Seismic Analysis

There is no uniform seismic activity in the study area. Although there are events scattered throughout most of the Southern Appalachian Tectonic Study area, there are only two areas of persistently significant seismic activity. One area includes part of southwestern Virginia and may extend into central Virginia; the second area includes parts of eastern Tennessee, western North Carolina, and western South Carolina. The localization of historical seismic activity in these two areas is further confirmed by those events which have been instrumentally recorded and located and which are also confined to these two areas.

Seismic activity in the contiguous area made up of the southwestern and central Virginia zones is aligned east-west, representing the only significant alignment of historical epicenters presently identifiable in the Southern Appalachian Tectonic Study area. This east-west trend is also very evident in the instrumental epicenters located by J. W. Dewey (written communication, 1979) who used a joint-epicenter determination method. The strikingly linear alignment of epicenters in this area is interpreted to be the expression of an active east-west structure.

Further confirmation of an east-west structure can be found in the strong east-west orientation of the meizo-seismal regions plotted for the larger historical events in this area. Although it is acknowledged that orientations

of meizoseismal regions can be controlled by anomalous geologic conditions, it should be noted that in southwestern Virginia those orientations cut across structure. Similar trends are observed for central Virginia earthquakes. This suggests that the east-west orientation of the meizoseismal regions for these events is controlled by an east-west-striking fault plane.

Analysis of the long-period Love and Raleigh waves for one of these events, the 1969 Elgood, West Virginia earthquake, indicates a strike-slip mechanism for a fault plane striking nominally east-west. Given the present day stress regime as defined by Sbar and Sykes (1977) an east-west trending fault is interpreted to be a preferred mechanism. Recorded first motion of P-wave arrivals for this event, although not numerous, tend to agree with this interpretation.

All of this evidence taken together strongly infers the existence of an active east-west structure with which the 1897 Giles County earthquake, as well as present seismic activity in that area, can be associated.

Epicenters located in Tectonic Subdivision 4 (see TECTONIC SUBDIVISIONS map) are more diffuse; that is, they are not clearly represented by linear trends. However, there is some suggestion of an east-west alignment of instrumentally located epicenters (J. W. Dewey, written communication, 1979) and some of the larger historical epicenters (equal to or greater than Intensity VI), although one

focal mechanism available for this area, the 1973 Maryville, Tennessee earthquake, was determined to have a northwest-striking fault plane solution.

When the EARTHQUAKE EPICENTER MAP is superimposed on the TECTONIC SUBDIVISIONS map, it is evident that certain areas have a higher frequency of events. These seismically active areas are bounded in part by rectilinear features. One such feature, the New York-Alabama lineament (NY-A), restricts a vast majority of events, equal to or greater than Intensity VI, to the southeast. A second set of boundaries oriented northwest-southeast (Boundaries A, B, and C, on the TECTONIC SUBDIVISIONS map) are also seismically significant. Events in the area of Tennessee-North Carolina-South Carolina (Tectonic Subdivision 4) appear to be well constrained by Boundaries A and B, and seismic activity in the contiguous area made up of the southwestern and central Virginia zones (Tectonic Subdivision 8) occurs northeast of Boundary C.

During the study, additional analyses were made of the data, because many researchers have recently indicated strong correlations between mafic intrusions and earthquakes. The best interpretation at this time suggests that no such correlation exists in the southern Appalachians.

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REGIONAL PHOTO-IMAGERY LINEAMENT ANALYSIS

This section presents pertinent information on data acquisition, analysis, and interpretation contained in a report prepared for TVA by Texas Instruments, Inc. Editorial modifications have been made where necessary to correctly represent presentation scale, terminology, and consistency of format.

Although the contractor furnished TVA with map data at scales of 1:250,000 and 1:2,000,000, the final presentation scale for the TVA report is 1:1,000,000.

Introduction

General.--This report summarizes the methods and preliminary results of a lineament analysis utilizing LANDSAT imagery and SKYLAB photography and covering approximately 79,500 square miles in the southern Appalachian Mountains region. The study was conducted by the Geological Services Section of Texas Instruments, Incorporated for the Geologic Services Branch of the Tennessee Valley Authority (TVA) during the period from May through December, 1978, under contract No. TV-45399A. The work was done primarily by A. B. Zuzek and A. P. Johnson with contributions by J. Bakhoven, B. M. Kelty, D. M. Burkhouse, and D. F. Saunders.

The purpose of the study was to map geomorphic linear elements[1] and curvilinear features[2] discernible on satellite imagery and/or photographs.

Location and Extent of Study Area.--The project area is located between 33°00' and 38°45'N. latitude and between 79°15' and 88°00'W. longitude. It covers the main structural elements of the southern Appalachian Mountains Region and comprises an area of approximately 79,500 square miles. Large portions of the surrounding area covering the Appalachian Plateau and Piedmont Provinces have been included in the study, as many lineaments extend outside the study area. The total area evaluated by LANDSAT imagery analysis including the project area is approximately 170,000 square miles covering the southern and central portions of West Virginia, the western portion of Virginia, the eastern portions of Kentucky and Tennessee, the western portion of North Carolina, the northern portions of Alabama and Georgia, and the northwestern portion of South Carolina.

Remote-sensing Materials.--This study involved the analysis of both LANDSAT imagery and SKYLAB photography supplied by TVA and including the following items:

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[1]In this report, "linear elements" are those linear or gently curved alignments of topographic features or tones identified on LANDSAT imagery, and "lineaments" are those linear elements or groups of aligned linear elements which are interpreted to have geologic structural significance (see O'Leary and others, 1976, for a discussion of these terms).

