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SURFACE COMPOSITIONAL AND STRUCTURAL ASPECTS OF MARTIAN SAMPLES;

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There are many excellent reasons to examine the surface composition of a wide range of Martian samples. The existing spectral data indicate that many dust and soil particles have a "thin" Fe^{+3} layer with a typical particle size in the 10 µm to 400 µm range. In view of the high CO_2 content of the atmosphere (1) one might expect that surface carbonates should be present. In addition to chemisorbed material there will probably exist physisorbed atmospheric components of the atmosphere including oxygen, nitrogen and water vapor. The latter could possibly give rise to some hydrated minerals.

Using ultra-high-vacuum/mass spectrographic techniques it should be possible to detect physisorbed and moderately strong chemisorbed species on the particle surfaces with a temperature programmed degassing procedure (2). In some instances such an approach is capable of helping distinguish between volcanic and impact generated materials by detecting the presence of fumerolic gases (3). Such gases typically condense on the exterior of the ejected particles. Additionally surface atomic and chemical compositions should be examined by a combination of modern surface analytical techniques. The combination we currently have in Buffalo at SUNY would appear to be one of the best available including ESCA (150 µm spot capability) Auger (SAM) with 300A focussing for surface compositional surveys, SIMS for high sensitivity trace element detection and ISS for immediate surface layer analysis.

One of the major questions the Viking mission was supposed to answer was whether or not primitive life forms (microorganisms) existed on the Martian surface. The confusing results obtained (an initial burst of radioactive CO_2 formed during the release experiment, but no exponential increase and no organics formed) left this question essentially unanswered. One of the important conditions for a life form is probably the existence of liquid water. It has been claimed that there are extensive regions where the surface pressure exceeds that of the triple point of water. A detailed evaluation by C. B. Farmer (4) concludes that liquid water may exist in equilibrium or in an evaporative steady state, particularly when mixed or covered by a significant layers of fine dust particles. The best areas, Farmer suggests, would be a low elevation with a latitude on the poleward side of the subsolar point, at or about the summer solstice. The dust contribution to the existence of liquid water is thought to exist when slow evaporation rates through the inter-dust-particle-channels or pores pertain.

We would like to extend this concept by pointing out that capillary condensation can stabilize the existence of liquid water at relative pressures as low as 0.2. This phenomenon occurs in pores of 20-500A diameter or width (mesopores) and may be predicted by application of the Kelvin equation:

$$RT\ln p/p^{o} = \gamma V\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

where p/p^o is the relative pressure; γ, V the surface tension and molar volume of the water. R_1 and R_2 would define the curvature of the pore being positive when measured from the more dense solid or liquid phase. Mesopores such as these are known to exist in terrestrial volcanic samples being formed during the "plastic" cooling and degassing stage of the magma. They are rare in lunar samples (5) due to the lack of an atmosphere, but should exist in Martian volcanic cinders. In addition to elevation and latitude restrictions, volcanic sites should be considered for possible liquid water retention and possible life forms.

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