NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

EARTH RESOURCES SURVEY PROGRAM
TECHNICAL LETTER NASA-81

Radar Imagery: Parmachenee Lake Area, West-Central Maine

By

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U.S. Geological Survey
Washington, D.C.

June 1967

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

Technical Letter
NASA-81
June 1967

Dr. Peter C. Badgley
Program Chief,
Earth Resources Survey
Code SAR - NASA Headquarters
Washington, D.C. 20546

Dear Peter:

Transmitted herewith is one copy of:

TECHNICAL LETTER NASA-81

RADAR IMAGERY:

PARMACHENEE LAKE AREA,

WEST-CENTRAL MAINE*

by

D. S. Harwood**

Sincerely yours,

William A. Fischer
Research Coordinator
Earth Orbiter Program

*Work performed under NASA Contract No. R-09-020-015
**U.S. Geological Survey, Washington, D. C.

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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D. S. Harwood **

June 1967

Prepared by the Geological Survey
for the National Aeronautics and
Space Administration (NASA)

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INTRODUCTION

The Parmachenee Lake area (figure 1) extends from the Maine-New Hampshire border northeast along the international boundary between Quebec and Maine to the Chain Lakes area of Maine; a distance of about 23 miles. Polarized and cross-polarized radar images at a scale of about 1:112,000 were obtained in August 1966. The polarized image, in general, shows a sharper tonal contrast and is the one used for this study. It is much less obscured by noise, which appears as banding parallel to the line of flight, than is the crosspolarized image.

Geologic setting

The Parmachenee Lake area lies in the northwestern part of a northeast-trending belt of pre-Silurian rocks (figure 2) that was named, in part, the Boundary Mountain anticlinorium by Albee (1960). A thick and highly folded eugeosynclinal sequence consisting of green, purple and black slate, mafic and felsic volcanic rocks, and graywacke is exposed in the anticlinorium. Black slate near the top of the pre-Silurian section has been dated as late Middle Ordovician (Harwood and Berry, 1967). No lower age limit for the sequence has been established.

The pre-Silurian rocks are unconformably overlain to the northwest and southeast (not covered by the imagery) by conglomerate, quartzite, limestone, and calcareous slate of Silurian age. Thin-bedded gray slate and quartzite of Silurian or Devonian age, or both, interfingers with and overlies the Silurian units.

There is a marked difference in the type and degree of folding in the rocks below and above the Late Ordovician Taconic unconformity. Northeast- and locally, northwest-trending isoclinal folds with vertical axial surfaces and steeply plunging axes characterize the pre-Silurian rocks. In contrast, the Silurian and Devonian rocks contain gently dipping beds and relatively open northeast to east-trending folds that have vertical axial surfaces and gently plunging axes.

The rocks in the area are in the chlorite zone of regional metamorphism. Locally, however, the rocks have been contact metamorphosed to highly resistant, spotted or equigranular hornfels around quartz monzonite stocks of Devonian age. Several small serpentinite bodies, probably of Late Ordovician age intrude the pre-Silurian rocks in the Parmachenee Lake area.

The stratigraphic and structural relationships are shown in a generalized columnar section in figure 3.

Radar imagery

Parmachenee Lake and the southwest end of the Parmachenee Lake area are shown in figure 4. The pronounced north-trending lineament along the west margin of figure 4 (a) is the Maine-New Hampshire state line. Extensive logging operations in this part of Maine produced an area of scrub hardwood trees that forms a distinct "topographic" break against the taller trees in New Hampshire. Note that thick stands of spruce and fir show as dark patches (figure 4,b) on the imagery whereas hardwood forests (figure 4,c) give a much lighter image. The grainy pattern on the radar imagery in this area is produced by dense networks of logging roads that generally contour the hills as shown in figure 5. Main haulage ways (figure 5,a) are graveled and are much more pronounced than the bulldozed skid roads (figure 5,b).