[2]Circular or subcircular curved features are termed "curvilinear elements" or "curvilinear geomorphic anomalies."

* LANDSAT MULTI-SPECTRAL SCANNER (MSS) imagery in spectral bands 4, 5, 6, and 7 at a scale of 1:500,000.

* LANDSAT MSS imagery as FALSE-COLOR COMPOSITES (FCC) of spectral bands 4, 5, and 7 at a scale of 1:500,000.

* SKYLAB color photographic prints and transparencies at a scale of 1:500,000 (partial coverage only).

Data Annotation, Presentation and Analysis

Data Annotation.--All spectral bands and the false color composites of LANDSAT imagery were examined for linear and curvilinear features. The stronger features were annotated directly on the LANDSAT prints. During the interpretation phase, each feature was assigned a relative discernibility value ranging from a high of 1 to a low of 4. The following were intentionally not annotated:

* The large number of short linear elements present on all prints

* Linear elements having a relative discernibility of less than 4

* Lineaments appearing to be strike ridges

* Curvilinear elements coincident with the curvature of folded strata

* Scan lines on LANDSAT prints

* Cultural patterns

Noncontiguous images were interpreted without regard to position within the project area or north orientation to

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provide objective lineament data during print annotation. The higher resolution SKYLAB photographs were used to help in judging the validity of questionable LANDSAT linear elements and lineaments.

Data Compilation and Analysis.--The annotated linear and curvilinear features on LANDSAT prints were compiled and the data transferred to 1:500,000 scale clear film base maps of the project area. Each band was compiled separately on a film base, one of a set which was supplied by TVA. These film copies were compared to maps of known faults within the project area, also provided by TVA, and lineament-fault relationships were analyzed. Lineaments and curvilinear elements coinciding with known faults were labeled as such and separated from the lineament data. Lineaments of high tectonic significance, such as the Brevard fault zone, were labeled as such on the final map.

The lineament data taken from band 6 imagery was analyzed for frequency of lineaments in 10° increments of strike in an eastward direction from the north-south line for each of the four physiographic provinces within the study area. Lineaments with an orientation of 0° to 90° were designated as striking E of N, and those with an orientation of 90° to 180° were presented as striking W of N. The four regions were sampled over approximately equal areas to provide a base for frequency comparison. These data are

presented on Figures 1a through 1d as histograms which show the distribution of lineament strikes in all of the sampled areas.

All linear and curvilinear features annotated on LANDSAT imagery were analyzed in terms of the following characteristics:

* Discernibility and repetition of lineaments on different bands of LANDSAT imagery
* Quality of image (strong east-west oriented scan lines on some images; heavy red color on FCC due to large amounts of vegetation, produced poor image quality which affected interpretation by reducing the amount of lineament data observable on the imagery)
* Coincidence of linear features with known faults, and other curvilinear elements with folded strata
* Type of lineament (drainage, tonal, topographic, etc.)
* Length, orientation and number of aligned linear features

The clear film overlays were spliced together to make a single map for each of the five bands. The data from these maps were later compiled to make separate master lineament and curvilinear overlay maps. The master lineament overlay identifies the individual lineaments as major or subordinate, shows their orientation, and classifies them into seven strike sets or trends: "A" through "F", and "X". The average direction of strike for the A through F lineaments was: "A" = N55°E, "B" = N85°E, "C" = N45°W, "D" = N20°W,

