UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Reflectance and thermal infrared aircraft scanner images of Newberry Caldera, Oregon

by

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Open-File Report 80-234

1980

Multispectral reflectance and thermal infrared aircraft scanner data of the Newberry Caldera area, Oregon, were acquired September 4-6, 1977. Mount Newberry is a composite shield volcano with a caldera at its summit which now contains sizable lakes and a variety of exposed volcanic flows. The caldera is located just south of Bend, Oregon, and about 64 km east of the crest of the Cascade Range. The data-acquisition area is bounded by lat 43°37.5′ to 43°52.5′ N. and long 121°07.5′ to 121°22.5′ W.

The images were acquired using a Texas Instrument RS14A multispectral scanner[1/] mounted in a Porter STOL aircraft. The scanner has a thermal channel of 7.5-12.5 μm and five visible and near-infrared bands: 0.4-0.5 μm, 0.5-0.6 μm, 0.6-0.7 μm, 0.7-0.8 μm, and 0.8-1.1 μm. All channels have a 3.0 milliradian instantaneous field-of-view, and the cross-track scan has a swath width of 80°. Gyroscopic compensation (±8°) was provided for the image data, and all channels of data were recorded as an FM modulated signal on magnetic tape. Hot and cold blackbody calibration data were recorded for each scan line.

Figure 1 shows the nominal flight line ground track and line numbers for data acquired at four altitudes above sea level: 6100 m, 5000 m, 3500 m, and 2900 m. The actual coverage can be determined from figures 2-38 for the four acquisition times of approximately 1000,1200,1400, and 2400 hours local solar time. The following table summarizes the altitude, swath wide, and ground resolution of each flight line:

FLIGHT LINE NO.	ALTITUDE (m)	SWATH WIDTH (m)	GROUND RESOLUTION (m)
1,2	6,100	7,200	15
3,4,5	5,000	5,300	11
6,7,8,9,10,11	3,500	2,800	6
12,13,14	2,900	1,800	4

Figures 2-38 are film prints of the thermal data and the 0.7-0.8 μm reflectance-channel data. These images are presented in the following order: by flight-line altitude; then, reflectance and thermal data; and finally, time of acquisition. Flight lines 1-11 were flown as close to north/south as possible. The winds aloft sometimes forced the aircraft to crab, and these images show coverage variations and geometric distortions.

The last figure, figure 39, is a generalized geologic map of the caldera area published by the State of Oregon, Department of Geology and Mineral Industries (Higgins and Waters, 1968). The various flows can be located on the thermal images by noting their relationship to the two lakes.

Interpretation of thermal-image data requires some caution. Ground-temperature variations are caused by meteorological factors, physical-property differences, topographic effects, and near-surface geothermal heat flow (Watson, 1975; Kahle, 1977; Miller and Watson, 1977). The scanner records radiance data which include atmospheric effects. Light tones are warm for the thermal data and high reflectance for the 0.7-0.8 μm data. No interpretation has been applied to this data set.

[1/] Use of brand names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

REFERENCES

Higgins, M. W., and Waters, A. C., 1968, Newberry caldera field trip, in Dole, H. M., ed., Andesite conference guidebook: State of Oregon, Department of Geology and Mineral Industries Bulletin 62, p. 59-77.

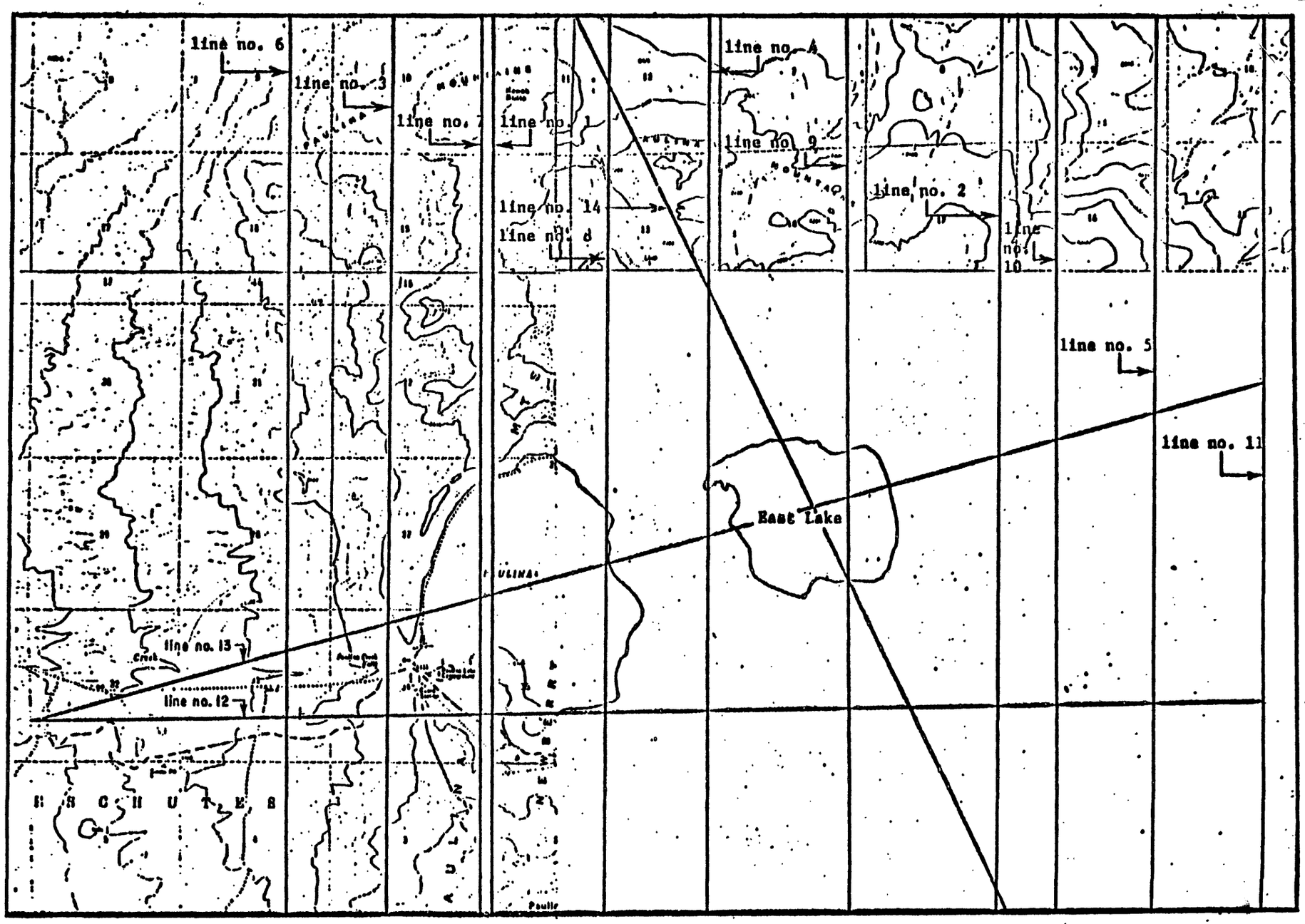
Kahle, A. B., 1977, A simple model of the earth's surface for geologic mapping by remote sensing: Journal of Geophysical Research, v. 82, no. 11, p. 1673-1680.

Miller, S. H., and Watson, Kenneth, 1977, Evaluation of algorithms for geologic thermal-inertia mapping: 11th International Symposium on Remote Sensing of the Environment, Proceedings, v. 2, p. 1147-1160.

Watson, Kenneth, 1975, Geologic applications of thermal infrared images: Institute of Electrical and Electronics Engineers Proceedings, v. 63, no. 1, p. 128-137.

lat. 43°47'
long. 121°20'

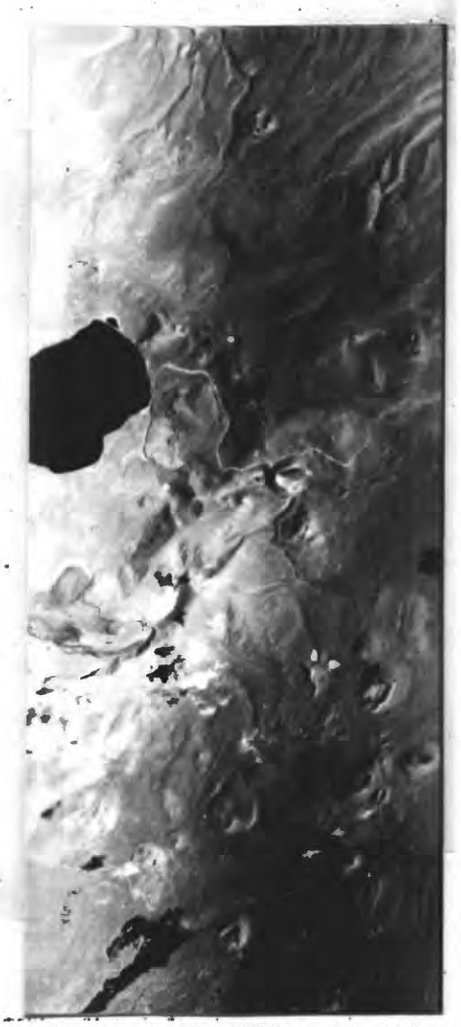
lat. 43°47'
long. 121°08'



lat. 43°42'35"
long. 121°20'

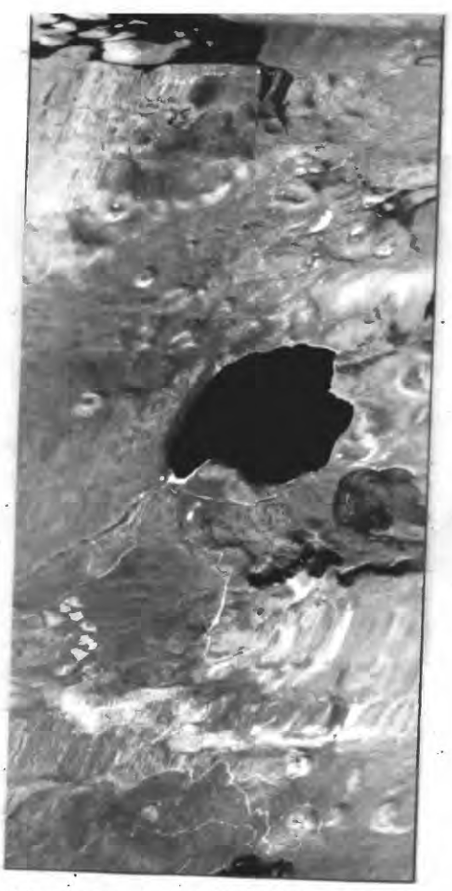
Figure 1.--Nominal flight line ground track and line numbers for data of the Newberry Caldera area. 1.74 km

Line no. 1, 0933 hr. solar time, Sept. 4, 1977

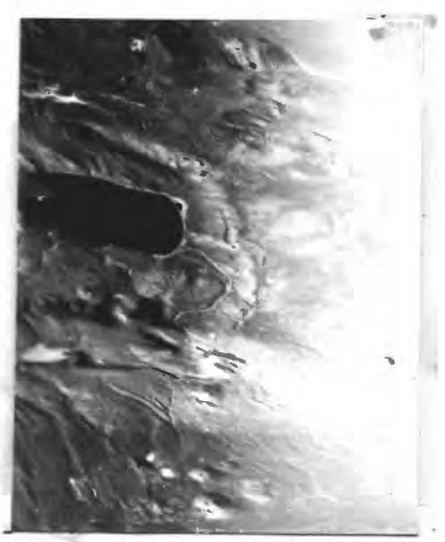


Line no. 2, 0941 hr. solar time, Sept. 4, 1977

Figure 2.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 6100 m.



