DEPARTMENT OF THE INTERIOR

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Air photo lineaments, southern Sierra Nevada, California

by

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INTRODUCTION

Air photos were examined to determine the areal distribution and orientation of conspicuous lineaments which were then plotted on a 1:125,000 base map of the southern Sierra Nevada (Plate 1, Sheets 1 and 2). Some of the lineaments are obviously caused by faulting, for example lineaments along the trace of the San Andreas, Garlock, and Kern Canyon faults. Most lineaments, however, particularly in well exposed terrane, probably reflect joint patterns in granitic rocks. In the more vegetated areas at generally lower elevations the cause of the lineaments is not readily evident. Most are elongate anomalously straight stream courses that are particularly evident in areas of dominantly dendritic drainage. Less common are lineaments caused by aligned topographic saddles or other topographic depressions.

Only cursory notice was given to most lineaments during the reconnaissance mapping, although some lineaments were examined for evidence of basement rock displacement. Only after field work was completed did it become obvious through further air photo examination that lineaments were fairly abundant and that only in part could they be easily characterized as either fault-caused or joints in granitic rocks. Thus it seemed worthwhile to catalog all suspected lineaments and see if there were any recognizable patterns. It should be emphasized that recognizing lineaments is somewhat in the eye of the beholder and that the longer one looks at an air photo, the more lineaments are evident. With this caveat in mind, the following data are presented.

The southern Sierra Nevada has been rather arbitrarily divided (figure 1) into four segments (Los Angeles, Bakersfield-S, -northwest, and -northeast [including Trona]). Generally there are more northwest-trending lineaments in the southern part of the area and more northeast-trending lineaments to the north, but the sheer number of well-exposed joints in the granitic terrane of the Domelands tends to overshadow the rest of the southern Sierra Nevada.

DISCUSSION

Air photo lineaments along known faults

San Andreas and Garlock faults. These two faults cause "master" lineaments in the southern Sierra Nevada. Depending on the scale one chooses, they are either strikingly linear elongate topographic features or a series of relatively short discontinuous *en echelon* lineaments. The latter reflect segments of most recent breakage on these faults, and the sum total of these short breaks combined with the older traces of these faults makes regional lineaments.

Kern Canyon-Breckenridge-White Wolf fault zone. There has been some considerable discussion of whether this feature is three separate and distinct faults or members of one through-going fault zone (see Ross, 1986). In either case, segments along the faults or fault zone are some of the most impressive lineaments in the southern Sierra Nevada. For example, north from Kernville to the north edge of the map area is an almost continuous lineament composed of aligned saddles and elongate narrow valleys. In fact, near the north edge of the map the topographic depression along the lineament is called "rincon" (which means "narrow valley" in Spanish). A conspicuous photo-lineament also extends from Isabella Reservoir south to the Havilah area along the south part of the Kern Canyon portion of this fault zone. This lineament probably continues in the bedrock exposures concealed now beneath the elongate north arm of the Isabella Reservoir.

Further south the Breckenridge fault forms an impressive lineament along the west side of Walker Basin. Still farther south are discontinuous lineaments south of Caliente. This segment, mapped as the White Wolf fault by Dibblee and Chesterman (1953), has had the photo lineaments accentuated by recent fault movement that caused the 1952 Arvin-Tehachapi earthquake (Oakeshott, ed., 1955).

Durrwood fault? A clearly recognizable lineament extends north-northwest from the north end of Big Meadow for about 6 kilometers. It is marked by narrow elongate valleys and aligned saddles. This is almost certainly the feature that Miller and Webb (1940) identified as the Durrwood fault. In addition to the line of canyons and saddles they also note "a high escarpment west of Sirretta Peak suggests faulting, but not conclusively." In a compilation, Smith (1965) extends the postulated Durrwood fault some 16 kilometers further south along essentially the same trend. Also, Bergquist and Nitkiewicz (1982) map a trace they call the Durrwood fault, but it is about 1 kilometer east of the very conspicuous physiographic trends that are presumed to be the Durrwood fault of Miller and Webb (1940). These various interpretations of the location of the Durrwood fault suggest at least that the "fault" is not readily obvious.

The Durrwood fault, as originally noted by Miller and Webb (1940), may be either a fault or a joint. Joints have been mapped nearby with strikes comparable to the physiographic trend (Bergquist and Nitkiewicz, 1982) and also several lineaments of similar strike are visible on air photos. The physiographic trench is partly along a narrow metasedimentary septum where differential erosion may be at least partly the cause of this topographic feature.

Recent seismic activity has occurred in this area. The latest swarm in this activity, which has been going on for at least 50 years, is centered only 8 km southeast of the Durrwood fault of Miller and Webb (1940). Shocks as great as M = 4.5 occurred in 1983-84 (Jones and Dollar, 1986), and have focal mechanisms that suggest north-striking, east-dipping planes with pure normal (east side down) motion. This motion suggests Basin-Range type extensional tectonics. There is no known connection between this seismicity and the Durrwood fault, but it might be a zone to observe more carefully in the future. The present data suggest, however, that the Durrwood fault of Miller and Webb (1940) is most likely a lineament that is joint-controlled.

The current seismicity appears to be distributed along a zone of weakness, and not on any one fault. If the Durrwood fault and the lineament south of Big Meadow are parts of this zone, as seems likely, one might expect in the future that this zone of weakness could coalesce into a more extensive fault capable of larger seismic events. Thus the strong lineament now known as the Durrwood fault is a good candidate to become such an earthquake-producing zone. In my reconnaissance work I have seen no evidence of deformation along the zone, but detailed study might well investigate the possibility.

