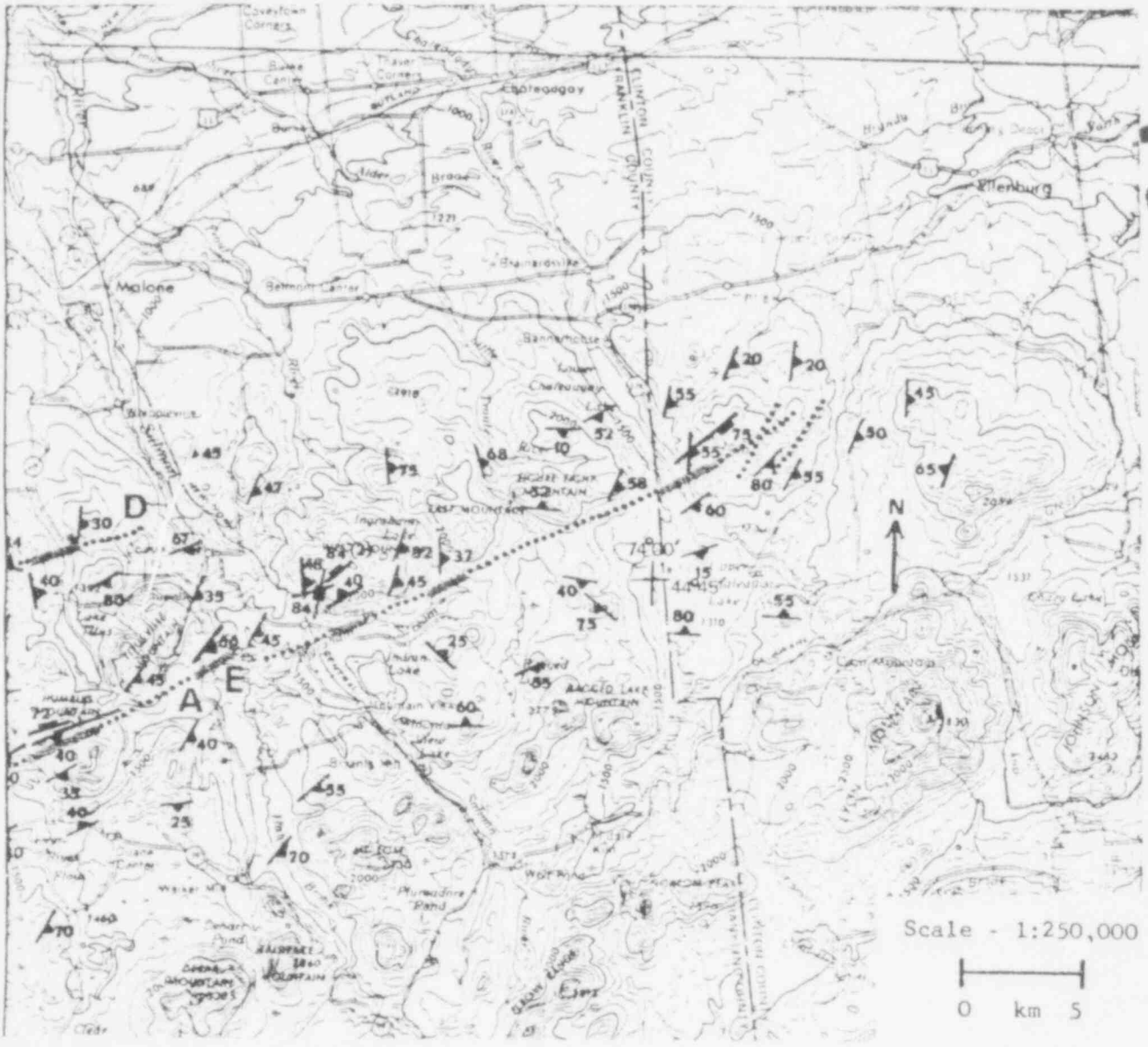
Figure 2 - Map of Landsat linear features, western portion of study area.




EXPLANATION

Landsat topographic line; dotted where not visited because outcrop considered unlikely, screened pattern indicates areas visited but exposures lacking. Outcrops are indicated by symbols for strike-dip, breccia, fault, and dike.

75 — Strike and dip of layering and foliation (this study).

25 — Strike and dip of foliation compiled from sources cited in text.

(2) 81 — Strike and dip of dike. Number of parentheses indicates more than one.

Figure 3 - Map of Landsat linear features, eastern portion of study area.

of faulting, namely, anomalous fracturing, brecciation, slickensides, and retrograde minerals such as chlorite, epidote, or muscovite. By "anomalous fracturing", we refer to a greater density of fractures and a greater variety of fracture attitudes than the normal regional jointing.

In addition to field studies, the traces of the linear features were compared with aeromagnetic trends shown on existing maps.

