UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Multispectral reflectance and thermal infrared aircraft mission of Mt. Hood, Oregon, September, 1977

by

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Introduction

Mount Hood in northwestern Oregon was the site of a multispectral reflectance and thermal infrared aerial survey. The area bounded by the coordinates 45°20' to 45°25.5' latitude and 121°40' to 121°46' longitude was overflown four times from September 1 to September 7, 1977.

Mount Hood is a relatively symmetrical composite volcano on the crest of the Cascade Range, the summit of which is 1800 m above the surrounding terrain. Of particular interest in this survey was the geothermally warm ground and fumarole fields located about 500 m south of the summit (Friedman and Frank, 1977). The primary intent was to map these thermal areas in order to detect any changes in size and location.

The purpose of this report is to show the coverage of this aerial survey and to present examples of the reflectance and thermal infrared data that were acquired.

Data Acquisition

The images were acquired with an RS14A Texas Instrument multispectral scanner mounted in a Porter STOL aircraft. The scanner has a thermal channel of 7.5 to 12.5 μm, and five visible and near infrared bands: 0.4 to 0.5 μm, 0.5 to 0.6 μm, 0.6 to 0.7 μm, 0.7 to 0.8 μm, and 0.8 to 1.1 μm. All channels have a 3 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 five altitudes above sea level: 6100 m, 4600 m, 3800 m, 3700 m, and 3000 m. The actual coverage can be determined from figures 2 through 27 for the four acquisition times of approximately 1000, 1200, 1400, and 2400 hours local solar time. The following table summarizes the altitude for each flight line.

FLIGHT LINE NO.	ALTITUDE (m)
1, 2, 3	6100
1	4600
4, 5	3800
6, 7	3700
8, 9	3000

The swath width and ground resolution of the data is continuously varying because of the terrain variation. Two special acquisitions were made over the fumarole fields. The first was flown at approximately 1000 hours local solar

time at an altitude of 3800 m above sea level. The second was flown at approximately solar midnight at an altitude of 4400 m above sea level (See fig. 27). Structural and heat flow implications of infrared anamolies of the areas overflown by these two lines are discussed in two reports (Friedman and Frank, 1977; Friedman, Williams, and Frank, in progress).

Figures 2 through 27 are photographic prints of the reflectance data (0.7 to 0.8 μm) and the thermal infrared data (8.0 to 14.0 μm). These images are presented in the following order: by flight line, altitude, then reflectance and thermal data, and finally time of acquisition. All flight lines were flown as close to north/south as possible. The winds aloft sometimes forced the aircraft to crab and these images show corresponding coverage variations and geometric distortions. We have used the standard convention that light tones are warm for the thermal data and high reflectance for the 0.7 to 0.8 μm data.

Interpretation of thermal image data require 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 does not discriminate these causes. No interpretation schemes have been applied to this data set.

REFERENCES

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5. Friedman, J. D., and Frank, David, 1977, Structural and heat-flow implications of infrared anamolies at Mt. Hood, Oregon: U.S. Geological Survey Open-File Report No. 77-599.

6. Friedman, J. D., Williams, David, and Frank, David, Structural and heat-flow implications of infrared anamolies at Mt. Hood, Oregon (1972-1977): U.S. Geological Survey manuscript, (in progress).