Pinyon Peak fault. The Pinyon Peak fault was first noted by Engel (1963) extending west-northwest from Walker Pass Lodge to the vicinity of the south fork of the Kern River. Smith (1965) extended the fault to the west where it was cut off by his extension of the Durrwood fault.

A conspicuous alignment of saddles and elongate notches in the topography makes a good photolineament along Engel's original mapped fault trace. A vegetation line and possible spring along the nearly straight-sided valley south of Canebrake continues the photolineament to the west (a total length of about 8 km). The topographic pattern of the saddles and notches suggests a possible antithetic fault along the north side of the Scodie Mountains, but the presence of numerous nearby lineaments of the same strike suggests the more likely possibility of joint-controlled lineaments in the granitic basement.

Jawbone fault. The Jawbone fault was mapped by Samsell (1962) as several branches striking north-northeast both north and south of Jawbone Canyon. A somewhat subtle air photo lineament marks where Samsell mapped the fault north of Jawbone Canyon. Most of this segment follows the contact between the granite of Bishop Ranch and other basement units as I mapped it (Ross, unpublished data). However, the "contact" is remarkably straight for an intrusive contact, and furthermore, lineaments on the same trend extend north and south of the contact. Thus the lineament could well be a fault trace.

Sierra Nevada fault. A short air photo lineament north of Jawbone Canyon makes an impressive cliff-forming scarp along the Sierra Nevada fault zone (the symbol with two east down balls on Plate 1, Sheet 1). Samsell (1962) notes "strata of the Ricardo Formation (Pliocene) are truncated and are juxtaposed with Mesozoic plutonic rocks" in the upper reaches of the aptly named Cliff Canyon. Elsewhere along the east front of the range within the area of Plate 1 the fault does not produce a photolineament.

Kern River fault. This fault (not to be confused with the Kern Canyon fault) produces one of the most distinctive topographic lineaments in the study area. Approaching this feature from the southwest along State Highway 178, one sees a seemingly impenetrable mountain wall some 600 meters high through which the highway sneaks at the last possible moment up narrow Kern Canyon. Dibblee and Chesterman (1953) found this to be a steeply southwest-dipping normal fault that in places has up to 0.6 meters of gouge and vertical fault grooves. The fault marks an abrupt contact between Cretaceous granitic rock on the NE and Cenozoic sedimentary deposits on the southwest.

This fault produces a "left-step" in the interface between bedrock and Cenozoic deposits. Other similar left-stepping interfaces are found further north, but only one (along Dead Ox Creek, about 25 kilometers to the north) has a conspicuous photolineament.

Bella Vista faults. About 4 kilometers southwest of Weldon are two discontinuous lineaments caused by springs, vegetation alignments, and topographic trenches. These lineaments extend for more than 3 kilometers and the main lineament markedly offsets the basement outcrop. These lineaments could be joints, but topographic disparities and the basement offset suggest a fault origin is more likely.

Examples of other lineaments

Lineaments caused by the significant strike-slip faults in the southern Sierra Nevada, the San Andreas, Garlock, and Kern Canyon-Breckenridge-White Wolf faults, are the most conspicuous and extensive lineaments on the air photos. Also conspicuous are the well-developed joint sets of the Domelands area. In addition to the well-defined lineaments along known faults and those representing obvious joint sets in granitic rocks, there are many other lineaments of more subtle origin and orientation. Description of some of these follow.

The canyon of Tejon Creek is a long, relatively narrow, but curvilinear feature that is a common target for the placement of a fault in regional compilations. However, the only prominent photo lineament in the canyon (1 on Plate 1, Sheet 1, near lat 35°00'N, long 118°30'W) is at its headwaters with a continuation eastward through a saddle to the drainage to the east. The lineament is essentially east-west and downstream the creek drainage curves to the northwest.

El Paso Creek, about 6 kilometers to the southwest, has a strong photolineament near its mouth (2 on Plate 1, Sheet 1, near lat 35°00' N, long 118°45' W) and Stratton Canyon (intermediate between Tejon and El Paso Canyons) has a long conspicuous photolineament in its upper reaches (3 on Plate 1, Sheet 1, near lineament 2). These two lineaments (2 and 3) combined generally parallel the course of Tejon Creek. Though their relations are possibly significant, I have no ready explanation for the sub-parallelism of these canyons.

An elongate straight topographic trench extends from about 4 kilometers west of Big Meadow south-southeast for about 16 kilometers (4 on Plate 1, Sheet 2, near lat 35°45' N, long 118°15' W). Part of this trench coincides with narrow elongate Cannell Meadow. South of Cannell Meadow the trench is discontinuous but the separate segments are well-aligned. This lineament may be caused by erosion along a joint, but several things suggest it may be more. The trench is between and parallel to the Kern Canyon fault and the postulated Durrwood fault. Though there are similarly aligned lineaments nearby that may be joint-controlled, the elongate trench seems to be larger than most nearby presumed joint-controlled features. The course of Corral Creek appears to be offset in a right-lateral sense where it crosses the trench (map locality 5 on lineament 4), although other drainages do not seem to be similarly affected: these observations suggest some connection with the Kern Canyon fault, but unfortunately the trace of the trench is entirely within the granodiorite of Castle Rock so basement offsets are not readily apparent. The northern part of the lineament (north of Cannell Meadow) is shown as an "approximately located" fault on the Bakersfield Sheet of the Geologic Map of California (Smith, 1965).