## Results

The linear features studied are shown at 1:250,000 on Figures 2 and 3, along with attitudes of foliation and layering, and the locations of faults, breccias, and dikes. As is well known to field geologists, faults and topographic linear features are characterized by a sparsity or lack of bedrock exposures; outcrops located along, or closely bracketing the linear features described below were found at only eight locations as shown on Figures 2 and 3. Areas marked by screened pattern indicate places where outcrop was searched for but not found. Outcrops found along the linear features are indicated by symbols for strike and dip, dike occurrence, or faulted rock.

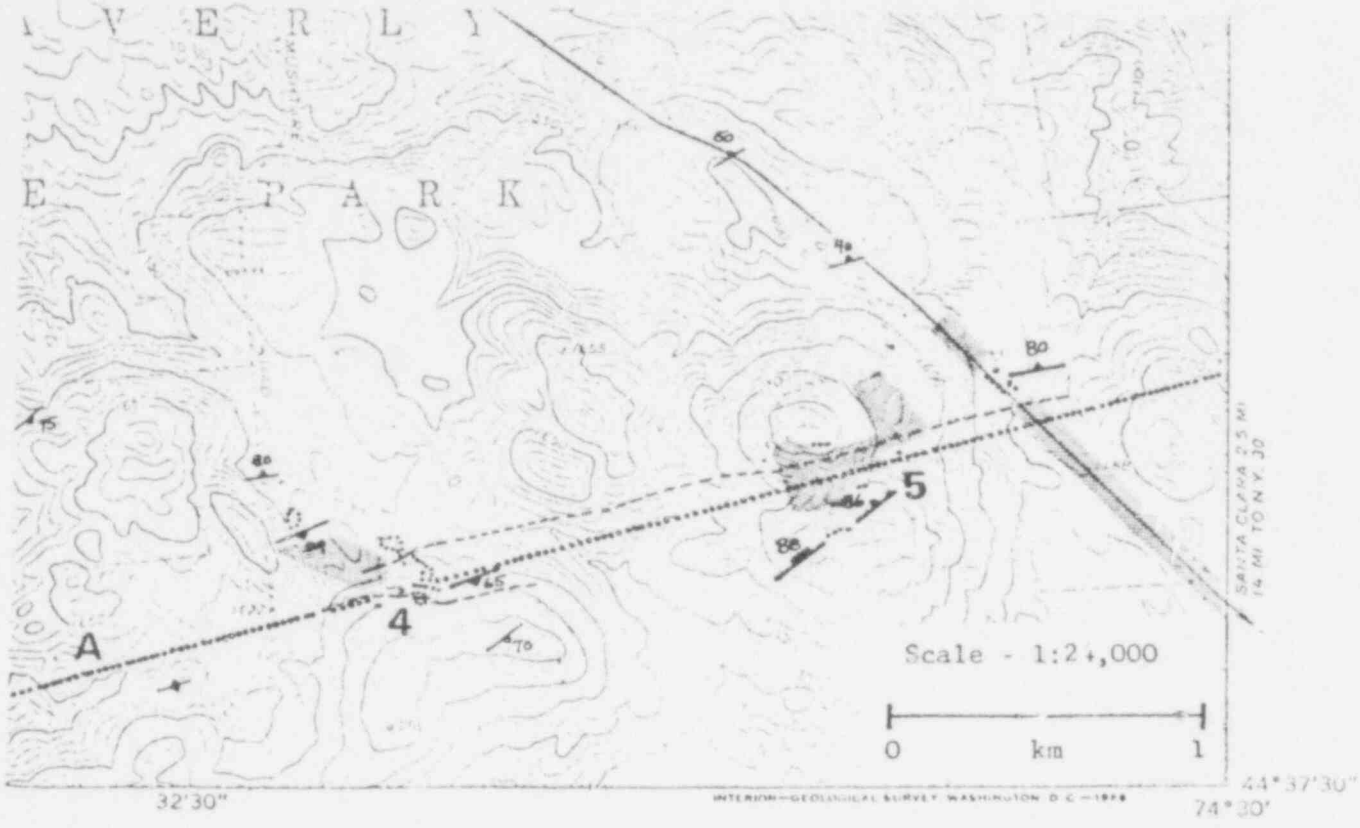
The individual linear features studied are designated A - E for reference purposes (Figs. 2 and 3).

### Linear Feature A

Linear feature A is the longest (~35 km) of the group. Bedrock is exposed along the trace of this line in at least four locations. These are shown in greater detail (1:24,000) on Figure 4.

Locations numbered 4 and 5 occur in the Saint Regis Falls 7½' quadrangle (Fig. 4) and are sites of amphibolite directly on the trace of the linear feature. The foliation in these outcrops is nearly parallel to the linear feature, and no evidence for faulting was observed. Amygdaloidal diabase (name based on preliminary thin-section examination) is present as a sill-like intrusion that intersects foliation at a low angle (~15°). The linear feature at locations 4 and 5 seems to be related to selective erosion parallel to foliation, although the occurrence of a subparallel dike may be indicative of control by unexposed fractures.