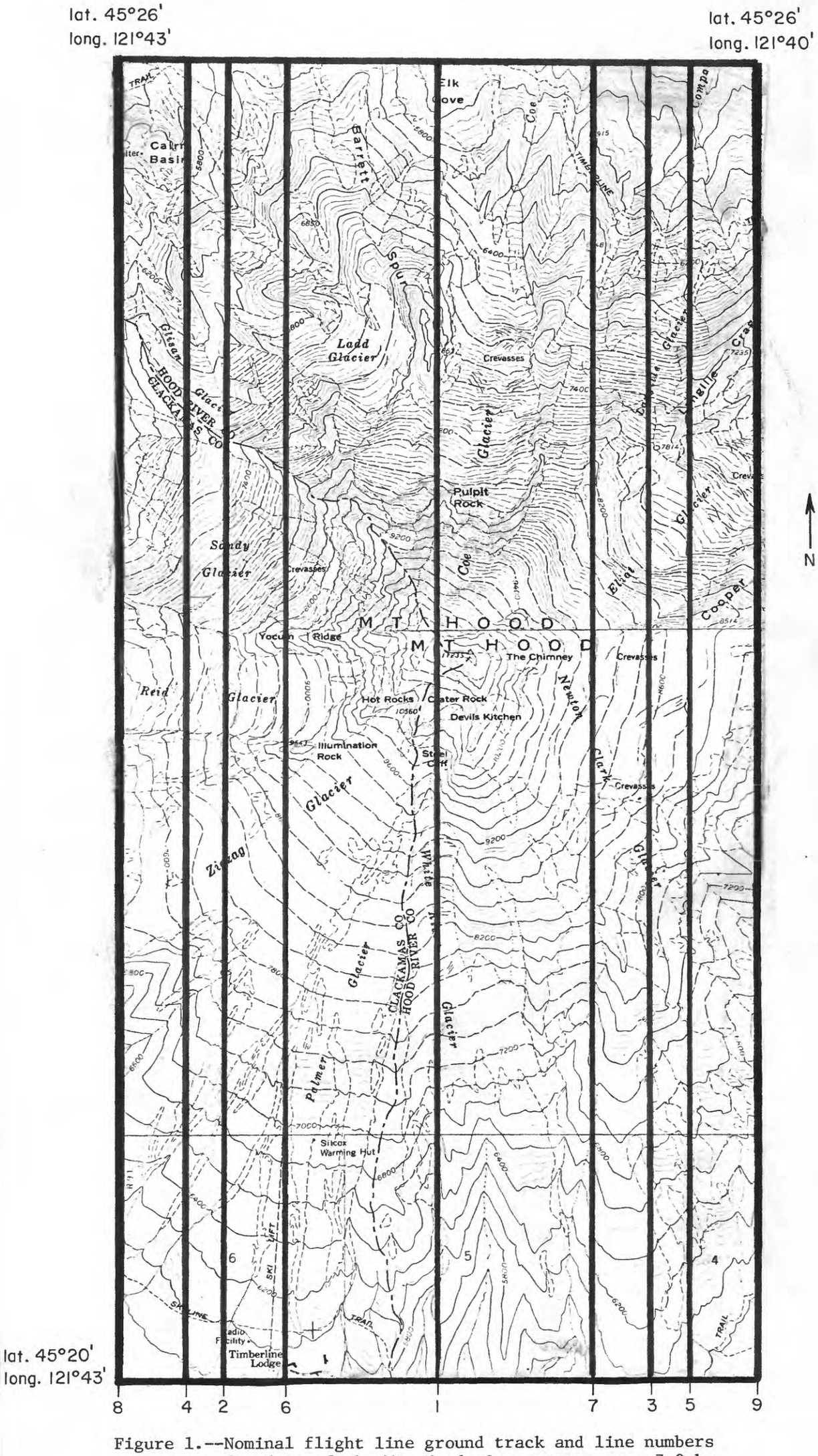


Figure 1.--Nominal flight line ground track and line numbers for data of the Mt. Hood, Ore. area. ⟵ 7.0 km

Line no. 1, 0929 hr solar time, Sept. 1, 1977

Line no. 1, 1050 hr solar time, Sept. 7, 1977

Line no. 1, 1428 hr solar time, Sept. 1, 1977

Line no. 2, 0939 hr solar time, Sept. 1, 1977

Line no. 2, 1051 hr solar time, Sept. 7, 1977

Line no. 2, 1433 hr solar time, Sept. 1, 1977

Line no. 3, 0944 hr solar time, Sept. 1, 1977

Line no. 3, 1059 hr solar time, Sept. 7, 1977

Line no. 3, 1437 hr solar time, Sept. 1, 1977

Figure 2.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 6100 m.

Line no. 1, 0955 hr solar time, Sept. 1, 1977

Line no. 1, 1108 hr solar time, Sept. 7, 1977

Line no. 1, 1447 hr solar time, Sept. 1, 1977

Figure 3.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 4600 m.