FIGURE 1

HISTOGRAMS OF LANDSAT BAND 6

LINEAMENT FREQUENCY VERSUS ORIENTATION

FOR THE FOUR PHYSIOGRAPHIC PROVINCES

WITHIN THE SOUTHERN APPALACHIAN AREA

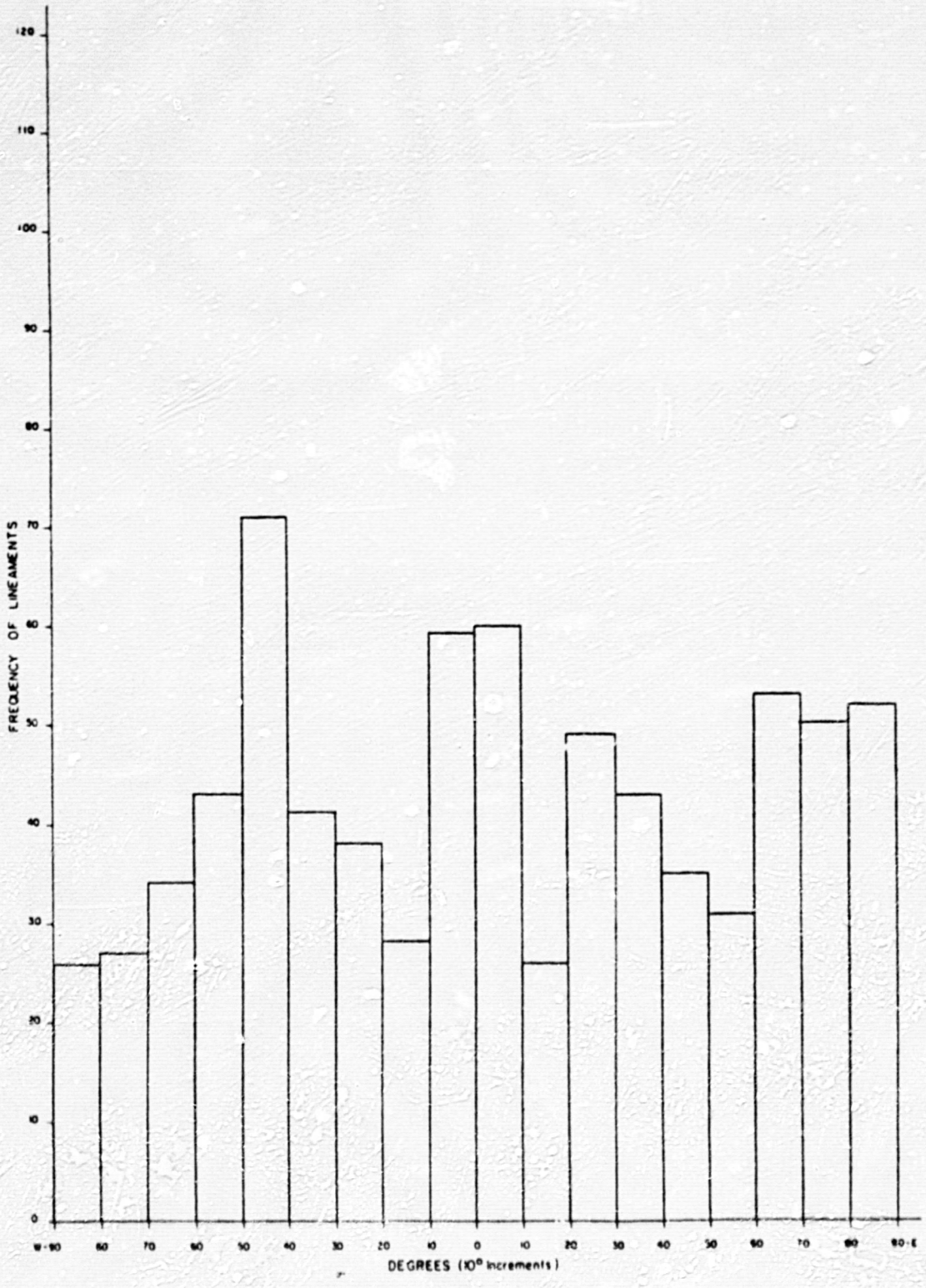


Figure 1a. Piedmont Province.

300 170

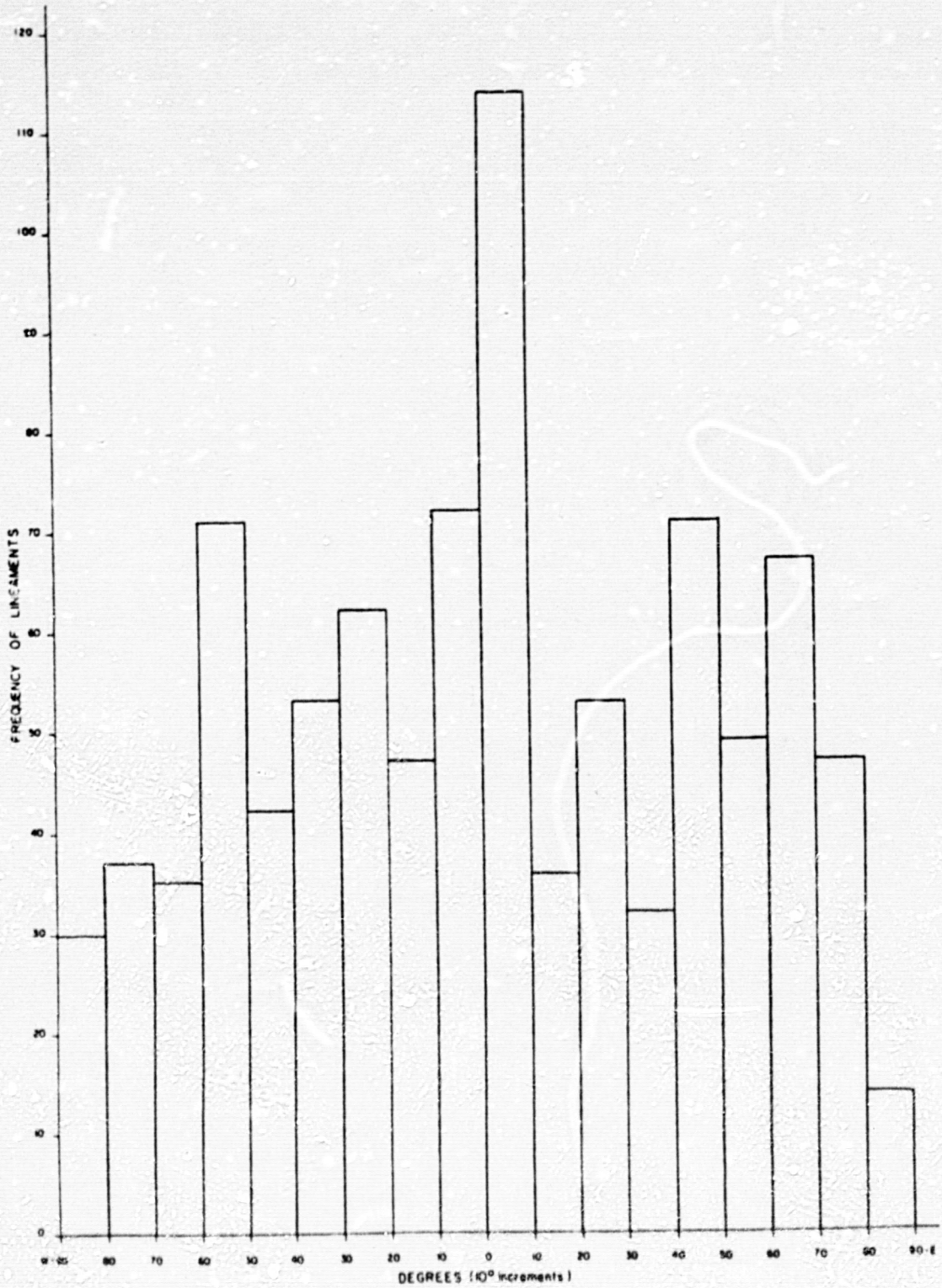


Figure 1b. Blue Ridge Province.