At location 6, which is in and to the west of the St. Regis River in the Santa Clara 7½' quadrangle (Fig. 5), the linear feature crosses hornblende charnockitic gneiss. Here also, the strike of the layering and foliation is parallel to the linear feature. No fault is exposed in the gneiss, but local zones of intense fracturing suggest the presence of a buried fault nearby. For example, at one location, five fractures




EXPLANATION

| | |
|---|---|
| ..... | Trace of linear feature A. |
| | Area of outcrop or closely spaced outcrops. |
| | Area traversed in this study which lacks outcrop. |
| — — — — | Contact between hornblende granitic gneiss to north, and amphibolite to south (within 10 m). |
| --------- | Inferred contact between the above rock units. |
| 65 | Strike and dip of foliation and layering (this study). |
| 75 | Strike and dip of foliation from Postel and others (1959). |
| | Strike of vertical foliation from Postel and others (1959). |
| 88 | Strike and dip of amygdaloidal diabase dike. |

Figure 4 - Structural map of locations 4 and 5 on linear feature A. Note parallelism to subparallelism (up to 25° divergence) of linear feature A and foliation and layering.

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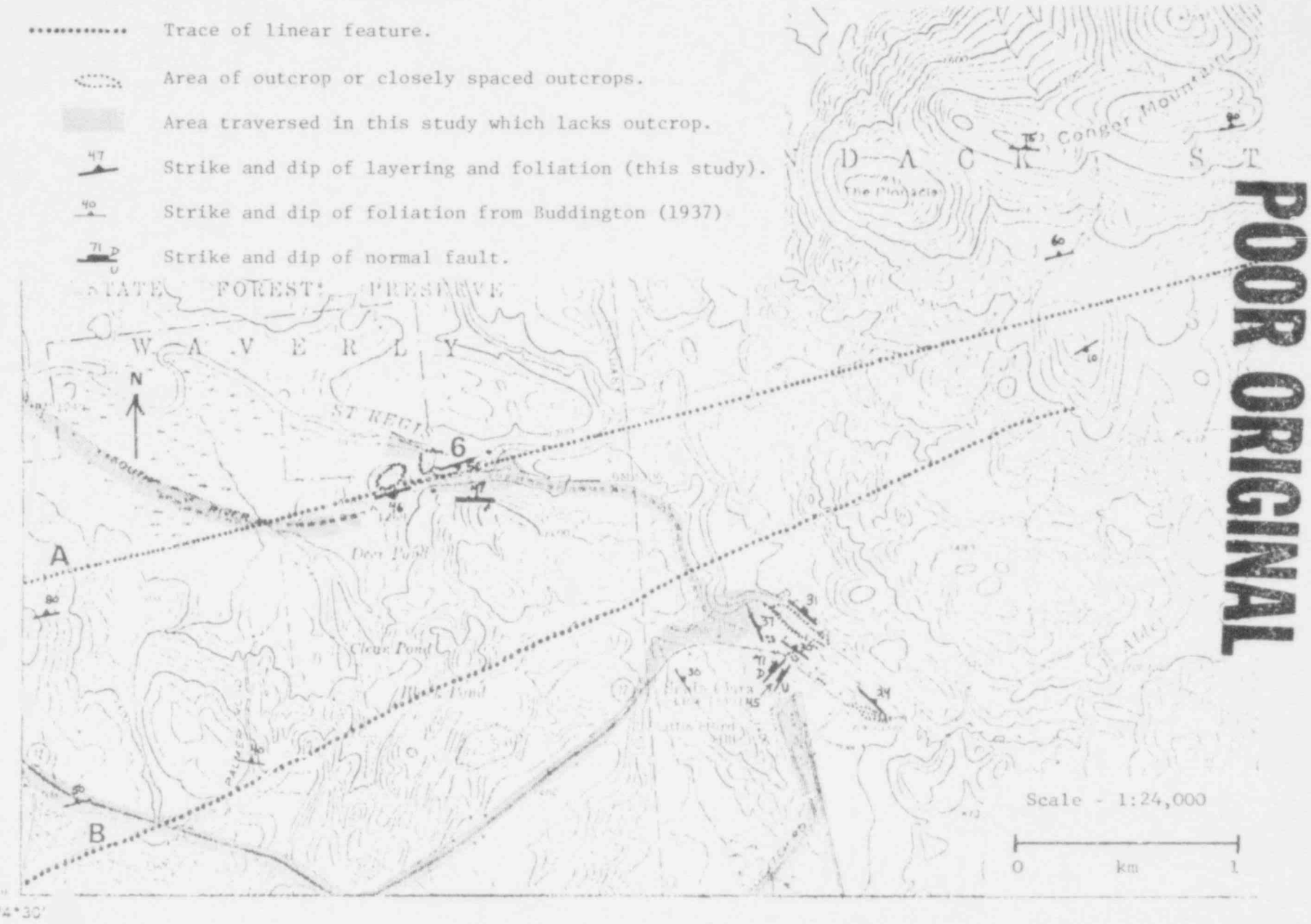




