U. S. Geological Survey

Open File Reports

NO. 1466: 1970


U.S. GEOLOGICAL SURVEY LIBRARY
CLASS

UNITED STATES

DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

[Report - Open file series]

PRELIMINARY ANALYSIS OF INFRARED IMAGERY

PAHUTE MESA AREA, NEVADA TEST SITE, NASA SITE 52

by

Robert H. Morris
W. D. Carter
Paul P. Orkild

1970

U. S. Geological Survey
OPEN FILE REPORT

U.S. GEOLOGICAL SURVEY
WASHINGTON, D. C.
20242

For release AUGUST 10, 1970

The U.S. Geological Survey is releasing in open file the following reports. Copies are available for inspection in the Geological Survey Libraries, 1033 GSA Bldg., Washington, D.C. 20242; Bldg. 25, Federal Center, Denver, Colo. 80225; and 345 Middlefield Rd., Menlo Park, Calif. 94025; and in other offices as listed:

1. Mineral resources of parts of the Departments of Antioquia and Caldas, Zone II, Colombia, by Robert N. Hall, Tomas Feininger, Dario Barrero L., Héctor Rico H., and Jairó Alvarez A. 164 p., 3 pl., 4 figs., 3 tables.

2. Preliminary analysis of infrared imagery, Pahute Mesa area, Nevada Test Site, NASA site 52, by Robert H. Morris, W. D. Carter, and Paul P. Orkild. 5 p., 6 figs. 601 E. Cedar Ave., Flagstaff, Ariz. 86001.

* * * * *

CONTENTS

	Page
Abstract	1
Introduction	2
Analysis of data	3
Conclusions	5

ILLUSTRATIONS

Figure 1. Index and portion of the geologic map of Pahute Mesa, Nevada Test Site, Nye County, Nevada

Figure 2. Nighttime infrared imagery (3-5 micrometer) showing suspected fault (dark) and welded tuffs (bright) at northern end of line A

Figure 3. Nighttime infrared imagery (3-5 micrometer) showing distribution of welded tuff layers (bright) at southern end of line A

Figure 4. Nighttime infrared imagery (8-14 micrometer) showing area of figures 2 and 3 from higher altitude along line B

Figure 5. Daytime infrared imagery (8-14 micrometer) showing effects as viewed from line C

Figure 6. A portion of vertical panchromatic photography (original scale 1:62,500) of the Pahute Mesa area

PRELIMINARY ANALYSIS OF INFRARED IMAGERY, PAHUTE MESA AREA, NEVADA TEST SITE, NASA SITE 52

by

Robert H. Morris, W. D. Carter, and Paul P. Orkild

ABSTRACT

Infrared images from two aircraft missions, flown by HRB-Singer Inc., August 10, 1966, and by NASA, Mission 30, September 3, 1966, have been analyzed. The HRB-Singer Inc. data, obtained in the 3-5 micrometer wavelength band between 10:32 and 11:53 p.m. (MST) in spite of smoke in the atmosphere, revealed a fault that had not been mapped in the field and that was not visible on vertical black and white aerial photography.

Twenty-four days later under clear weather conditions, the NASA aircraft obtained infrared imagery in the 8-14 micrometer band on a night overflight of the same area, but the fault mentioned above is not readily identified.

Nighttime infrared observations assist stratigraphic and structural studies. Rhyolitic lava flows and welded tuff layers, having relatively high thermal inertia, are well outlined as bright (warm) areas on both sets of the nighttime imagery.

INTRODUCTION

Infrared investigations began at the Atomic Energy Commission's Nevada Test Site (designated site 52 by the NASA remote sensor investigations) in southern Nevada near Pahute Mesa on August 10, 1966, with an overflight by HRB-Singer Inc., on contract to the U. S. Geological Survey. The mission, 4027-17, consisted of seven passes between 10:32 and 11:53 p.m. (MST); three flying north, three flying south, and one flying southwest. The instrument used was a Reconofax IV infrared scanner operating unfiltered in the 3-5 micrometer band. The night weather was complicated by a thick layer of smoke (and haze) from distant California forest fires.

A second mission was flown on September 3, 1966, by the NASA Convair 240 (Mission 30) using an unfiltered Reconofax IV infrared scanner in the 8-14 micrometer band. Parallel north-south lines were flown at night between 3:11 and 3:48 a.m. (MST) under optimum weather conditions--a clear moonlit night. A similar mission was flown between 9:30 and 11:00 a.m. with clear skies and bright sunlight.

Ground support consisted of marking the flight lines with strobe lights for the night missions. The principal investigator was in the aircraft to guide the aircraft crew. No ground monitoring was conducted during the overflight periods.

The object of the missions was to determine 1) if anomalous thermal variations were present in the area; 2) if so, to define their location, limits, and causes so that ground monitoring programs could be planned for future missions; and 3) to compare the effects of radiant emission

recorded in 3-5 micrometer and 8-14 micrometer wavelength bands. Geologic mapping of the area had been completed prior to the mission.

Pahute Mesa area is in the northwestern part of the Atomic Energy Commission's Nevada Test Site. The site is located about 12 miles northwest of Yucca Flat and 24 miles northeast of Sarcobatus Flat. Mercury, the main base camp, is 60 miles to the southeast. The area consists of canyon and mesa terrain ranging in elevation from 5200 to 7300 feet above sea level. Sparse desert vegetation characterizes the lowlands. In the higher elevations sage, pinon, and other desert plants are relatively abundant.

