

SENSING THE SOIL PHYSICS PROPERTIES AT THE SURFACE OF MARS

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Method. The microtexture at the top surface of the martian soil was characterized remotely, both by polarimetry and by radiometry.

The degree of linear polarization has a maximum value P_{\max} which is related to the albedo A . Coefficient b is defined, which is related to the soil texture and calibrated in terms of grain size (Geake and Dollfus 1985), or as a fraction of the area exhibiting uncovered clean rocks. P_{\max} was mapped over several martian terrains with the photopolarimetre VPM on board the Soviet orbiter MARS-5 (Ksanfomaliti et al. 1976 - Dollfus et al. 1983 - Dollfus and Deschamps 1986).

The thermal inertia $I = (K \rho C)^{1/2}$ is essentially a measurement of the heat conductivity K through the first few decimeters below the top surface sensed by polarimetry. Instrument IRTM was used on board the Viking spacecraft (Kieffer et al. 1977 - Palluconi and Kieffer, 1981). Coefficient I expresses the soil compaction, or else a certain particle size in the soil texture, according to theories by Kieffer et al. (1977) or Vdovine et al. (1980). Thermal inertias presented here are two orders of magnitude better in spatial resolution than earlier global results (Zimelman and Leshin, 1987).

Regional sensing : The MARS-5 VPM polarimetric scans raked a strip covering two contrasted regions of approximately the same surface area ($300 \times 1200 \text{ km}^2$), the dark hued Mare Erythraeum and the light hued Thaumasia. Both these two regions were sampled on more than 50 areas. Over these wide areas, several smaller typical terrains were labelled A to F, over which the three characteristic parameters A (albedo), b (grain size) and I (thermal inertia related to conductivity) were derived on several places. The dots in the enclosed graphs and the volumes in the enclosed 3-D figure are these measurements, plotted against different combinations of the parameters.

Results : Over the large dark region Mare Erythraeum, labelled F, 57 samplings characterize everywhere a same type of terrain, despite the large geomorphological diversity of the surface. The values of b indicate a ubiquitous coating or mantling with small dark grains of albedo 12.7% and 10 to $20 \mu\text{m}$ in size. There is no room for a significant fraction of the surface with rocks or stones clean of a dust. With I , the indication is for a sub-surface dislocated in particules around 300 to $600 \mu\text{m}$ in size, or smaller if a cement between the particles increases the conductivity. Alternatives include a surface layer of small grains but cemented in a thick layer of duricrust implying a uniform thickness all over this large region, or sand-size particles completely coated with dark $20 \mu\text{m}$ grains.

Conversely, the adjacent lighter terrain Thaumasia, also very diversified in its geomorphology, discloses a large variety of soil properties, characterized by the five areas A to E, widely spread in the plots of the enclosed figures. Area A, Thaumasia Fossae, is covered with light and large grains of $70\text{--}100 \mu\text{m}$, with albedo 17%, or exhibits 12% of its surface with exposed clean rocks over a bed of small light grains (or intermediate situations). The subsurface is dislocated into particles $150\text{--}300 \mu\text{m}$ in size or smaller if cemented. A duricrust surface layer may change this figure.

Area B, at the rim of Lampland, is covered with medium dark grains (albedo 14%) of size $20\text{--}30 \mu\text{m}$, or smaller but with 3.5% of clean rocks. The subsurface has same conductivity as for area A. The fractured terrain C between Lampland

and Babakin has grains almost as light hued as for A, but smaller (20–35 μ m), or 3.3% of exposed clean rocks. The subsurface is dislocated with slightly larger particles. D is a splotch around Babakin; grains are dark (13.7%) and coarse (50–80 μ m) or with rock elements clean of dust over 10% of the area. The subsurface is still slightly more conductive. There is a possibility for a thick layer of dark 80 μ m grains partly cemented, fitting the values for all the three parameters. Area E, the bottom of the trench Ogygis Rupes, is mantled with dark and coarse grains, or with 8% of clean rocks exposed among a bed of small dark grains. The subsurface is dislocated in particles around 250–300 μ m or larger if the accumulation of dust is thick.

Interpretations: Speculations are that the dark region Mare Erythraeum could be globally a landscape in which wind have removed the surface grains, leaving the dark surface coated with its own dust of small sticky grains. The lighter hued terrains in Thaumasia may be places of deposition for large and non adhesive grains displaced by saltation process. A different composition may explain the lighter albedo and the larger grain size if the material has also less friability.

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