Line no. 4, 1011 hr solar time, Sept. 1, 1977

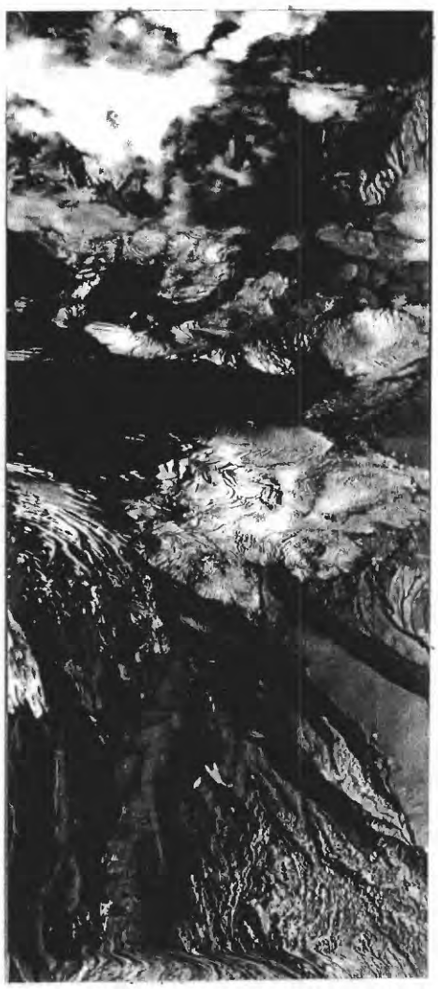
Line no. 4, 1118 hr solar time, Sept. 7, 1977

Line no. 4, 1453 hr solar time, Sept. 1, 1977

Figure 4.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3800 m.

Line no. 5, 1015 hr solar time, Sept. 1, 1977

Line no. 5, 1115 hr solar time, Sept. 7, 1977



Line no. 5, 1501 hr solar time, Sept. 1, 1977

Figure 5.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3800 m.

Line no. 6, 1021 hr solar time, Sept. 1, 1977

Line no. 6, 1127 hr solar time, Sept. 7, 1977

Line no. 6, 1504 hr solar time, Sept. 1, 1977

Figure 6.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3700 m.

Line no. 7, 1026 hr solar time, Sept. 1, 1977

Line no. 7, 1122 hr solar time, Sept. 7, 1977

Line no. 7, 1508 hr solar time, Sept. 1, 1977

Figure 7.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3700 m.

Line no. 8, 1033 hr solar time, Sept. 1, 1977 (Northern portion)

Line no. 8, 1033 hr solar time, Sept. 1, 1977 (Southern portion)

Figure 8.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3000 m.

Line no. 8, 1137 hr solar time, Sept. 7, 1977 (Northern portion)

Line no. 8, 1137 hr solar time, Sept. 7, 1977 (Southern portion)

Figure 9.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3000 m.

Line no. 8, 1513, hr solar time, Sept. 1, 1977 (Northern portion)

Line no. 8, 1513 hr solar time, Sept 1, 1977 (Southern portion)

Figure 10.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3000 m.

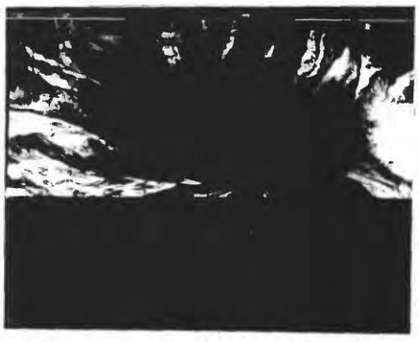
Line no. 9, 1030 hr solar time, Sept. 1, 1977

Line no. 9, 1133 hr solar time, Sept. 7, 1977

Line no. 9, 1521 hr solar time, Sept. 1, 1977

Figure 11.--Mt. Hood reflectance data (0.7 to 0.8 μm) acquired at 3000 m.

Line no. 1, 0429 hr solar time, Sept. 1, 1977



Line no. 1, 1050 hr solar time, Sept. 7, 1977

Line no. 1, 1428 hr solar time, Sept. 1, 1977

Line no. 2, 0439 hr solar time, Sept. 1, 1977

Line no. 2, 1051 hr solar time, Sept. 7, 1977

Line no. 2, 1433 hr solar time, Sept. 1, 1977

Line no. 3, 0944 hr solar time, Sept. 1, 1977

Line no. 3, 1059 hr solar time, Sept. 7, 1977

Line no. 3, 1437 hr solar time, Sept. 1, 1977

Figure 12.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 6100 m.