Figure 5 - Structural map of location 6 on linear feature A. Note subparallelism (up to 5° divergence) of linear feature A and layering and foliation.

trending N 44° E and dipping 52° southwest, are spaced only 4 cm apart. If the inferred fault exists, it must pass south of the outcrop examined where outcrop control is absent (Fig. 5). The local sharp turn of the river to the north at location 6 (Fig. 5) may be an expression of selective stream erosion along north-trending fractures which occur in the outcrop. Thus at location 6, linear feature A seems to be the result of selective erosion along both 1) foliation and layering, and 2) fractures, some of which may be related to faulting.

Location 8 is along the course of the Deer River in the Lake Titus 7½' quadrangle (Fig. 6). Outcrops of hornblende charnockitic gneiss occur along, and closely bracket, the trace of linear feature A at this location. No abnormal fracturing was seen in outcrop. Layering and foliation of the rock is at an angle (~20 - 25°) to the trace of the linear feature. The feature is subparallel (up to 15° divergence) to one direction of an orthogonal joint set (Fig. 7) which has normal spacing. This joint set is well expressed in exposures along a stepped waterfall of ~6m relief. The river course is influenced by the orthogonal joint set: the shorter sections of the river are subparallel to the N 70° E direction and the longer segments are parallel to the N 15° W direction. This nearly orthogonal joint set closely approximates the regional set for the Santa Clara 15' quadrangle (see Isachsen and McKendree, 1977). Linear feature A does not appear to be fault-related at location 8 because no evidence for faulting exists in outcrops along its trace. Similarly, it does not seem to be caused by selective erosion along layering and foliation because of the divergence in strike between the two. Based on the exposures seen, the best explanation for linear feature A at location 8 is that it may be related to one direction of an orthogonal joint set.

## Linear Feature B

Linear feature B is ~20 km long and extends from Sylvan Falls on the West Branch of the St. Regis River to west of the hamlet of Santa Clara (Fig. 2). Outcrop is present along the trace of the linear feature in at least one location.

Location 1, in the Lake Ozonia 7½' quadrangle (Fig. 8), is an outcrop of leucogranitic gneiss and clinopyroxenite which is jointed but lacks any well-developed anomalous fractures such as might be indicative of faulting nearby. Foliation was too faint to obtain a strike and dip. However, the buried contact between granulite to north and clinopyroxenite to south must trend parallel to linear feature B, based on the areal arrangement of bedrock exposures which are separated by only 3-6 m of cover. The presence of clinopyroxenite coupled with a swampy, topographic low suggests that marble layers are present. Thus, at location 1, linear feature B is believed due to selective erosion of relatively less resistent units parallel to its strike. Farther to the east, however, at Sylvan Falls (Fig. 2), Postel and others (1959) located a small

