

Relative dating of Mt. Etna prehistoric flows

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Lavas from major Etnean eruptions during the past 400 years are well known, the historic record being quite complete for this period. Older eruptions, however, are far from being accurately described; and prior to about 1300, historical records are inaccurate or virtually non-existent. Paleomagnetic studies in the past 20 years have helped to clarify the record of lava flows, providing corrected dates for flows originally dated 1100 to about 1500. In almost every case, the new ages were older than the published dates. Accurate determination of flow dates is critical for understanding the eruption history of Etna, and to better predict future activity. In this study, we have used remote sensing data to examine the flows redated by paleomagnetism, and have analyzed areas around Etna where older, undated flows are exposed.

Materials of the same age and composition show differences in surface weathering and vegetation as a function of the exposure time, location, elevation, etc. Different aged materials will also be modified by natural environmental factors, and by human intervention. All of these lead to spectral differences that allow us to differentiate flows based on their relative ages.

The data we used were acquired by NASA aircraft-borne imaging scanners. Data were obtained in 1992 with the Thematic Mapper Simulator (TMS: visible-near infrared-short wave infrared) and in 1986 with the Thermal Infrared MultiSpectral Scanner (TIMS: thermal infrared). The two data sets were radiometrically calibrated, corrected for atmospheric effects, and coregistered and mosaicked to UTM projection. TMS data are sensitive to spectral differences due to vegetation changes, and development of iron oxides and clay minerals. TIMS data respond to emissivity differences due to variable silica content, presence of carbonate and vegetation, development of secondary weathering coatings, among others.

Our analyses and interpretations show general agreement with the 1982 CNR 1:60,000 geologic map for the more recent materials, even if subtle differences occur because of the different elevation and sector of the volcano. We substantiate the suggested new dates determined from paleomagnetic data. Flows previously thought to be 16th century appear to be considerably older based on their spectral reflectance and emittance characteristics. For areas mapped only as "old flows", we were able to delineate individual flow units, and assign relative ages to them. We were particularly successful on the north and west sides of Mt. Etna, which are both drier and less intensively cultivated than the eastern and southern flanks

Work by MA and DP was performed at the Jet Propulsion Laboratory/California Institute of Technology under contract to the National Aeronautics and Space Administration.