300 171

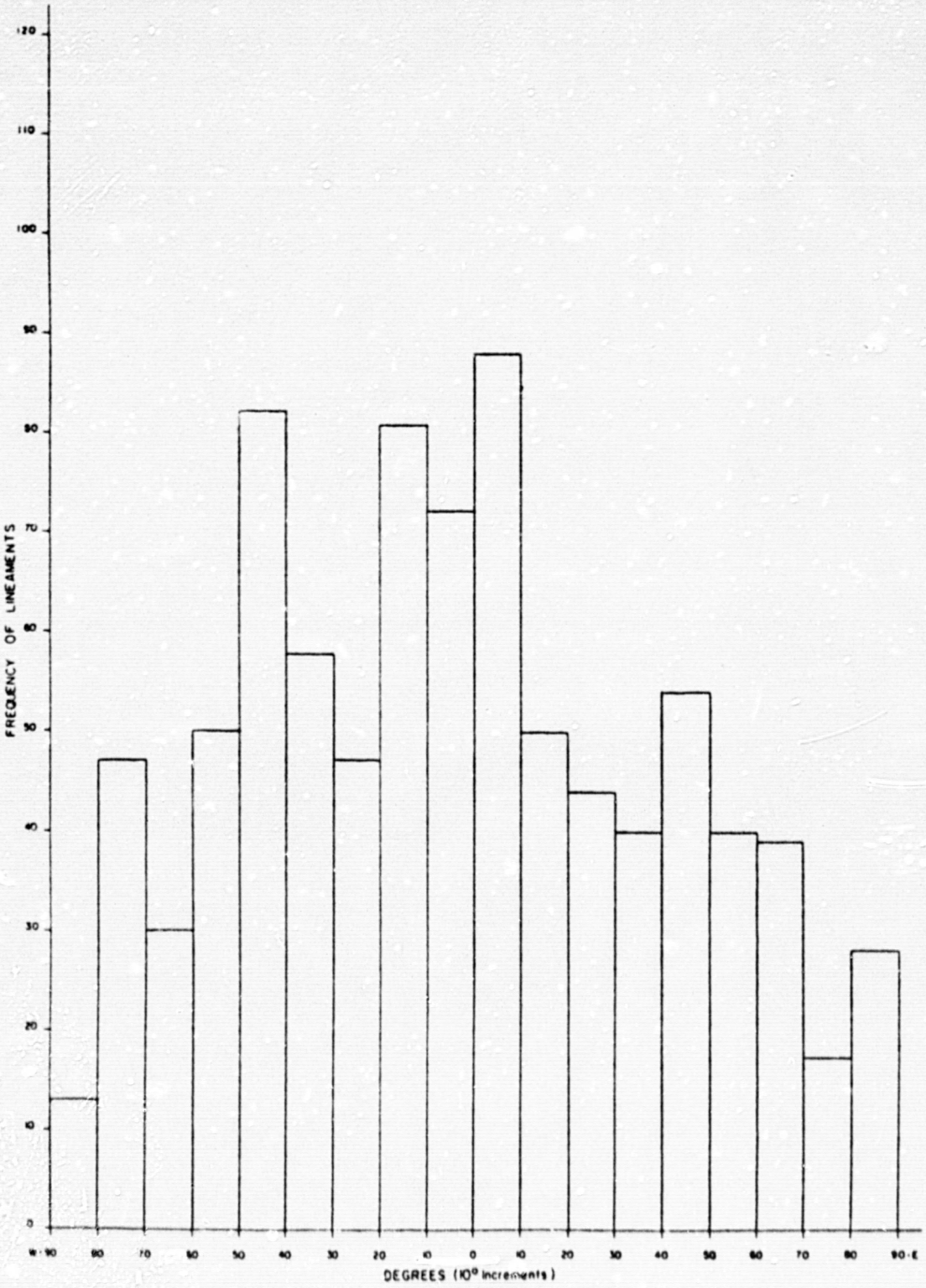
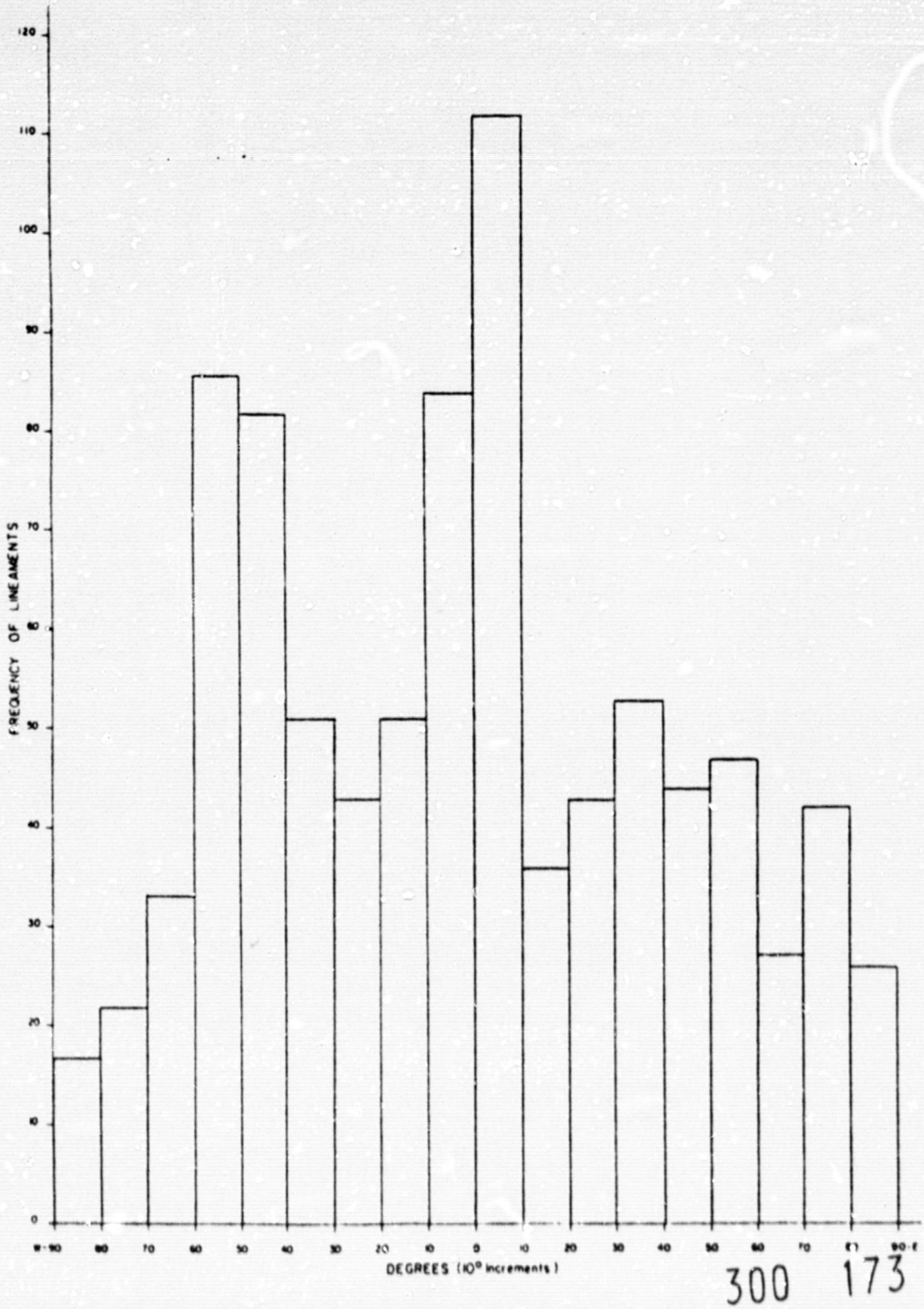