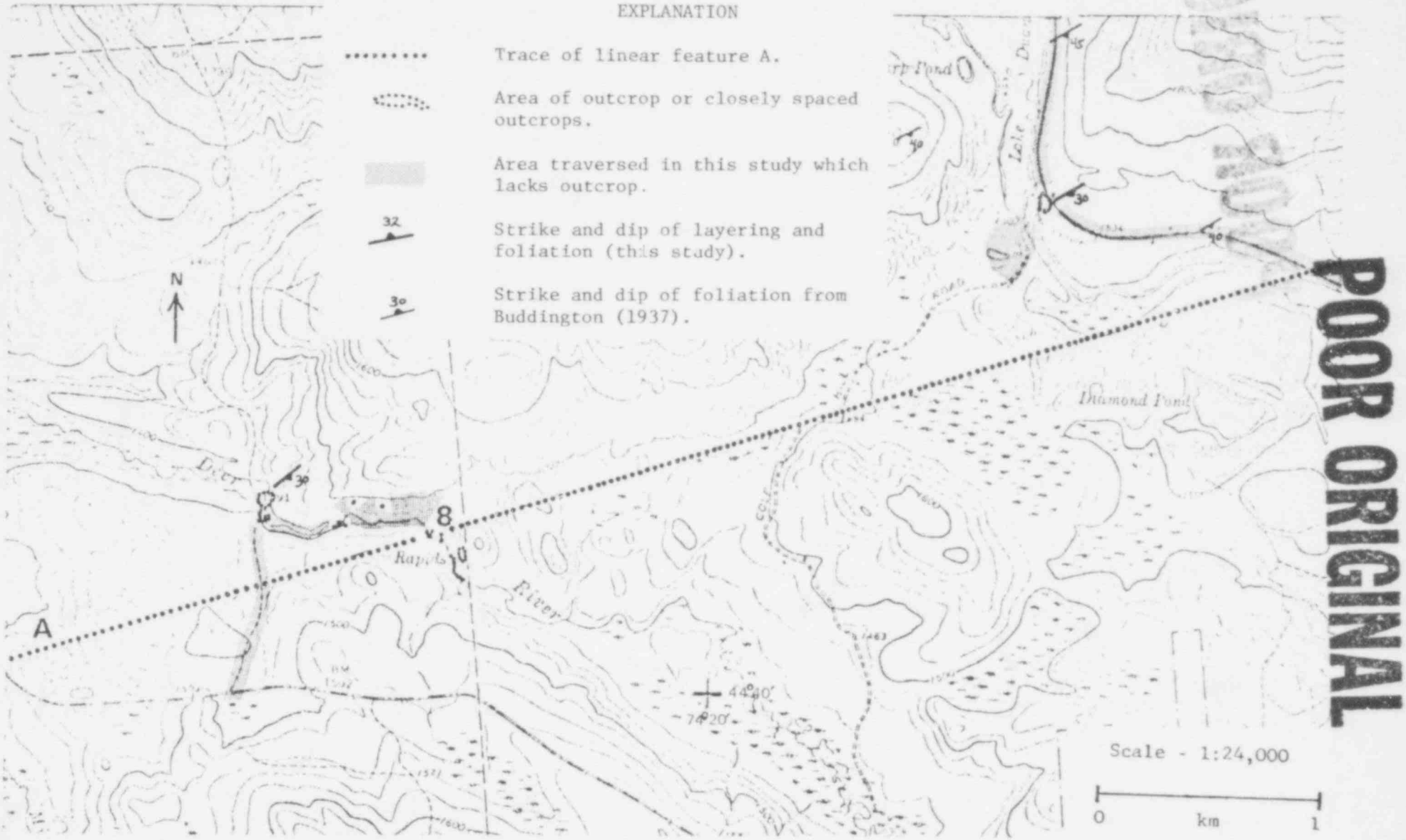








Figure 6 - Structural map of location 8 on linear feature A. Note parallel to oblique (up to 35° divergence) trends of linear feature A and layering and foliation.

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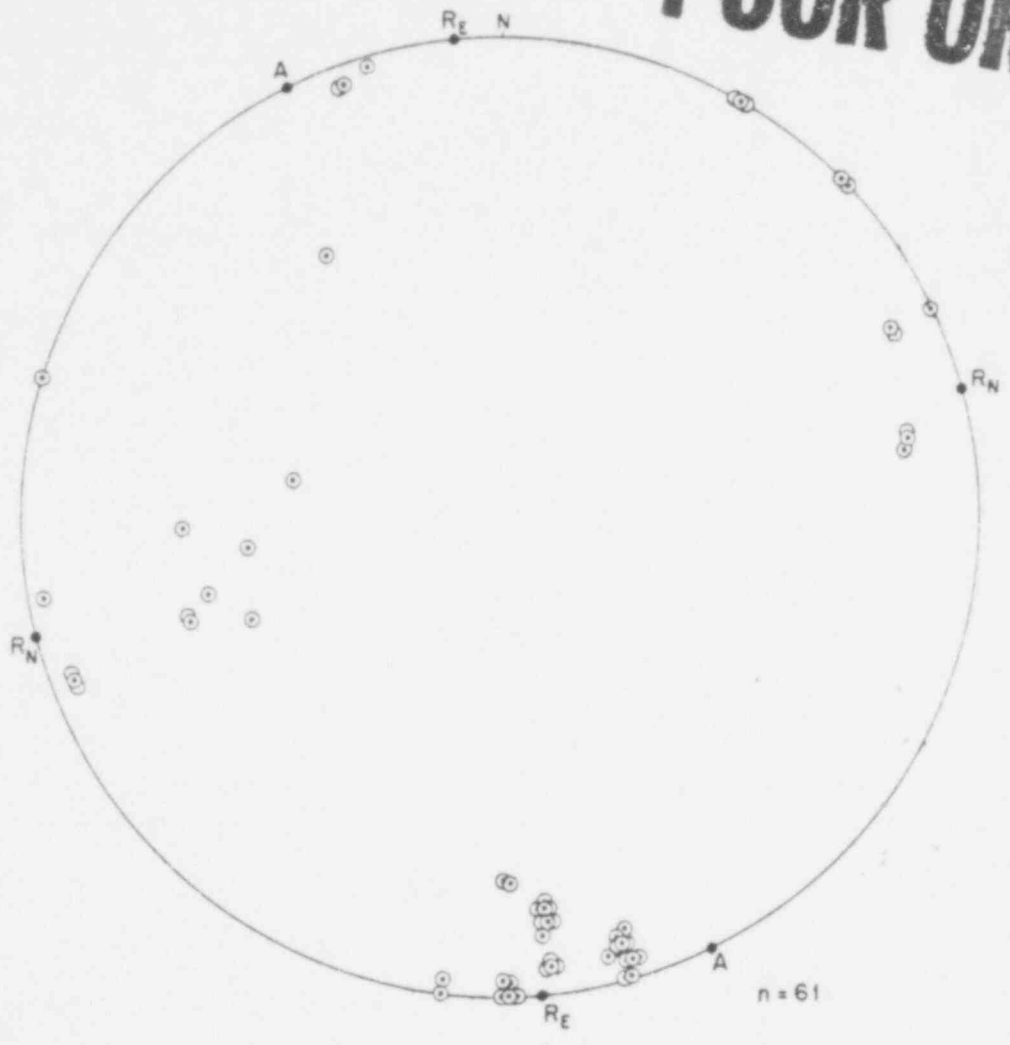


