SEASONAL AND SECULAR VARIATION OF THE SOLIS LACUS ALBEDO FEATURE: RELATION TO THE MARTIAN DUST-TRANSPORT CYCLE; Steven W. Lee, Dept. of Geology, Arizona State Univ., Tempe, AZ 85287

As documented over the course of thirty-six martian years, dramatic seasonal and secular variations occur in albedo features in the Solis Planum region of Mars; the most striking of these is the classical dark albedo feature, Solis Lacus. This region is also known as a source area for local and global dust storms. Telescopic observations beginning in 1907 [1] indicate that Solis Lacus is generally most distinct during southern spring and summer, and less distinct in southern fall and winter. Mariner 9 and Viking Orbiter images reveal that Solis Lacus contains and is surrounded by a conspicuous pattern of bright and dark wind streaks (Figure 1).

A seasonal dust-transport cycle is proposed to explain these observations. 1) During late southern spring or early summer, dust is eroded from the surface and transported from the region by local dust storms which may contribute to a global dust storm. Removal of dust over a wide area results in the dark Solis Lacus feature. The presence of bright streaks throughout the year, however, indicates that the surface is not swept completely clean of dust. 2) During the cessation stage of global dust-storm activity (typically mid- to late-southern summer), enhanced deposition in the lee of obstacles forms the prominent patterns of bright streaks [2,3] observed within and around Solis Lacus. 3) As the year progresses (southern fall and winter), sedimentation from the atmospheric dust load occurs over the entire region, decreasing the contrast of the albedo features to their surroundings. 4) Dust-storm activity the following year renews the cycle by again removing dust from the region. Differences in the time of occurrence, severity (local or global), and longevity of dust-storm activity may lead to the observed year-to-year variability of albedo features.

Analysis of radar data has characterized this region as having a very high, possibly seasonally variable radar reflectivity [4,5,6]. Such properties and variation have been attributed to either the presence of liquid water in the near-surface regolith or the seasonal deposition/erosion of a surface dust layer from several centimeters [6] to tenths of a centimeter [7] in thickness. For the following reasons, the observed aeolian features exclude the possibility of the seasonal transport of such significant dust deposits. 1) The production of wind streaks is thought to involve as little as a few μm of dust covering a few tens of percent of the surface [8,9]. The observed persistence of the streak patterns is not consistent with the presence of thick dust deposits. Experimental studies [9] indicate that deposition of more than a few tens of μm of dust would obliterate the observed albedo features. 2) Integrating the deposition possible from the observed atmospheric dust loading [10], an annual accumulation ~30 μm thick would result if no erosion took place. 3) The regional thermal inertia values are $\sim 8 \times 10^{-3}$ $cal/cm^2/sec^{1/2}/°K$ and are indicative of a surface covered by particles larger than ~100 μm in size [11]. Several cm of dust would exhibit a much lower thermal inertia signature. A saltation triggering mechanism [12] may effectively eject surface dust into suspension and result in the observed local dust storms.

Cycling of at most a few tens of μm of dust through this region could easily be accomplished by annual deposition followed by erosion during local dust storms. Such levels of aeolian activity adequately explain the noted occurrence and variability of the regional albedo features. Deposition or

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erosion of large quantities of dust are not required nor are they consistent with the observations.

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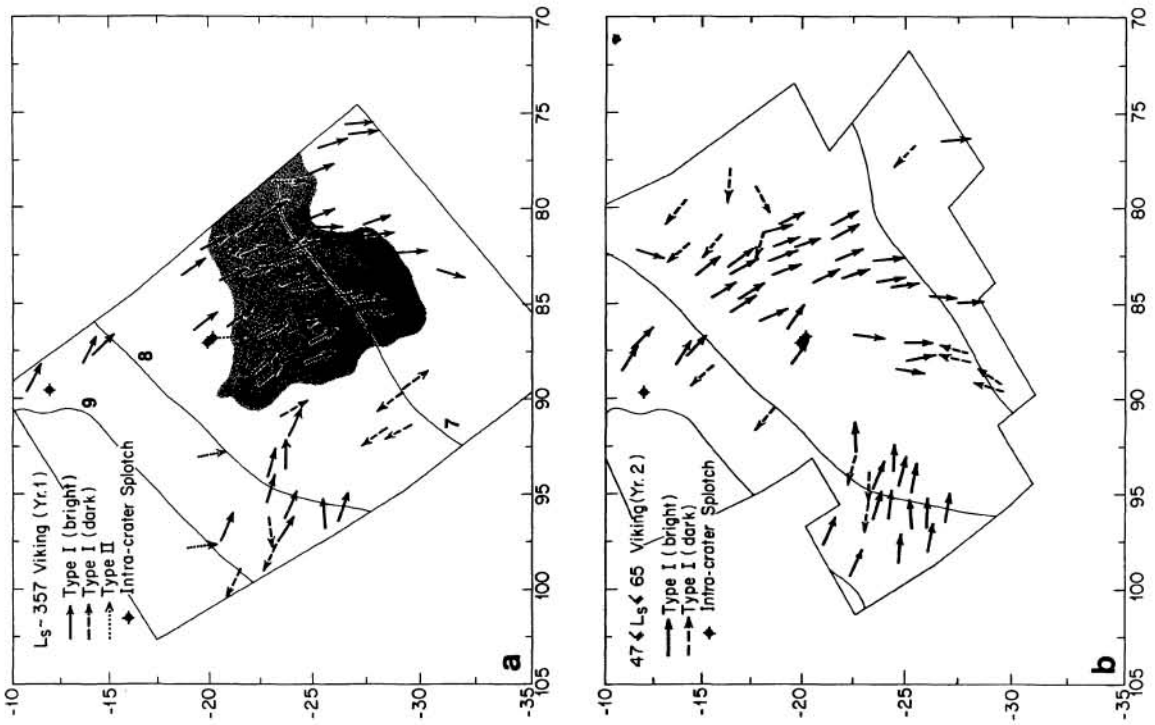

Figure 1. Sketch maps of albedo features in Solis Planum. The features were digitized from Viking Orbiter images obtained during the first two consecutive martian years of the mission. No suitable images were available outside of the indicated boundaries. The shaded region corresponds to the Solis Lacus albedo feature. Wind streak classification follows the scheme developed in [13]. The topographic base (contours in km shown in Fig. 1a) was digitized from the USGS 1:25M global topographic map.

a) Late southern summer (Year 1).
b) Mid-southern autumn (Year 2).

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