Line no. 1, 1116 hr. solar time, Sept. 6, 1977



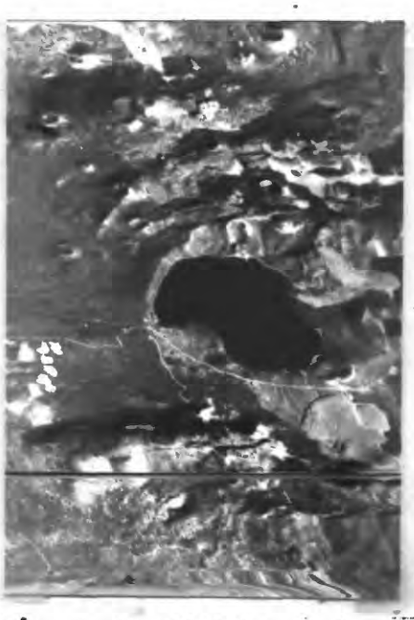
Line no. 2, 1123 hr. solar time, Sept. 6, 1977

Figure 3.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 6100 m.

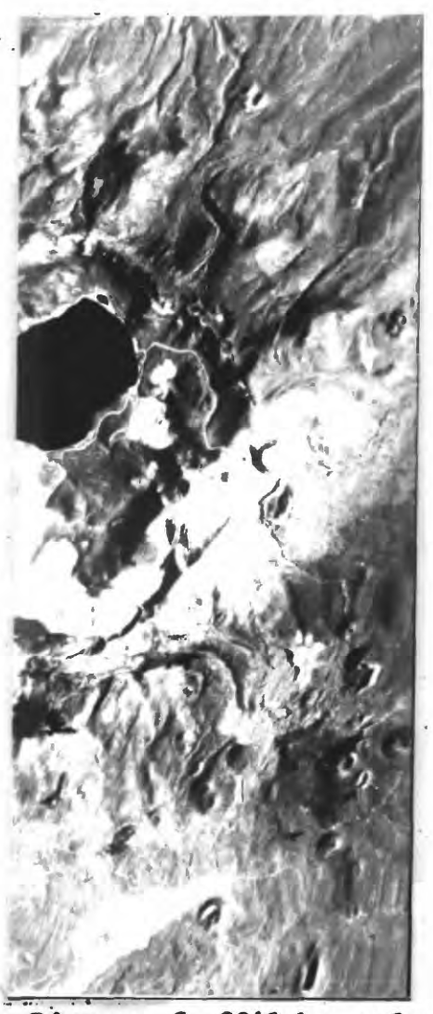
Line no. 1, 1340 hr. solar time, Sept. 5, 1977

Line no. 2, 1348 hr. solar time, Sept. 5, 1977

Figure 4.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 6100 m.

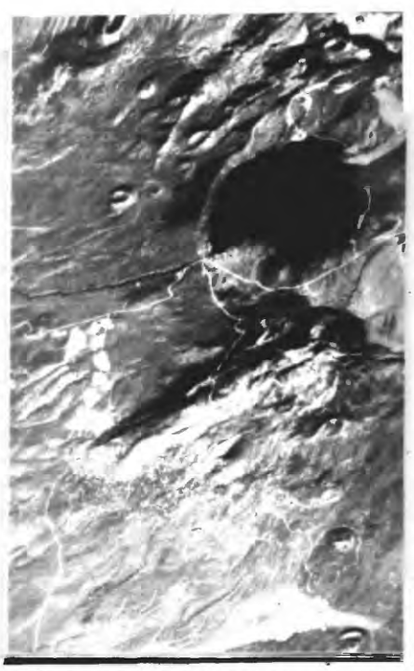


Line no. 1, 0933 hr. solar time, Sept. 4, 1977



Line no. 2, 0941 hr. solar time, Sept. 4, 1977

Figure 5.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 6100 m.



Line no. 1, 1116 hr. solar time, Sept. 6, 1977

Line no. 2, 1123 hr. solar time, Sept. 6, 1977

Figure 6.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 6100 m.

Line no. 1, 1340 hr. solar time, Sept. 5, 1977

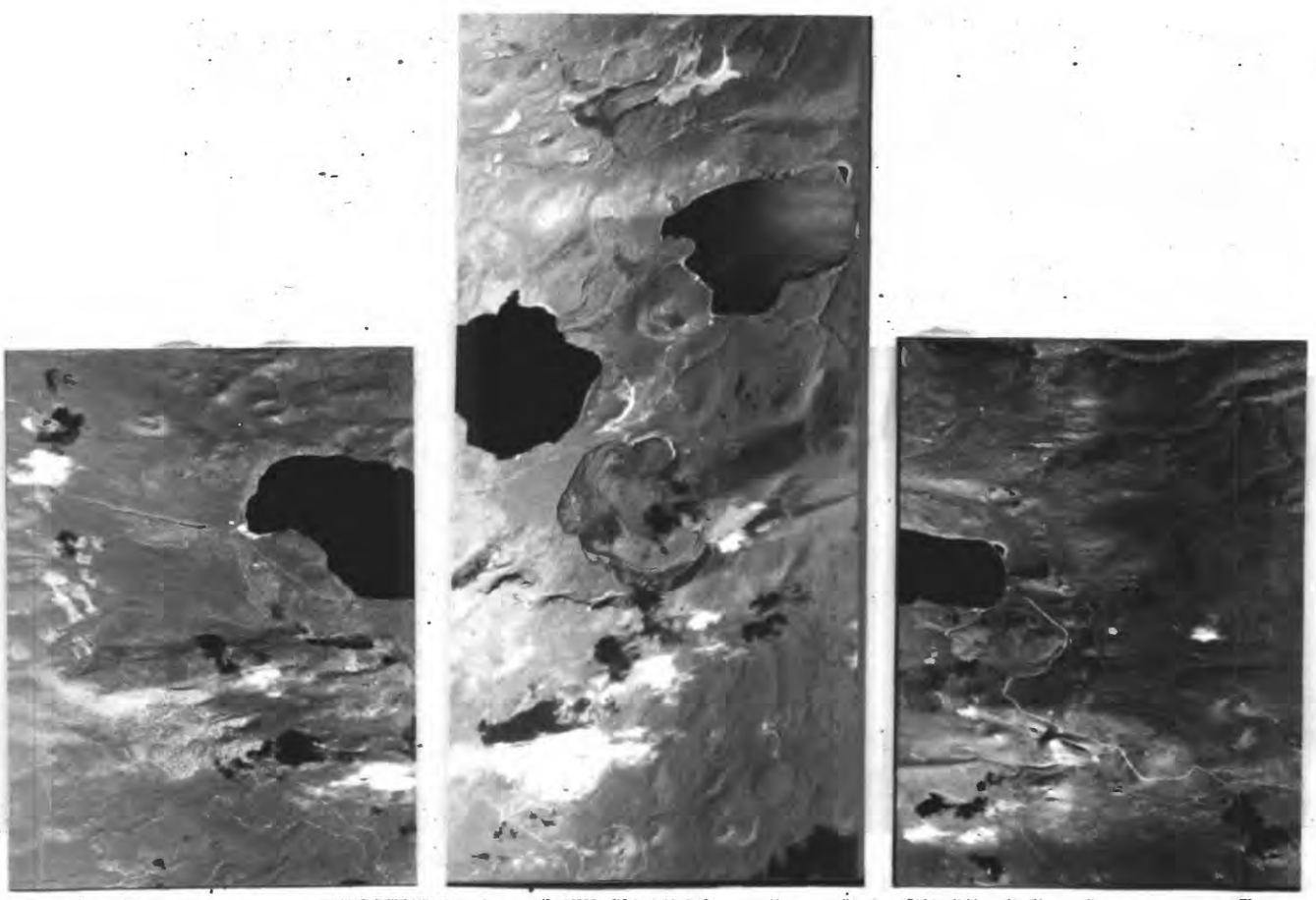
Line no. 2, 1348 hr. solar time, Sept. 5, 1977

Figure 7.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 6100 m.

Line no. 1, 2307 hr. solar time, Sept. 5, 1977

Line no. 2, 2317 hr. solar time, Sept. 5, 1977

Figure 8.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 6100 m.