Figure 1c. Valley and Ridge Province.

300 172



300 173

Figure 1d. Cumberland Plateau Province.

"E" = N3°W, and "F" = N35°E. Trend "X" was defined later and consisted of easily discernible and continuous lineaments with no apparent preferred direction of strike; this trend is shown on the map entitled LINEAMENT MAP--TREND X.

Lineaments with a scale length of 30 miles or more were labeled with a geographic name; shorter lineaments were numbered. Published names of lineaments were also adopted from Heyl (1972), Saunders and Hicks (1976), and Drahovzal (1976) where there was apparent coincidence of strike and geographic location.

The master lineament overlay finally was enlarged to a 1:250,000 presentation scale and retaped on clear film at that scale. Each lineament strike set (trend) was assigned a separate tape pattern, with major and minor lineaments differentiated by tape width. A similar procedure was used to produce the 1:250,000 scale map of curvilinear features, except that individual curvilinear elements were labeled with a number corresponding to the band of LANDSAT imagery on which the feature appeared, i.e.,: (1--band 7, 2--band 5, 3--FCC, 4--band 4, and 5--band 6). Map registration was checked, and all data were edited at each step of the procedure to insure a high standard of accuracy and completeness. Five 1:250,000 scale sheets, each covering approximately one-fifth of the study area, were submitted previously as lineament and curvilinear maps.

A 1:2,000,000 scale reduction was made of the final overlay and, using this map, separate overlay maps were prepared for each strike trend. These maps were used to establish offsetting (cross-cutting) age relationships between the lineament trends. The principle of offsetting relationships as applied to this project states that if two lineament trends intersect, the one that is offset or modified must have existed prior to the other feature and is therefore the older of the two trends. This principle does not apply to terminations of one trend against another, because the possibility exists that lineaments may be present across the lineaments against which they terminate, but they are not expressed surficially. It should be stressed also that the observed relationships may be produced by reactivation that obliterates the original relationships. Clear films of the 1:2,000,000 scale composite lineament map and overlays of each strike trend were presented previously. Table I summarizes the age relationships.

Description of Major Lineament Trends.--The characteristics of the six lineament strike trends (A through F) are summarized in the following paragraphs:

Lineament Trend "A" extends the length of the study area at an orientation of about N55°E. This trend consists of several linear drainage, tonal and topographic features with some curvature, a variable length and a high

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discernibility factor. Lineaments of this trend roughly parallel the regional trend of the Appalachian system and appear to be confined to the physiographic region in which they occur. "A" trend lineaments include the Brevard fault zone, which forms the boundary between the Blue Ridge and Piedmont physiographic provinces of the Appalachian system. The Brevard lineament is well illustrated on the COMPOSITE LINEAMENT MAP. Segments 53 and 142 are short segments related to the Brevard zone. "Splaying" of the Brevard zone into the Mount Airy, Gladehill and Rocky Mount lineaments can be seen at its northeastern point of termination, which is probably the result of the dying out of the fault zone at this point. The Warrior River lineament (Saunders and Hicks, 1976) has been included in this trend, but deflection at its northeastern end also parallels the "F" trend (N35°E). The Warrior River lineament is shown on the COMPOSITE LINEAMENT MAP.