A long slightly arcuate lineament extends from just east of California Hot Springs west-southwest for about 7 kilometers along Deer Creek and the same trend continues beyond Deer Creek, with gaps, for another 13 kilometers (6 on Plate 1, Sheet 2, near lat 36°52' N, long 118°45' W). This topographic trend cuts several granitic and metamorphic units without obvious offsets. Although part of this trend is shown as an "approximately located" fault on the California State Geologic map (Smith, 1965), there seems to be no compelling reason to call this a fault rather than a joint-controlled lineament.

About 4 kilometers south of the lineament through California Hot Springs is a parallel lineament of about the same length along White River (7 on Plate 1, Sheet 2). About 2 kilometers north of California Hot Springs, the relatively straight upper reach of Tyler Creek defines another lineament that is sub-parallel to the Hot Springs lineament (8 on Plate 1, Sheet 2). These lineaments, and many more of about the same east-northeast orientation in the Bakersfield northwest segment of the map area, suggest that all are part of a regional joint trend. In fact, east-northeast orientations are the most common in that segment of the map area (fig. 2).

An interesting group of lineaments are located just west of Walker Basin west of and near parallel with the Breckenridge fault (9 on Plate 1, Sheet 1, near lat 35°20' N, long 118°35' W). This lineament zone extends no more than 7 kilometers and individual lineaments do not exceed 2 kilometers in length. These sub-parallel lineaments are expressed as linear topographic trenches on the lower east slope of Breckenridge Mountain. Most of the trenches are higher on the east side and suggest antithetic faults. These are designated on Plate 1, Sheet 1 by a separate symbol.

A series of sharply distinctive east-west lineations cross Linns Valley with one particularly distinct trace just south of Glennville (10 on Plate 1, Sheet 2, near lat 35°45' N, long 118°45' W). It consists of two slightly overlapping *en echelon* segments that total about 9 kilometers in length. The stream traces that etch out these lineaments have local meanders and thus the lineaments are somewhat discontinuous, but the overall effect on an air photo (scale about 1:82,000) is of striking alignments. These lineaments may be related to the east-northeast-trending lineaments in the California Hot Springs area, the most common orientation of lineaments in the Bakersfield northwest segment.

In the northeast part of the Bakersfield-S segment there is a prominent northwest-trending grain of major drainages, also shown by elongate alluviated areas. The longest lineament extends more than 10 kilometers (11 on Plate 1, Sheet 1, near lat 35°20' N, long 118°5' W). These lineaments and more similarly aligned ones further east in the Bakersfield-S segment are the most common lineament alignment and suggest they are part of a regional joint set.

G. P. Louke (unpublished data, 1981) has mapped a similarly trending, northeast-side-down normal fault northwest of, and trending into, Kelso Valley. Careful examination of the air photos of that area revealed no obvious lineament, but it does raise the suspicion that some of the similarly aligned lineaments may be faults.

Southeast of Antimony Peak in the Los Angeles segment a slightly curvilinear, but essentially straight, stream course extends from near the San Andreas fault northeast for about 5 kilometers (12 on Plate 1, Sheet 1, near lat 34°55' N, long 119°5' W). Surprisingly this lineament cuts directly across the San Emigdio fault. The lineament only extends a short distance southwest of the San Emigdio fault before the stream drainage markedly diverges from the lineament trend so possibly the southwest extension is fortuitous. Nevertheless, there is at least a hint that whatever is controlling that northeast-trending drainage is younger than the San Emigdio fault.

Black Bob Creek flows in a narrow, straight, northwest-trending canyon for 4 kilometers that crosses several basement contacts without seeming effect. One of very few obvious photo lineaments in the Los Angeles segment (13 on Plate 1, Sheet 1, near lat 34°55' N, long 119°00' W) it is probably a representative of a major joint pattern, as are several similar, less conspicuous parallel nearby lineaments.

Upstream from the linear segment, Black Bob Canyon turns, through several meanders, to a southerly course. At the meandering curve area a generally straight tributary, Bradley Canyon, enters Black Bob Canyon. Bradley Canyon has some gently curvilinear, but essentially straight, segments. The stream course in Bradley Canyon is slightly irregular but, on the whole, averages out to be a good lineament. This lineament and the one formed by Black Bob Canyon (the lower stretch) would appear to form a possibly conjugate joint set. This supposition is amplified by other nearby lineaments in the vicinity of Grapevine Canyon (about 8 km east of locality 13), which also has a strongly elongated northwest-trend parallel to the Black Bob Canyon lineament, but has no obvious lineaments. Perhaps these lineaments reflect joints or microfaults formed in response to the nearby west-trending shear of the San Andreas or are a response to the westward bending of the southernmost Sierra Nevada that has been documented by the paleomagnetic measurements of Kanter and McWilliams (1982).

Lineament character

The lineaments observable on air photos (Plate 1) dominantly cut basement rocks, and are predominantly in areas of granitic rock outcrop. Some lineaments project from basement rock areas into alluviated terrane and are probably controlled by underlying bedrock. Other lineaments (only a few) are entirely in alluvial areas, particularly south of the Garlock fault. Perhaps these lineaments reflect rather recent motion on the Garlock fault zone. One of the most conspicuous lineaments in Cenozoic deposits extends from the west margin of the map area (Plate 1, Sheet 2, near lat 35°40' N, long 119°00' W) south-southwest for some 15 km, mostly outside the map area. It is shown on the Bakersfield Sheet of the Geologic Map of California as an "approximately located" fault (Smith, 1965). The lineament is particularly noticeable in contrast to the intricate dendritic drainage pattern of the Plio-Pleistocene non-marine deposits of the area.