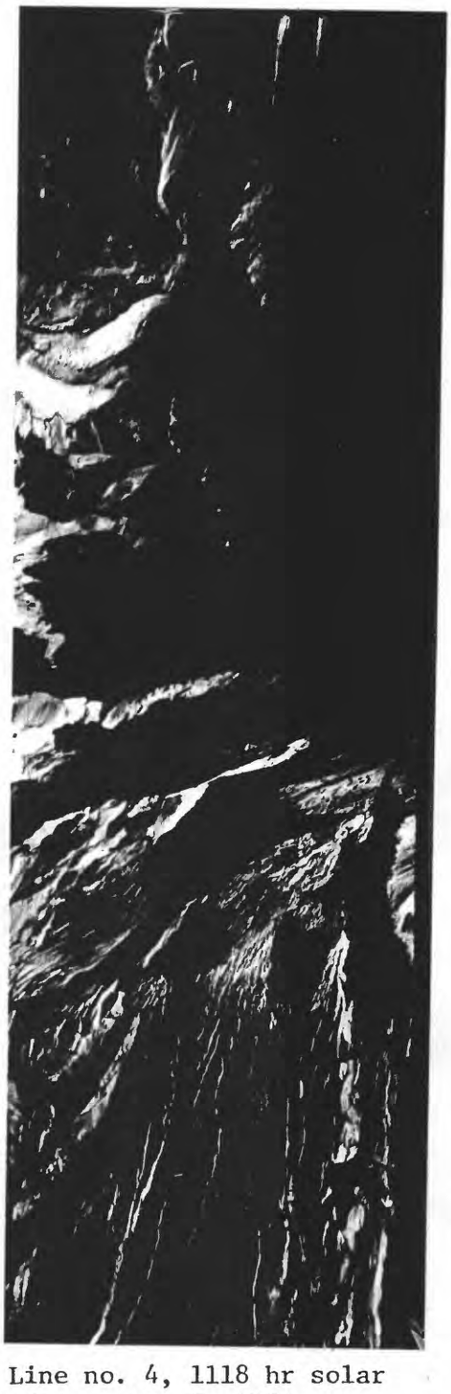
Line no. 1, 0955 hr solar time, Sept. 1, 1977

Line no. 1, 1108 hr solar time, Sept. 7, 1977

Line no. 1, 1447 hr solar time, Sept. 1, 1977

Figure 13.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 4600 m.

Line no. 4, 1011 hr solar time, Sept. 1, 1977



Line no. 4, 1118 hr solar time, Sept. 7, 1977

Line no. 4, 1453 hr solar time, Sept. 1, 1977

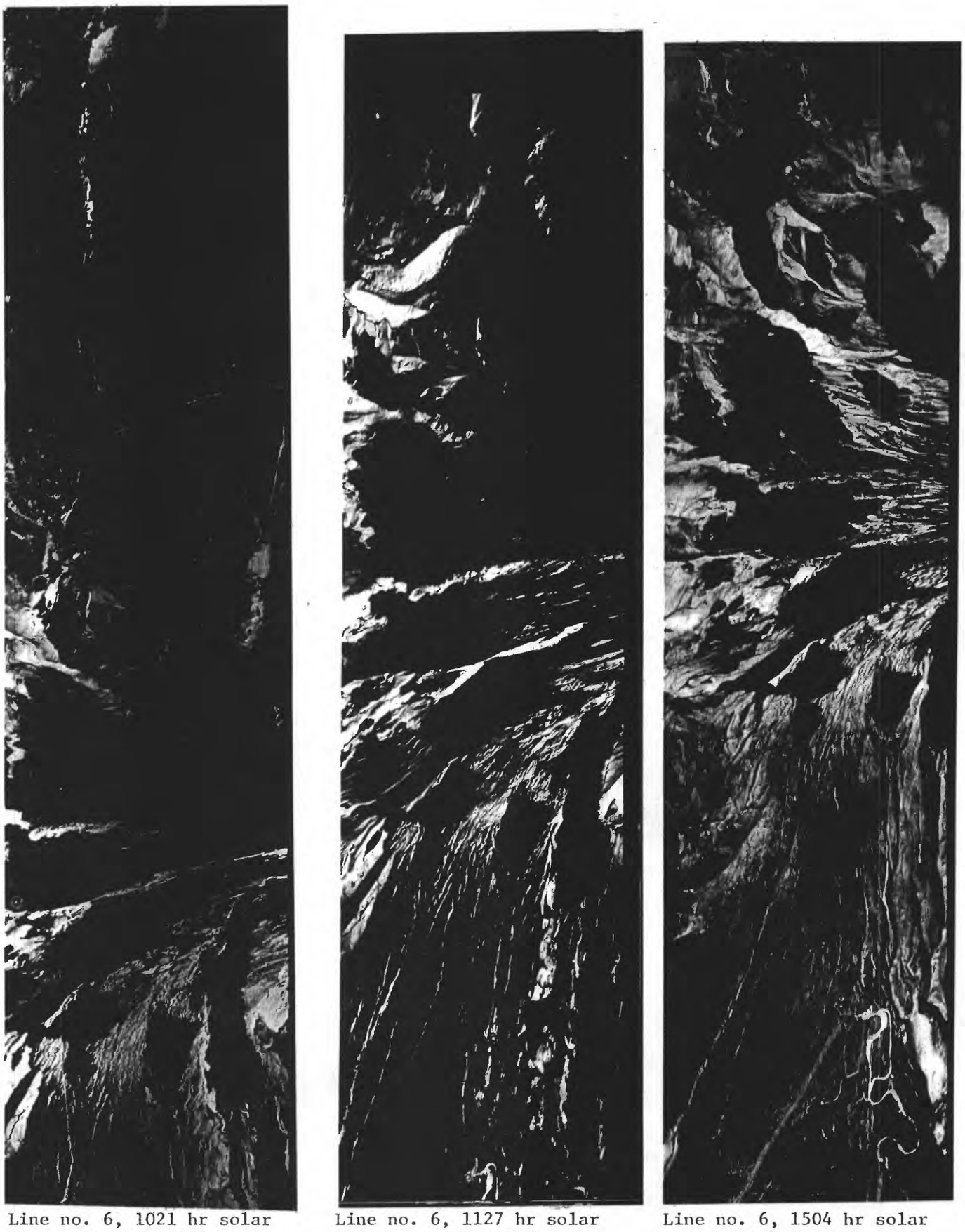
Figure 14.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3800 m.

