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A PRELIMINARY EVALUATION OF ERTS-1 IMAGES ON THE VOLCANIC AREAS OF SOUTHERN ITALY (NASA CONTRACT FO-013)

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The test site selected for the investigation covers nearly all the regions of active and quiescent volcanism in southern Italy,i.e. the Eastern part of the island of Sicily, the Aeolian Islands and the area of Naples.

The three active European volcanoes (Etna, Stromboli and Vesuvius) are included.

The investigation is in the frame of a programme for the surveillance of active volcanoes by geophysical (including remote sensing thermal methods) and geochemical methods.

It is also in connection with the Geodynamics project for the Mediterranean-Alpine region.

By the multispectral analisys of ERTS-1 data we intend to study the spectral behaviour of the volcanic materials as well as the major geological lineaments with special reference to those associated with the volcanic region.

Secondary objectives are also the determination of the hydrographic network seasonal behaviour and the relationship between the vegetation cover and the different type of soils and rocks.

We received the images of the first available pass over the test site (August 9 1972) only in January 1973.

However, we were able to produce a first enhancement of the images by false colour composition of two passes (August 9 and Nov. 23 1972) in order to perform a first evaluation of the seasonal effects.

In this paper only the results obtained by the Aug.9 pass over the Southern part of Sicily are discussed and illustrated.

Technical approach.

For the composition we used only the 5,6,and 7 bands because the band 4 was not shipped.

The selection of the best set of filters and light intensity was done by means of a multiple projector.

The photographic composition was accomplished by a sequential contact printer using the same filters and intensities employed in the multiple projector.

The colour composite images are performed using yellow, magenta and cyan colours in order to standardize the results.

In order to map the different steps of reflectance, an optical-fiber device was employed, scanning the selected composite transparencies.

As a second phase a "multispectral reader" will be used, scanning simultaneously different images of the same area and producing electrical signals which will be add or subtracted or divided.

This technique will be used in order to have a more quantitative interpretation.

Description of the colour enhanced images.

Fig. 1 represents an uncontrolled mosaic of three images (band 7) taken on Aug. 8 and 9 1972 over Sicily.

In that season the soil is very dry and bare except in some re_ stricted areas.

The sun elevation was 56 degrees.

Fig 2 and 3 represent two composite colour enhancements of the Southern part of Sicily.

The enhancement of Fig. 2 is done by the subtractive method using cyan (band 5) magenta (band 6) and yellow (band 7).

The composite image of Fig. 2 is particularly suitable to see the geological lineaments (SE corner, on the Ragusan plateau) as well as the contrast between recent lava flows and the typical vegetation of Mount Etna (upper right).

The composite image of Fig. 3 was obtained by reversing colours of the bands 5 and 6; the additives used was red (band 5) green (band 6) and blue (band 7).

The vegetation is particularly enhanced by this composition.

Fig. 4 is an enlargement to the scale of 1:1oo.ooo of Fig. 2 showing the Etna Volcano. (coord : 37,30 N; 15,00 E)

The max. elevation of the cone is of 3300 m.a.s.l.

This active strato-volcano produces basic lavas; the last great eruption occurred in May 1971.

The main eruptions normally occur from the central cone but the most dangerous lava flows erupt from secondary fissures opening on the slopes.

Our investigation, so far, is concentrated on the analysis of the spectral behaviour of lavas; several tones were observed in the areas covered by the volcanic materials, as appears on the different colour composition.

The main difficulty to establish a correlation between the tone and the lava type and/or age, lies on the vegetation cover.

However we attempted a first rough classification of the volcanic materials based on the following criteria:

1) Extention of old lavas completely covered by vegetation. In this case there is a large error in computing the spectral difference between the lavas and the vegetation cover.
2) Recent lava flows (less than 400 years about). The extention of lava flows is clear and the vegetation yelds a small error in computing the areas.
3) Very recent volcanic activity (from 196o). A relatively small area around the main crater clearly shows a reflectance quite similar to that of water; this can be explained by the total lack of vegetation and can also depend on the thin cover of pyroclastic deposition. In this case the reconnaissance is good.

A positive result is the identification of some, small areas surrounded by lava flows and of different reflectance which can be correlated with the exposures of sedimentary formations.