The abundant lineaments in granitic rocks do not appear to be related to individual plutons, because they commonly cross contacts of the various granitic units. Lineaments in metamorphic units, not attributable to metamorphic foliation, are much less common, but present locally. Some cross contacts between metamorphic pendants and granitic units.

The most obvious, and abundant, lineaments are in granitic rocks in the Domelands. In less well-exposed areas, particularly at lower elevations, anomalously straight stream courses produce the most common lineaments. I have no direct evidence that anomalously straight stream channels in the lower elevations are joint-controlled, but straight stream channel segments in well-exposed areas parallel to obvious joints suggest this may also be the major control in the more poorly exposed lower areas.

Joints or microfaults?

Cursory field investigations and air photo examination suggests many of the air photo lineaments in the southern Sierra Nevada are joints, that is "A surface of fracture or parting in a rock, without displacement" (Bates and Jackson, 1987). Other workers in the Sierra Nevada have recognized minor strike-slip faulting along some "joints" (Cloos, 1936; Mayo, 1941; Moore, 1963; and Bateman, 1965). Lockwood and Moore (1979) systematically examined "joints" in the central Sierra Nevada, and noted that many had measurable strike-slip offset, both left- and right-lateral, and suggested that the term microfault would more accurately describe them. The lineaments in the southern Sierra Nevada range from unfaulted true joints to significant strike-slip faults of considerable displacement (for example, the Kern Canyon fault). Many lineaments in the southern Sierra Nevada probably have minor, but measurable, offset judging by the widespread occurrence of faulted lineaments further north in the Sierra Nevada. Further investigations of "joints" in the southern Sierra Nevada, particularly the well-exposed Kern Plateau area, would be helpful.

Lineament orientation

Over 800 lineaments (table 1) were recognized in the southern Sierra Nevada. The dominant strike is from N30-N60E (fig. 2), a concentration that is largely influenced by well-exposed lineament sets in the Domelands area. Next most prevalent are the N80W and east-west striking lineaments which are also most common in the northeast part of the map area. N30W-striking lineaments are dominant in the south part of the Bakersfield AMS Sheet (Plate 1, Sheet 1). Also common are lineaments striking north to slightly west of north. These composite data suggest two sets of conjugate systems: northwest-northeast and east-west-north-south.

The compendium of lineament data to the north in the central Sierra Nevada (Lockwood and Moore, 1979) shows a dominance of north- to northeast-trending lineaments. In the south part of the central Sierra Nevada they also document a swing to a more easterly maxima. In a gross way their data are compatible with the dominant lineament directions in the southern Sierra Nevada. Probably most noteworthy is the dominance of northeast-trending lineaments in both regions.

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Appendix

A reconnaissance study that included the Domelands, whose prime purpose was the appraisal of the mineral resource potential of the area (Bergquist and Nitkiewicz, 1982), collected a modest amount of data on lineaments, both by field measurements and air-photo interpretation. Although collection of lineament data was of secondary importance in the study, nevertheless the measuring of 87 steeply dipping lineaments and the photo interpretation of 75 more from the heart of the best exposed granitic terrane in the region, provide a sample to compare with the more extensive air-photo interpreted data on lineaments throughout the southern Sierra Nevada.

Bergquist and Nitkiewicz (1982) noted a dominant northeast set and a subordinate northwest set of lineaments. They further note that the Domelands is "crisscrossed with lineaments, most of which are fractures with very minor or no displacement, however, some of the prominent lineaments are faults, defined in places by mineralized zones, scarps, springs, drag flexures, and offset lithologies." No specific data are presented as to location or magnitude of these faults. The Domelands would seem to be a fruitful area for a lineament study similar to that of Lockwood and Moore (1979) to the north.

A rose diagram (fig. 3A) of the field measured steeply dipping lineaments of Bergquist and Nitkiewicz (1982) shows the greatest concentration of lineaments at north-northwest, somewhat fewer are north-northeast, and a fair number are essentially east-west-striking. However, the compendium of all the strike directions in 5° increments (table 2) suggests no very impressive preferred concentration. A plot of all recorded air-photo lineaments in the Domelands (fig. 3B) shows a decided northeast preferred orientation. If these two plots are added together (fig. 3C) the composite compares favorably with major preferred orientations (NNW, NE, and E-W) of the Bakersfield northeast segment (fig. 2B). These data from the Domelands suggest some lineaments measured in the field may be too subtle to produce photolineaments and their inclusion in a compilation tends to subdue the dominance of the visually prominent photolineaments. Conversely, measurement of a large number of lineaments in the field may yield more definitive data on the meaning of specific lineaments that will concentration on the preferred orientation of the more visible lineament sets.