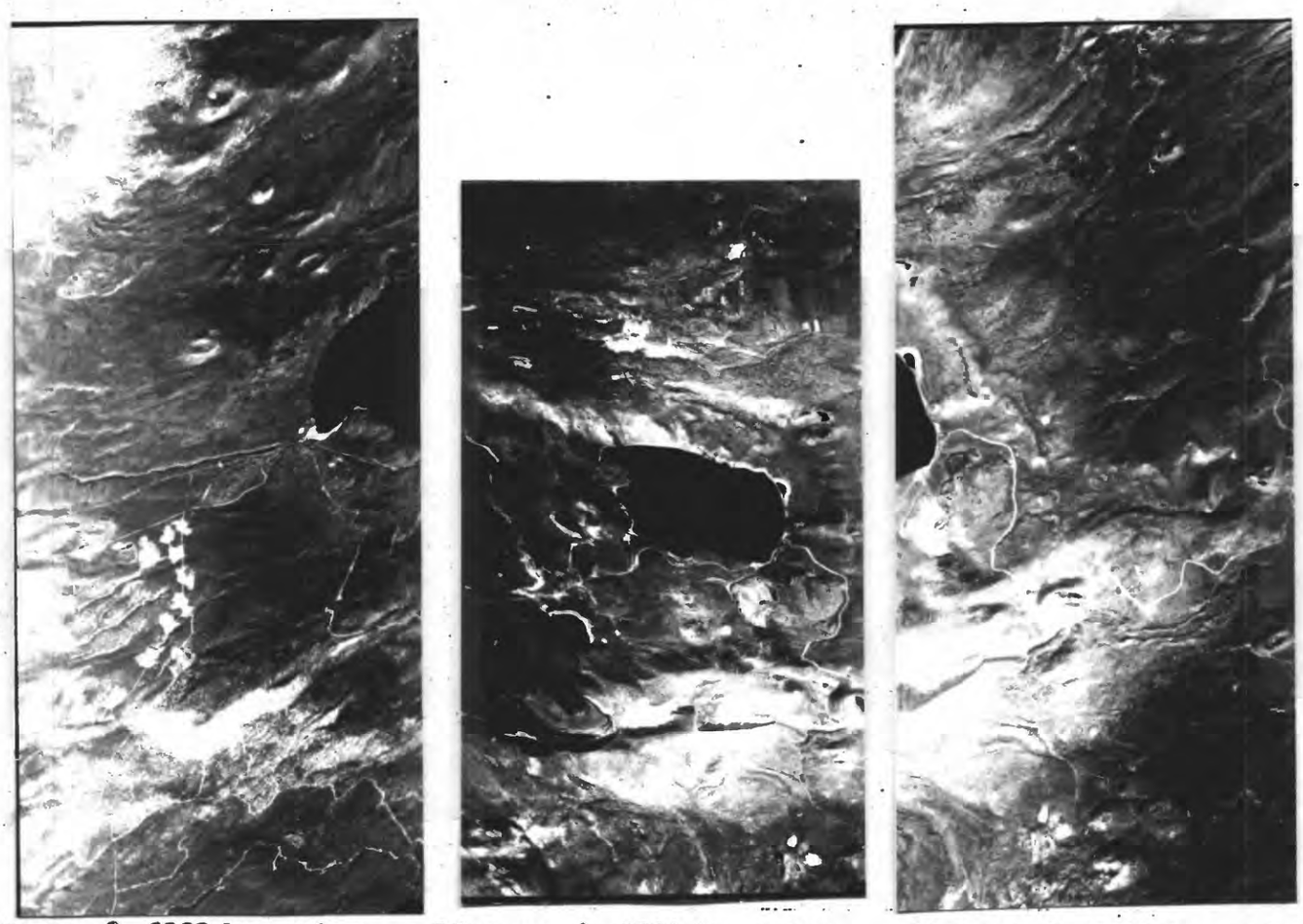


Line no. 3, 0952 hr. solar time, Sept. 4, 1977

Line no. 4, 0957 hr. solar time, Sept. 4, 1977

Line no. 5, 1003 hr. solar time, Sept. 4, 1977

Figure 9.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 5000 m.



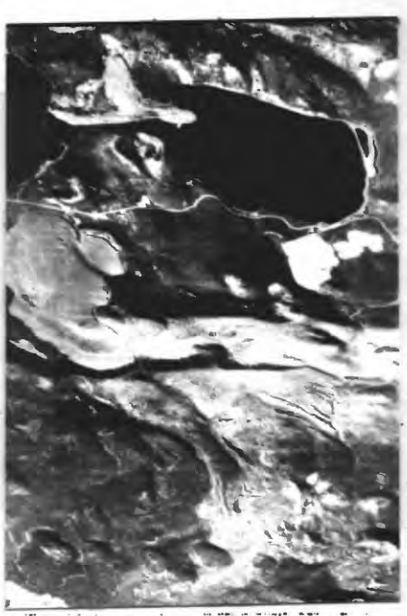
Line no. 3, 1133 hr. solar time, Sept. 6, 1977

Line no. 4, 1139 hr. solar time, Sept. 6, 1977

Line no. 5, 1145 hr. solar time, Sept. 6, 1977

Figure 10.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 5000 m.

Line no. 3, 1348 hr. solar time, Sept. 5, 1977



Line no. 4, 1404 hr. solar time, Sept. 5, 1977

Line no. 5, 1410 hr. solar time, Sept. 5, 1977

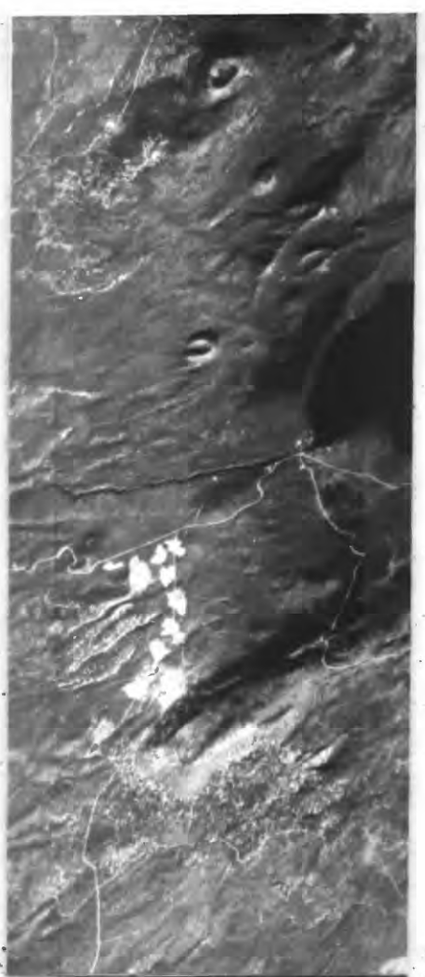
Figure 11.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 5000 m.

Line no. 3, 0952 hr. solar time, Sept. 4, 1977

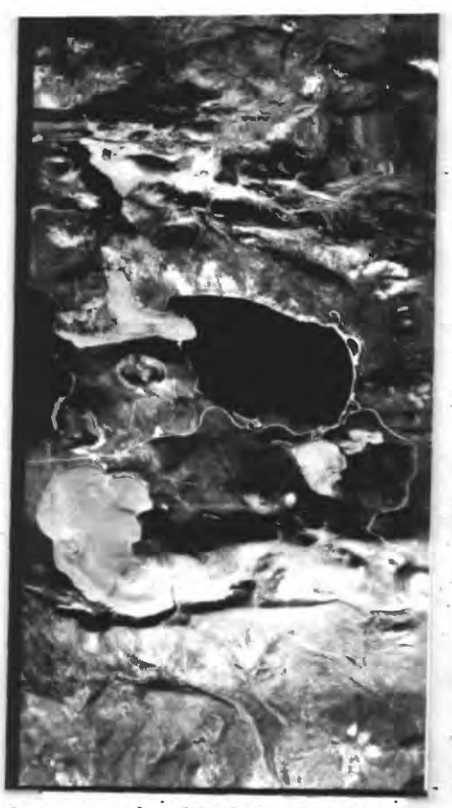
Line no. 4, 0957 hr. solar time, Sept. 4, 1977

Line no. 5, 1003 hr. solar time, Sept. 4, 1977

Figure 12.--Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 5000 m.



Line no. 3, 1133 hr. solar time, Sept. 6, 1977



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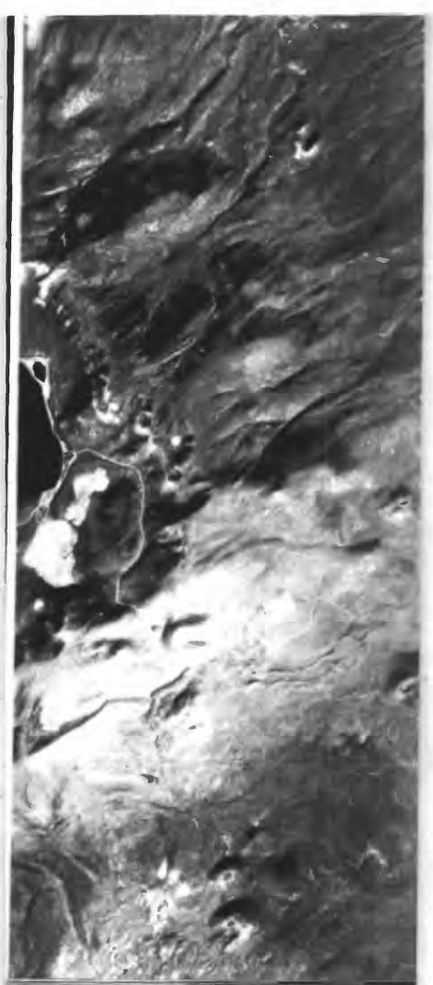
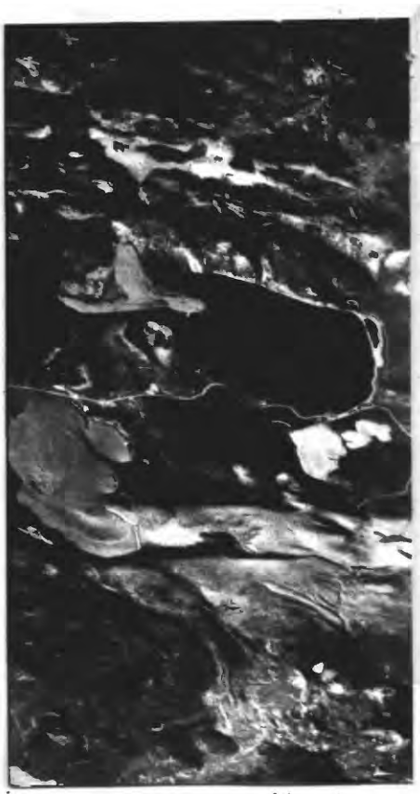


Line no. 5, 1145 hr. solar time, Sept. 6, 1977

Figure 13.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 5000 m.