Fig. 5 is a map of the relative reflectivities measured around the cone by a reader employing a fiber-optic system.

Remarks.

As a preliminary correlation we remark that, though the interpretation is affected by errors, the potential discriminative power of the multispectral analysis is confirmed.

The limitation of this investigation is also given by the insufficient number of bands to be analized and by the difficulty to receive the repetitive coverages.

In fact, the repetitive observation of the same area will enable the investigators to follow the spectral behaviour of the surface under different sun angles and azimuths and in different seasons, especially taking account of the influence of the vegetation cover.

Furthermore we began to analyze the potential of ERTS imagery enhanced by the colour composition to define the main geological features in the surveyed area.

Good results were obtained particularly on the SouthEast of Sicily over the Ragusan plateau, where several faults are clearly observed.

In some cases a better pattern recognition is reached by the synoptic power of the ERTS enhanced images.

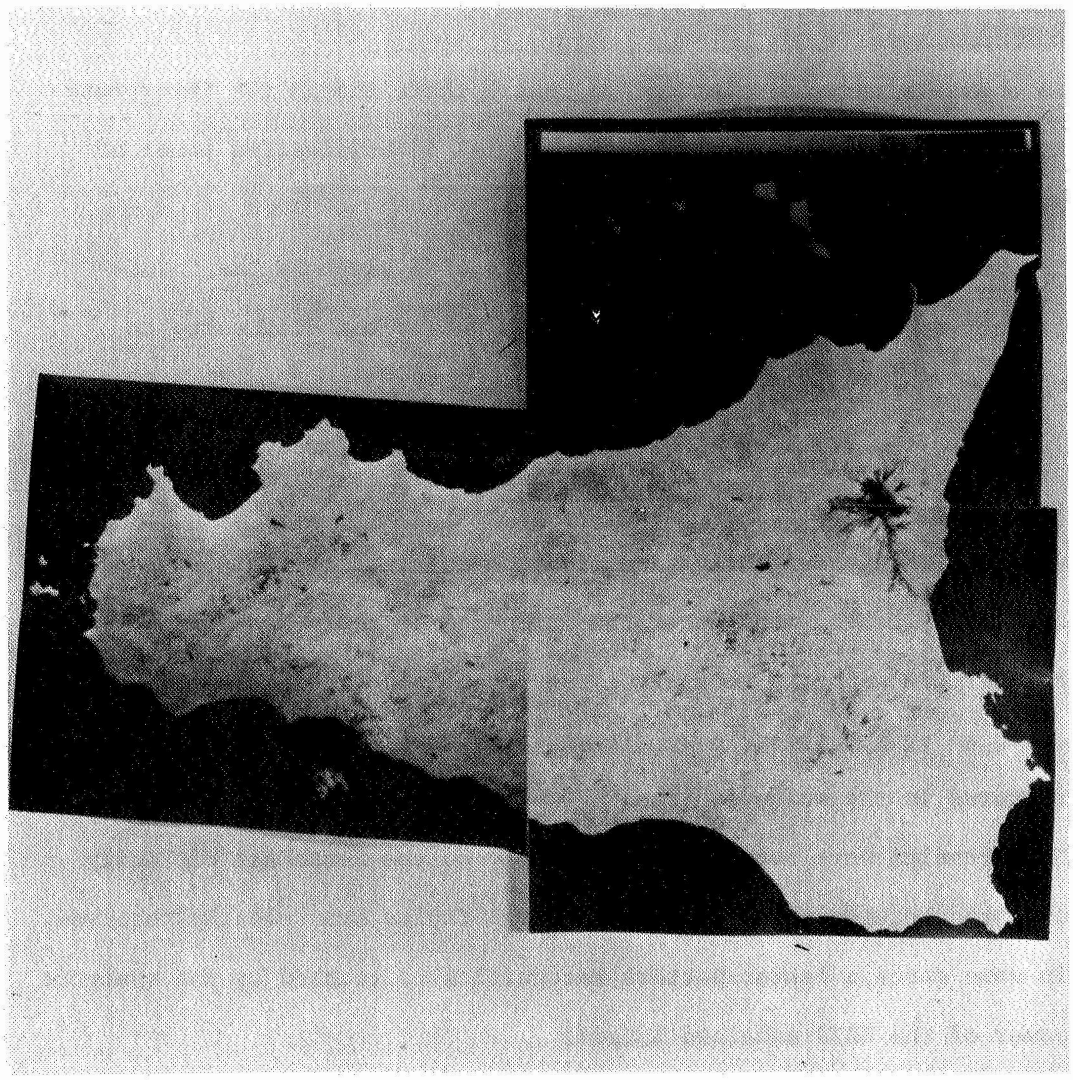

Figure 1. Assembling of Three ERTS-1 Images over Sicily (Band 7)
Orbits of August 8 and 9, 1972

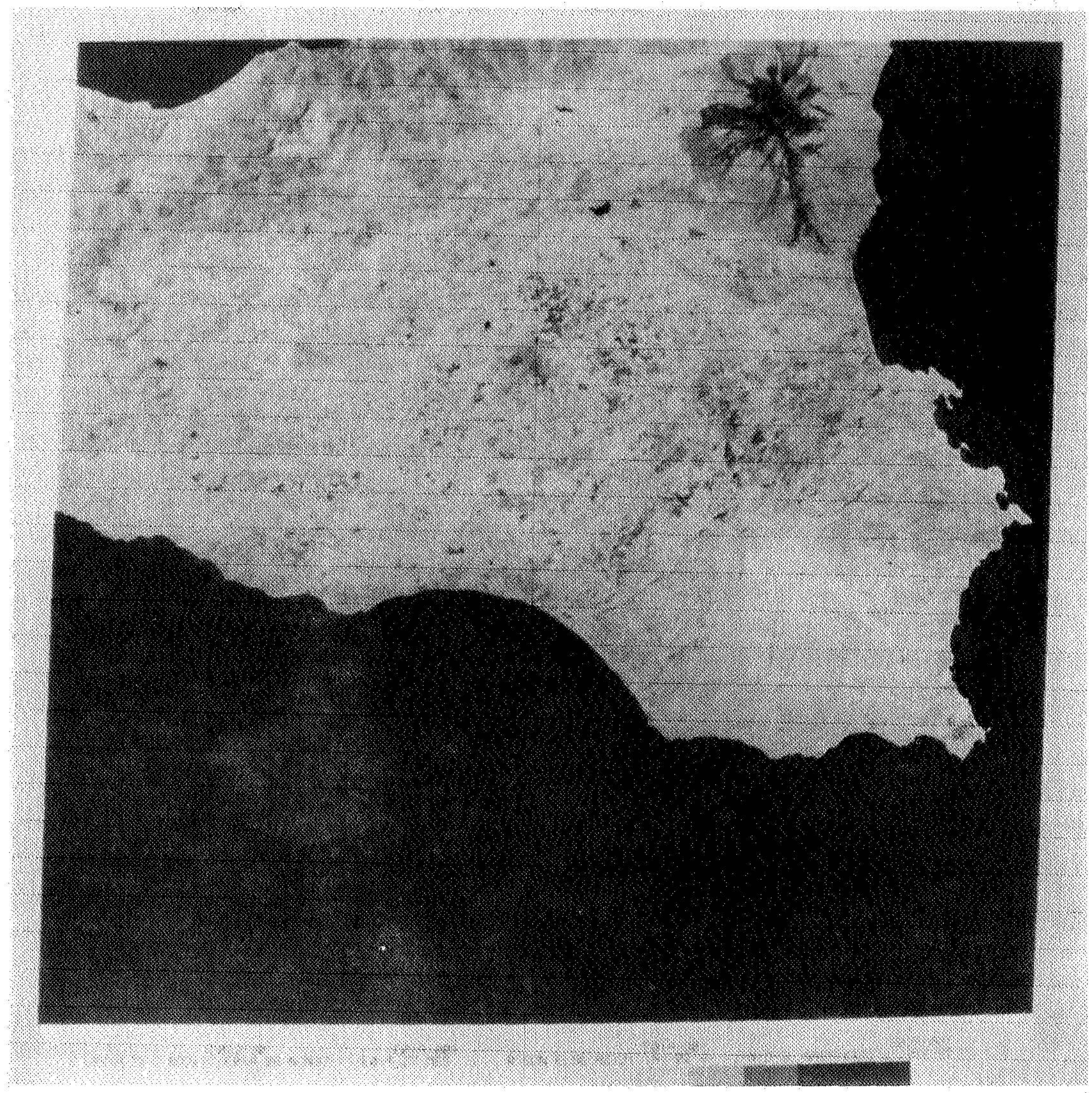

Figure 2. Composite Image of the Southeastern Sicily from Bands 5, 6, and 7, Original Colours: Cyan, Magenta and Yellow