Table I illustrates the physical and time relationships of "A" lineaments with the other five lineament trends.

"A" lineaments are shown on LINEAMENT MAP--TREND A.

Lineament Trend "B" crosses the project area at an orientation of about N85°E. This trend consists of drainage, tonal and topographic linear elements that are easily discernible on all bands of LANDSAT imagery and SKYLAB photographs. These lineaments are of various lengths and exhibit little curvature or deflection as they cross all physiographic

PHYSICAL AND TIME RELATIONSHIPS OF LINEAMENT STRIKE SETS - SOUTHERN APPALACHIAN AREA

STRIKE SET	A	B	C	D	E	F
A						
B	A OFFSETS B* LEFT-LATERAL B TERMINATES A					
C	C OFFSETS A* RIGHT-LATERAL C TERMINATES A	INCONCLUSIVE EVIDENCE				
D	D TERMINATES A	B OFFSETS D* LEFT-LATERAL	D OFFSETS C* LEFT-LATERAL			
E	E OFFSETS A LEFT-LATERAL	INCONCLUSIVE EVIDENCE	E OFFSETS C* LEFT-LATERAL	D OFFSETS E* LEFT-LATERAL		
F	A OFFSETS F* RIGHT-LATERAL	INCONCLUSIVE EVIDENCE	C AFFECTS F BENDING	D OFFSETS F* LEFT-LATERAL	E OFFSETS F* LEFT-LATERAL	

* OLDER SET AS ESTABLISHED BY OFFSETTING RELATIONSHIPS

provinces of the Appalachian system. Lineaments of this orientation occur in eight zones from 8 to 40 miles in width. Some examples of these are the Clinch River-Princeton zone and the Talladega-Atlanta zone.

"B" lineaments described by other authors include the Pittsboro and Clinch River lineaments (Saunders and Hicks, 1976), and the Summerson and Warfield lineaments (Heyl, 1972). The Pittsboro lineament was found by the authors to be divided into two segments: the Pittsboro lineament and segment 407, as shown on the COMPOSITE LINEAMENT MAP. The Summerson lineament (Ivydale lineament) is believed by Heyl to be a Precambrian basement fault that has right-lateral displacement and is upthrown to the northwest. Southward and parallel to the Summerson lineament is the Warfield lineament (segments 323 and 324), which Heyl describes as a right-lateral wrench fault.

Table I illustrates the relationships of "B" lineaments to the other lineament trends.

"B" orientation lineaments are shown on LINEAMENT MAP--TREND B.

Lineament Trend "C" crosses the Appalachian system with a strike of about N45°W, as illustrated on LINEAMENT MAP--TREND C. Lineaments of this orientation tend to occur in a fairly uniform distribution throughout the project area, although two zones can be seen to have a width of over 60 miles. The zones include the Liberty-Summerville

zone, and the Sugar Hill-Twin Oaks zone. These lineaments cross all physiographic provinces of the project area with a gentle curvature that seems to be most pronounced in the Valley and Ridge province. "C" lineaments consist of topographic, tonal and drainage alignments of various lengths and discernibility.

Lineaments of this orientation discussed by other authors include the Boone Reservoir lineament (segment numbers 426, 427, 428, and 397) and the Anniston lineament (Brindley Mountain lineament), as described by Saunders and Hicks (1976), and the Harpersville lineament, as described by Drahovzal (1976). Extensions of the Harpersville lineament southward are labeled number 22 and Addison; possible southward extensions of the Anniston lineament are labeled number 156 and Riverside. "C" lineaments are coincident with Late Triassic diabase dikes described by King (1961), and Lester and Allen (1950).

Relationships of "C" lineaments to the other strike trends are illustrated in Table I.

Lineament Trend "D" has an orientation of about N20°W, as shown on LINEAMENT MAP--TREND D. This set consists of drainage, tonal and topographic linears of various lengths and discernibility. The majority of "D" lineaments occur in the Blue Ridge and Valley and Ridge provinces, as was confirmed by histogram analysis.

"D" lineament relationships with the other strike trends are summarized in Table I.

Lineament Trend "E" has an orientation of about N3°W. "E" lineaments, as shown on LINEAMENT MAP--TREND E, appear to have a more uniform distribution in the southern half of the study area. In the northern portion, lineaments of this trend occur as isolated segments as illustrated by the Abingdon lineament. Lineaments in the southern part of the study area exhibit more deflection and curvature than the other strike trends as illustrated by the Waynesville and Wolf Mountain lineaments. The Berryton lineament can also be observed to be "splaying" outward at its southern end into lineaments 137, 405, and 457.

"E" lineaments include tonal, topographic and drainage elements of various lengths and discernibility. They occur in zones as much as 16 miles wide.

Table I illustrates the relationships between the "E" trend and the other established strike trends.

Lineament Trend "F" is actually composed of three separate subsets (F, F_1, and F_2) with an average strike of about N35°E. These lineament sets vary markedly in strike, curvature, deflection, length, and discernibility, as seen on LINEAMENT MAP--TREND F. Subset "F" (N35°E) shows the least deflection or curvature of the three subsets, as illustrated by the N35°E orientation of the Tazewell-252-

300 180

Richwood lineament segments. A lineament consisting of segments 381-382-383-384-385-200-400-402-403-459-342 illustrates the outstanding curvature that is characteristic of subset "F_1". This subset F_1 has a strike of about N25°E. Subset "F_2" has a strike of about N40°E. This subset F_2 has some curvature as is illustrated by segments 126-111-463-464. Segments 463 and 464 were named previously by Saunders and Hicks (1976) as the Fort Payne lineament.