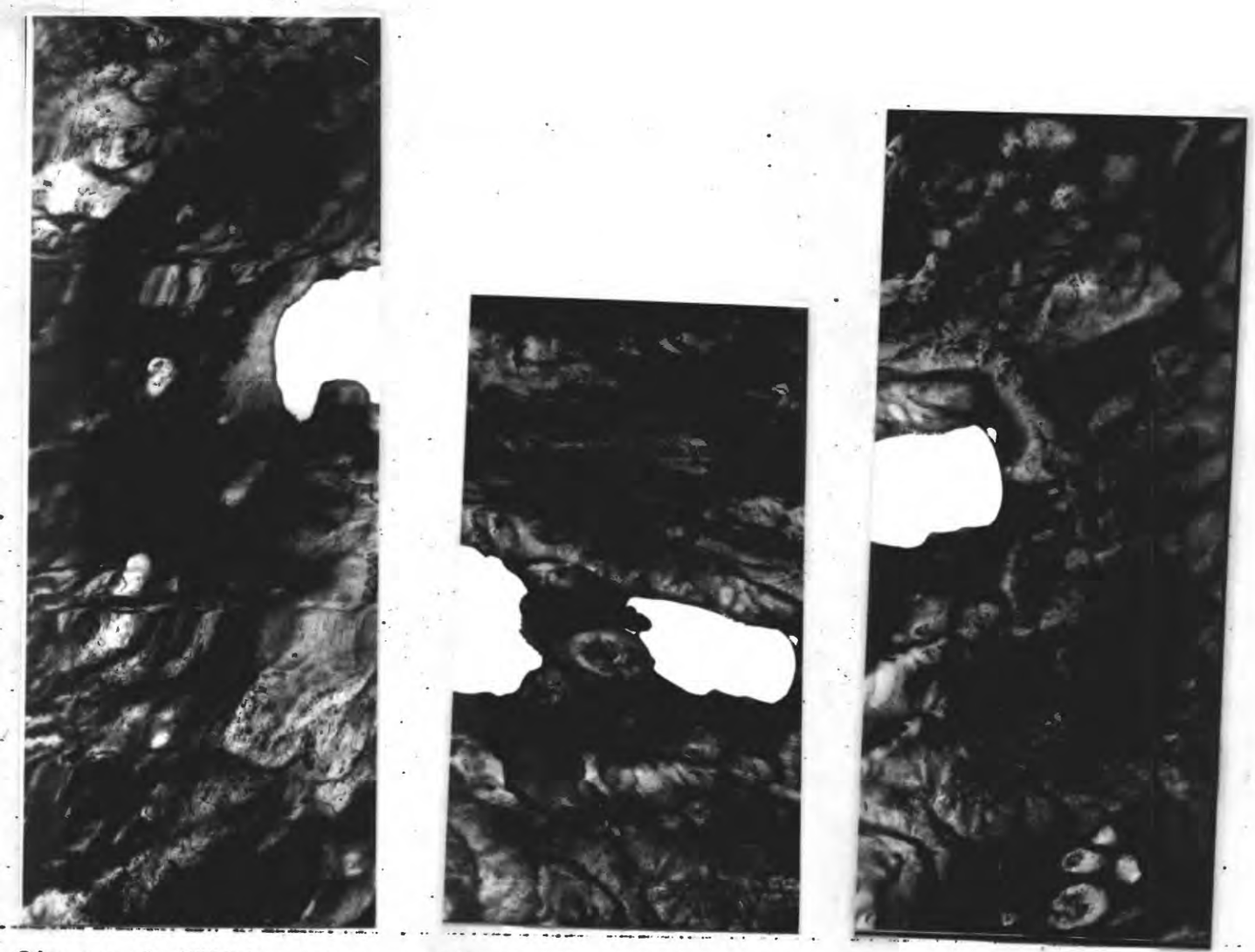
Line no. 3, 1358 hr. solar time, Sept. 5, 1977



Line no. 4, 1404 hr. solar time, Sept. 5, 1977

Line no. 5, 1410 hr. solar time, Sept. 5, 1977

Figure 14.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 5000 m.



Line no. 3, 2331 hr. solar time, Sept. 5, 1977

Line no. 4, 2339 hr. solar time, Sept. 5, 1977

Line no. 5, 2344 hr. solar time, Sept. 5, 1977

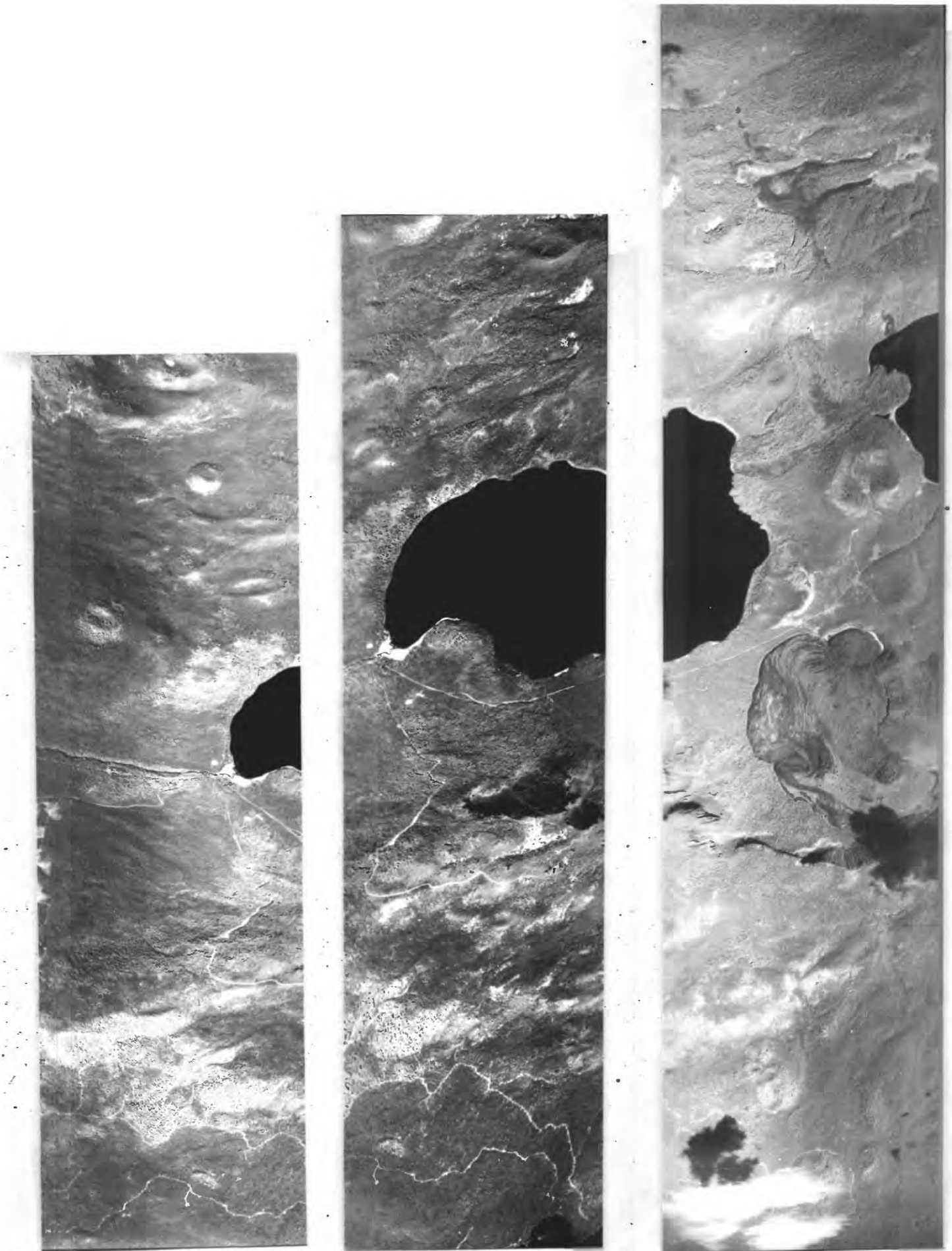
Figure 15.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 5000 m.

Line no. 6, 1013 hr. solar time, Sept. 4, 1977

Line no. 7, 1019 hr. solar time, Sept. 4, 1977

Line no. 8, 1023 hr. solar time, Sept. 4, 1977

Figure 16.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 3500 m.



Line no. 6, 1156 hr. solar time, Sept. 6, 1977

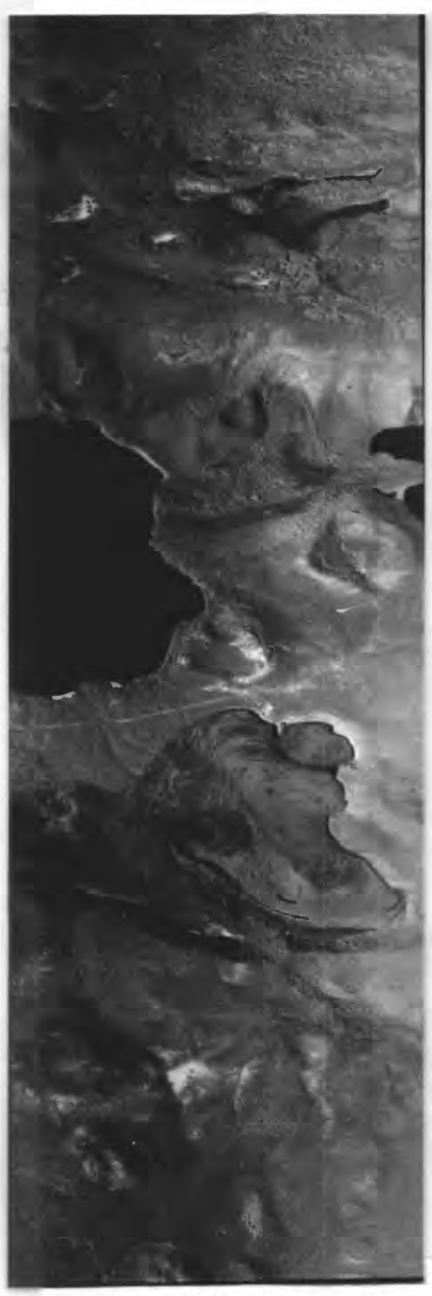
Line no. 7, 1201 hr. solar time, Sept. 6, 1977

Line no. 8, 1207 hr. solar time, Sept. 6, 1977

Figure 17.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 3500 m.