Figure 3. The Same Image Obtained by Reversing Colours of the Bands 5 and 6, Additives Used: Red, Green and Blue

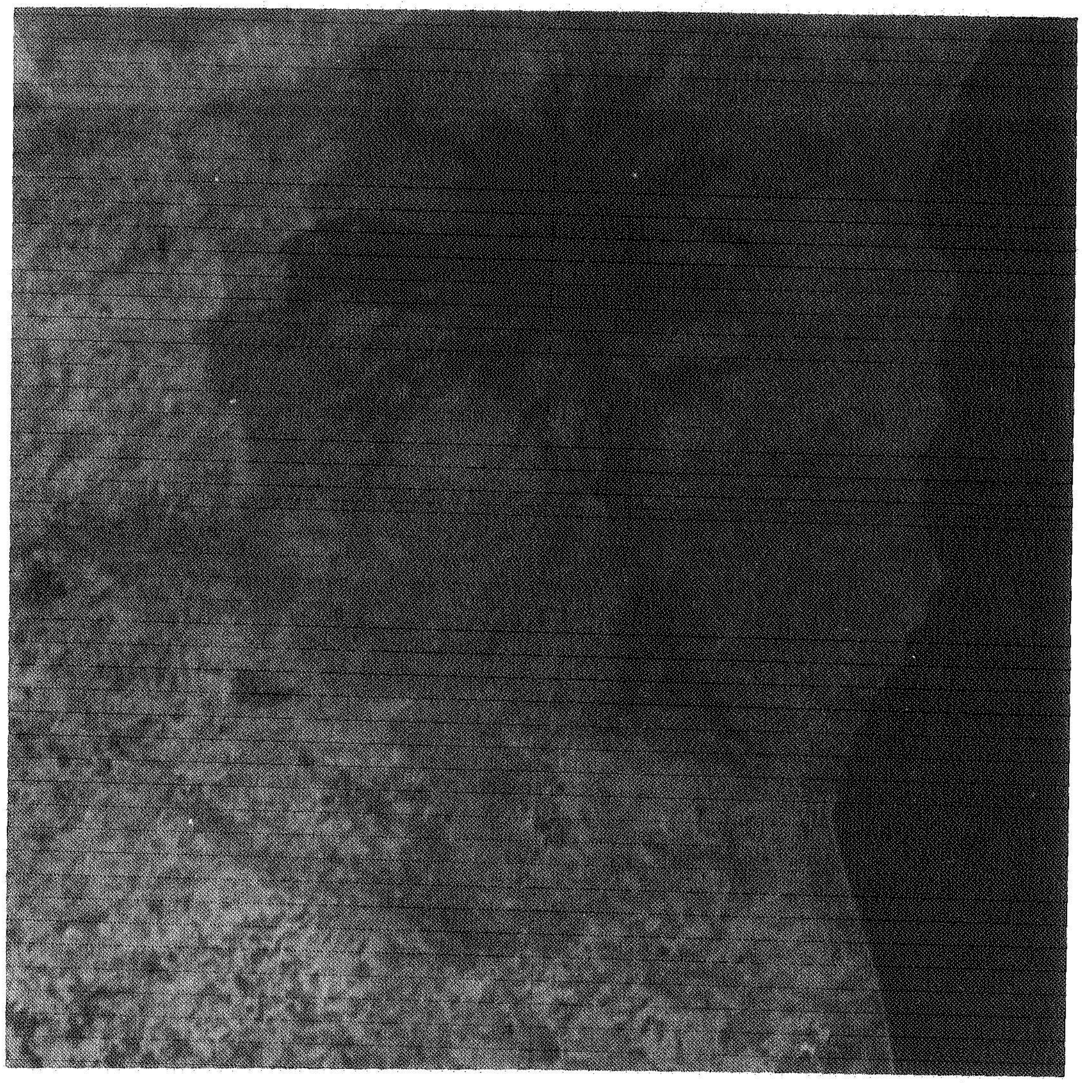

Figure 4. Enlargement from Image of Figure Showing Mount Etna and the Recent Lava Flows (Original Scale 1:100,000)