Figure 7 - Equal-area plot showing joints measured at location 8. NNW and ENE maxima closely approximate the regional, orthogonal fracture sets for Santa Clara 15' quadrangle (see Isachsen and McKendree, 1977). Course of Deer River is strongly influenced by fracture sets. Linear feature A, which strikes N 70° E, is subparallel (up to 15° divergence) to one direction of orthogonal fracture sets.

⊙ Pole to joint.

A Pole to trace of linear feature A.

$R_N$ Pole to north-northwest-trending segments of Deer River.

$R_E$ Pole to east-northeast-trending segments of Deer River.

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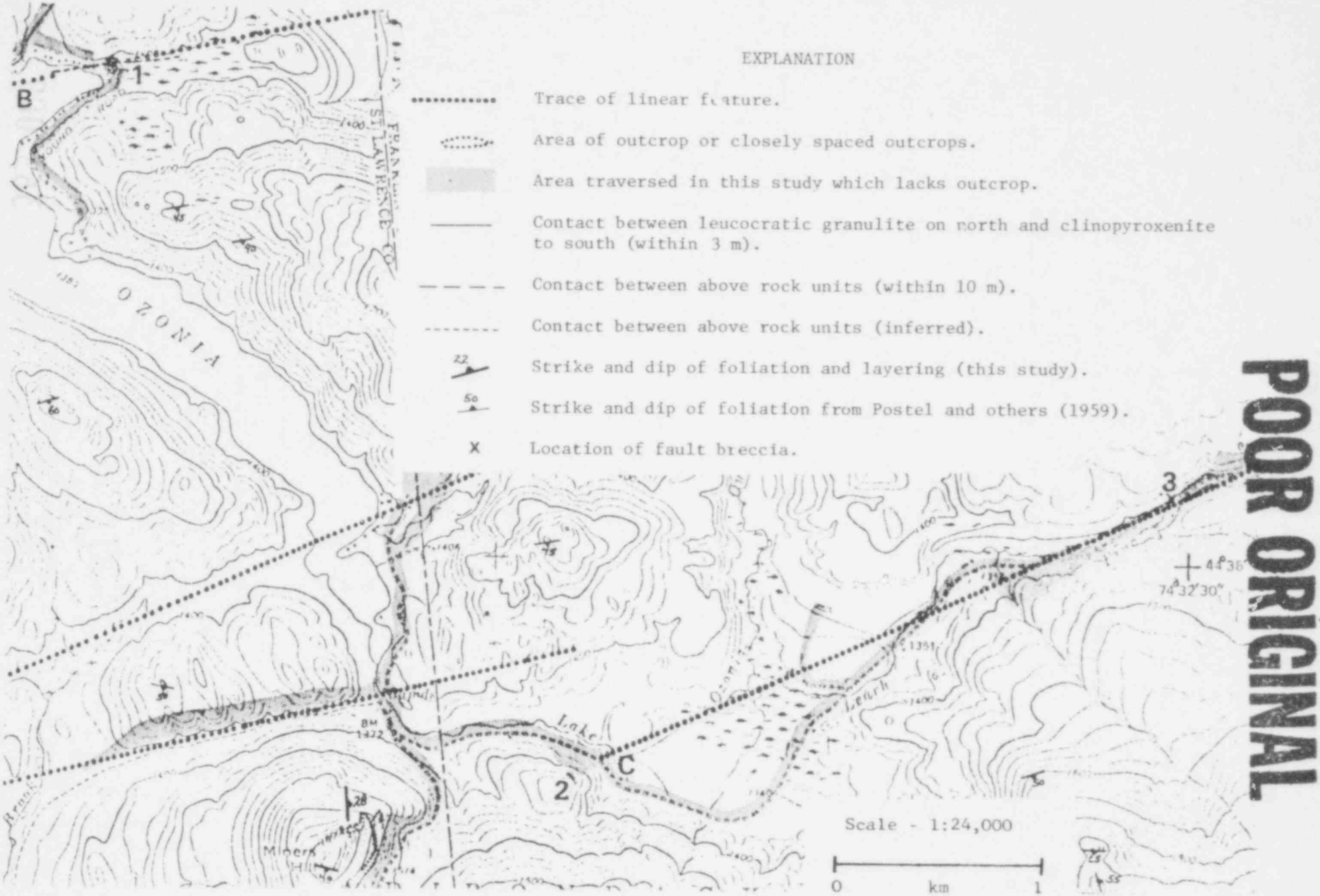



Figure 8 - Structural map of location 1 on linear feature B and locations 2 and 3 on linear feature C.

east-trending fault which occurs west-southwest of the westernmost extension of linear feature B. This east-trending fault, although west of the topographic expression of linear feature B, suggests that the feature may be fault-controlled in part. No field check was made of this exposure.

