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Radar and Landsat lineament maps of the Glens Falls 1^{o} x 2^{o} Quadrangle - New York, Vermont, and New Hampshire

by

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Lineament Analysis of the Glens Falls $1^{o} \times 2^{o}$ Quadrangle, NY, VT, and NH

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Landsat multispectral scanner (MSS), Landsat return beam vidicom (RBV) (Freden and Gordon 1983) and side-looking airborne radar (SLAR) (Moore, 1983) images were used in the lineament analysis of the Glens Falls $1^{o} \times 2^{o}$ quadrangle located in New York, Vermont, and New Hampshire. The Landsat images were analyzed on uncontrolled mosaics at scales of 1:1,000,000 and 1:,600,000 (resolution 80m). The SLAR images were analyzed from strip data at a scale of 1:400,000 (resolution 6-10m) and from a controlled mosaic at a scale of 1:250,000. Sun elevations varied from 27 to 48 degrees on the MSS and RBV images. The X-band (3 cm) SLAR data were flown in a north-south direction with a west look-direction and used a depression angle (from the horizontal) of 9 to 31 degrees. The SLAR data were flown by Goodyear Aero-Service under contract to the U.S. Geological Survey.

Two lineament maps were produced from the above data. One map was made from the combined Landsat RBV and MSS data and a second map was made from the radar data. An examination of the Landsat lineament map shows that there is virtually no correlation of mapped lineaments and known mineral occurrences.

Look-angle bias does not appear to be a factor in that the Landsat images do not show a high frequency of NE-SW (perpendicular to the direction of solar illumination) trending lineaments nor does the radar show a high frequency of N-S trending lineaments. The low frequency of E-W lineaments on the radar data may be a look-angle bias but neither the radar nor the Landsat data shows E-W lineaments and it is probable that the paucity of lineaments in this set is real.

The terrain in the quadrangle varies from low rolling glaciated terrain in the northeast, to moderately rugged mountains in the center, to the Hudson Valley plains in the west center to glaciated alpine terrain in the northwest.

Three classes of lineaments were selected for mapping. The first class includes sharply defined linear to slightly curvilinear to highly curved or circular elements mappable on the Landsat and SLAR images. The second class includes diffuse linear or curvilinear features which consist of slightly irregular tonal lineaments lacking the distinct sharply defined boundaries of the first class of lineaments. These first two classes of lineaments probably represent shallow fracture systems which may or may not have demonstrable offset. Some obviously are faults and others may represent erosional scarps between rock types of differing erosional characteristics. Still others may be joint sets or prevalent joint directions. The third class includes general trends which represent broad or diffuse tonal ineaments that are interrupted by crossing features but which nonetheless are intermittantly traceable for tens of kilometers. This last class of lineaments are suspected by the author to represent the surface manifestation of deeper-seated features which have printed through the cover rocks.

A majority of the faults mapped in the companion geologic map (Thompson and others, in preparation) were recognized, in part, on the Landsat or SLAR images. It is probable that some of the mapped lineaments represent parts of faults which have yet to be mapped.

The structural effects of at least three different orogenies are present on the map. In New Hampshire, northeastern and southeastern Vermont, the Acadian Orogeny has produced the strong lineament pattern which varies from N20E to N30E. In Vermont and southeastern New York, the Taconic Orogeny has produced the major lineament pattern which varies from N5E to N20E, and

southwest of the Hudson Valley in New York (southwestern part of the map), the Alleghenian Orogeny has produced the lineament pattern which varies from N27E to N44E.

The effect of glacial features including oriented positive relief features and broader glacial valleys and groves, varies from NS to N30W and thus are not easily confused with the various structural elements caused by the various orogenies. Lineament patterns are generally distributed uniformly except along the major river valleys and areas of low relief where the lineaments have been obscured by cultural patters. The Hudson River Valley in the southwest part of the map and the Lake Champlain Valley and environs in the north-central part of the map are examples of culturally saturated areas. Lineaments in these areas were difficult to identify and for the most part have been omitted.

