

REMOTE SENSING OF FISSURE-FED BASALT FLOWS AND THEIR SOURCE AREAS:
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The recognition of lava textures in remote-sensing images and the relationship of texture-type to distance from the vent are being tested on terrestrial basaltic lava flows as a means of locating fissure vents. Applying remote-sensing techniques to the problem of fissure-vent location may be appropriate for identifying source areas of extensive plains lavas on the Moon and Mars.

This study is a multisensor approach using visible-, near infrared-, and microwave-wavelength images in conjunction with field observations. The study area is the Craters of the Moon (COM) Volcanic Field in the Eastern Snake River Plain. It is one of three volcanic fields aligned along the Great Rift of Idaho (1, 2). The flows in question are those identified by Kuntz et al. (3) as the 2,000 year old to 4,000 year old basaltic pahoehoe and minor aa flows erupted chiefly from fissure vents at Vermillion Chasm and along the Great Rift (Fig. 1). Vent areas are indicated by 'X'.

The use of remote-sensing techniques to correlate fissure-fed flows with their source was first tested on the Keaiwa lava flow, Hawaii (4). The preliminary assessments, made from the comparisons between thermal infrared images and field studies, indicated that primary surface textures and weathering products influenced the TIR signatures. Based in part on these findings, special attention is being given to certain surface properties of the COM flows: 1) primary surface textures of pahoehoe and aa, 2) soil development, 3) vegetation cover, including shrubs, trees, moss, and lichen, 4) glassy crust, and 5) surface roughness as it affects specular reflection and surface scatter.

Previous remote-sensing studies of the COM Volcanic Field were successful in separating pahoehoe and aa lavas and in noting the increase in soil and vegetation on older flows, using LANDSAT data (5, 6) and the JPL, dual polarization L-band radar and L-band Seasat-A radar (7, 8). Newly acquired X-band radar (courtesy Oregon Army National Guard) is added to the list of images in this study.

Comparisons of multispectral radar, aerial photographs, and field observations of the 3,500 to 4,000 year old flow (Fig. 1) have resulted in the following preliminary assessments. First, in accordance with the studies by Swanson (9), shelly pahoehoe occurs only at the vent area, Vermillion Chasm. Forming in response to rapid degassing of the magma at the time of eruption, shelly pahoehoe is an excellent near-vent indicator. It is detected on aerial photographs as very light-toned, smooth-textured areas, and on radar images as noticeably dark areas due to the effects of specular reflection. On-site measurements confirm that it is a very smooth surface with pahoehoe rubble, 2 cm to 25 cm, commonly filling in shallow depressions. Local surface roughness rarely exceeds 1 meter and the most common vegetation, sagebrush, has an average plant height of 50 cm to 60 cm. Other vegetation includes rabbitbrush, grasses, moss, and lichen. Estimated bush cover is 40 percent of the surface, while lichen may actually cover up to 100 percent of any given 20 cm x 20 cm area of the shelly pahoehoe. Secondly, with distance away from Vermillion Chasm, the pahoehoe surface is a filamentous design of mixed-toned gray and rough texture in the aerial photographs. Radar return is a mixed-toned gray. On the ground, the pahoehoe has the Blue Dragon glassy crust and is characterized by numerous collapsed lava tubes, depressions as large as 15 meters in diameter and at least 10 meters deep, and domes up to 10 meters high. Local surface roughness ranges from 2 meters to the 10 meter cases listed above. Average plant height is again 50 cm to 60 cm; estimated bush cover is

35 percent of the surface. Lichen may obscure up to 90 percent of a typical 20 cm x 20 cm surface area of pahoehoe. Thirdly, aa lava is very dark-toned and rough textured on the aerial photographs, and is very light-toned on radar images due to the abundance of surface scatter. Blocks in an aa field range in size from 4 cm to 2 meters. Aa surfaces are devoid of vegetation except for an occasional bush or pine tree. Aa seems to occur in localized areas.