Line no. 5, 1016 hr solar time, Sept. 1, 1977

Line no. 5, 1115 hr solar time, Sept. 7, 1977

Line no. 5, 1501 hr solar time, Sept. 1, 1977

Figure 15.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3800 m.



Line no. 6, 1021 hr solar time, Sept. 1, 1977

Line no. 6, 1127 hr solar time, Sept. 7, 1977

Line no. 6, 1504 hr solar time, Sept. 1, 1977

Figure 16.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3700 m.

Line no. 7, 1026 hr solar time, Sept. 1, 1977

Line no. 7, 1122 hr solar time, Sept. 7, 1977

Line no. 7, 1518 hr solar time, Sept. 1, 1977

Figure 17.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3700 m.

Line no. 8, 1033 hr solar time, Sept. 1, 1977 (Northern portion)

Line no. 8, 1033 hr solar time, Sept. 1, 1977 (Southern portion)

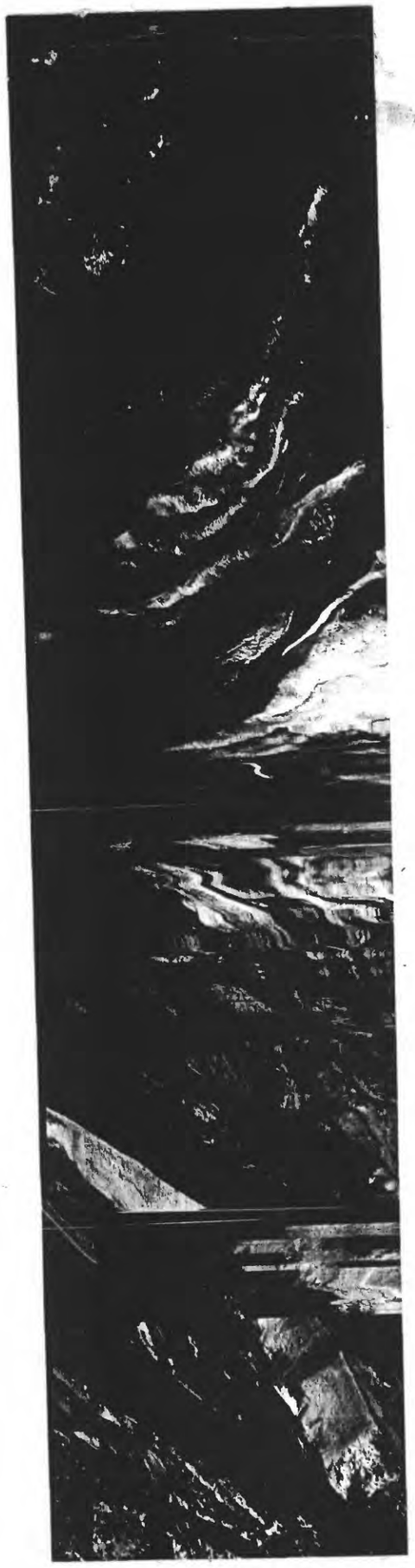
Figure 18.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3000 m.