The geology of the area is relatively simple, consisting of flat-lying block-faulted strata of Tertiary age. The rocks consist largely of interlayered volcanic lava flows, and tuffs of varying density. Silicic rhyolitic lava flows and welded tuffs of relatively higher density form benchlike outcrops; nonwelded and bedded tuffs of lower density form the intervening gentle slopes. North- to northeast-trending normal faults cut through the area.

ANALYSIS OF DATA

Figure 1 is an index map of a portion of the geologic map of Pahute Mesa showing the location of flight lines for the data included in this report. Line A marks the center of the flight line along which figures 2 and 3 from the Singer mission were obtained. Lines B and C mark the center of the flight lines of the NASA mission which obtained imagery in figure 4 (night) and figure 5 (day). The rectangle D (figure 1) indicates the approximate coverage of the vertical black and white

aerial photograph (figure 6), original scale 1:62,500, which is included for comparative purposes.

Figure 2 shows terrain at the northern end of flight line A in 3-5 micrometer infrared imagery. Rhyolitic lava flows and welded tuffs form prominent benchlike outcrops and stand out as bright (warm) bands on the imagery. An apparent fault, which was not mapped in the field and is not apparent on vertical panchromatic aerial photographs, is distinguished by a line separating dark (cold) from light (warm) materials.

Figure 3 is also an infrared 3-5 micrometer imagery covering the southern end of line A. It shows rhyolite as a bright (warm) band at the left and several other rock units as darker-toned areas.

Figure 4, nighttime 8-14 micrometer imagery, flown along line B at a much higher altitude, covers the entire area of figures 2 and 3 and extends beyond their borders. The thermal response of strata and the apparent fault zone can be observed but are less distinct than in the 3-5 micrometer imagery.

The 8-14 micrometer band imagery shown in figure 5 was obtained on a clear, very bright sunlight day. The imagery appears to be adversely affected, the light (warm) washed-out over-exposed areas are the terrain slopes facing the incident rays of sunlight, the dark (cold) areas appear to be the shadow areas of the topographic lows and of slopes facing away from the incident rays of the sun. The poor imagery may be the result of improperly set gain or amplitude controls. The washed-out nature of the imagery precludes its use for geologic interpretation.

Figure 6 is a portion of an aerial photograph of the same area; different strata can be recognized by their topographic expression, relative resistance to erosion and their tone or relative reflectance. Lineaments are recognizable, especially in the northeast quadrant where they are abundant. The linear fault referred to in figures 2, 3, and 4 is visible but of low contrast and short extent so that it could be easily overlooked by the photo interpreter.

It should be pointed out that the fault shown on the map (figure 1) east of the linear fault referred to in the text is not apparent on the infrared imagery. Apparently the rocks in juxtaposition are of similar thermal characteristics and do not produce a substantially different infrared image.

CONCLUSIONS

Infrared images in both the 3-5 micrometer and 8-14 micrometer bands appear to be useful supplements for geologic reconnaissance and photo interpretation in the Nevada Test Site area. Strata having high density and high thermal inertia are sharply outlined as bright (warm) areas on the 8-14 micrometer imagery. Similarly, fault zones having sufficient displacement to place rocks of differing density and thermal characteristics in juxtaposition can be readily observed. A fault in which the juxtaposed rocks are similar is not apparent on the infrared imagery.

The washed-out daytime imagery is unsuitable for geologic interpretation.

Legend for Figure 1

Quaternary

Qac	Alluvium and Colluvium (0-800+ ft)
QTb	Basalt of Basalt Ridge and of Buckboard Mesa (0-200 ft)
QTbd	Feeder Dikes

Tertiary

Thirsty Canyon Tuff:

Ttt	Trail Ridge Member (0-280 ft)
Ttsr	Spearhead and Rocket Wash Members (0-435 ft)
Tat	Ash-fall and Reworked Tuff (0-175 ft)
Tgs	Gravel and Tuffaceous Sediments (0-500+ ft)

Timber Mountain Tuff:

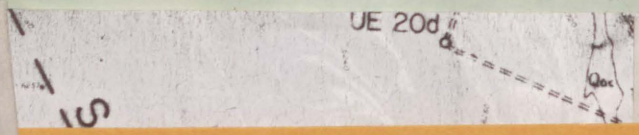
Tma	Ammonia Tanks Member (0-300+ ft)
Tmr	Rainier Mesa Member (0-1,300 ft)
Tdf	Debris Flow (0-200± ft)
Trm	Rhyolite Lavas of Timber Mountain Caldera Moat (0-600+ ft)

Paintbrush Tuff:

Tpc	Tiva Canyon Member (0-370 ft)

Lavas of Scrugham Peak Quadrangle:

Trpq	Quartz-bearing Rhyolite Lavas (0-1,140 ft)
Trpb	Biotite Rhyolite Lavas (0-1,000± ft)
Trph	Hornblende Rhyolite Lavas (0-400± ft)
Trpp	Pyroxene-bearing Rhyolite Lavas (0-980± ft)
Tb	Bedded Tuff (0-1,080+ ft)



POCKET CONTAINS
6 ITEMS.