SEASONAL VARIABILITY OF MARITAN SURFACE ALBEDOS: IMPLICATIONS FOR DUST DEPOSITION AND REMOVAL

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The surface of Mars has been observed to have variable surface markings from the earliest, telescopic views of the planet. More recently, Mariner 9 and Viking spacecraft visual observations have demonstrated numerous albedo variations, which are generally assumed to be related to aeolian activity (e.g., 1; 2). In addition, broadband IRTM measurements of surface albedo have demonstrated regional variations in surface albedo, primarily associated with the occurrence of global dust storms (3,4). All of these observations suggest significant aeolian redistribution of material on the surface, and provide evidence for long- and short-term accumulation of dust-storm fallout in specific, northern hemisphere regions (5). The primary evidence for this model is three fold. First, the proposed deposits have low thermal inertia and high albedo, indicating fine, bright material. Second, these regions have a lower rock abundance than found elsewhere (6). And third, the atmosphere over these deposits is clearer than over neighboring, dark surfaces (7), suggesting that dust is preferentially removed from dark regions and redeposited elsewhere, but remains on the surface in bright regions, with a resulting net accumulation.

The purpose of this study was to observe the albedo of specific bright and dark regions in both hemispheres through time to look for surface brightness changes associated with dust depositon and removal. Such variations were reported by Pleskot and Miner (8) in a preliminary study of a limited number of areas. The IRTM data from both Viking spacecraft were collected into 1° latitude by 4° longitude bins, at 3 hour intervals for each 10° of L_s. Thus, the albedo of a given 1° x 4° area can be studied as a function of L_s, keeping the local time of observation constant. Conversely, the albedo can be plotted as a function of local time to study the surface phase function and the occurrence of condensate and dust hazes.

The variations of albedo with L_s for representative bright and dark areas are shown in Figure 1. These results cover the time period from the beginning of the Viking mission (L_s = 84°), through the first (L_s = 190° to 240°) and second (L_s = 270° to 340°) global dust storms. The atmosphere had cleared to pre-storm values following the second storm by L_s 30° (3). As these results indicate there was a significant brightening associated with the onset of both storms, due to surface and atmospheric effects. The maximum brightness at the peak of the second storm is nearly equal for the bright and dark regions, indicating that the atmosphere was optically thick over these dark regions. For other dark regions, such as Sinus Meridiani and Solus Planum, the atmosphere was apparently somewhat clearer. The increase in brightness, even for bright regions, indicates that the albedo and scattering phase function of suspended dust varies from dust on the surface. An interesting feature observed for many areas is a decrease in brightness near L_s 300°, possibly due to a temporary atmospheric clearing.

An important result obtained from this study is the observed increase in surface brightness of some dark regions following the global storms. In Figure 1a, it is apparent that the bright regions have returned to pre-storm albedos by L_s 350°. In comparison, Acidalia Planitia and Syrtis Major have

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albedos 0.1 higher than their pre-storm values at this time. The bright material is gradually removed from the surface by L_s 90° of the following year. Other dark regions, including the southern hemisphere regions of Solus and Hesperia Planum, had returned to pre-storm albedos by L_s 330°, suggesting differences in either the amount of dust deposited or the rate of removal. These observations confirm that bright material is deposited on dark surfaces in the northern hemisphere, but is subsequently removed, resulting in little or no net accumulation. There is no evidence for dust removal from bright regions, consistent with their being regional dust sinks.

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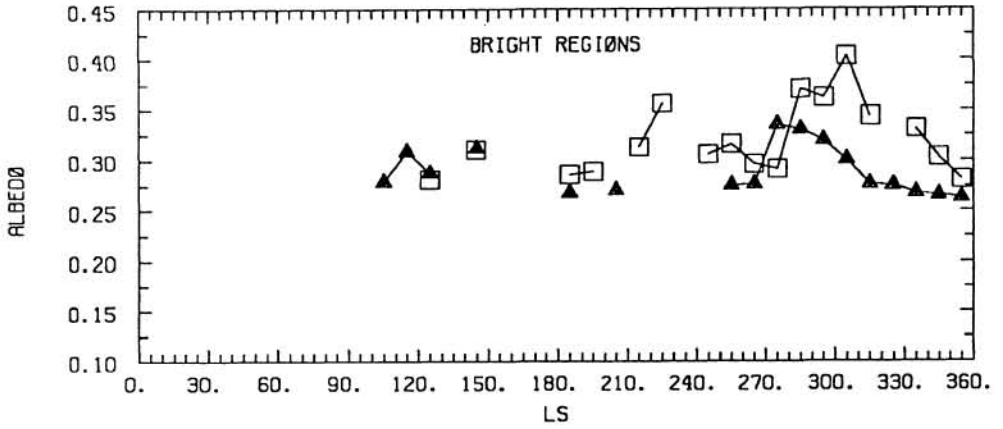

Fig. 1a. Variation of albedo with L_s. Arabia (open square) and Tharsis (closed triangle).

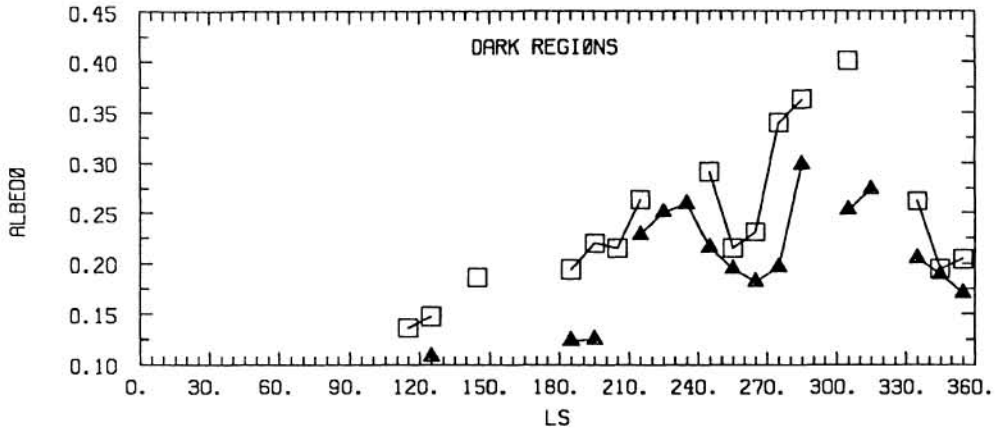

Fig. 1b. Acidalia Planitia (open square) and Syrtis Major (closed triangle).

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