Table I summarizes the relationship of the "F" trends to the other strike trends.

Description of Curvilinear Features.--Curvilinear features on LANDSAT imagery consist of circular to subcircular drainage patterns, and tonal or topographic features. Buried features such as intrusives, volcanic centers, cores of gneissic and migmatitic rock, and folds of metamorphic and sedimentary rocks can be expressed at the surface as curvilinear features. Curvilinear elements were mapped using the same procedures and recognition criteria employed in mapping linear features. Features intentionally not mapped included curvilinear elements coincident with folded strata or with the sinuous traces of thrust faults. Each feature is indexed with a number or sequence of numbers corresponding to the band or bands of LANDSAT imagery from which the feature was interpreted (1--band 7, 2--band 5, 3--FCC, 4--band 4, and 5--band 6).

Curvilinear element population can be seen to vary from one geologic province to another. Curvilinear data are

somewhat scarce in the Valley and Ridge Province, and more abundant in the Piedmont, Blue Ridge and Cumberland Plateau Provinces. The scarcity of curvilinear data in the Valley and Ridge is due to the fact that no surface folds or thrust traces were annotated as curvilinear elements, and only the very conspicuous basement features would "show through" the folded, over thrusted sedimentary sequence. The higher incidence of data in the Cumberland Plateau is thought to be due to the relatively gentle structure, which does allow the curvilinears to "show through." The large number of curvilinear and tonal anomalies occurring in the Piedmont and Blue Ridge Provinces probably is due to the high incidence of gneissic and exfoliation domes. These domes are typical of crystalline terrain and appear on LANDSAT imagery as circular shaped tonal and curvilinear drainage anomalies.

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INTERPRETATION

Analysis of the data derived from the aeromagnetic, gravity, historical seismicity, and photo-imagery investigations described previously under METHODOLOGY was primarily conducted by simultaneously examining registered overlays of the various combinations of maps. The following outline describes the significant features that evolved from this combined map analysis and indicates how they are manifested in the various sources of data. Manifestations in data other than that described under METHODOLOGY, and general observations and comments are also noted. Although many minor coincidences of data were seen, the features described in the following outline are considered by the TVA staff and its consultants to be the most significant. They are either visible on multiple sources of data or are profoundly visible on fewer sources.

EAST-WEST TRENDING TECTONIC STRUCTURAL ZONE (Nominal 37°20'N. latitude)

Magnetic Expression

1. This zone is a series of disruptive anomalies extending westward from Giles County.

2. This zone intersects and disrupts a prominent linear magnetic gradient referred to as the New York-Alabama lineament (King and Zietz, 1978).

3. Extension of this zone to the west of the New York-Alabama lineament tends to truncate magnetic highs lying to the south.

Gravity Expression

1. This zone appears to be associated with an east-west disruption of gravity anomalies.

2. This zone intersects and disrupts a prominent linear gravity gradient referred to as the New York-Alabama lineament.

3. Extension of this zone to the west tends to truncate positive gravity anomalies lying to the south.

Seismic Expression

1. The Giles County event is located in a prominent zone of seismic instrumental and historical epicenters that trends east-west along the southernmost portion of the Virginia-West Virginia border (J. W. Dewey, written communication, 1979).

2. This east-west zone may be traced into the central Virginia seismic zone.

3. The meizoseismal regions of this zone are oriented east-west, which would infer an east-west-striking fault plane.

Photo-Imagery Lineament Expression

1. The east-west zone is coincident with the Hinton, 323, and 324 lineaments shown on the COMPOSITE LINEAMENT MAP.

General Observations

1. This east-west zone lies within the 38th Parallel lineament zone (Heyl, 1972), which is recognized on a continental scale on the basis of geology, gravity, magnetics, and seismicity.

2. The Bane Dome and the re-entrant of the Valley and Ridge near Roanoke, Virginia, lie within this zone. These abnormal structures possibly are the result of a Precambrian topographic high that existed prior to Late Paleozoic overthrusting and may, as a result of variations in friction, have served to atypically alter the style of deformation of the overthrusting strata.

BOUNDARIES FORMING EIGHT TECTONIC SUBDIVISIONS

New York-Alabama Lineament (NY-A)

Magnetic Expression

1. The New York-Alabama lineament is easily identified in the study area as a series of prominent linear total magnetic field gradients that trend about N45°E through Knoxville, Tennessee and forms a more or less continuous zone through the study area. The trend is not generally parallel to Appalachian structure (King and Zietz, 1978).

2. Along this lineament, basement rock unit trends with both high and low calculated susceptibility contrasts appear to have been abruptly truncated.

3. Generally, more mafic lithologies exist on the northwest side of the lineament. Southeast of the lineament, susceptibility contrasts are generally low (.001-.004 cgs) and the magnetic gradients indicate few shallow anomaly sources. Northwest of the lineament, susceptibility contrasts are generally higher (.002-.007 cgs) and magnetic gradients show both shallow and deep anomaly sources.

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4. Magnetic anomalies tend to be deflected toward parallelism with the lineament in the vicinity of the lineament.

5. Magnetic trends shift from a northeast orientation on the southeast side of the lineament to a more random pattern in detail and a more northerly strike on the northwest side.

Gravity Expression

1. Gravity lows are found southeast of the lineament, and relatively higher gravity values occur to the northwest.

2. Strike of anomalies is northeastward on the southeast side of the lineament, changing to prevailing north on the northwest side of the lineament.