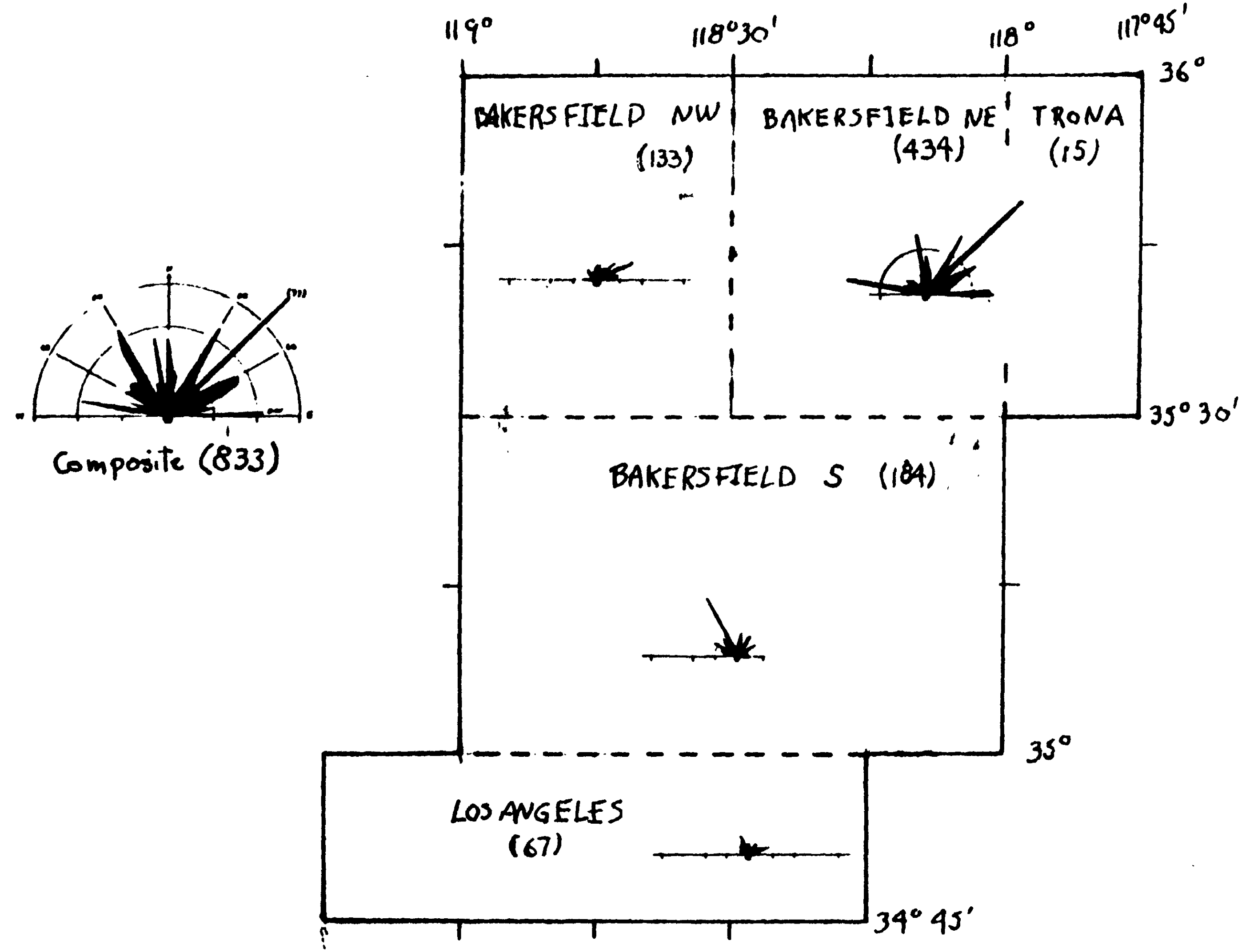


Figure 1. Index map showing lineament distribution on rose diagrams for each segment of the southern Sierra Nevada at the same scale. Composite of all lineaments for comparison. See figure 2 for larger rose diagrams.

Figure 2. Summary rose diagram showing orientations for the 833 air photo lineaments of the southern Sierra Nevada and rose diagrams of orientations for the Bakersfield-NE plus Trona, Bakersfield-NW, -S, and Los Angeles segments (see figure 1 for location). Not plotted on these diagrams are lineaments resulting from recent movements on the San Andreas and Garlock faults. These long, semi-continuous lineaments range from N55 to 80 W on the San Andreas fault on the Los Angeles segment, and on the Garlock fault range from N65 to 75E on the Los Angeles segment and from N45 to 60E on the Bakersfield-S segment. Number of data points are shown in parentheses.