Line no. 6, 1422 hr. solar time, Sept. 5, 1977

Line no. 7, 1426 hr. solar time, Sept. 5, 1977

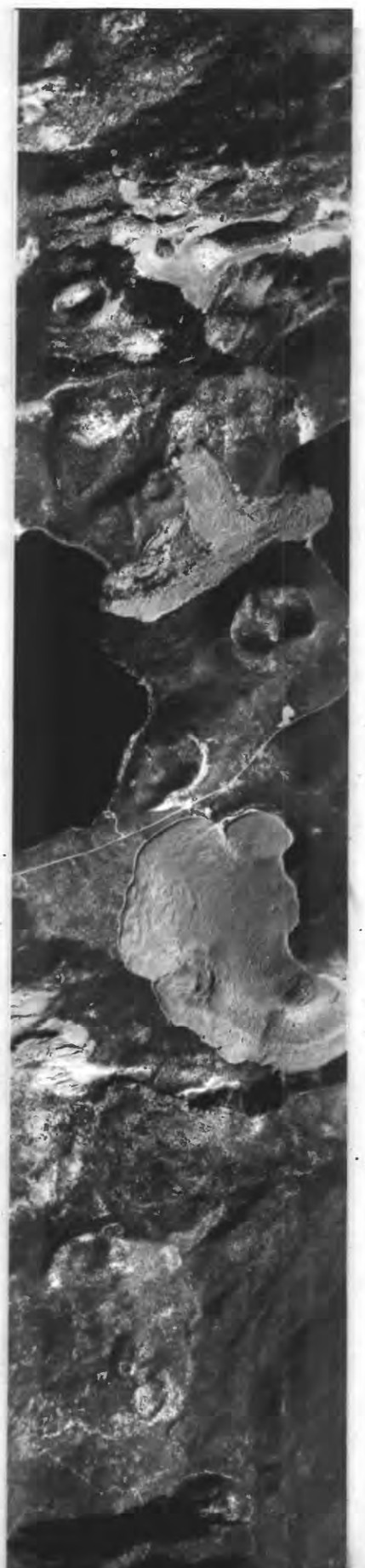


Line no. 8, 1431 hr. solar time, Sept. 5, 1977

Figure 18.--Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 3500 m.

Line no. 6, 1013 hr. solar time, Sept. 4, 1977

Line no. 7, 1019 hr. solar time, Sept. 4, 1977



Line no. 8, 1023 hr. solar time, Sept. 4, 1977

Figure 19.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

Line no. 6, 1156 hr. solar time, Sept. 6, 1977

Line no. 7, 1201 hr. solar time, Sept. 6, 1977

Line no. 8, 1207 hr. solar time, Sept. 6, 1977

Figure 20.--Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

Line no. 6, 1422 hr. solar time, Sept. 5, 1977

Line no. 7, 1426 hr. solar time, Sept. 5, 1977

Line no. 8, 1431 hr. solar time, Sept. 5, 1977

Figure 21.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

Line no. 6, 2357 hr. solar time, Sept. 5, 1977

Line no. 7, 0002 hr. solar time, Sept. 5, 1977

Line no. 8, 0009 hr. solar time, Sept. 5, 1977

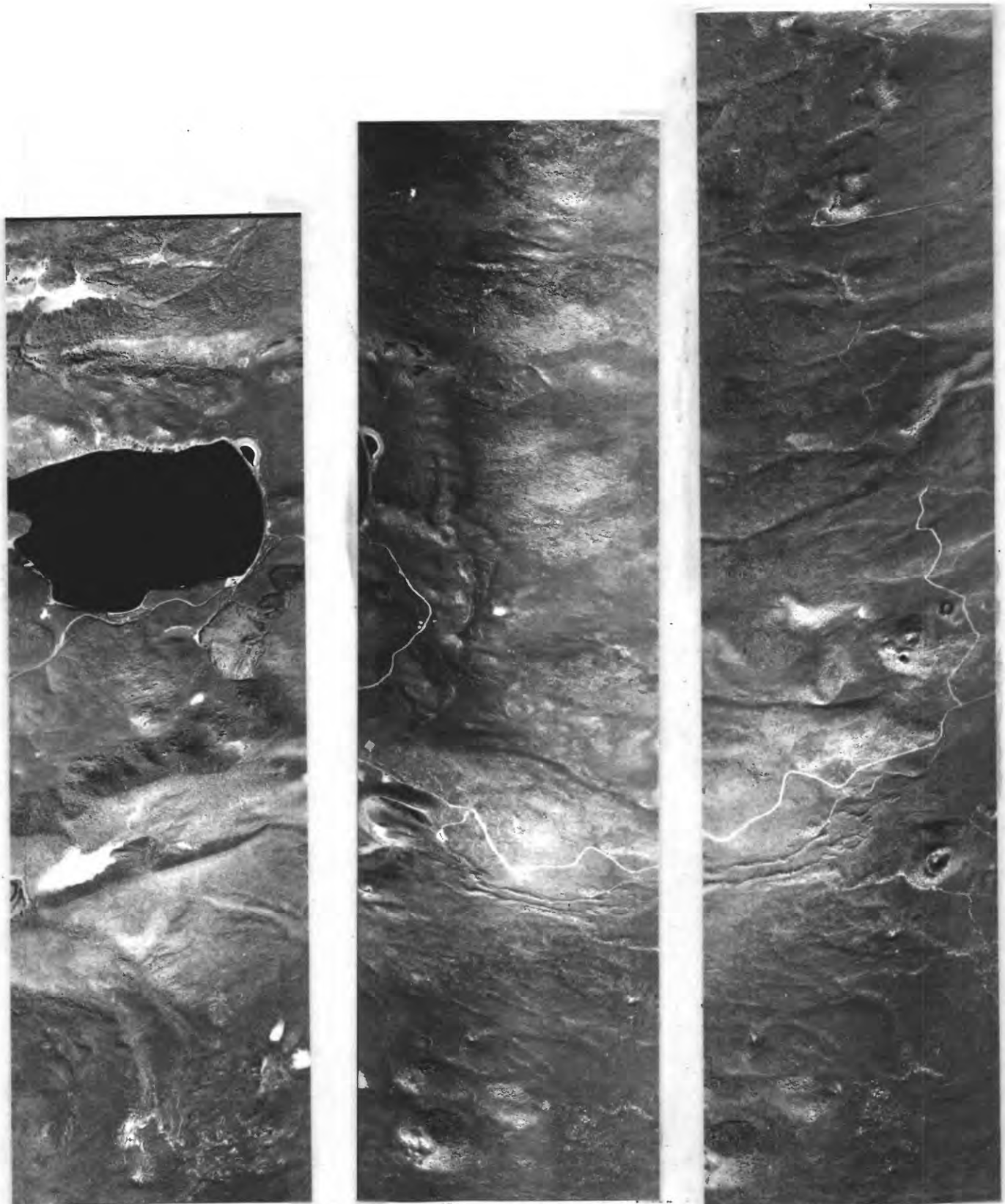
Figure 22.--Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

Line no. 9, 1029 hr. solar time, Sept. 4, 1977

Line no. 10, 1034 hr. solar time, Sept. 4, 1977

Line no. 11, 1040 hr. solar time, Sept. 4, 1977

Figure 23.--Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 3500 m.

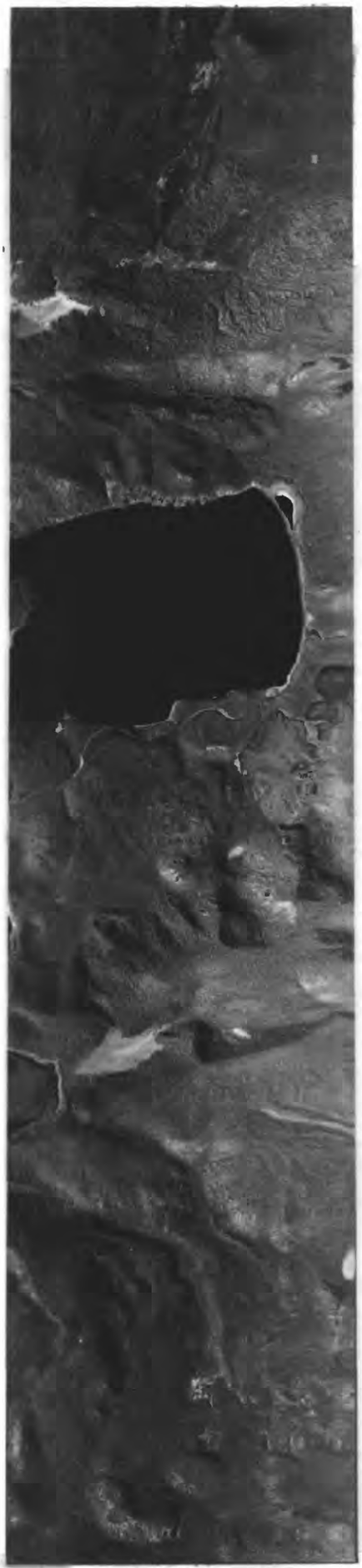


Line no. 9, 1213 hr. solar time, Sept. 6, 1977

Line no. 10, 1218 hr. solar time, Sept. 6, 1977

Line no. 11, 1223 hr. solar time, Sept. 6, 1977

Figure 24.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 3500 m.