Relationship of mineral deposits to lineaments

The overall location of mineral deposits bears little relationship to the lineament pattern with three possible groups of exceptions. The lack of relationship is best exemplified by the observation that few mineral deposits lie on or even within two kilometers of lineaments.

The three exceptions are 1) the molybdenum deposits in the extreme northeastern and central part of the quadrangle, 2) the garnet deposits in the west-central part of the quadrangle, and 3) the iron and lead deposits in the central part of the quadrangle.

Perhaps the most important association of mineral localities with lineaments are the molybdenum deposits in the extreme northeast and the center of the quadrangle (D and E respectively on the radar map). They are closely associated with diffuse albeit identifiable long lineaments which strike N60^{o}W to N65^{o}W and are part of a system of subparallel lineaments which have been observed by the author to occur throughout New England (notice a third subparrallel diffuse lineament in the south-central part of the map at letter F). Because of the great length and continuity of these lineaments, the author believes that they are related to deep-seated faults which are part of a continental fracture system. The northeastern most molybdenum deposit lies directly on the lineament. The deposits at Cuttingsville, Vermont (in the center of the radar map) are only 5 kilometers south of and along a subparallel lineament to the major diffuse lineament which extends eastward from the map area nearly to the Atlantic Ocean. Still other molybdemum deposits occur immediately south of the Glens Falls quadrangle in the Albany, NY 1^{o} x 2^{o} quadrangle within 5 kilometers of the extension of the broad diffuse lineament in the south-central part of the Glens Falls Quadrangle (radar map, letter F). Throughout New England other molybdenum deposits appear to be closely associated with this lineament system and a recent study

by the author (unpublished) indicates that 62% of all molybdenum deposits in the eastern United States (John Slack, oral comm., and Schmidt, 1978) occur within 5 kilometers of a major lineament system which strike N60°W to N65°W. Although 5 kilometers might appear to be a large distance, if one considers the probablity that these major lineaments originate tens of kilometers deep, the molybdenum deposits need not occur directly on the mapped lineaments.

Garnet is found only in the northwest within the perimeter of the Adirondack mountains (A on radar map). Every garnet deposit is located either along, within ½ kilometer of, or along the extension of a mapped radar lineament which trends approximately N25°W, N65°W or in one instance N10°W. Although none of the mapped lineaments are coincident with mapped faults, it would appear likely that these deposits lie along systems of fractures. It is clear that the garnet related lineaments are only a part of the larger Adirondack system which features these three directions.

The iron and lead deposits just south of the center of the quadrangle (B on radar map) are spatially coincident with a swarm of short lineaments which strike N12°E. These deposits may be related to the concentration of iron, lead, and zinc deposits in the north-central part of the quadrangle (C on radar map).

The iron, lead, and zinc deposits in the north-central part of the map may have also been effected by the presence of the N60°W trending lineament system. Note the southernmost broad lineament which is in the central part of the quadrangle is arcuate at its western end. If this arcuate segment is due to a counterclockwise rotation of the original lineament, a restoration to the presumed original straight lineament has the effect of rotating the approximately N-S lineaments in the north-central iron, lead, zinc district to the same general orientation as the lineaments which are associated with the

iron, lead district south of the quadrangle center. Although this does not account for all the 38 degrees of rotation seen on the arcuate segment, additional rotation can be accounted for between the several broad lineaments in the central part of the map. This idea is admittedly provocative, but I believe that it bears additional study.

References

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Explanation

Broad (solid line) or diffuse (long-dashed line) tonal linear or curvilinear feature, not necessarly continuous.

Linear or curvilinear feature.

Diffuse linear or curvilinear feature.

Linear or curvilinear feature concident with or extension of mapped fault (Thompson, McLelland, and others, 1986)

▲ Mineral deposit (Symbols below represent major mineral production)

Au = Gold	Ga = Garnet
Ag = Silver	Mo = Molybdenum
As = Arsenic	Pb = Lead
Ab = Asbestos	Py = Pyrite
Cu = Copper	U = Uranium
Fe = Iron	W = Tungsten
G = Graphite	Zn = Zinc