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METEOROLOGICAL OBSERVATIONS OF SYNOPTIC DISTURBANCES: SENSITIVITY TO LATITUDE.

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The Mars Pathfinder MET experiment will make pressure, temperature, and wind measurments on the surface of Mars. The Viking Lander Meteorology Experiment measurements were marked by the presence of variations associated with synoptic weather disturbances throughout the fall and winter seasons. These variations were characterized by periods in the broad range of about 2–10 days, and were most prominent at the midlatitude (48°N) Viking Lander 2 site. The synoptic disturbances were observed to essentially disappear during the summer season. At the subtropical (22.5°N) Viking Lander 1 site, variations with similar periodicities were seen, but the amplitudes of these were reduced in comparison to those at Lander 2 by factors of 2–3 or more. The identification of the weather variations has been helped greatly by numerical simulations of the Mars atmospheric circulation performed with various models.

These models show that the winter midlatitudes are the center of activity for traveling disturbances of planetary scale, disturbances that have their fundamental origin in the baroclinic instability of the wintertime Mars atmospheric circulation. The numerical studies are consistent with the Viking observations in that the disturbances decay in amplitude toward lower latitudes; direct comparisons of the models with the Viking data are quite favorable, although the models seem to produce larger amplitudes in the subtropics than were seen at the Lander 1 site. If Mars Pathfinder is able to survive for 2–3 months, then it will observe the transition from the very quiescent summer season into the much more active winter season. The further north it is located, the more clearly will it be able to detect the signatures of the midlatitude weather systems. The basic mission constraint of a low-elevation landing site should favor the observation of the weather disturbances: The model simulations show that the weather activity is enhanced in the subtropics in the three low regions of the northern hemisphere.

This is at least partly due to the presence of "standing eddies" in the circulation that are forced by the topography. A landing site close to 15°N should allow measurement of the weather disturbances, along with observations of the thermal tides, slope winds, and the relatively steady winds associated with the general circulation—the "trade winds" of Mars. Model simulations show that the latter can be very strong in certain locations, especially near the western edges of low-elevation regions. A landing site near 15°N would be significantly further equatorward than the Viking Lander 1 site, and thus would provide more of a view of tropical circulation processes. There could be some "surprises" in such observations.

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IMPLICATIONS OF HIGH-SPATIAL-RESOLUTION THERMAL INFRARED (TERMOSKAN) DATA FOR MARS LANDING SITE SELECTION.

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Thermal infrared observations of Mars from spacecraft provide physical information about the upper thermal skin depth of the surface, which is on the order of a few centimeters in depth and thus very significant for lander site selection. The Termoskan instrument onboard the Soviet Phobos '88 spacecraft acquired the highest-spatial-resolution thermal infrared data obtained for Mars, ranging in resolution from 300 m to 3 km per pixel [1–3]. It simultaneously obtained broadband reflected solar flux data. Although the 6°N–30°S Termoskan coverage only slightly overlaps the nominal Mars Pathfinder target range, the implications of Termoskan data for that overlap region and the extrapolations that can be made to other regions give important clues for optimal landing site selection.

For example, Termoskan highlighted two types of features that would yield high lander science return: thermally distinct ejecta blankets and channels. Both types of features are rare examples (on Mars) where morphology correlates strongly with thermal inertia. This indicates that evidence of the processes that formed these morphologic features probably still exists at the surface. Thermally distinct ejecta blankets (Fig. 1) are not significantly mantled by eolian material, and material ejected from depth should be exposed at the surface [4]. In addition, their unmantled surfaces should still contain morphologic clues to the exact process that formed the uniquely martian fluidized ejecta blankets. Thermally distinctive channel floors (e.g., Fig. 2) probably have material exposed from various stratigraphic layers and locations. In addition, the possibility that flat channel floors owe their enhanced inertias to water-related processing (bonding) of fines makes these sites intriguing

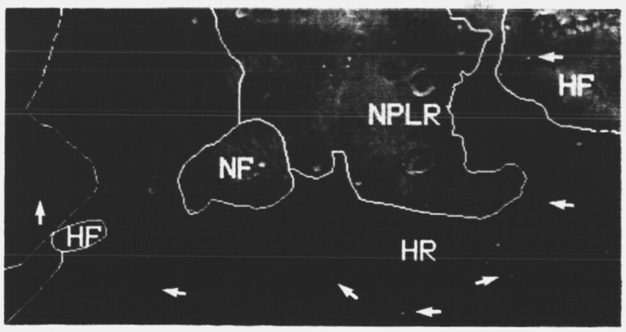

Fig. 1. Ejecta blankets distinct in the thermal infrared (EDITHs): Termoskan thermal infrared image. North is top. A small part of Valles Marineris appears at top right. Time of day is near local noon. Darker areas are cooler, lighter areas are warmer. Note the thermally distinct ejecta blankets, which appear as bright or dark rings surrounding craters (examples denoted by arrows). EDITH boundaries usually closely match fluidized ejecta termini. White lines are geologic map boundaries (from [6,7]). Throughout the data, almost all EDITHs observed are on Hesperian-aged terrains with almost none on the older Noachian units, presumably due to a lack of distinctive layering in Noachian terrains (see [4] for more information). EDITHs are excellent locations for future landers because of relatively dust-free surface exposures of material excavated from depth.