Line no. 8, 1137 hr solar time, Sept. 7, 1977

Line no. 8, 1513 hr solar time, Sept. 7, 1977 (Northern portion)

Line no. 8, 1513 hr solar time, Sept. 7, 1977 (Southern portion)

Figure 19.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3000 m.



Line no. 9, 1037 hr solar time, Sept. 1, 1977 (Northern portion)

Line no. 9, 1039 hr solar time, Sept. 7, 1977 (Southern portion)

Figure 20.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3000 m.

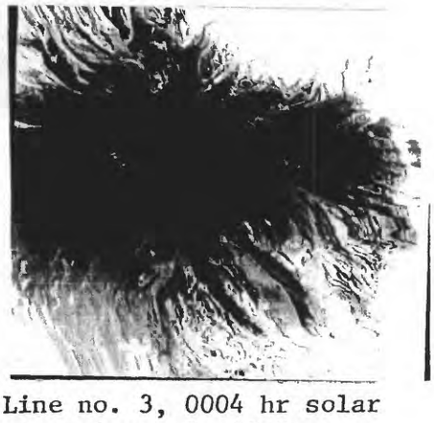
Line no. 9, 1133 hr solar time, Sept. 7, 1977

Line no. 9, 1521 hr solar time, Sept. 1, 1977

Figure 21.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3000 m.

Line no. 1, 0006 hr solar time, Sept. 2, 1977

Line no. 2, 0001 hr solar time, Sept, 2, 1977



Line no. 3, 0004 hr solar time, Sept. 2, 1977

Figure 22.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 6100 m.

Line no. 1, 0011 hr solar time, Sept. 2, 1977 (Northern portion)

Line no. 1, 0011 hr solar time, Sept. 2, 1977 (Southern portion)

Figure 23.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 4600 m.

Line no. 4, 0027 hr solar time, Sept. 2, 1977

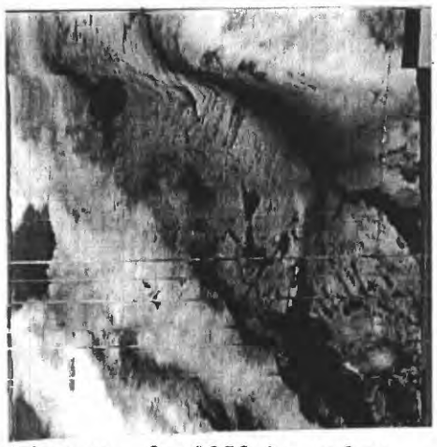
Line no. 5, 0023 hr solar time, Sept. 2, 1977

Figure 24.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3800 m.

Line no. 5, 0039 hr solar time, Sept. 2, 1977

Line no. 7, 0033 hr solar time, Sept. 2, 1977

Figure 25.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3700 m.



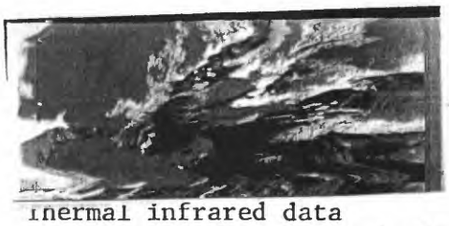
Line no. 8, 0052 hr solar time, Sept. 2, 1977 (Northern portion)

Line no. 8, 0052 hr solar time, Sept. 2, 1977 (Southern portion)

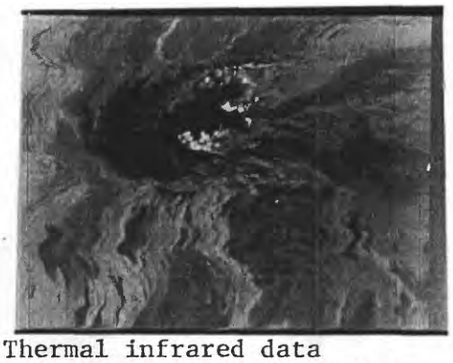
Line no. 9, 0087 hr solar time, Sept. 2, 1977

Figure 26.--Mt. Hood thermal IR data (8.0 to 14.0 μm) acquired at 3000 m.

Reflectance data acquired at 3800 m. altitude, and 1008 hr. solar time, Sept. 1, 1977



Thermal infrared data acquired at 3800 m. altitude and 1008 hr. solar time, Sept. 1, 1977



Thermal infrared data acquired at 4400 m. altitude and 0107 hr. solar time, Sept. 2, 1977

Figure 27.--Reflectance (0.7 to 0.8 μm) and thermal infrared (8.0 to 14.0 μm) data from the fumarole fields of the Mt. Hood, Oregon area.