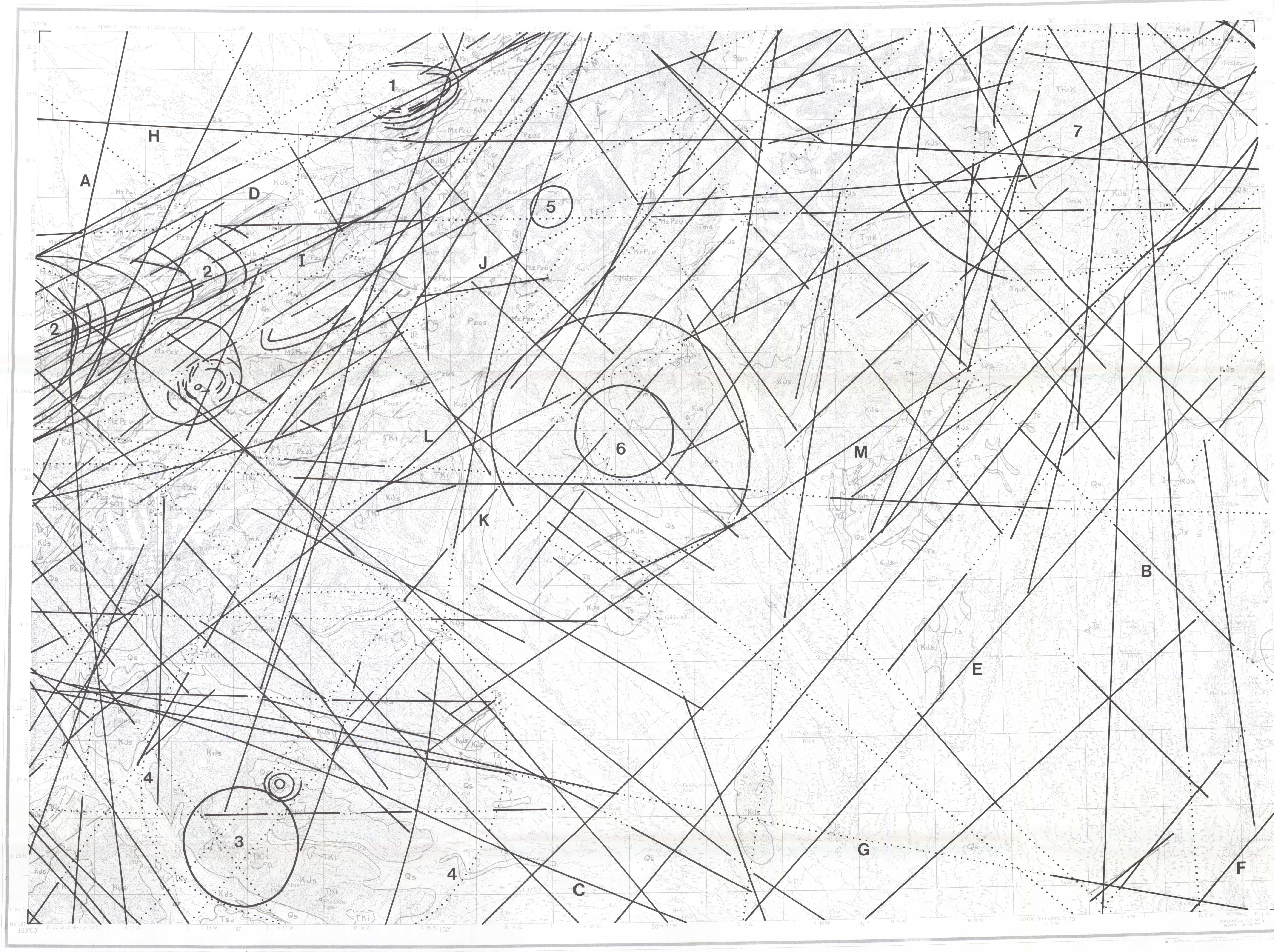
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

FOLIO OF THE TALKEETNA QUADRANGLE, ALASKA
MISCELLANEOUS FIELD STUDIES
MAP MF–870C
SHEET 1 OF 2



BASE FROM U.S.GEOLOGICAL SURVEY, 1:250 000

Scale 1:250,000

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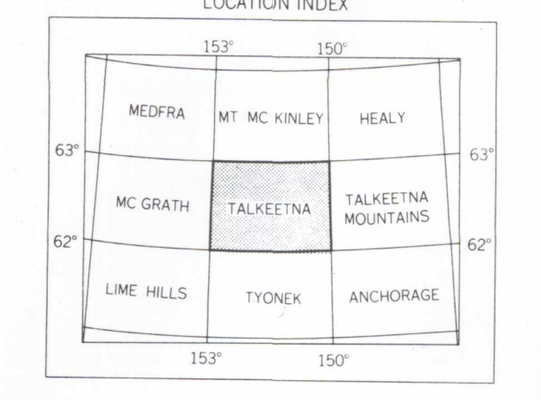
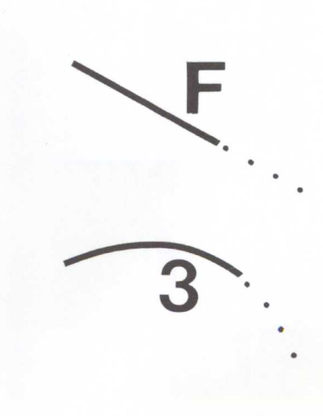


