SURFACE PROPERTIES OF MARS' POLAR LAYERED DEPOSITS AND POLAR LANDING SITES. A. R. Vasavada[1] and K. E. Herkenhoff[2], [1]Department of Earth and Space Sciences, University of California, Los Angeles CA 90095-1567, USA (ash@mvacs.ess.ucla.edu), [2]USGS Astrogeology Team, 2255 N. Gemini Drive, Flagstaff AZ 86001, USA.

Introduction: The landed component of the Mars Surveyor 1998 missions, the Mars Polar Lander (MPL), will reach the planet's south polar region along with the Mars Microprobes on Dec. 3, 1999. The spacecraft will land on the south polar layered deposits, which partially cover the region poleward of 70S latitude, and will conduct the first *in situ* observations of the polar subsurface, surface, and atmosphere. Like on Earth, the polar regions of Mars are strongly influenced by seasonal and climatic cycles, and are ideal sites for landed experiments.

The location of MPL's landing site is limited by atmospheric entry constraints to a latitude of 75+/-2 degrees. This latitude range overlaps a contiguous, dissected plateau of layered deposits known as Ultimi Lobe between 170W and 230W longitude [1]. West of 205W, Ultimi Lobe forms a broad plateau with elevations up to ~2 km above the surrounding cratered terrain. Elevations gradually decrease east of 205W. Because the area is unexplored at the lander's scale, properties and processes at that scale can be inferred only from remote sensing or theoretical results. In anticipation of the landed mission, here we review the derived surface properties of the southern layered deposits, and present new determinations of surface thermal inertia.

Surface Thermal and Optical Properties: D. A. Paige and colleagues have used Viking Infrared Thermal Mapper (IRTM) 20-micron measurements to derive thermal inertias poleward of 60S latitude [2]. Thermal inertia measures the thermal response of a surface layer to variations in incident energy, and is given here in SI units. The results are representative of the surface down to the diurnal skin depth (a few centimeters). We have derived new thermal inertia maps in a similar fashion to [2], but also included important corrections for Mars' radiatively active atmosphere [2,3].

Results indicate that all surfaces poleward of 70S latitude--excluding the residual ice--are characterized by very low thermal inertias of ~75-125. These values imply that the near-surface is fine-grained, and free of ice and rocks. An apparent particle size of ~10 microns can be inferred from laboratory thermal conductivity measurements of well-sorted glass beads at relevant atmospheric pressures [4].

An analysis of surface color and albedo indicates that bright red dust appears to be the major nonvolatile component of the layered deposits, possibly along with a minor dark component [5]. There is little detectable color difference between the layered deposits near the pole and the surrounding cratered terrain, perhaps indicating that a continuous mantle overlies both units. The composition of the near-surface layer is uncertain. If it is a layer of typical atmospheric dust, an additional cementing agent is probably necessary to support observed scarp slopes of up to 20 degrees, and to prevent removal of the material by wind [6].

Dark Dune-Forming Material: Dark, dune-forming material is distributed over both polar regions. In the north, dark material is closely associated with erosional scarps in the layered deposits [7]. The dark, north polar sand sea has very low derived thermal inertias near ~75 [8]. In the south, the dark material appears topographically trapped within depressions on the deposits and within impact craters on the surrounding terrain. Although not well-resolved in thermal inertia maps, the dark material in the south probably has a similarly low inertia.

The dark material's low inertia can be reconciled with its apparently sand-sized grains if it is composed of either basaltic ash fragments or aggregates of a minor, dark dust component of the layered deposits that forms as a sublimation residue [8, and references therein]. Such material may be confined to the observed low-albedo patches, or perhaps may be more widely distributed if under a thermally unimportant layer of bright dust.

Surface Roughness: In Viking images of the southern layered deposits with spatial resolutions >100 m/pixel, the smooth surface of the broad plateau near 75S and 200W-230W is interrupted only by low relief, E-W striking ridges and the rims of partially buried impact craters. Ridge slopes are ≤10 degrees as indicated by images taken at low sun angles. Regions where the deposits are very thin or absent have km-scale roughness typical of the underlying cratered terrain.

At resolutions <100 m/pixel, the surface of the southern layered deposits displays considerable texture. Grooves, flutes, and pits have been noted in the analysis of Mariner 9 images, suggesting mechanical erosion most likely from wind [9].

Summary: Much of the south polar region has similar color, albedo, and thermal inertia. The continuity in color and albedo can be explained by the widespread presence of a few microns of bright dust [5]. However, the thermal inertia results are representative of a layer at least a few centimeters thick. Accordingly, the south polar region may be mantled by at least a few centimeters of typical Mars dust. However, we speculate that the erosion (sublimation) of the southern layered deposits produces low-inertia material similar to the dark, low-inertia material thought to form from the sublimation of the northern deposits. Perhaps such material covers much of the south polar region under a thin coating of bright dust. Even if the dark material in the south is confined only to observed low-albedo patches, its thermal properties are probably similar to those of dark material in the north and to those of non-polar dust mantles.

The possibility that a dust mantle or sublimation lag covers the southern layered deposits raises the question of whether landed spacecraft will be able to access the “pristine”, presumably volatile-rich layered deposits. The thickness of the surface layer is highly uncertain. If a sublimation lag, its thickness may be self-limited to the length scale of either vapor or thermal diffusion. Meter-thick, local concentrations of eolian bright or dark material could also inhibit the lander’s access to the layered deposits. Unfortunately, these issues cannot be addressed with currently available data.

The MPL’s landing site will most likely be ice-free and relatively rock-free compared to areas such as the Viking and Pathfinder landing sites. Regional slopes appear not to pose a major hazard. Rather it is smaller features such as the grooves and texture visible at the ~10-m scale that may be hazardous.

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