Two northeast trending ridges at the northern edge of figure 4 (d and e) are formed by resistant units of mafic volcanic rocks. Because these ridges trend parallel to the line of flight they are much more pronounced on the radar imagery than on the aerial photographs. Southwest of Upper Black Pond (figure 4,f) the radar imagery clearly shows several small folds in which the mafic volcanic rocks plunge to the northeast beneath rocks of Silurian age.

The contact between the resistant graywacke member and black slate member of the Dixville Formation is locally marked by a pronounced ridge (figure 4,g). Also a lens of mafic volcanic rocks and a small intrusive body surrounded by a small but resistant aureole of hornfels is shown on figure 4 (h and i, respectively).

Sinuous ridges and gullies near the southern margin of figure 4 (j) mark dry channels cut in thick till by melt-water streams from the retreating Pleistocene ice sheet.

Further to the northeast (figure 6) a gentle west-dipping unit of felsite underlain by less resistant calcareous slate and limestone of Silurian age forms a pronounced strike-controlled ridge (fig. 6,a). The trend of this ridge, held up by Silurian units, crosses the trend of the pre-Silurian units at a small angle. The north end of the ridge of Silurian rocks is offset by a northwest-trending lineament (figure 6,b) that is interpreted to be a southwest-dipping normal fault. The northeast block of the fault apparently moved down and to the northwest with respect to the southwest block. Additional field work is needed, however, to verify the fault.

Parts of two small stocks of quartz monzonite appear in figure 6 (c and d) as distinct circular lowlands dotted with small ponds and lakes. Figure 7 is an aerial photograph that covers part of the southern stock shown in figure 6 (d). Big

Island Pond (figure 6,e and figure 7,a) serves to orient the imagery and photograph. A very pronounced northwest-trending lineament (figure 6,f) crosses the western part of the smaller quartz monzonite stock. The lineament extends north of the international boundary (figure 6,g) where it is apparently coincident with a small stream. In Canada, the lineament is accentuated by a logging road (figure 7,b) parallel to the stream, but there are no man-made features coincident with the lineament to the southeast where it crosses the quartz monzonite stock. There is apparently no offset of the northern border of the quartz monzonite along this lineament, but detailed mapping has not been done in this area. The lineament presents a target for the summer's field work that would not have been recognized without radar imagery because it is not apparent on the aerial photograph (figure 7).

Conclusions

Radar imagery of the Parmachenee Lake area shows the influence of resistant bedrock units on topography far better than the existing aerial photographs. There is no indication in this area, however, that the radar beam can distinguish rock types in any way other than by their topographic expression. Because the radar enhances topographic features that parallel the line of flight, it might be prudent to cover an area of complex geology on orthogonal flight lines and thus reduce any possible bias in the interpretation.

There is little indication that the radar beam effectively penetrates the dense foliage in the area. On the contrary, the radar appears to be very effective in distinguishing evergreen from deciduous trees. Radar imagery of this area taken when the leaves are off the trees might prove more valuable than that taken during the summer.

Radar imagery is a valuable adjunct to aerial photographs in this area of Maine. Its chief advantages are enhanced topographic expression of resistant bedrock units, continuous strip coverage, and its all-weather capabilities. Aerial photographs show the logging roads, which are invaluable to woods navigation, much more clearly than the radar imagery.

References

Albee, A. L., 1960, Boundary Mountain anticlinorium, west-central Maine and northern New Hampshire: U. S. Geol. Survey Prof. Paper 424-C, p. C51-C54.

Harwood, D. S., and Berry, W. B. N., 1967, Fossiliferous lower Paleozoic rocks from the Cupsuptic quadrangle, west-central Maine: U. S. Geol. Survey, Prof. Paper 575-D (in press).