EXPLANATION OF IMAGERY INTERPRETATION



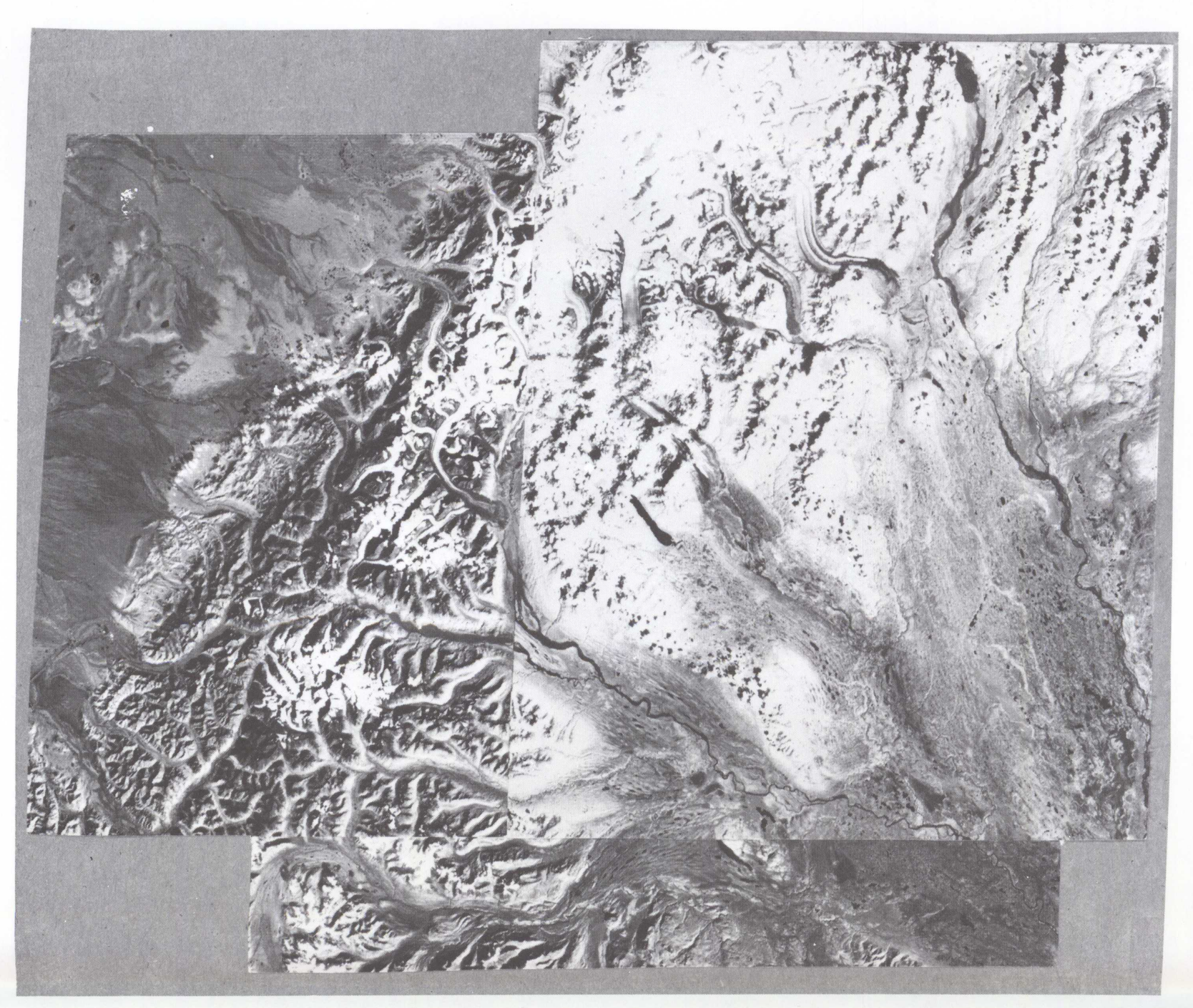


Figure 1.-Example of Landsat imagery used in analyses of the Talkeetna quadrangle. Band 6.

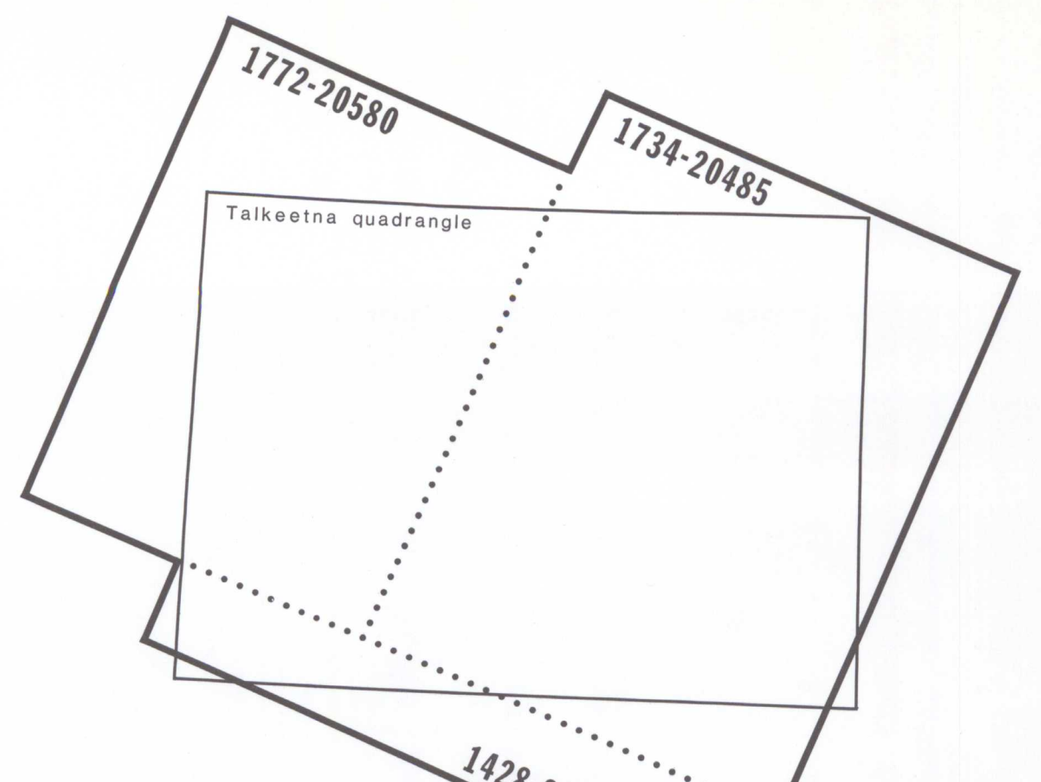


Figure 2.-Map showing location of Landsat imagery used in the analyses of the Talkeetna quadrangle. Dotted lines indicate mosaicked image boundaries.