Seismic Expression

1. The lineament appears to form the northwest boundary separating a seismically active region to the southeast from a region of low seismicity to the northwest.

Photo-Imagery Lineament Expression

1. No regional scale photo-imagery lineament is coincident with the New York-Alabama lineament. Several short segments are coincident.

2. The northwest extent of Trend F lineaments is terminated by the New York-Alabama lineament.

General Observations

1. The New York-Alabama lineament is not seismically active.

2. The Giles County earthquake occurred 100 miles east of the lineament.

Northwest-Trending Structural Boundaries

GENERAL COMMENTS

a. These boundaries are seen as a series of northwest-trending anomalies and/or terminations of anomalies that extend into the midcontinent region.

b. These boundaries are not observed to be seismically active.

c. These boundaries represent structural and petrologic changes in the basement rocks.

d. The southeastern extensions of these discontinuities are complicated by the effect of Appalachian lithologic and structural features.

BOUNDARY A

Magnetic Expression

1. This boundary truncates the southwest extent of the major magnetic highs in Tectonic Subdivision 3 (see TECTONIC SUBDIVISIONS map).

2. This boundary crosses the New York-Alabama lineament as a magnetic lineament.

3. This boundary is the southwest termination of a zone of the greatest depth to magnetic basement, as seen on the COMPUDEPTH MAP.

Gravity Expression

1. This boundary is the southwest termination of a major gravity low in Tectonic Subdivision 4.

2. This boundary crosses the New York-Alabama lineament as a gravity lineament.

Seismic Expression

1. A statistically significant portion of earthquakes in the southern Appalachian region occur northeast of this boundary.

Photo-Imagery Lineament Expression

1. Boundary A represents the northeast limit of a group of Trend C (N45°W) lineaments that occur in Tectonic Subdivisions 1 and 2. Tectonic Subdivisions 3 and 4 have significantly fewer Trend C lineaments.

2. No regional scale photo-imagery lineament is coincident with Boundary A. Several short segments are coincident.

Seismic Refraction Expression

1. A seismic refraction profile striking northeastward crosses Boundary A at approximately 35.9°N. latitude and 85.2°W. longitude and indicates a near-vertical 8 km offset (northeast side up) in the Conrad discontinuity (Borcherdt and Roller, 1966).

BOUNDARY B

Magnetic Expression

1. This boundary truncates the northeast extent of major magnetic highs in Tectonic Subdivision 3.

Gravity Expression

1. This boundary crosses the New York-Alabama lineament as a gravity lineament.

Seismic Expression

1. This is the northeast boundary of an area of significant seismic activity occurring in Tectonic Subdivision 4.

Photo-Imagery Lineament Expression

1. Trend C lineaments, which are generally absent throughout much of Tectonic Subdivisions 3 and 4, increase to the northeast in the vicinity of Boundary B.

2. No regional scale photo-imagery lineament is coincident with Boundary B. Several short segments are coincident.

BOUNDARY C

Magnetic Expression

1. This boundary crosses the New York-Alabama lineament as a magnetic lineament.

2. This boundary is the northeast termination of a zone of the greatest depth to magnetic basement, as seen on the COMPUDEPTH MAP.

Gravity Expression

1. This boundary is the northeast termination of a major gravity low in Tectonic Subdivision 6.

2. This boundary crosses the New York-Alabama lineament as a gravity lineament.

Seismic Expression

1. This is the southwest boundary of an area of significant activity occurring in Tectonic Subdivision 8, which includes the Giles County earthquake.

Photo-Imagery Lineament Expression

1. No regional scale photo-imagery lineament is coincident with Boundary C. Several short segments are coincident.

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OTHER FEATURES

Other features on the various data sets that are seen to be parallel or subparallel to the tectonic subdivision boundaries are interpreted as being less significant in establishing these boundaries.

SUMMARY OF INTERPRETATION

It is the opinion of TVA and its consultants that the results of this study strongly suggest the existence of an east-west trending tectonic structural zone (tectonic structure as defined by Appendix A) with which the 1897 Giles County, Virginia earthquake was associated and to which a recurrence of an event of this magnitude would be restricted.

It is furthermore felt that the existence of a long northeast-trending lineament transected by three northwest-trending lineaments, as defined by multiple sources of data, serves to develop eight tectonic subdivisions (tectonic provinces as defined by Appendix A) having different lithologic, structural, or seismic characteristics. As such, the previously imposed "classical" interpretation that Giles County, Virginia, and the Sequoyah, Watts Bar, and Bellefonte nuclear plants all lie within the same Southern Valley and Ridge Tectonic Province is not warranted.

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References Cited

Borcherdt, R. D., and Roller, J. C., 1966, A preliminary summary of a seismic-refraction survey in the vicinity of the Cumberland Plateau Observatory, Tennessee: U.S. Geol. Survey Tech. Letter No. 43.

Heyl, A. V., 1972, The 38th Parallel lineament and is relationship to ore deposits: Econ. Geology, v. 67, p. 879-894.

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REPORT SUMMARY

This report presents the results and interpretation of data gathered to date that may assist in the assessment of the TVA seismic issue. In light of past practices regarding the applications of "classical" tectonic provinces defined by structures that are seemingly unrelated to the present seismicity, TVA believes that this study has utilized the best, state-of-the-art means to define structures and provinces that serve to locate and encompass present-day sources of seismicity within the study area. We further believe that the conclusions reached in this report do not indicate any structural continuity in the southern Appalachian region that would warrant migration of the 1897 Giles County, Virginia earthquake to the Sequoyah, Watts Bar, or Bellefonte nuclear plants.