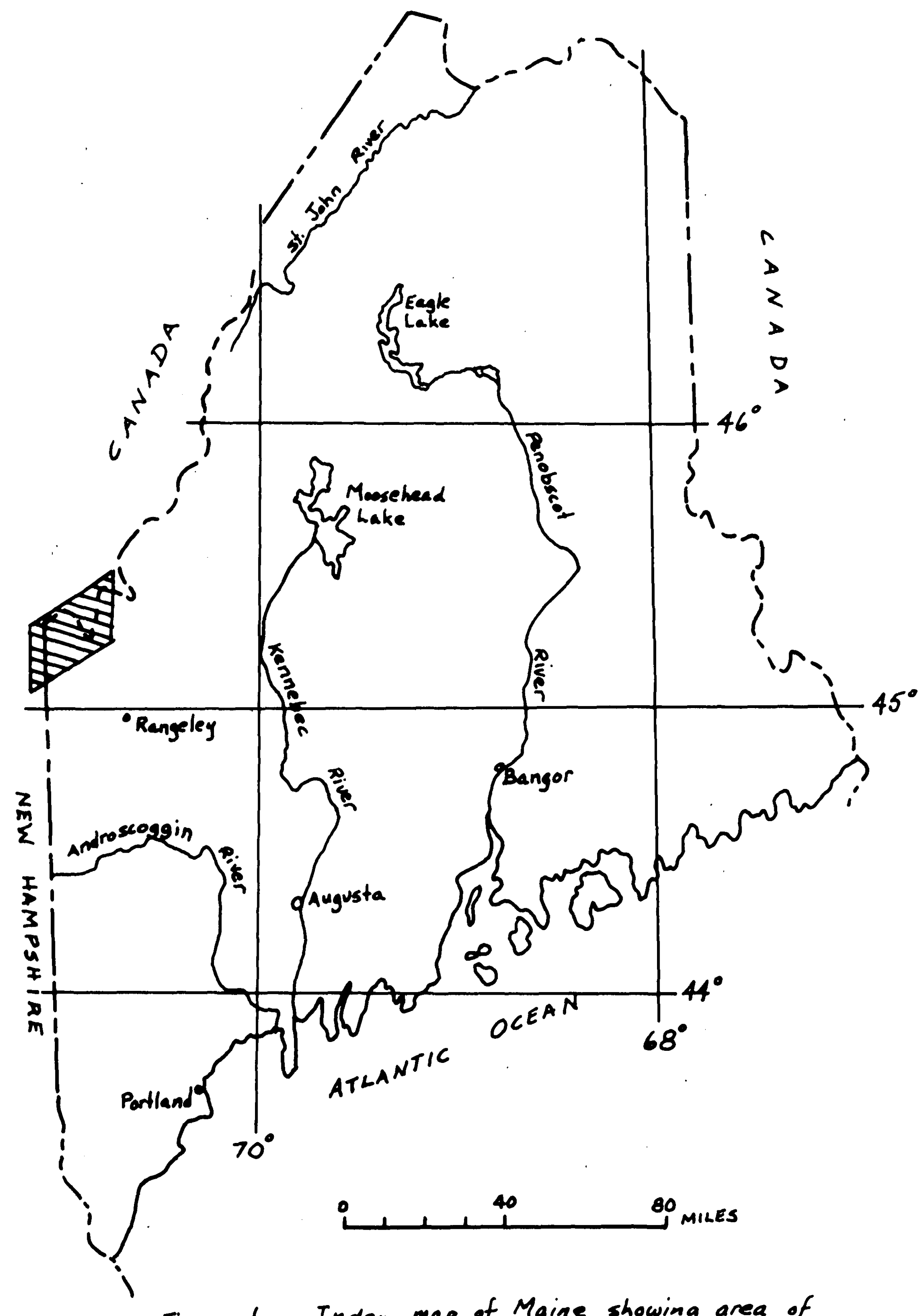


Figure 1 - Index map of Maine showing area of radar imagery covered by this report.