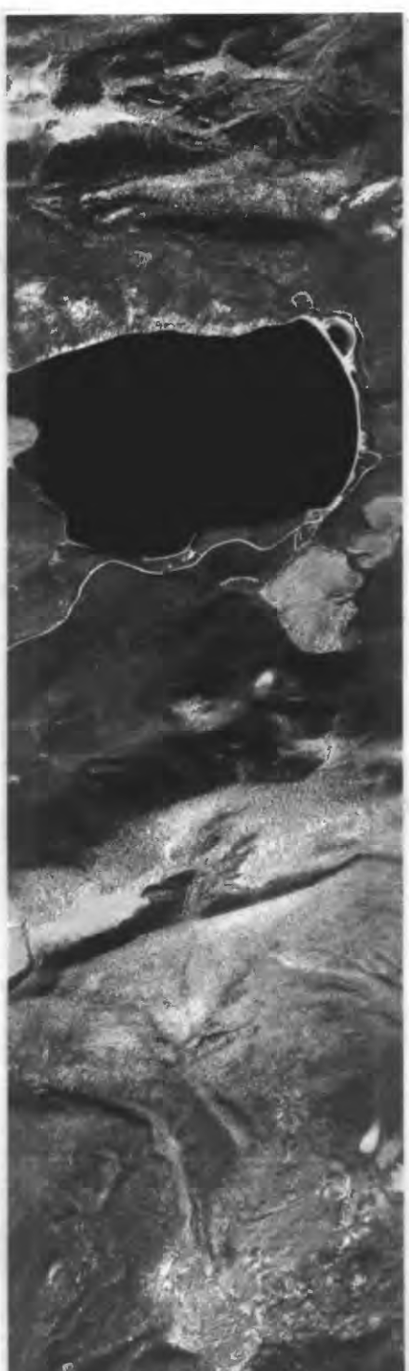


Line no. 9, 1436 hr. solar time, Sept. 5, 1977

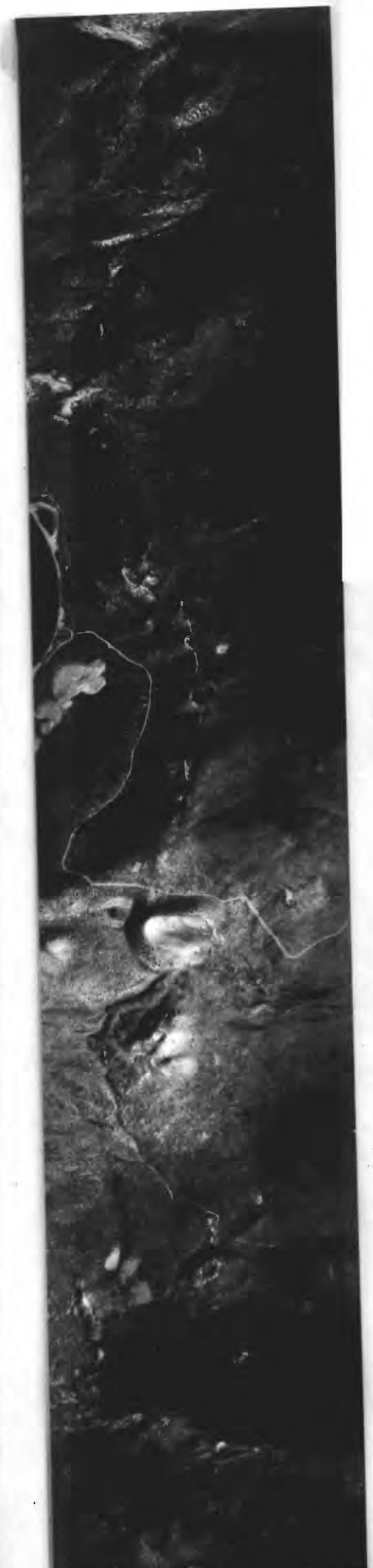
Line no. 10, 1442 hr. solar time, Sept. 5, 1977

Line no. 11, 1447 hr. solar time, Sept. 5, 1977

Figure 25.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 3500 m.



Line no. 9, 1029 hr. solar time, Sept. 4, 1977



Line no. 10, 1034 hr. solar time, Sept. 4, 1977

Line no. 11, 1040 hr. solar time, Sept. 4, 1977

Figure 26.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

Line no. 9, 1213 hr. solar time, Sept. 6, 1977

Line no. 10, 1218 hr. solar time, Sept. 6, 1977

Line no. 11, 1223 hr. solar time, Sept. 6, 1977

Figure 27.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

Line no. 9, 1436 hr. solar time, Sept. 5, 1977

Line no. 10, 1442 hr. solar time, Sept. 5, 1977

Line no. 11, 1447 hr. solar time, Sept. 5, 1977

Figure 28.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

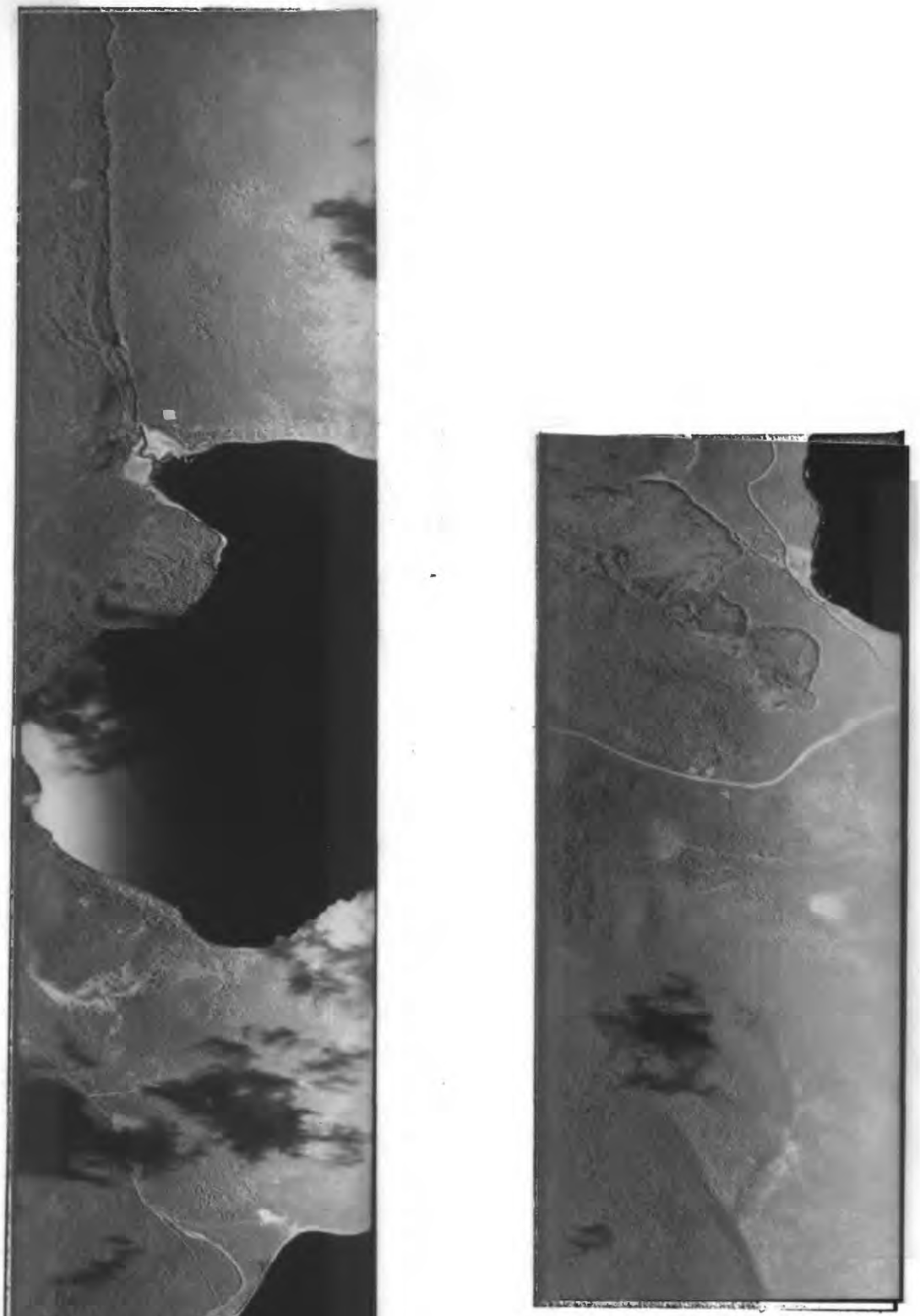
Line no. 9, 0013 hr. solar time, Sept. 5, 1977

Line no. 10, 0020 hr. solar time, Sept. 5, 1977

Line no. 11, 0024 hr. solar time, Sept. 5, 1977

Figure 29.--Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 3500 m.

West End



East End

Line no. 12, 1103 hr. solar time, Sept. 4, 1977

Figure 30.--Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 2900 m. (The actual orientation of Line 12 is east-west, see Figure 1)

East End

Line no. 12, 1247 hr. solar time, Sept. 6, 1977

East End

Line no. 12, 1511 hr. solar time, Sept. 6, 1977

Figure 31.--Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 2900 m. (The actual orientation of Line 12 is east-west, see Figure 1)

Line no. 13, 0047 hr. solar time, Sept. 5, 1977

Line no. 12, 0052 hr. solar time, Sept. 5, 1977

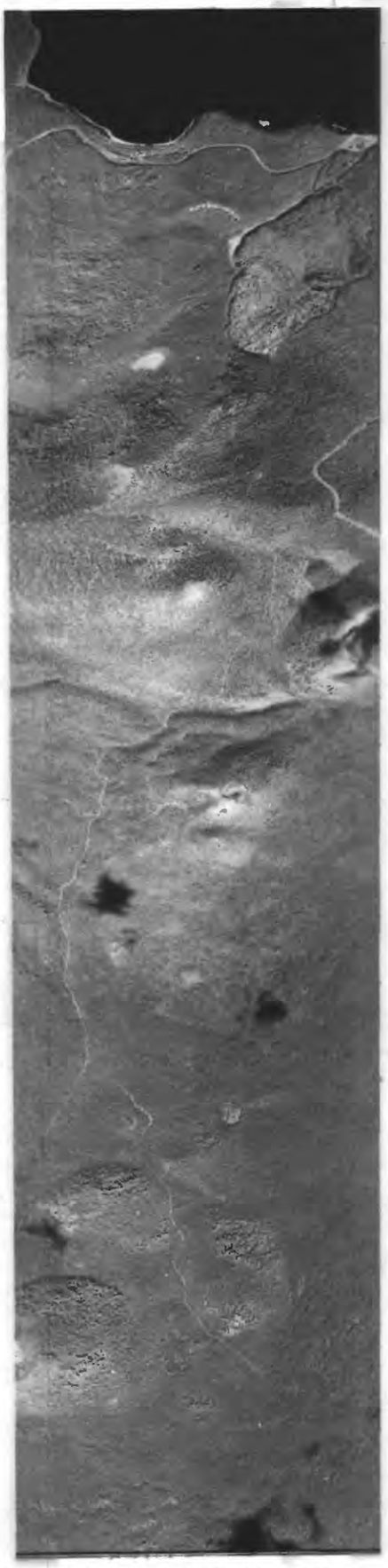
Figure 33. --Newberry Caldera thermal infrared data (8.0 to 14.0 um) acquired at 2900 m.