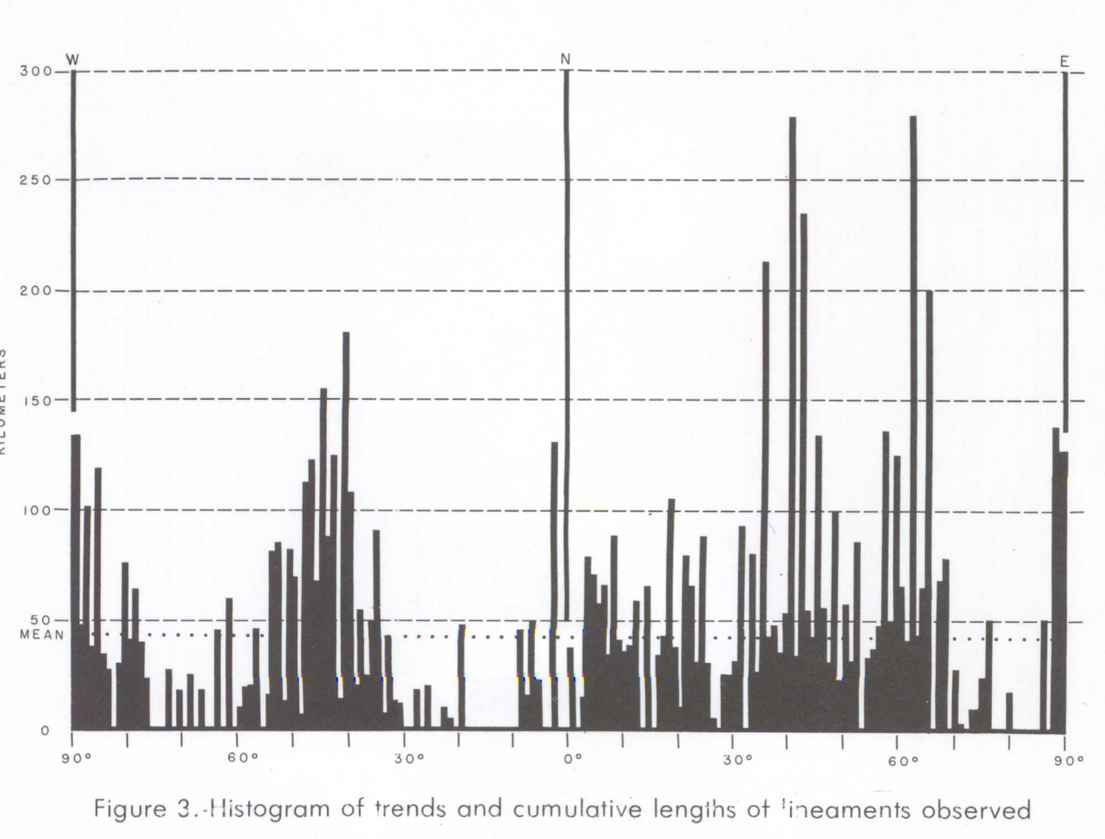


Figure 3.-Histogram of trends and cumulative lengths of lineaments observed on Landsat imagery of the Talkeetna quadrangle.