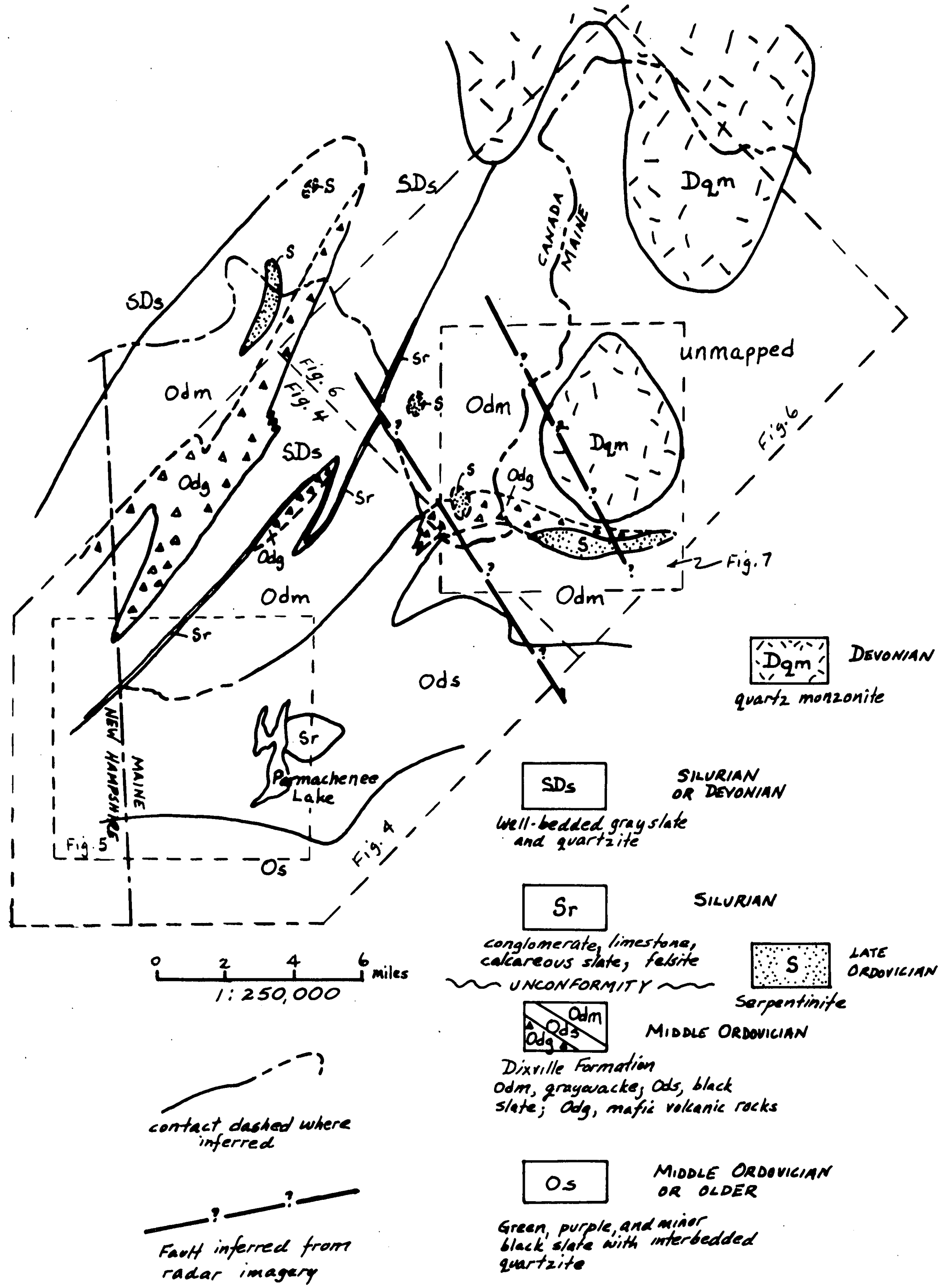
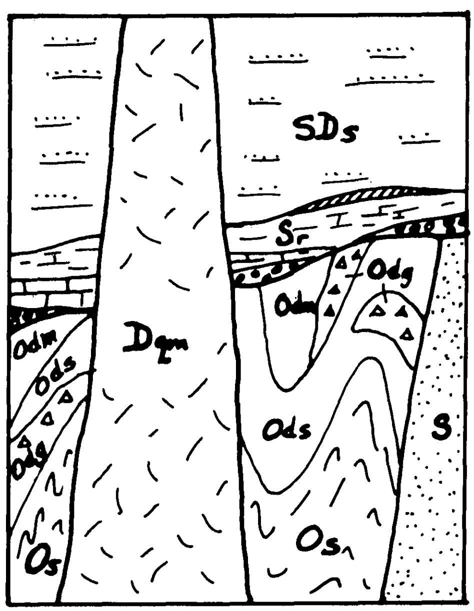