A. COMPOSITE

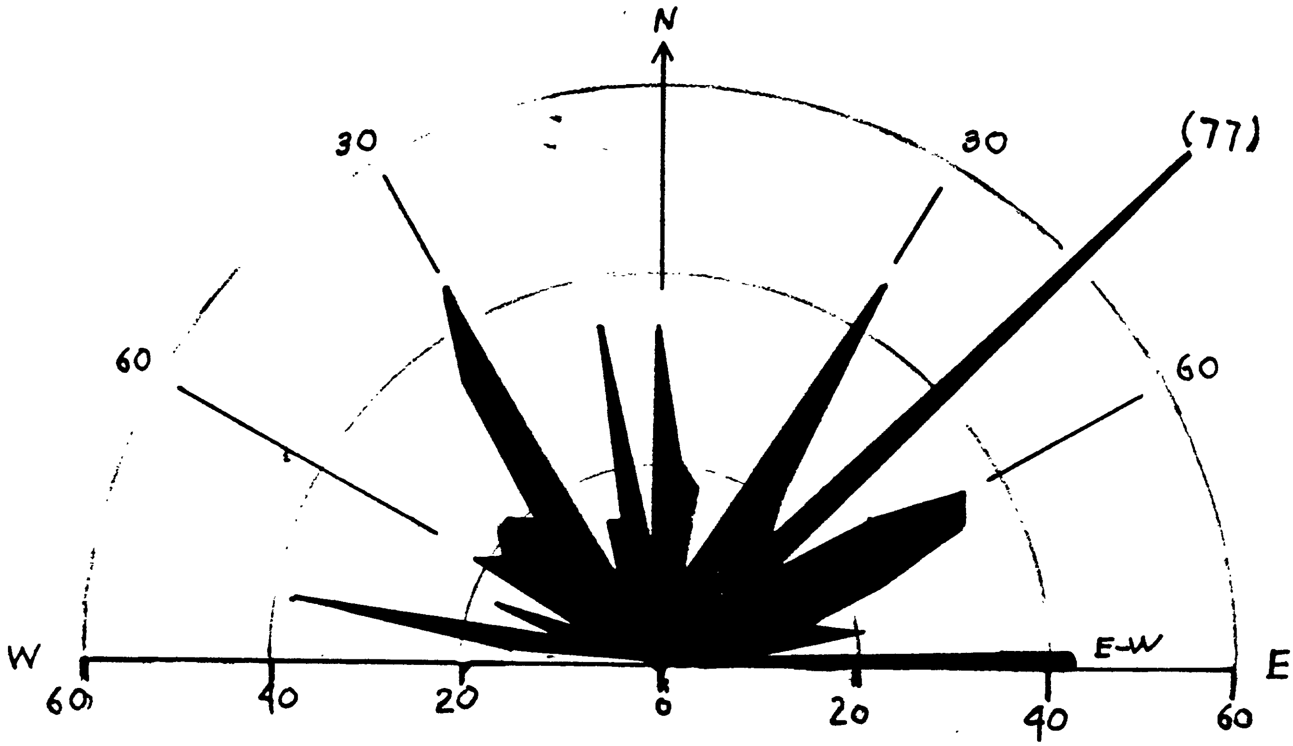
B. BAKERSFIELD-NE plus TRONA

C. BAKERSFIELD-NW

D. BAKERSFIELD-S

E. LOS ANGELES

COMPOSITE
(833)



Number of lineaments

Figure 2A

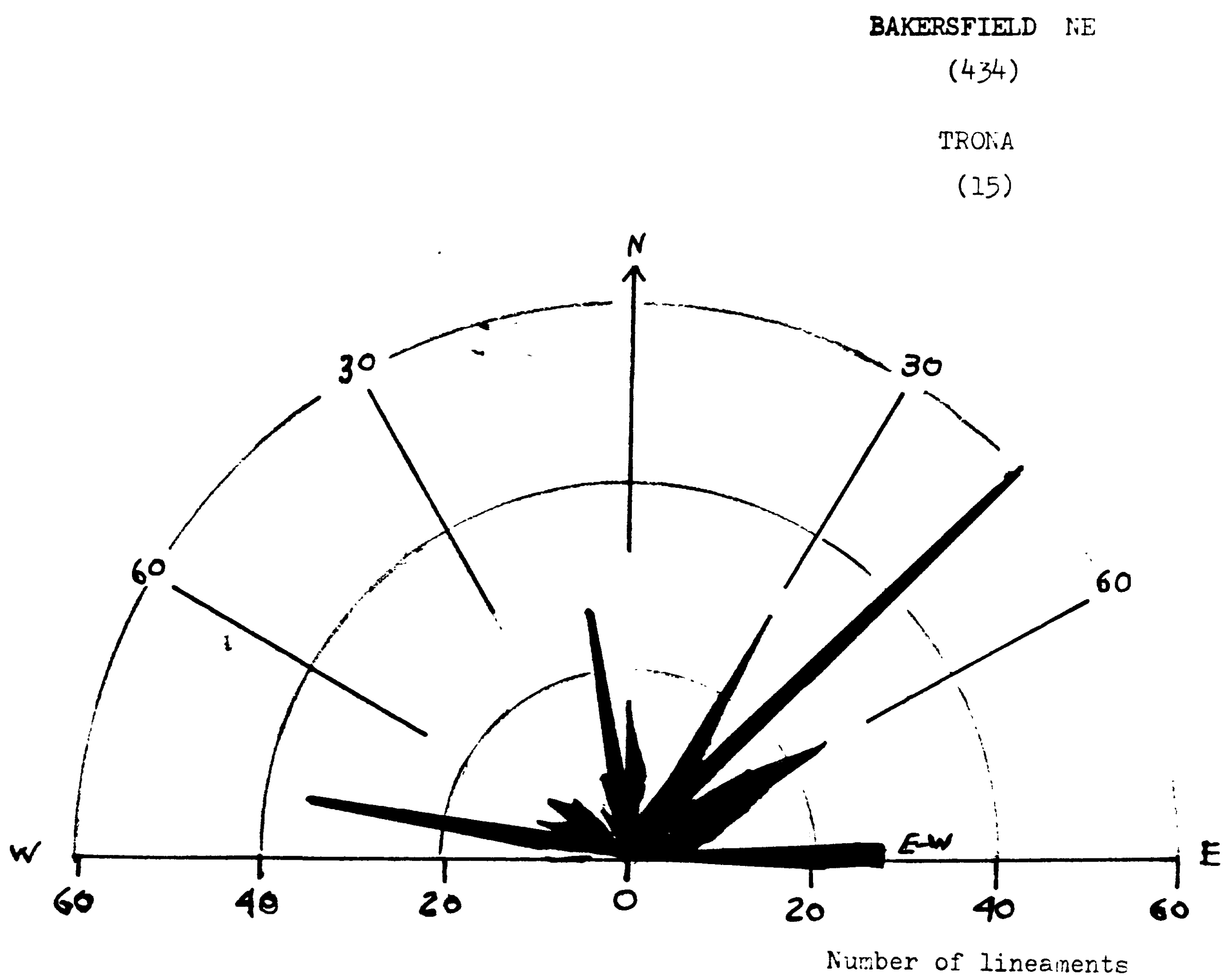
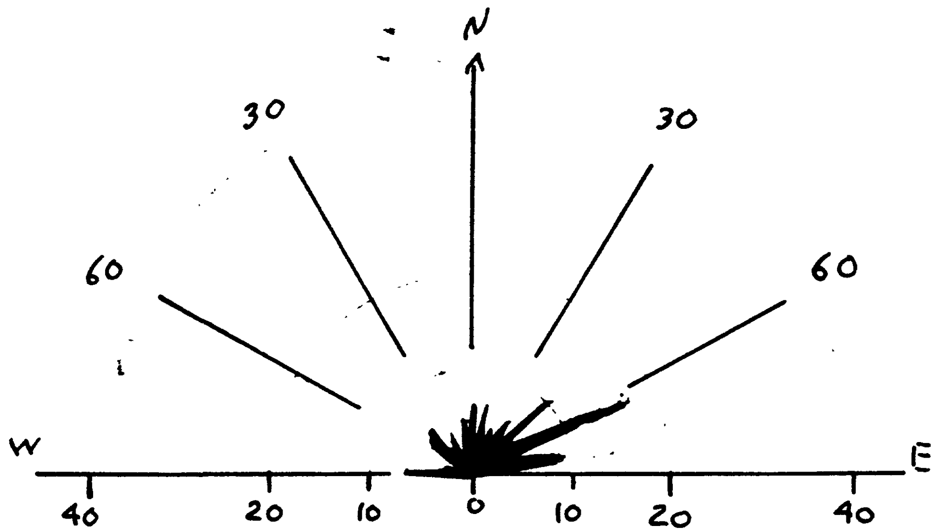