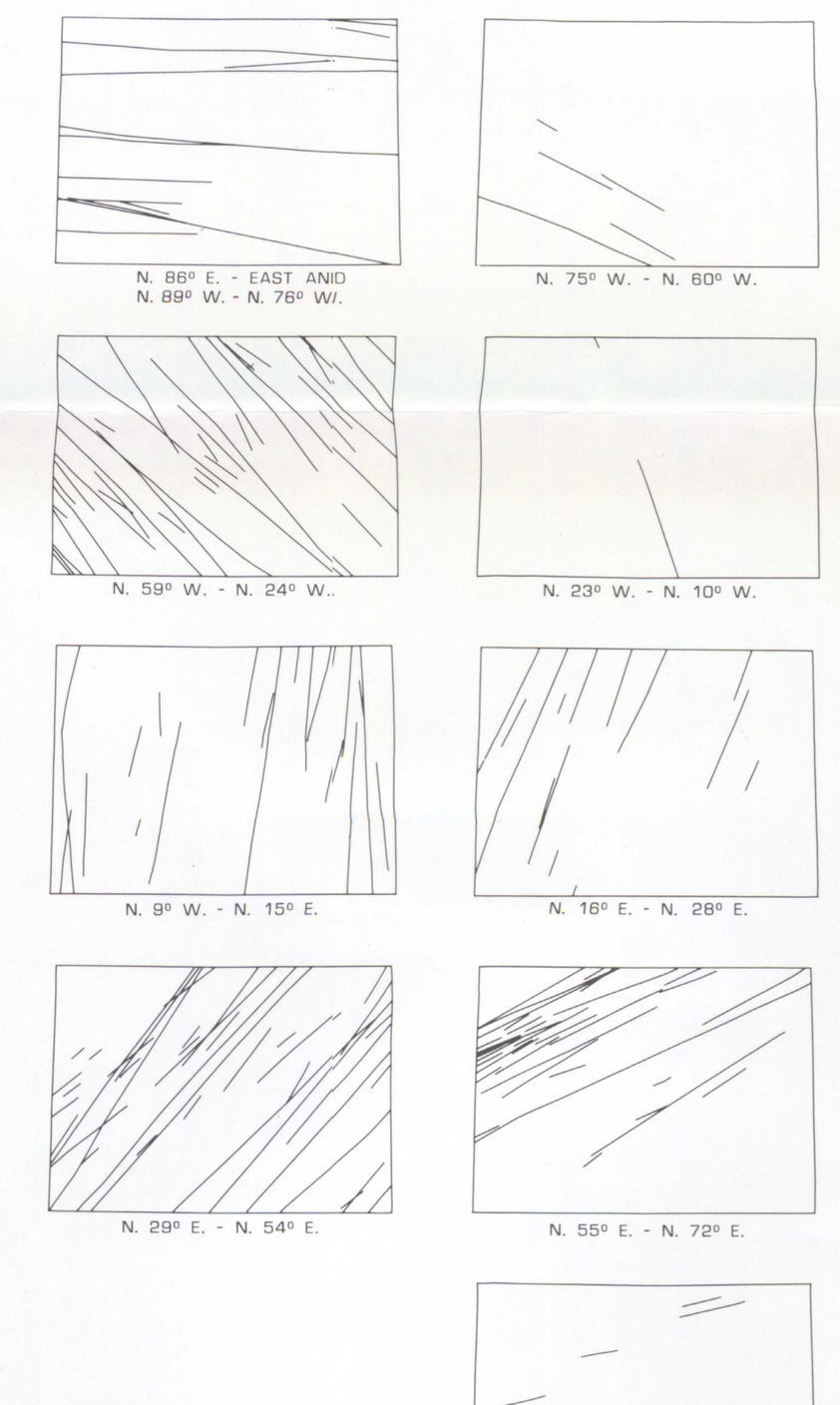


Figure 4.-Maps showing the areal distribution of lineament trends observed on Landsat imagery of the Talkeetna quadrangle. Range of trends were determined from Figure 3.

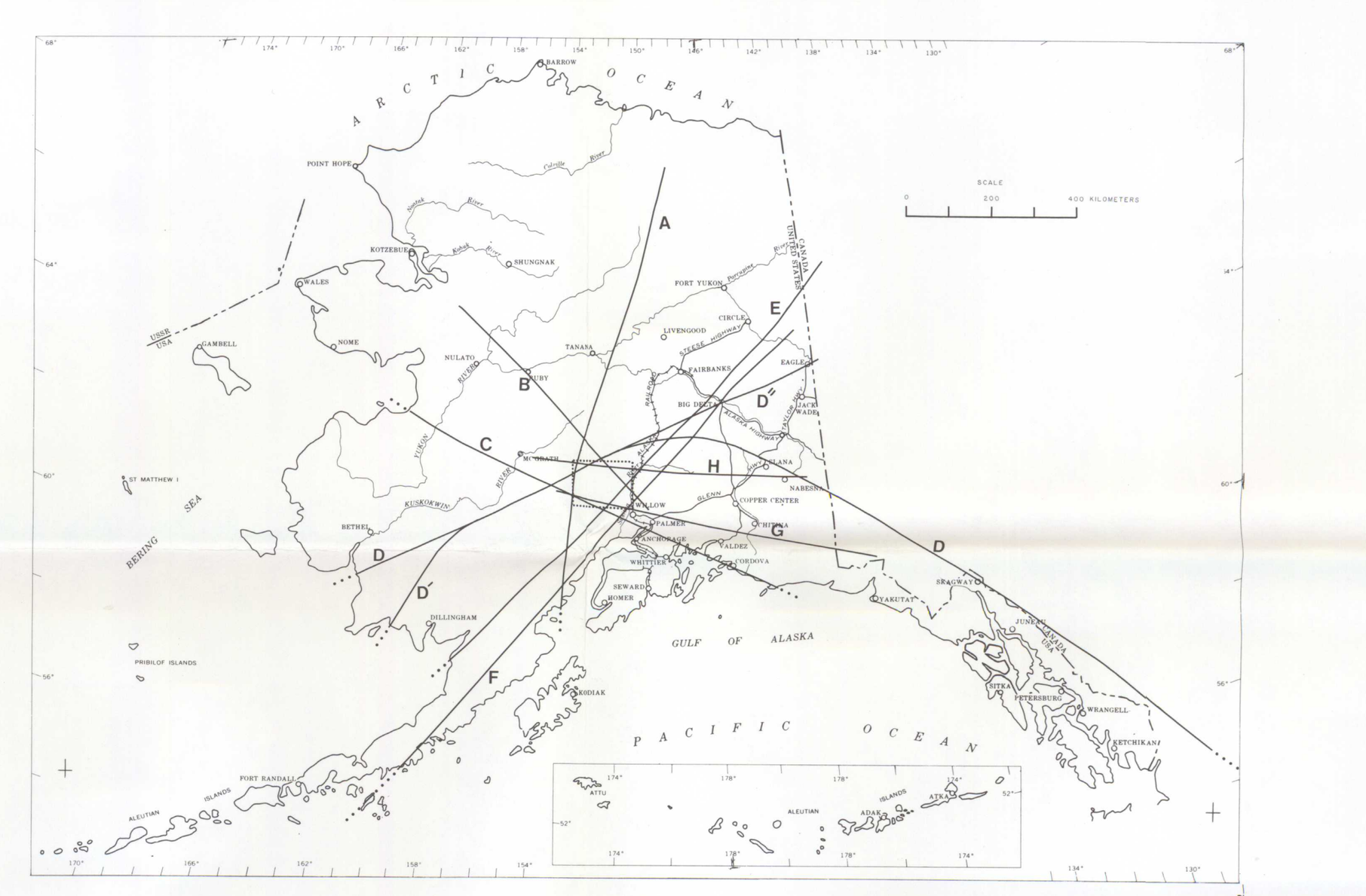


Figure 5.-Index map of Alaska showing the approximate location of the Talkeetna quadrangle and lineaments that extend for more than 100 km beyond the quadrangle that are described in Table 2.