Figure 2 - Generalized geologic map of the Parmachenee Lake area



Dqm - biotite-muscovite quartz monzonite

SDs - well-bedded gray state and quartzite

Sr - Thin lenticular units of polymict and quartz-pebble conglomerate, limestone, cakareous slate and felsite

UNCONFORMITY

Od - Dixville Formation

Odm, Graywacke with minor green and black slate, lenses of mafic and felsic volcanic rocks

Ods, Black slate with lenses of quartzite and mafic volcanic rocks

Odg, Mafic volcanic rocks, flows and agglomerates

Os - Green, purple, and minor black slate with interbedded distinctly laminated quartzite

S - serpentinite

Figure 3 - Generalized columnar section of the Parmachenee Lake area

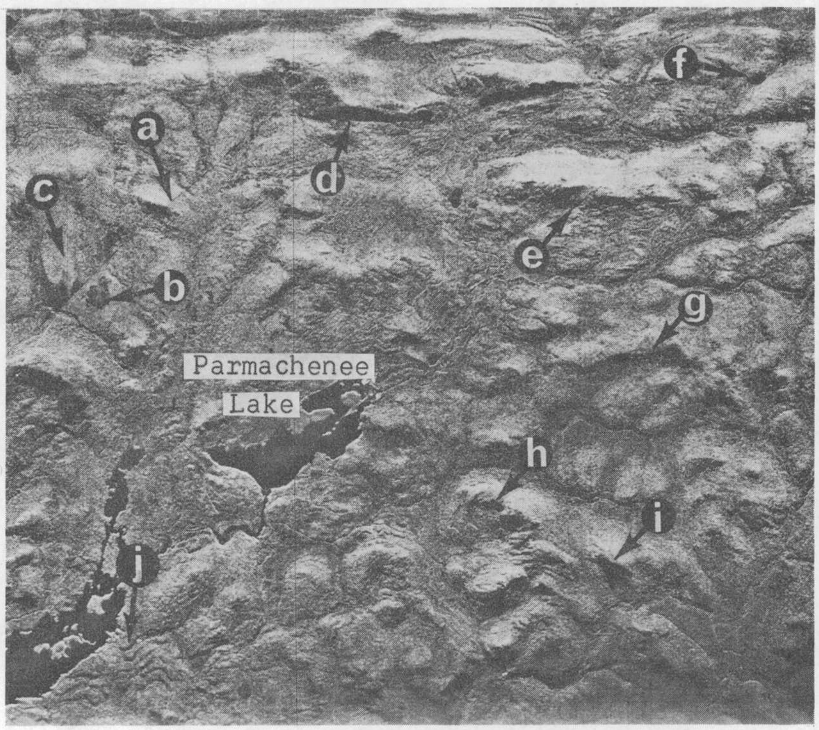


Fig. 4

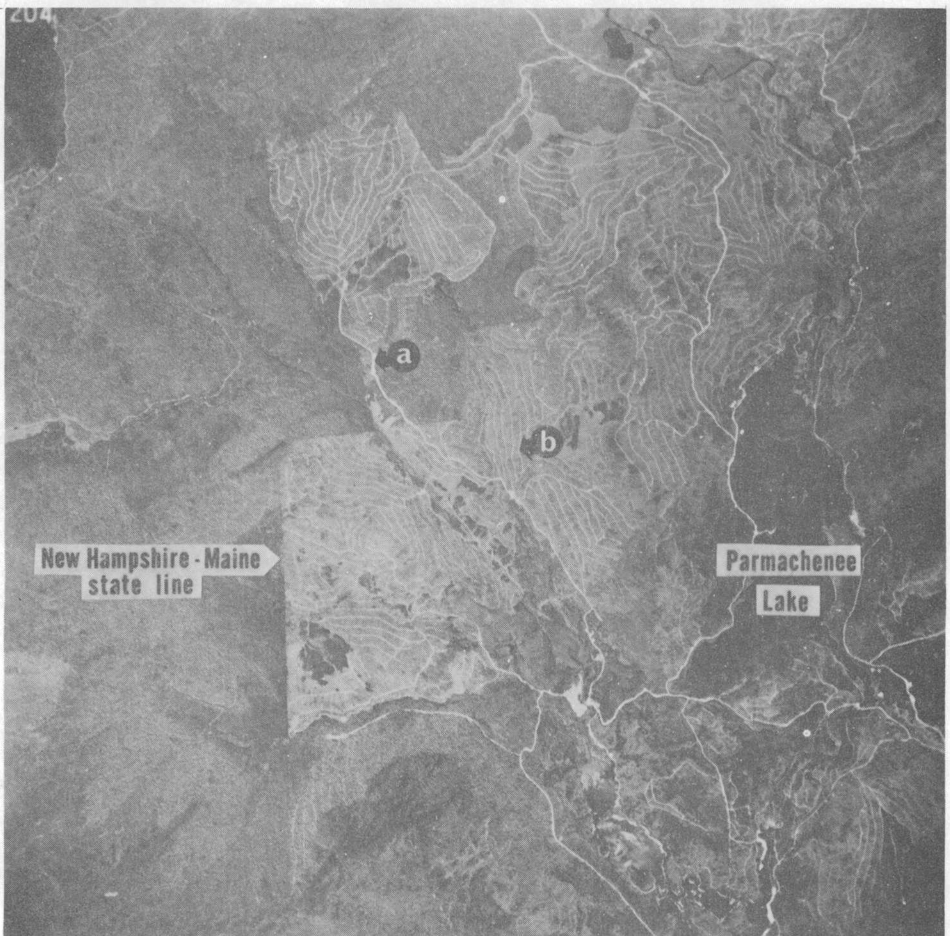


Fig. 5

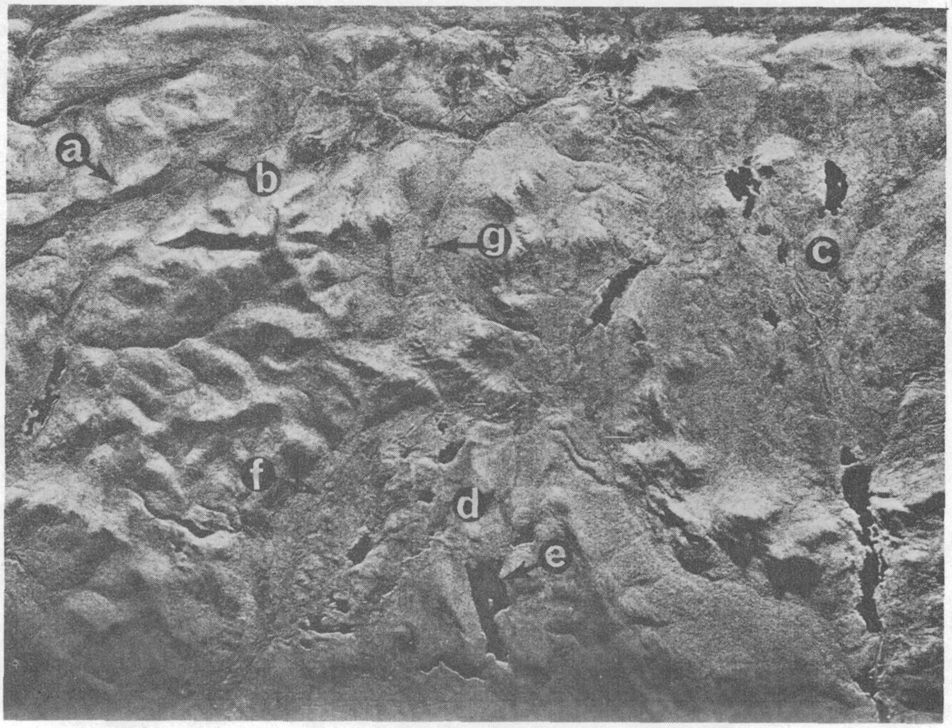


Fig. 6

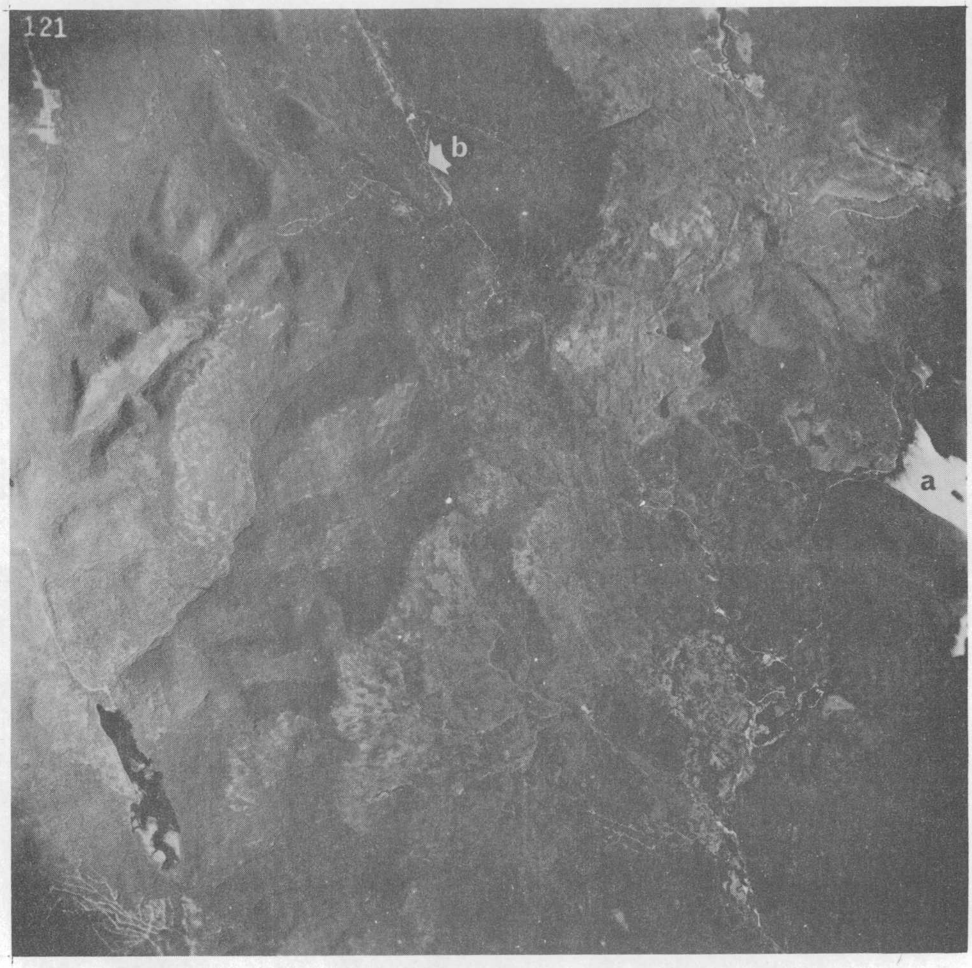


Fig. 7