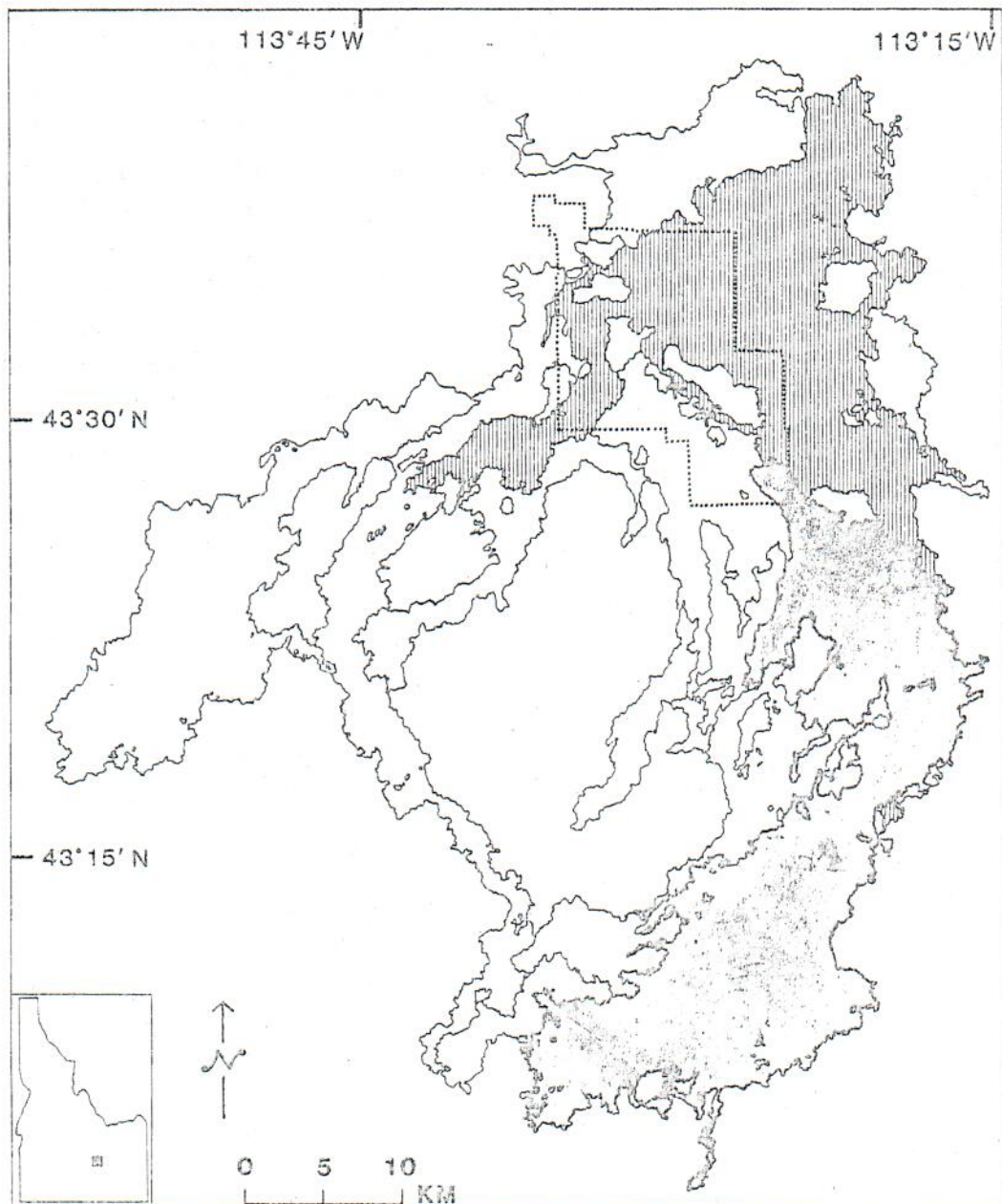
Using these preliminary assessments as a springboard, the next steps to be undertaken include 1) image processing of LANDSAT digital tapes, such as ratioing of MSS bands, to find correlations with other remote-sensing techniques, 2) determining the effects of lichen on the reflectivity of the rock surface, 3) learning the contribution to the overall surface roughness by shrubs, and 4) explaining the distribution of aa lava in terms of preflow topography, rheology of the lava, and distance from the vent area.

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FIGURE 1 (following page). Location map of the basalt flows in the Craters of the Moon Volcanic Field, Idaho.

CRATERS OF THE MOON VOLCANIC FIELD, IDAHO



(ADAPTED FROM KUNTZ ET AL., 1980)