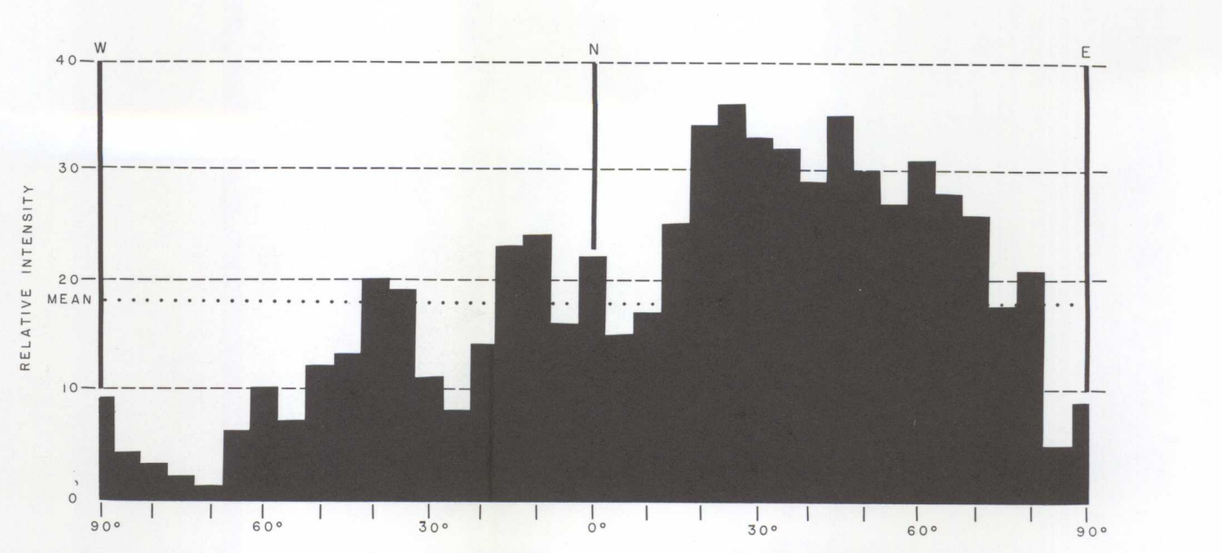
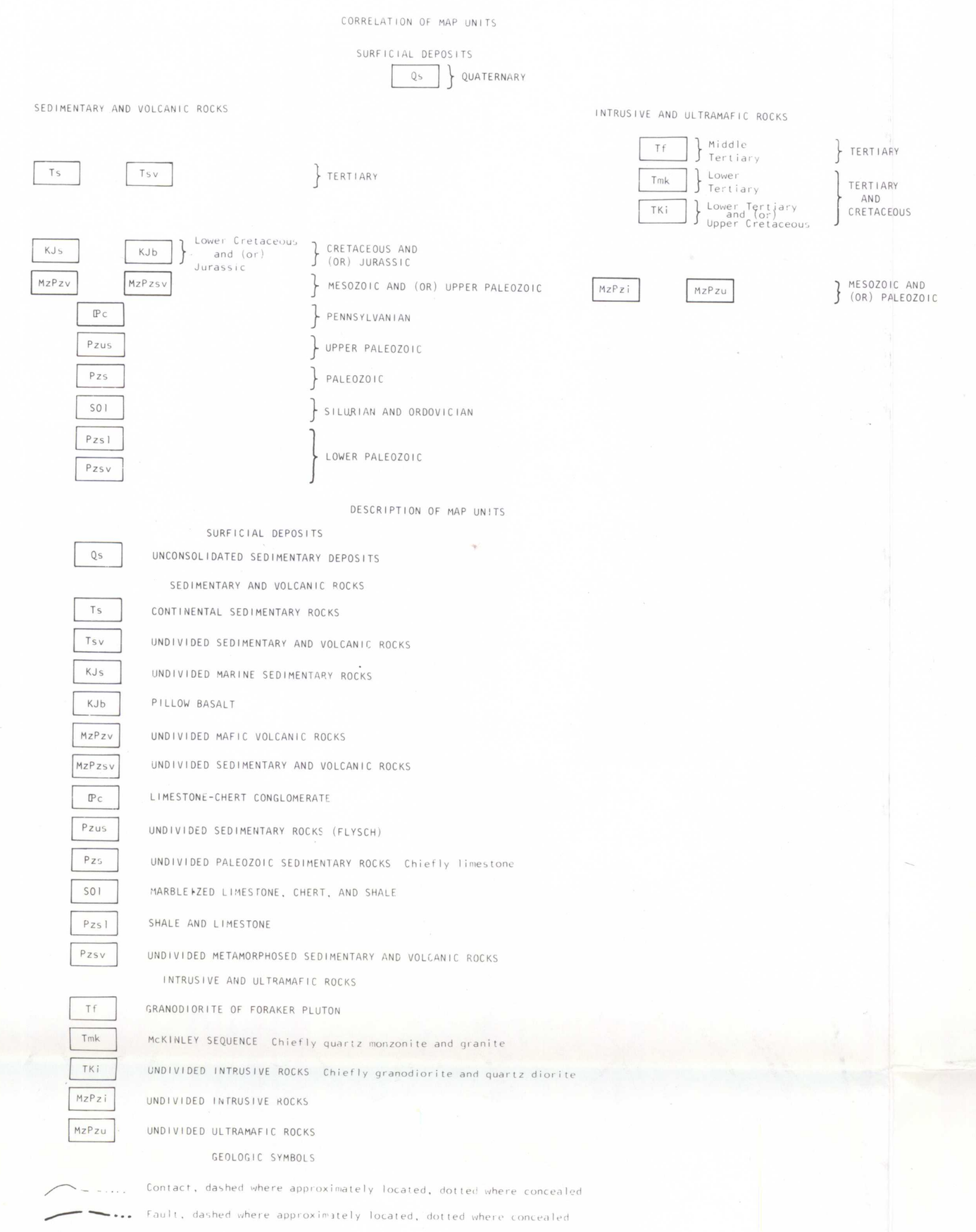


Figure 6.-Histogram of trends and relative intensities of lineaments less than 10 km long as determined by use of a diffraction grating on Landsat imagery of the Talkeetna quadrangle. Relative intensities are subjective.