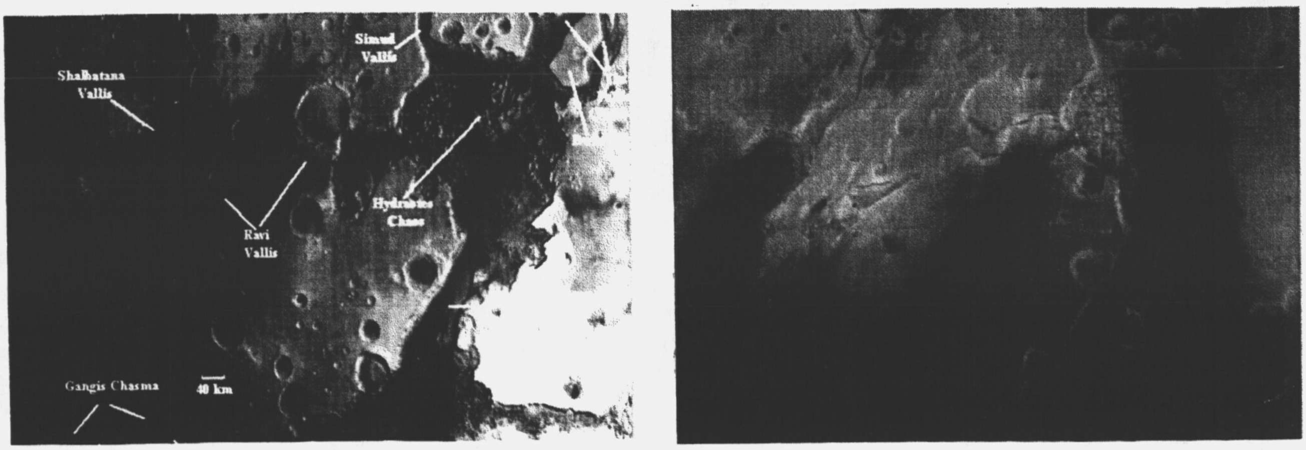

Fig. 2. (Top) Termoskan thermal and (bottom) visible images centered approximately upon 1°S, 39°W. North is top. In all thermal images shown here, darker is cooler. Shalbatana, Simud, and Tiu Valles all continue for several hundred kilometers north of this image. Note the cool and generally uniform floors of all channels except the eastern (and rough floored) end of Ravi Vallis. Note also that the thermal boundaries closely match the boundaries of the channel floors and depart significantly from albedo boundaries seen in the visible image. Note also the dark, presumably eolian deposits localized within the southern portions of Shalbatana Vallis and the southwestern portion of Hydraotes Chaos and spreading onto the surrounding plains in both cases. Buttes, including the large labeled one in the northeast of the image, within the channels appear similar in temperature and appearance to the surrounding plains, not the channels. We favor noneolian explanations of the overall channel inertia enhancements based primarily upon the channel floors' thermal homogeneity and the strong correlation of thermal boundaries with floor boundaries. See [5] for more information.

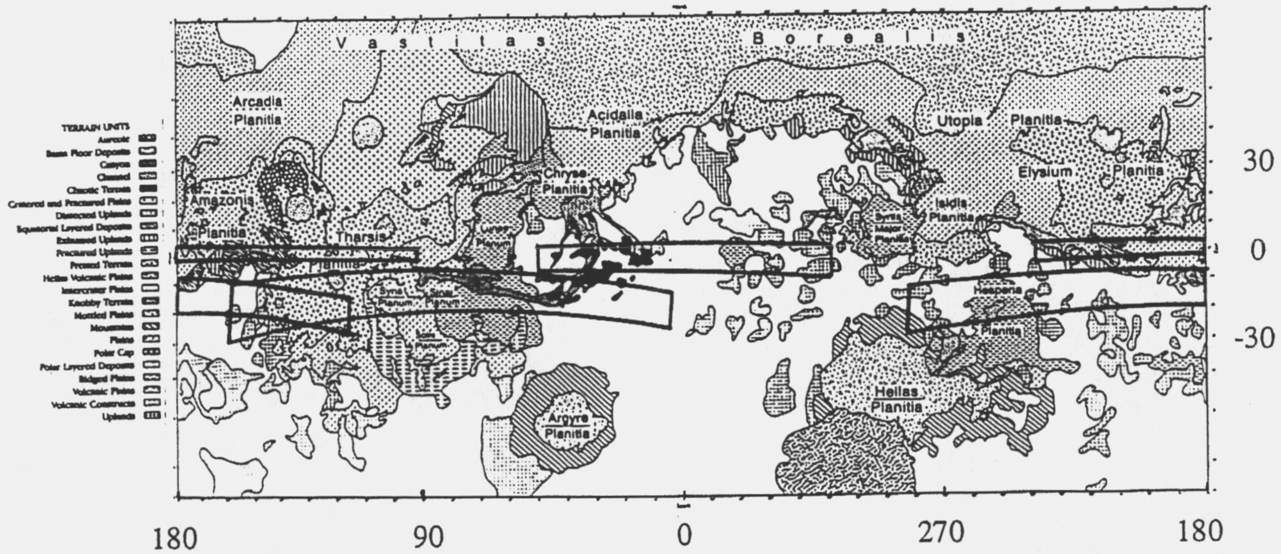

Fig. 3. Coverage of Termoskan's four panoramas (boxed regions) overlaid on a simplified geologic map of Mars from Barlow and Bradley (1990). Note that on this simplified map, ridged plains are not split into Noachian and Hesperian ages. Note also that regions near the outer edges of each panorama are badly foreshortened because they were observed near the limb.

[5].

Where coverage exists (Fig. 3), Termoskan can also be used to assess thermal inertias and the degree of thermal inertia homogeneity. These are important for lander safety considerations as well as science. Those interested in particular regions are encouraged to contact the author for more details.

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