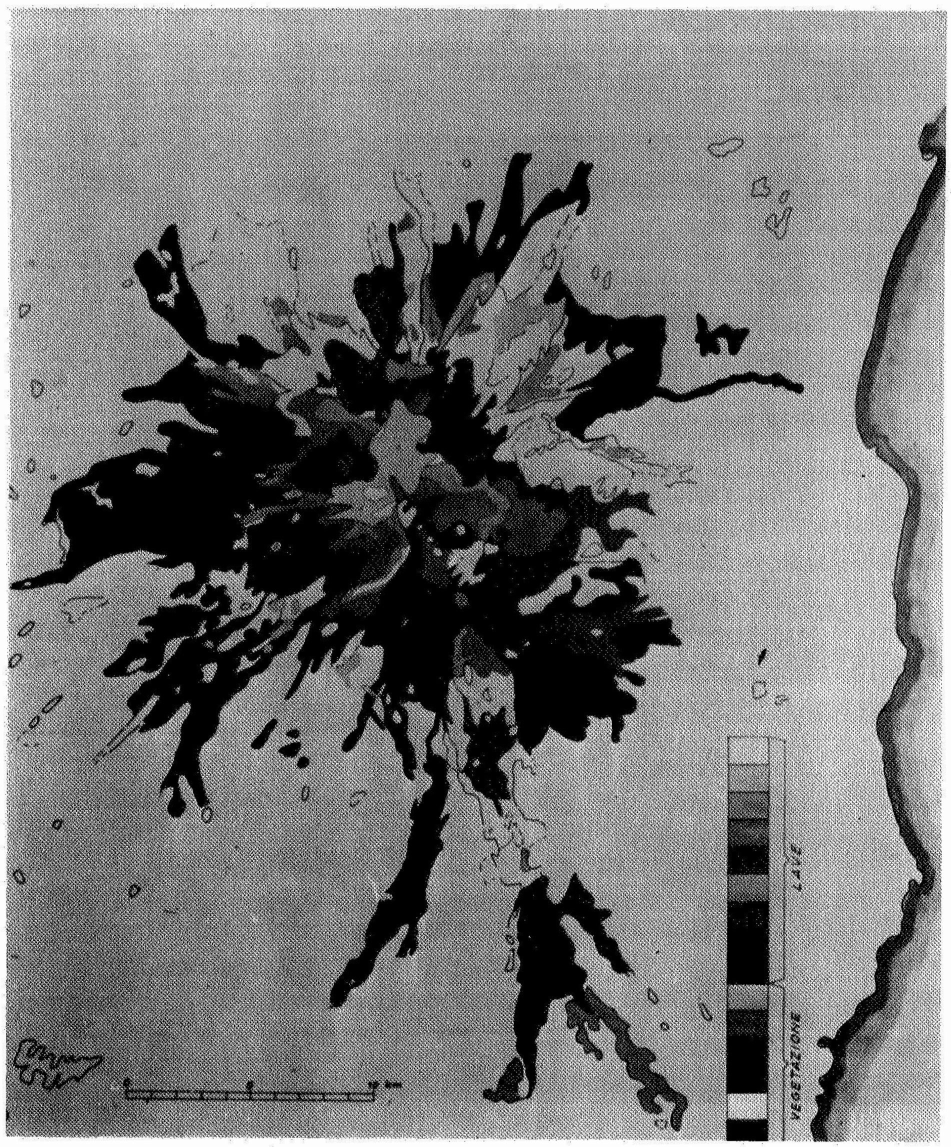

Figure 5. Map of Relative Reflectivities Measured Around the Volvanic Cone; Reflectivity Increases from Top to Bottom of the Scale