INTERPRETATION OF LANDSAT IMAGERY OF THE TALKEETNA QUADRANGLE, ALASKA

BY
WM. CLINTON STEELE AND NAIRN R. D. ALBERT
1978

EXPLANATION FOR GENERALIZED GEOLOGIC MAP



INTERPRETATION OF LANDSAT IMAGERY OF THE TALKEETNA QUADRANGLE, ALASKA

To aid in the mineral resource assessment of the Talkeetna quadrangle, Landsat images were analyzed for possible extensions of known faults, color anomalies which might be related to mineralization, lineaments, circular and arcuate features, and quadrangle-wide fracture patterns. Details concerning the different types of imagery used are given in table 1, and image coverage is shown on figure 2. The methodology and limitations of this type of study are discussed in Albert (1975) and Albert and Steele (1976a, b).

Two nearly orthogonal sets of lineaments are present. The most prominent set trends approximately N. 44° E. and N. 43° W., and the other set trends approximately N. 7° E. and N. 88° W. (figs. 3 and 4).[1] These four trends are rather uniformly distributed throughout the quadrangle and contain most of the longer lineaments. They also correspond to the major lineament trends found in the Nabesna (Albert, 1975), McCarthy (Albert and Steele, 1976a), and Tanacross (Albert and Steele, 1976b) quadrangles and to the characteristic north, east, northeast, and northwest trends of a planetary fracture pattern (Hodgson and others, 1976; Albert and Steele, 1976a, b). Trends other than the two orthogonal pairs are generally limited in distribution and contain shorter and fewer lineaments (fig. 4).

One major exception, however, is lineaments that trend approximately N. 63° E., which are common throughout Alaska and which may be faults with right-lateral movement. In the Talkeetna quadrangle this trend has no orthogonal counterpart and is associated with, and near, the Denali fault. Lineaments with this trend in the Talkeetna Mountains quadrangle (W. C. Steele, unpub. data, 1977) and Goodnews and Hagemeister Island quadrangles region (Steele, 1978), as well as in this quadrangle, commonly correspond to mapped faults. The Farewell segment of the Denali fault, the Castle Mountain fault system, the Iditarod-Nixon Fork fault, part of the Kaltag fault, the Yukon Flats discontinuity and fault, and the Porcupine lineament also trend N. 60-65° E. and show right-lateral strike-slip movement where the offset is known (Grantz, 1966). Lathram and Raynolds (1977) identified the N. 60° E. trend as a major statewide lineament trend, and Albert (1978) identified a similar trending major lineament in the eastern part of the North Slope Petroleum Province. This trend is also present in the Tanacross (Albert and Steele, 1976b), Big Delta (N. R. D. Albert, unpub. data, 1977), Chandalar (Albert and others, 1978), and Philip Smith Mountains (J. R. Le Compte, unpub. data, 1978) quadrangles.

We selected as significant lineaments those which appear spatially related to known geologic, geophysical, mineralogical, and geochemical features within the quadrangle and elsewhere in Alaska (table 2 and fig. 5). Many lineaments have no obvious correlation with features within the quadrangle. However, because the lineaments correspond to significant features outside the quadrangle, we believe they may also have significance within the quadrangle, although this significance is presently obscure. Genetic relations between features detected on Landsat imagery and other geologic data are not necessarily implied. Particularly noteworthy are several lineaments, such as lineaments D, I, and J, with an approximate N. 63° E. trend which extend through major areas of known mineralization and through geochemically anomalous areas. Lineament M and nearby subparallel lineaments are also noteworthy in that they coincide with the Yentna mineral belt (Hawley and Clark, 1973), correspond to and connect several faults mapped by Reed and Nelson (1977), and correspond to faults and lineaments mapped by Hawley and Clark (1973).

Lineaments less than 10 km long have trends similar to longer lineaments. However, they also have trends at N. 10° W., N. 25° E., and N. 80° E., which we suspect are fracture sets, although their cause is not apparent from known geology. These shorter lineaments were analyzed on the first derivative image using a diffraction grating with a spacing of eight lines per millimeter (Offield, 1975; Albert and Steele, 1976b). The relative intensities were ranked in 5° intervals and are shown in figure 6. All major peaks in figure 3 are also evident in figure 6, and most have a similar intensity.

Several faults mapped by Reed and Nelson (1977) and Nelson and Reed (1978) can be seen on the imagery and appear to be longer than mapped (sheet 2). Although a few faults and their possible extensions (such as lineaments D, I, and J) were noticed without the aid of a geologic map, most conjectured extensions were identified in conjunction with the map. On the basis of known geology and its expression on the imagery, we believe that the fault extensions south of Chelatna Lake (those associated with lineament M) and near the Denali fault (those associated with lineaments D and I) are particularly likely.

Circular features 3, 4, 5, 6, and 7 may reflect intrusive bodies (table 2). Similar features reflect plutons in the Tanacross (Albert and Steele, 1976b) and Chandalar quadrangles (Albert and others, 1978).

Iron-oxide colored areas, visible on the simulated natural color image, are usually associated with granitic or calcareous rocks. Several known iron-oxide areas within the quadrangle not detected on the imagery and several apparent iron-oxide colored areas observed on the imagery but attributed to artifacts generated by the computer are not shown on sheet 2.

Although some granitic and calcareous units generally could be identified in the imagery, other rock types could not be distinguished. The false-color images with sinusoidal stretches are particularly useful, however, in distinguishing materials within alluvial areas. For example, many Quaternary units on the surficial deposit map (Nelson and Reed, 1978) are readily evident in the sinusoidally stretched false-color images. We suspect that the distinct spectral signatures of these units reflect contrasts in vegetation on deposits of different ages and types.