## Linear Feature C

Linear feature C is ∿13 km long and extends from a point south-southeast of Lake Ozonia to a point south of the hamlet of Santa Clara (Fig. 2). Outcrop occurs along the trace of linear feature C in at least two locations.

Locations 2 and 3 (Fig. 2) in the Lake Ozonia 7½' quadrangle (Fig. 8) are exposures of platey-quartz granulite. At location 2, no evidence for faulting was observed, but at location 3 the rock is highly fractured, with fragments reduced to only a few cm in diameter. No measureable, mesoscopic offset was observed along the fractures, but the intense development of fracturing suggests proximity to a fault. Thus, linear feature C is considered predominantly fault-controlled.

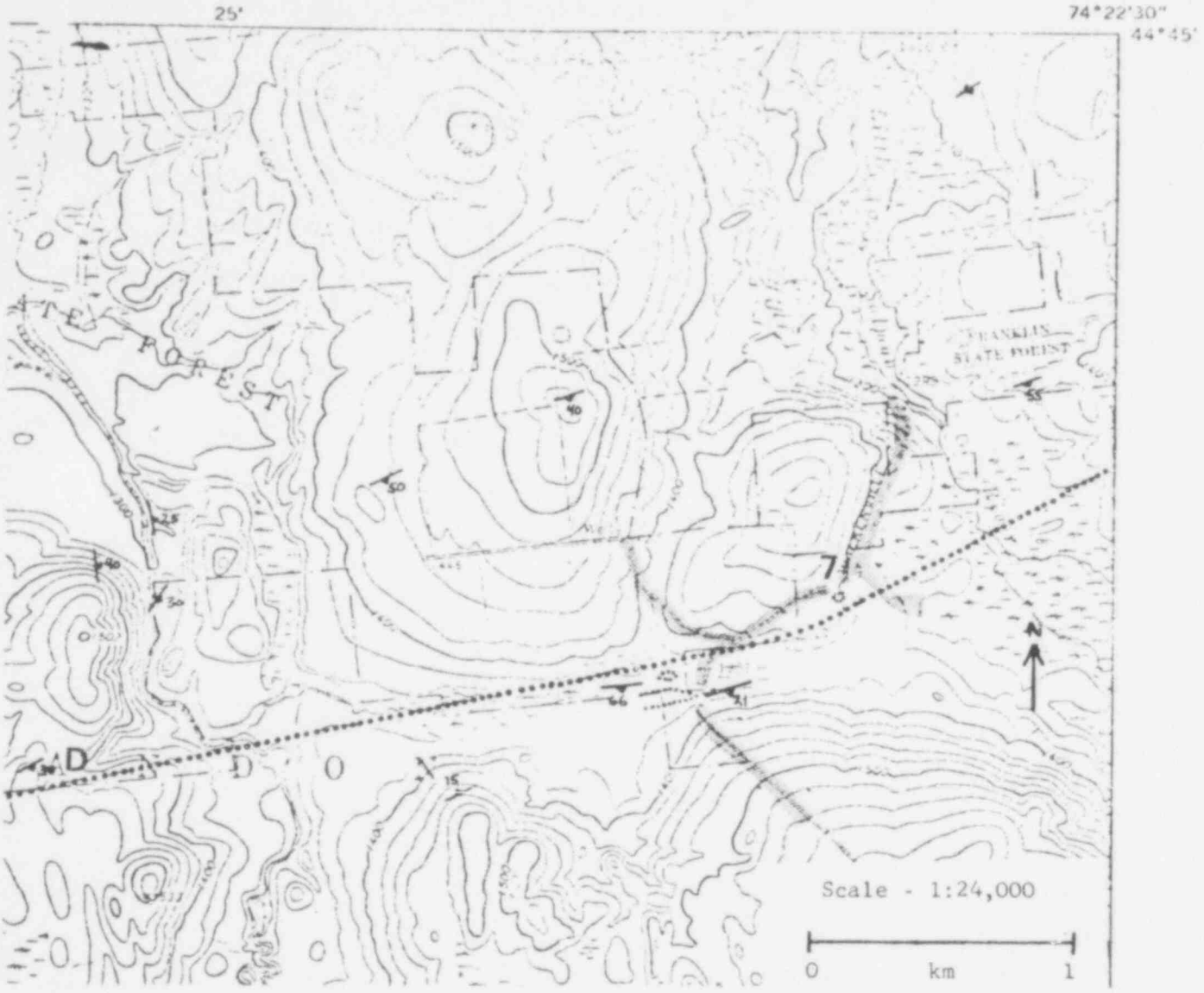
## Linear Feature D

Linear feature D is ∿14 km long, and extends from southeast of Reynoldston to west-northwest of Chasm Falls (Figs. 2 and 3). Outcrop is present along the trace of linear feature D in at least one location, namely at location 7 in the Santa Clara 7½' quadrangle (Fig. 9). The rock here is massive metagabbro and metadiabase which lacks any features suggestive of faulting. West-southwest of this locality, the strike of bedrock layering and foliation is parallel to the trend of linear feature D, suggesting that the linear feature at location 7 is controlled by selective erosion parallel to layering of bedrock.

In outcrops near the eastern end of linear feature D (Fig. 3), however, the trend of bedrock foliation intersects the trend of the linear feature at an angle of 35°. No evidence for faulting was observed in these outcrops. However, they are located ∿60 m south of the trace of linear feature D and, thus, are not directly on its trace. Outcrop control is therefore insufficient to allow speculation on the nature of this linear feature at location 7.

## Linear Feature E

Linear feature E is ∿23 km long and extends west to east from south of Owls Head to east of Lower Chateaugay Lake (Fig. 3). It may be an eastward extension of linear feature A (Figs. 2 and 3). No outcrop was observed along or near the trace of this linear feature in the areas checked, hence, its origin cannot be evaluated.




EXPLANATION

- Trace of linear feature D.
- Area of outcrop or closely spaced outcrop.
- Area of no outcrop.
- 55 — Strike and dip of foliation and layering (this study).
- 30 — Strike and dip of foliation from Buddington (1937).
- Strike of vertical foliation from Buddington (1937).

Figure 9 - Structural map of location 7 on linear feature D. Note parallel to subparallel (up to 13° divergence) trends of linear feature D and foliation and layering.

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## Comparison of Linear-Feature Trace with Regional Aeromagnetic Trends

The traces of linear features A through E were compared with regional aeromagnetic trends using maps at scales of 1:250,000 (U.S. Geological Survey, 1975 and unpubl. U.S. Geological Survey Map) and 1:62,500 (Balsley, Buddington and others, 1959 and Balsley, Postel and others, 1959). The flight line spacing was one-quarter mile at 1000 feet altitude for the eastern two-thirds of the area, and one-half mile at 500 feet altutude for the western third.