Line no. 14, 1047 hr. solar time, Sept. 4, 1977

Line no. 14, 1232 hr. solar time, Sept. 6, 1977

Line no. 14, 1458 hr. solar time, Sept. 5, 1977

Figure 36.--Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 2900 m. (The actual orientation of Line 14 is NW-SE)

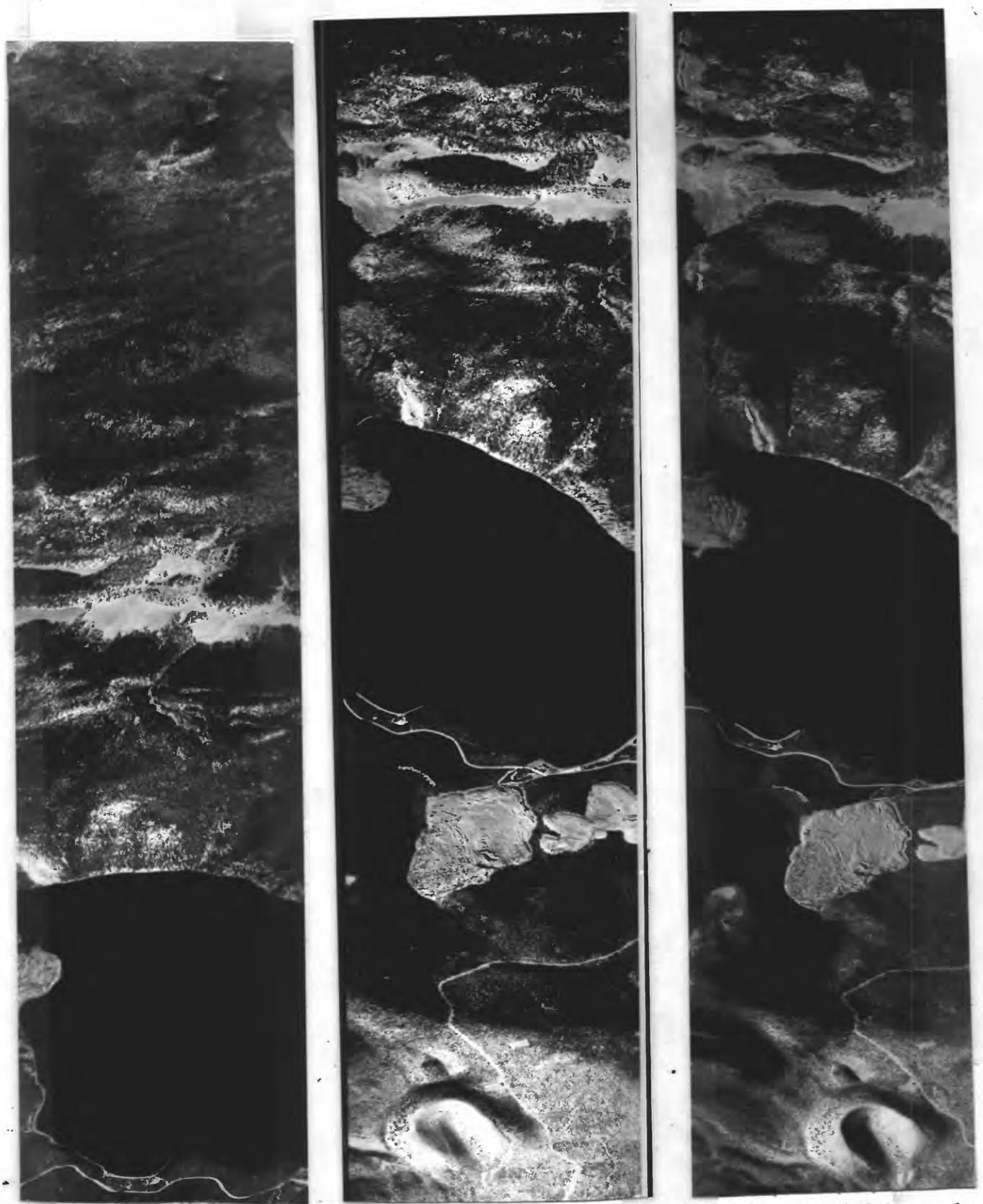


Line no. 14, 1047 hr. solar time, Sept. 4, 1977

Line no. 14, 1232 hr. solar time, Sept. 6, 1977

Line no. 14, 1458 hr. solar time, Sept. 5, 1977

Figure 36.—(Continued)



Line no. 14, 1047 hr. solar time, Sept. 4, 1977

Line no. 14, 1232 hr. solar time, Sept. 6, 1977

Line no. 14, 1458 hr. solar time, Sept. 5, 1977

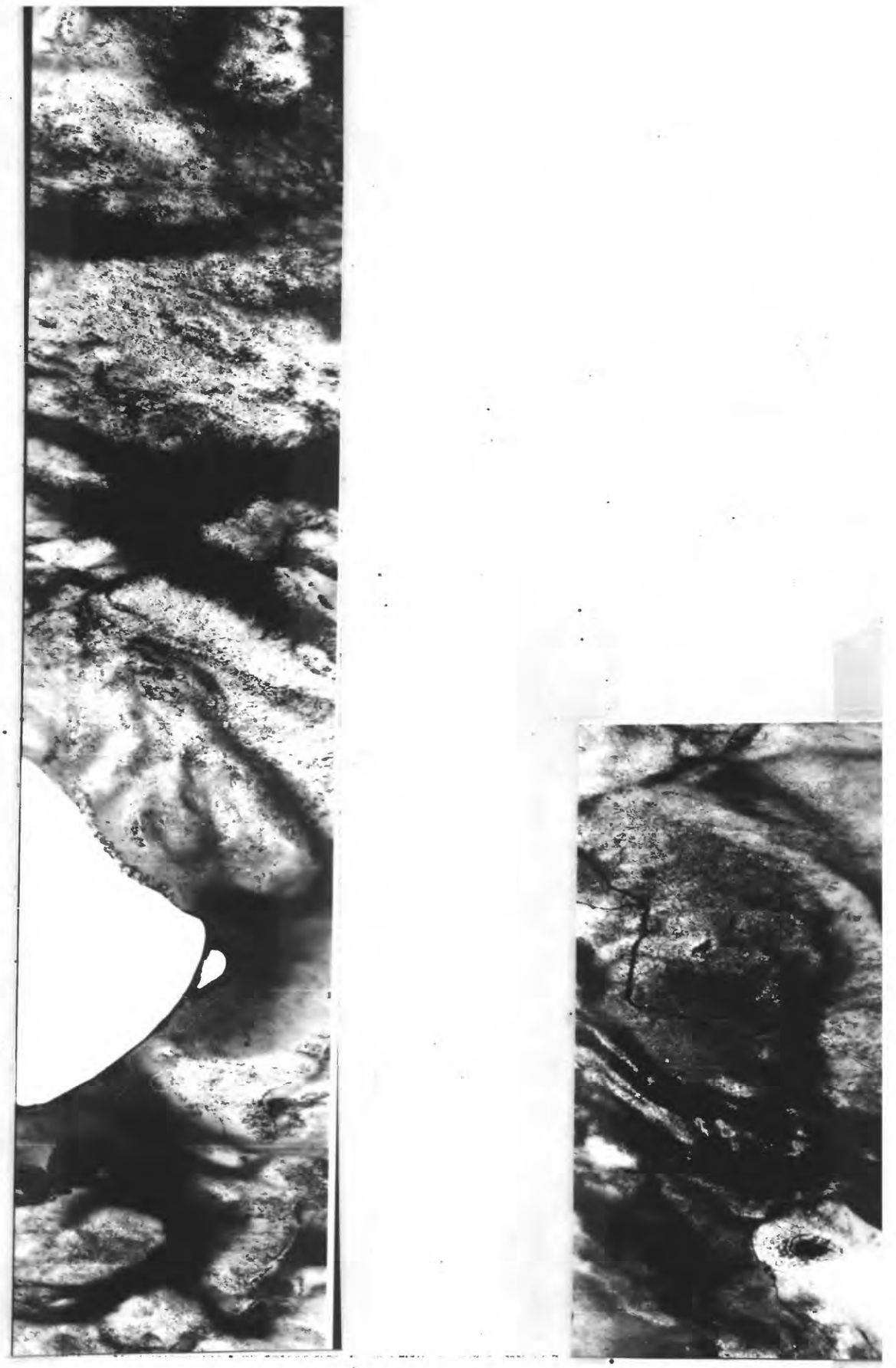
Figure 37.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 2900 m. (The actual direction of Line 14 is NW-SE, see Figure 1)

Line no. 14, 1047 hr. solar time, Sept. 4, 1977

Line no. 14, 1232 hr. solar time, Sept. 6, 1977

Line no. 14, 1458 hr. solar time, Sept. 5, 1977

Figure 37.--(Continued)



Line no. 14, 0032 hr. solar time, Sept. 5, 1977

Figure 38.--Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 2900 m. (The actual orientation of Line 14 is NW-SE, see Figure 1)