[1]Peak locations for prominent trends are based on a data-smoothing modification to a computer program designed to aid in the analysis of lineaments (Steele, 1976). The smoothing function is performed by averaging cumulative lengths over a 7° interval.

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Table 1.-Table of Landsat imagery used in analyses of the Talkeetna quadrangle.

[Scenes used for computer enhancement were: 1428-20554, taken 9/24/73; 1734-20480, taken 7/27/74; and 1772-20580, taken 9/3/74. Computer compatible tapes were processed by Pat S. Chavez, Jr., Teresa E. Grow, and Lynda Sowers, U.S. Geological Survey, Flagstaff, Ariz. Imagery is available from EROS Data Center, Sioux Falls, South Dakota 57198 (specify Public Affairs Office (PAO) number when ordering). For descriptions of these types of enhancement see Albert and Steele (1976a, b). Example of imagery is shown in figure 1.]

Image type	Computer-enhanced	Bands and colors used	Projection	PAO number	Transparency scale	Print scale
U.S.D.A. Alaska mosaic	No	7 B&W	Alber's Equal Area	N/A	N/A	1:1,000,000
False-color with linear stretch	Yes	4 Blue 5 Green 6 Red	Orthographic	E-626-810	1:1,054,133	1:250,000
False-color with sinusoidal stretch (#1)	Yes	4 Blue 5 Green 7 Red	Orthographic	E-627-810	1:1,054,133	1:250,000
False-color with sinusoidal stretch (#2)	Yes	4 Blue 6 Green 7 Red	Orthographic	E-628-810	1:1,054,133	1:250,000
Simulated natural color	Yes	4 Green 5 Red Syn blue	Orthographic	E-629-810	1:1,054,133	1:250,000
Horizontal first derivative	Yes	6 B&W	Orthographic	E-323-810	1:1,054,133	1:250,000

Table 2.-Table of significant lineaments, and circular and arcuate features of the Talkeetna quadrangle.

