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Imagery from Infrared Scanning of the East and Southwest Rift Zones of Kilauea and the Lower Portion of the Southwest Rift Zone of Mauna Loa, Island of Hawaii

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INTRODUCTION

From July 31 through August 4, 1973 night time flights for obtaining infrared imagery along the east and southwest rift zones of Kilauea and the southwest rift zone of Mauna Loa were undertaken on the island of Hawaii. Flights were also made on Hualalai and Kohala volcanoes but because of inconclusive results are not included in this report. Ground control stations had been established during daylight hours several days prior to starting the flight program. Students stationed at the ground central points guided the aircraft on predetermined flight paths by the use of directional lights which were visible to the plane's navigator. Results of the infrared scanning program are considered to be very successful. Events leading up to the final imagery on 8 x 10 color prints will be discussed below.

The sum of $23,900 was designated by the NSF to be expended on aerial photogeologic work on the Hawaii Geothermal Project. Infrared scanning was the only aerial technique employed in this phase.

A firm specializing in infrared surveys, Dadaelus Enterprises of Ann Arbor, Michigan was selected as best equipped and experienced in Hawaiian conditions to accomplish the infrared imagery survey. Towill Engineering Corporation of Honolulu provided the aircraft, pilot and navigator and submitted a report with maps and black and white aerial photographic mosaics. These firms earlier the same year had flown paths for Dr. George Keller of the Colorado School of Mines, who was engaged in locating a deep drill hole near the summit of Kilauea.

FLIGHT PATHS AND DESCRIPTIONS

(1) East Rift Zone of Kilauea

Two long parallel flight paths were flown along the East rift zone from points outside the boundary of Hawaii Volcanoes National Park to Cape Kumakahi. Shorter paths crossing the two long parallel lines were flown at the intersection of the rift zone with the main highway between Pahoa and Kalapana. Approximately 35 line miles of usable record was obtained. From this the following strips were selected for reproduction in infrared false color imagery:

Three miles of flight paths high on the rift zone at an average ground elevation of 2100 feet provide excellent examples of rift lineation and temperature aureoles. The DIGICOLOR prints showed a

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temperature range of 14°C to 20°C. Numerous sites along the rift showed spots of white color indicating the temperature exceeded the highest range on that temperature set. This is not surprising in view of the fact that wisps of steam are issuing from some of the vents probably as a result of meteoric water coming in contact with residual heat of lavas from the 1966 eruption in this area. Downslope from the steam vents, a fairly extensive area shows a slightly higher surface temperature than its surroundings, by an average of 1°C.

The area for the second set of DIGICOLOR prints in the Kilauea east rift zone was selected from a flight path of approximately two miles in length across the area of intersection of the rift zone and the Pahoa-Kalapana highway at a ground elevation of approximately 1000 feet. The temperature range of this path is 16°C - 25°C or 1.5°C per color. Again numerous sites showing white along the rift zone indicate hot spots and an aureole of decreasing temperatures are distributed outward from the rift. Fine examples of surface temperature zones are demonstrated in this imagery.

(1) Southwest Rift Zone of Kilauea

A flight path 12 miles long was followed from the point of intersection of the western boundary of Hawaiian Volcano National Park and the main highway between Kilauea summit to Pahala to a point on the sea coast approximately 4 miles east of Punaluu.

The altitude maintained was about 3000 feet above ground level. Throughout most of the strip a thermal anomaly was evident along the Great Crack. The temperature range on the flight path was 18°C - 22°C. Of unusual interest on this path is a thermal anomaly in a target-like pattern near the southern end of the Greak Crack approximately 1 1/4 miles from the coastline at an elevation of 300 feet above sea level. The target-like pattern is 1200 feet wide 1600 feet long. The roughly circular pattern of thermal anomaly lies 600 feet northwest of a splinter extension of the Great Crack. The highest temperature within the target area reaches the red color or 22°C in two small spots, and within the Great Crack extension, small local spots reach white, or off scale.

The anomaly appears to be associated with the lower slopes along the south side of Puu Kolekole, a prehistoric cinder cone, and with the extension of the Great Crack.

This surface thermal anomaly as registered by infrared scanning imagery should receive careful attention as a potential area for further geophysical investigation and possibly research drilling.

(3) The Southwest Rift Zone of Mauna Loa

A flight path with the total length of approximately 22 miles followed the southwest rift of Mauna Loa from an elevation of approximately 7000 feet above sea level to the tip of South Point. Only the lowest five mile section of this path to the tip of South Point showed any significant thermal anomalies. This portion has been reproduced in DIGICOLOR and prints developed.

The temperature range on one sub-set is 16°C - 22°C. Thermal anomalies appear along the cliff face of the Kahuku fault as clusters along the base of the cliff and as linear features possibly indicating bedding planes in the lava flows. Numerous spots along the cliff register red and a few local areas show white, or off scale.

The cause of these anomalies is not known at the present time. The Kahuku fault scarp, which reaches 400 feet in height in this area, faces west. Consideration must be given to the possibility that the anomalies result from residual late afternoon solar heat. The imagery was taken at 0030 hours in order to reduce the effect of residual heat. The physical distribution of the warmer areas does not appear to show a pattern that might be caused by residual heating, none the less this factor must be kept in mind.

Another, more intriguing possibility lies in the concept that heat may be rising from depth along the plane of the Kahuku fault and issuing at the base of the cliff and along bedding planes of the lava flows. The Kahuku fault is a major structural feature of Mauna Loa shield volcano. It extends ten miles inland from the coast and has been followed out to sea for a distance of over 15 miles. Depth recordings made on board the R/V Valdivia in 1973 while steaming past the extension of the fault 4 miles off shore registered a vertical displacement along the fault plane of 1900 meters.

Further geophysical and geological work should be concentrated in the section of the lower portions of the Kahuku fault. This may have promise as an area in which to locate an array of research drill holes.

Also of interest along the South Point shoreline as registered by the infrared imagery is the temperature distribution in the sea water. Directly offshore a large patch of water shows as a white area indicating that its temperature is greater than 22°C. It is not recognized at this time whether this is a bay of warm surface water brought in by ocean currents or wind or whether the warming is caused by some other process.