No marked aeromagnetic discontinuities were observed corresponding to traces of the linear features studied, although linear feature B is parallel to a narrow (1.5 km wide) low for its entire length. This negative anomaly strengthens the interpretation that linear feature B is underlain, in part, by marble, which has a low content of magnetic minerals compared to the granitic gneisses lying to the north and south.

## Summary

Five, sub-parallel linear features, first observed on Landsat images, were investigated by selective, detailed outcrop mapping to determine their character on the ground. The dominant characteristic of each was sparsity of outcrop along the linear trace.

Linear feature A, ∿35 km long, appears to be a result of selective erosion along: (a) layering and foliation of bedrock at two locations, (b) both layering and foliation of bedrock and fractures at one location, and (c) fractures at another location.

Linear feature B, ∿20 km long, appears to be caused by selective erosion of less resistant units. This interpretation, however, is based on structural relationships at only one location. The feature may be fault-controlled at its western margin, based on the work of Postel and others (1959).

Linear feature C, ∿13 km long, is shown to be fault-controlled, based on one exposure along its trace.

Linear feature D, ∿14 km long, appears to be due to selective erosion along layering and foliation, based on one exposure along the feature.

Linear feature E, ∿23 km long, could not be evaluated due to lack of outcrop along its trace.

No marked aeromagnetic discontinuities were observed along any of linear features studied.

Acknowledgements

Stephen F. Wright performed part of the field investigation and contributed ideas concerning the nature of the studied linear features.

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16. ABSTRACT (200 words or less)

Five, prominent (13 to 35 km long), sub-parallel, ENE-trending linear features located along the northern flank of the Adirondack uplift were investigated as to nature and origin by selective detailed mapping. These features had been first observed on Landsat images. Outcrop mapping at 1:24,000 of the Proterozoic (Helikian), granulite-facies rocks involved, revealed only eight critical locations where bedrock is exposed along or near (within 75 m) the five linear features. One linear feature (~14 km long) is considered to be entirely fault controlled. Another (~23 km long) could not be evaluated due to lack of outcrop along its trace. The remaining three linear features appear to be the result of selective erosion along one or a combination of the following features: layering or foliation of bedrock, fractures and joints, less resistent rock units. No marked aeromagnetic discontinuities are associated with any of the five linear features.

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