BAKERSFIELD NE
(434)
TRONA
(15)
N
30
30
60
60
W
E
E-W
60
40
20
0
20
40
60
Number of lineaments

Figure 2B

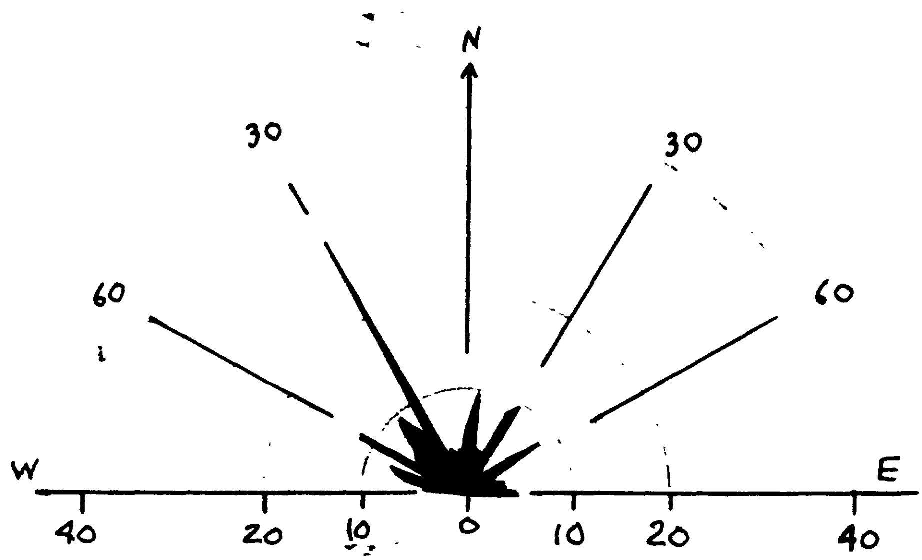
BAKERSFIELD NW
(133)



Number of lineaments

Figure 2C

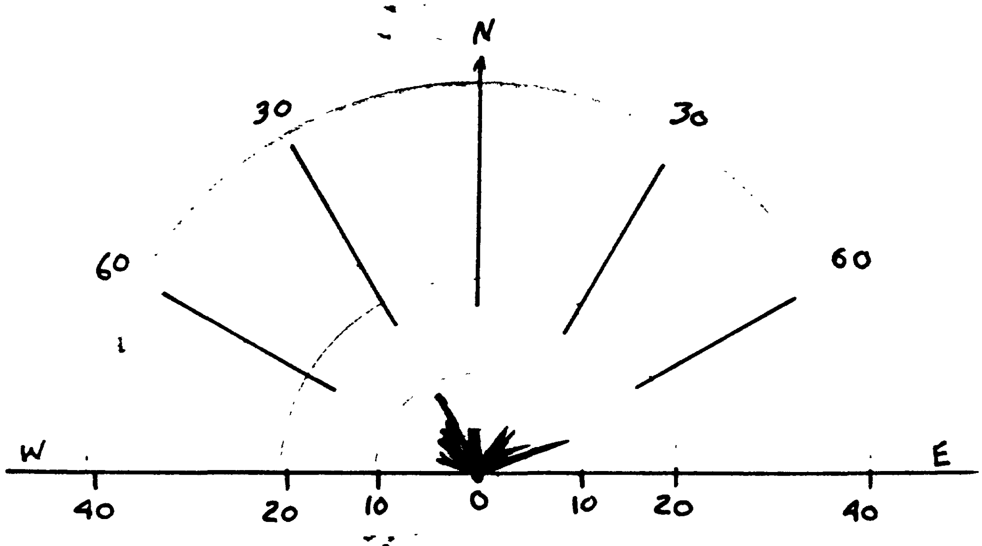
BAKERSFIELD S
(184)