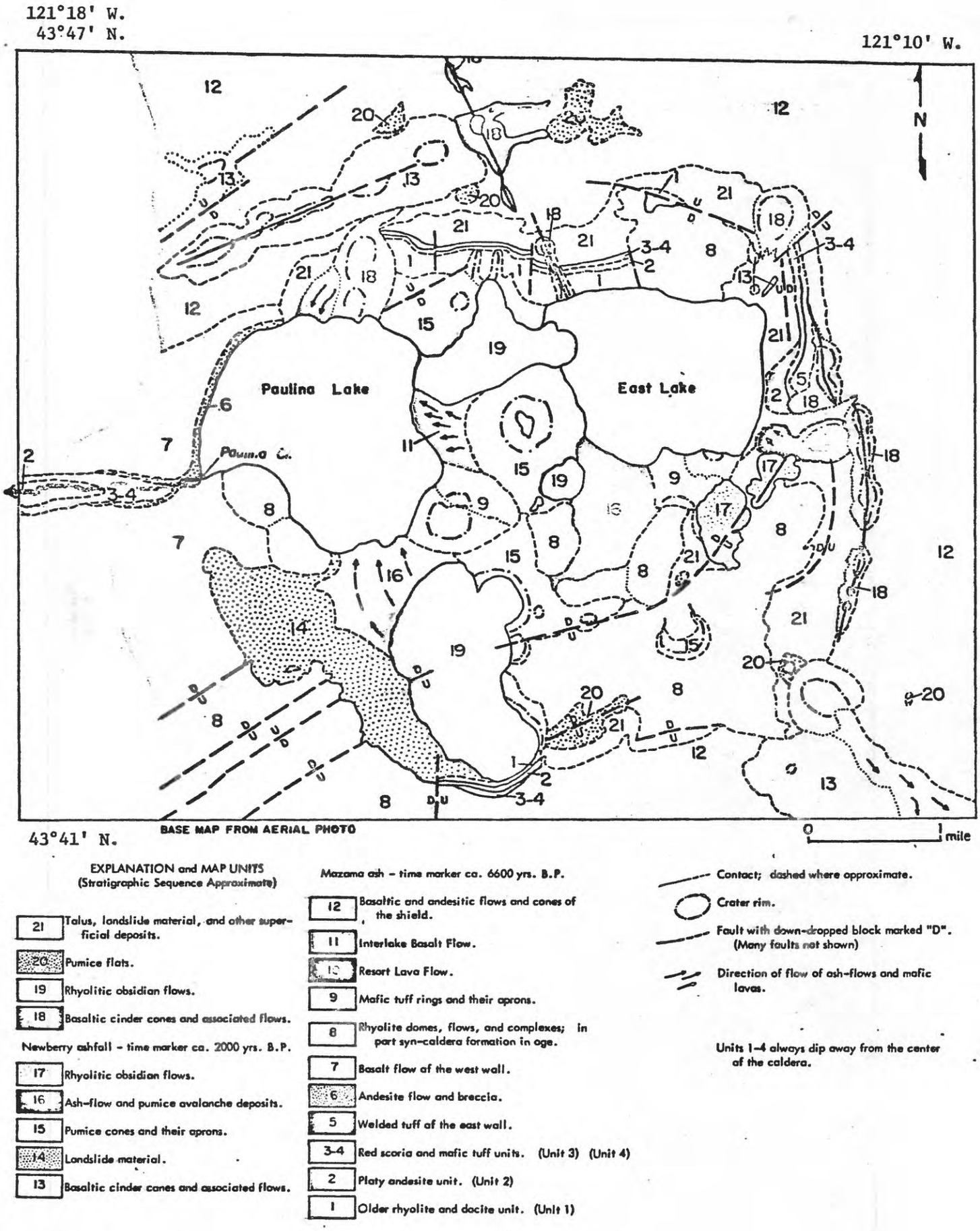
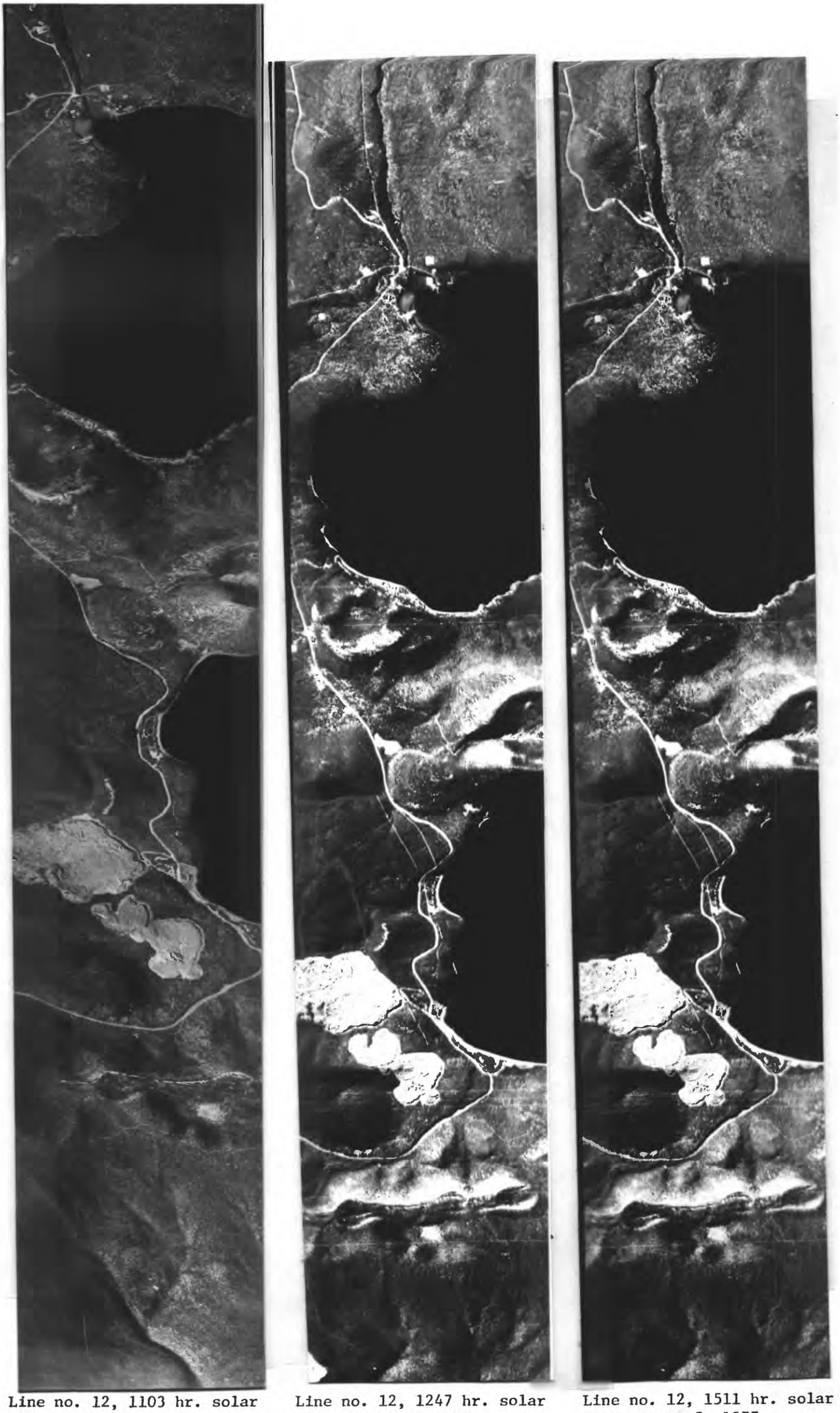


Figure 39.--Generalized geologic map of Newberry Caldera (Higgens and Waters, 1968).



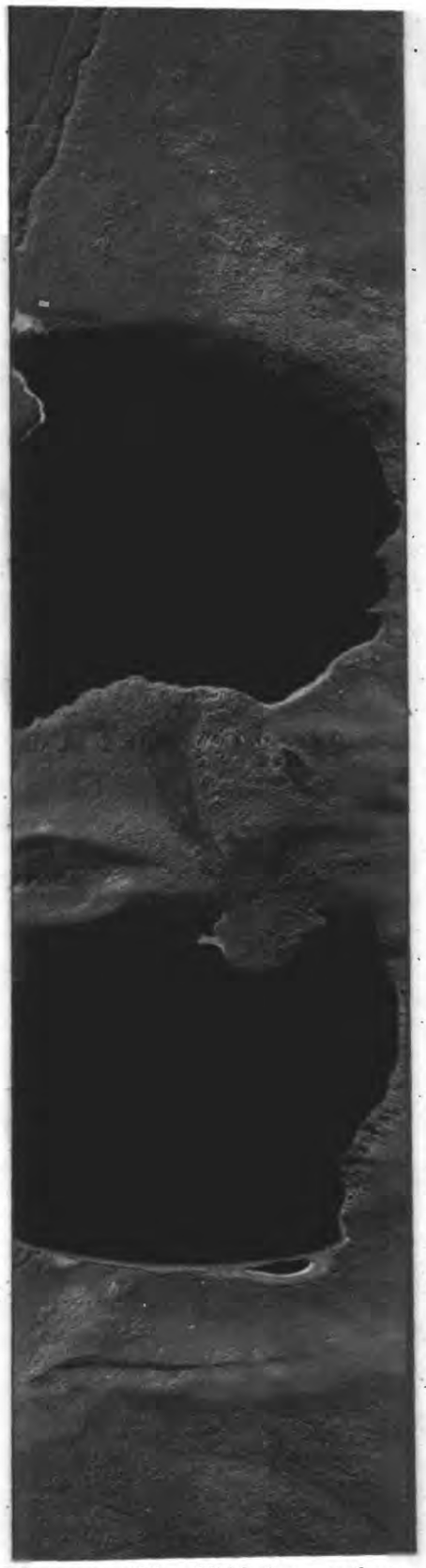
Line no. 12, 1103 hr. solar time, Sept. 4, 1977

Line no. 12, 1247 hr. solar time, Sept. 6, 1977

Line no. 12, 1511 hr. solar time, Sept. 5, 1977

Figure 32.--Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 2900 m. (The actual orientation of Line 12 is east-west, see Figure 1)

Line no. 13, 1058 hr. solar time, Sept. 4, 1977



Line no. 13, 1243 hr. solar time, Sept. 4, 1977

Line no. 13, 1507 hr. solar time, Sept. 4, 1977

Figure 34.—Newberry Caldera reflectance data (0.7 to 0.8 μm) acquired at 2900 m. (The actual orientation of Line 13 is NE-SW, see Figure 1)

Line no. 13, 1053 hr. solar time, Sept. 4, 1977

Line no. 13, 1243 hr. solar time, Sept. 6, 1977

Line no. 13, 1507 hr. solar time, Sept. 5, 1977

Figure 35.—Newberry Caldera thermal infrared data (8.0 to 14.0 μm) acquired at 2900 m. (The actual orientation of Line 13 is NE-SW)