Feature	Approximate trend and length (km) (diameter for circular and arcuate features)	Correlation with geology	Correlation with gravimetric data[1]	Correlation with aeromagnetic data	Correlation with known mineralization	Correlation with geochemical anomalies
A	North 1,100	Delimits western extent of metamorphic rocks of Yukon-Tanana complex.[2] Extends through Iliamna Volcano in Lake Clark quadrangle.[3] Coincides with narrowing of outcrop pattern of sedimentary rocks in eastern Brooks Range.[4] Corresponds to major lineament.[5] Coincides with terminus of Iditarod fault and crosses Kaltag, Denali, and Castle Mountain faults without apparent offset.[2] Coincides with western extent of eugeosynclinal rocks in Tanana quadrangle.[4] Approximately coincides with thrust fault and western extent of flysch and mafic volcanic rocks in Talkeetna quadrangle.[6]	Coincides with minor low salient in Sagavanirktok quadrangle.	Parallels contours in Philip Smith Mountains quadrangle.[7]	Passes through or near several Au placer mines and through major Cu prospect near Sheep Creek in Chandalar quadrangle.[8]	None observed.
B	N. 44° W. 675	Coincides with apparent termination and offset of units in Koyukuk Basin.[2]	Generally coincides with contour deflections in Talkeetna quadrangle.	None observed.	Coincides with northeastern extent of Au placers in Yentna mineral district.[9,10]	None observed.
C	N. 68° W. 1,000	Corresponds to major lineament[5,11].	Coincides with termination of low in Anchorage quadrangle, approximately coincides with termination of high in Prince William Sound, and parallels contours in Cordova quadrangle.	None observed.	None observed.	None observed.
D	N. 63° E. 4,750	Corresponds to major lineaments[5,11,12], Farewell fault[3,13], thrust faults in Talkeetna quadrangle[6], and Denali fault between Kuskokwim basin and Yukon Territory[2]. Coincides with southern limit of intrusive rocks in shale and limestone unit in Talkeetna quadrangle[6], and southwestern limit of metamorphic rocks of the Yukon-Tanana complex[2]. Follows strike of northwestward extension of Fraser-Yalakom fault system in British Columbia.[14]	Coincides with significant lows along Alaska Range and axis of low in Lime Hills quadrangle.	Coincides with high which may be related to plutonic body[15] and parallels contours in Nabesna and Mt. Hayes quadrangles[16].	Coincides with Ag and Sn deposits.[10]	Coincides with Cr[17], Sn, Be, W[18], and Mo[19] anomalies and approximate northern limit of Pb, Cu, and Zn anomalies[19].
D′	N. 63° E. 340	Corresponds to Togiak-Tikchik fault[3] and major lineament[5].	None observed	Parallels contours in Goodnews quadrangle.[20]	None observed.	None observed.
D″	N. 63° E. 520	Corresponds to Farewell fault[3], trends of folds in Yukon Territory[2], and major lineament[5].	Coincides with general trend of contours in Healy quadrangle and deflection of contours in Big Delta quadrangle.	None observed.	None observed.	None observed.
E	N. 43° E. 1,300	Corresponds to southwestern part of Castle Mountain fault[5] and major lineament[5,11].	Coincides with axis of high in Talkeetna Mountains quadrangle and deflection of contours in Healy quadrangle, and parallels contour trend in Naknek quadrangle.	Parallels contour trends in Black River[20] and Naknek[21] quadrangles, and approximately corresponds to contact between buried volcanic and sedimentary rocks[15].	None observed.	None observed.
F	N. 43° E. 1,575	Coincides with major northeast-trending granite body south of Talkeetna quadrangle[3,22] and corresponds to much of Shaw Creek fault[4], major lineament[5,11], Susitna fault[13], faults in Chignik quadrangle[22], approximate trace of Bruin Bay fault[2], and trend of folds in Charley River quadrangle[2].	Coincides with significant highs south of Talkeetna quadrangle for 600 km, trend of contours in Talkeetna Mountains quadrangle, and deflections in contours in Alaska Range.	Parallels contours in Charley River[20], Talkeetna Mountains[16], and Ugashik[21] quadrangles.	None observed.	None observed.
G	N. 79° W. 800	Corresponds to major lineament[23] and approximate trace of Border Range fault[2,13]. Coincides with approximate boundary between flysch-type sedimentary rocks in Chugach Mountains and volcanic and associated sedimentary and intrusive rocks in Wrangell Mountains in McCarthy quadrangle[23,24].	Coincides with termination of low in Anchorage quadrangle, trend of contours on north flank of Chugach Mountains, axis of low in Valdez quadrangle, and approximate trend of contours on south flank of Wrangell Mountains.	None observed.	None observed.	Coincides with Sn[18] and Ag[25] anomalies.
H	N. 87° W. 790	Coincides with contact between eugeosynclinal deposits in Gulkana and Talkeetna Mountains quadrangles[2] and corresponds to major lineament[5].	Coincides with saddle in a low in Gulkana quadrangle and trend of contours in Nabesna and Gulkana quadrangles.	Parallels contours in Talkeetna Mountains and Gulkana quadrangles.[16]	Coincides with southern limit of area of Ag and Sn deposits in quadrangle.[10]	Coincides with Cr[17], Sn, W, Be[18], Cu, Pb, Zn, Mo[19], and Ag[25] anomalies in northwestern part of quadrangle and Sn, W[18], Mo[19], and Ag[25] anomalies in northeastern part.
I	N. 63° E. 78	Corresponds to McKinley segment of Denali fault system and coincides with southern boundary of body of marine sedimentary rocks and pillow basalts north of Denali fault, northern boundary of flysch and mafic volcanic rocks, and northern boundary of Foraker pluton.[6]	None observed.	None observed.	None observed.	Coincides with Sn and Be anomalies near Ripsnorter Creek[18], area of Cr[17] and Cu[19] anomalies, and southern limit of Mo and Zn anomalies[19].
J	N. 63° E. 88	Corresponds to faults in Talkeetna quadrangle.[6]	Coincides with trend of contours in Talkeetna quadrangle.	None observed.	Passes through Cr occurrences in dunite.[10]	Coincides with Mo anomaly and southern limit of Zn anomaly.[19]
K	N. 41° E. 250	Corresponds to faults in Talkeetna quadrangle.[6]	None observed.	None observed.	None observed.	Coincides with several Au anomalies.[25]
L	N. 47° E. 270	Locally coincides with southern extent of flysch and approximately corresponds to major fault in Talkeetna quadrangle.[6]	None observed.	None observed.	Coincides with southeastern extent of most lode deposits and lies close to Cr deposits.[10]	Coincides with W anomaly between junction of east and west forks of Yenta River[18], several Cu[19], Au, and Ag[25] anomalies, and trend of Cr[17] anomalies.
M	N. 58° E. 106	Locally coincides with boundaries of continental sedimentary rocks, and connects and corresponds to faults in Yenta mineral belt[9] in Talkeetna quadrangle.[6]	None observed.	None observed.	Coincides with three areas of Au placer mines.[10]	None observed.
1	N. 63° E. 12	Largely occurs in metamorphosed sedimentary and volcanic rocks, subparallel to faults on southeastern side of feature, thrust fault near axis, and axis subparallels Denali fault.[6]	None observed.	None observed.	Coincides with Ag, Sn, Pb, W, and U mineralization.[10]	Coincides with Cr[17], Sn, W, Be[18], Cu, Pb, Zn[19], and Ag[25] anomalies.
2	N. 63° E. 30	May be part of drag feature truncated by, and axis subparallel to, Denali fault.[6]	Axis coincides with axis of high.	Arcs correspond to saddles in high, and high coincides with axis of feature.[15]	None observed.	Coincides with Cr[17], Cu, Mo, and Zn[19] anomalies.
3	No trend 15	Encloses numerous small intrusive bodies.[6]	None observed.	Encloses three highs that may reflect small buried intrusive bodies.[15]	None observed.	Coincides with Cu[19], Au, and Ag[25] anomalies.
4	No trend 46	Encloses numerous small intrusive bodies.[6]	None observed.	Western part of feature coincides with saddles in high between two plutons.[15]	None observed.	Coincides with Sn, W[18], Cu[19], Au, and Ag[25] anomalies.
5	No trend 6	Occurs within Foraker pluton.[6]	None observed.	None observed.	None observed.	Coincides with Cu and Mo anomalies.[19]
6	No trend 33	Encloses McKinley sequence pluton.[6]	Coincides with high.	Coincides with area of reversal related to metamorphic rocks.[15]	None observed.	Coincides with moderate W[18], and minor Be[18] and Au[25] anomalies.
7	N. 63° E. 48	Encloses and is centered on part of McKinley sequence pluton.[6]	Coincides with major contour deflection.	None observed.	None observed.	Coincides with areas of strong Sn[18] and Mo[19] and moderate W[18], Cu[19], Au, and Ag[25] anomalies.

1. Barnes (1976)
2. King (1969)
3. Beikman (1974b)
4. Beikman and Lathram (1976)
5. Lathram and Raynolds (1977)
6. Reed and Nelson (1977)
7. Decker and Karl (1977c)
8. DeYoung (1978)
9. Hawley and Clark (1973)
10. Reed and others (1978)
11. Lathram and Albert (1976)
12. Albert (1975)
13. Beikman (1974a)
14. Campbell (1972)
15. Griscom (1978)
16. Decker and Karl (1977b)
17. Curtin and others (1978d)
18. Curtin and others (1978c)
19. Curtin and others (1978b)
20. Decker and Karl (1977a)
21. Decker and Karl (1977d)
22. Beikman (1975)
23. Albert and Steele (1976a)
24. MacKevett (1976)
25. Curtin and others (1978a)

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