Number of lineaments

Figure 2D

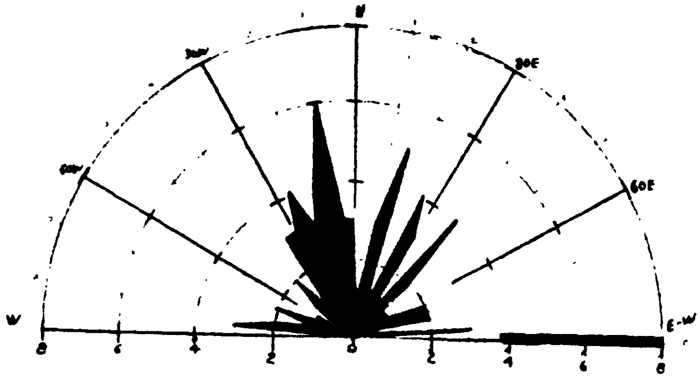
LOS ANGELES
(67)



Number of lineaments

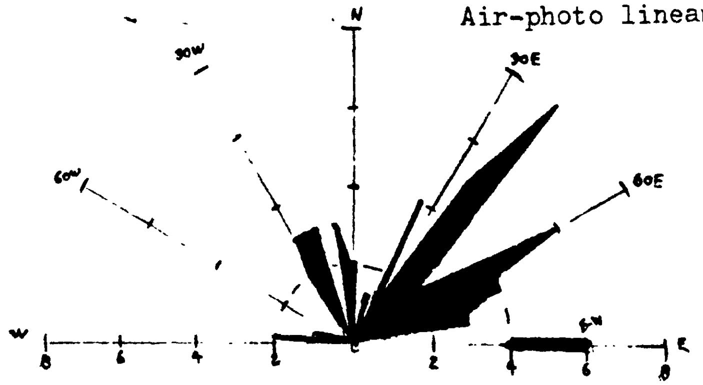
Figure 2E

Field-measured lineaments (87)



Number of lineaments

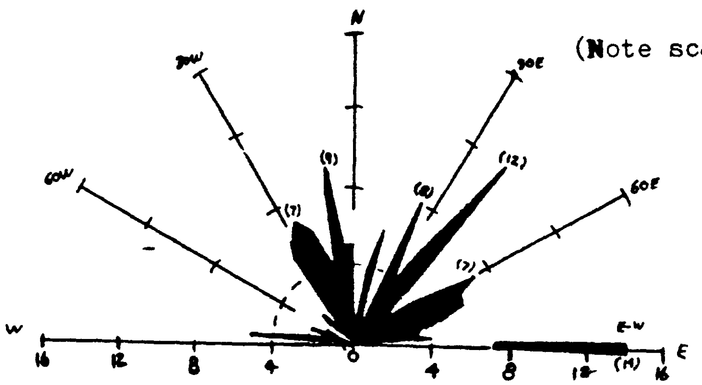
Air-photo lineaments (75)



Number of lineaments

Composite (field-measured + air-photos) (162)

(Note scale change)



Number of lineaments

Figure 3. Compilation of lineaments in the Domelands (Bergquist and Nitkiewicz, 1982)

Table 1. Compendium of air photo lineaments, southern Sierra Nevada, California

Strike	Segments: Bakersfield NE	Bakersfield NW	Bakersfield S	Los Angeles	Trona	Total
N 85 W	8	3	2	2	-	15
80	35	1	2	-	-	38
75	2	1	5	2	-	10
70	10	-	7	-	-	17
65	7	-	-	-	1	8
60	6	-	12	2	1	21
55	10	2	4	2	1	19
50	7	4	5	3	2	21
45	7	5	8	1	-	21
40	-	5	10	3	1	19
35	-	2	6	5	1	14
30	5	2	29	8	-	44
25	3	3	3	1	-	10
20	8	-	4	2	1	15
15	8	2	3	2	-	15
10	27	4	2	2	-	35
5	6	-	4	-	-	10
N-S	17	6	7	2	2	34
N 5 E	9	1	10	1	-	21
10	7	7	4	1	-	19
15	2	2	2	1	2	9
20	3	4	3	1	-	11
25	6	3	8	1	-	18
30	30	3	10	3	-	46
35	14	6	1	1	1	23
40	8	4	2	3	1	18
45	60	11	4	2	-	77
50	7	3	3	1	-	14
55	16	1	8	2	-	27
60	25	7	1	3	-	36
65	16	17	1	-	-	34
70	14	3	1	8	-	26
75	10	5	1	-	-	16
80	9	8	3	1	-	21
85	4	2	3	-	-	9
E-W	28	6	6	1	1	42
Total	434	133	184	67	15	833

Table 2. Compendium of lineament strike data, Domelands (Bergquist and Nitkiewicz, 1982)

Strike	Field-measured	Air-photo interpretation	Composite
N 85 W	3	2	5
80	2	-	2
75	1	1	2
70	2	-	2
65	1	-	1
60	1	-	1
55	-	-	-
50	1	-	1
45	2	-	2
40	1	-	1
35	3	2	5
30	3	3	6
25	4	3	7
20	3	3	6
15	4	-	4
10	6	3	9
5	3	2	5
N-S	3	2	5
N 5 E	1	-	1
10	3	1	4
15	5	1	6
20	1	-	1
25	4	4	8
30	3	1	4
35	1	5	6
40	4	8	12
45	2	3	5
50	1	1	2
55	1	3	4
60	1	6	7
65	2	4	6
70	2	4	6
75	2	3	5
80	-	3	3
85	3	1	4
E-W	8	6	14
Total	87	75	162