

VARIATIONS IN MARS' NORTH RESIDUAL POLAR CAP FROST COVERAGE IN MARINER 9 AND VIKING IMAGES D. S. Bass (UCLA), K. E. Herkenhoff (JPL) and D. A. Paige (UCLA)

A comprehensive study of orbiter images of Mars' north residual polar cap frost has been undertaken to determine whether frost differences can be used to qualify interannual cycles of deposition-and-erosion. Examination of Mariner 9 and Viking Orbiter north polar data shows dramatic changes in frost coverage at the cap edge between images obtained at approximately the same solar longitude. Further study should lead to conclusions regarding residual cap frost distribution and its relationship to interannual cycles.

Current research concerning the nature of Mars' residual polar ice and associated layered terrains has not included a systematic study of frost coverage as observed in Mariner 9 and Viking Orbiter datasets. Limited regions have been examined, yielding evidence that points to interannual variations of deposition-and-erosion cycles rather than seasonal cycles. It has been reported that high resolution Viking photos show large disappearances of frost on the north polar cap [1]. Further, Kieffer [2] and Paige *et al.* [3] have noted the disappearance of a frost outlier near Chasma Boreale at 80.2 N, 44 W. Comparisons of Mariner 9 images with those taken approximately three years later by the Viking 2 Orbiter show a marked increase in frost coverage, suggesting that layered deposits may be forming in these areas over an interannual time scale.

We have begun a detailed study of residual cap frost changes as observed in Mariner 9 and Viking data. By examining Mariner 9 data of the north polar cap from $L_S=90$ to $L_S=180$, we have found eleven high resolution and four low resolution images that show changes in frost coverage when compared to Viking photo mosaics. In each case, there is more bright frost in the Viking images than in the Mariner 9 photos. cursory examination of approximately 200 Viking observations of the north polar cap show even more dramatic differences in the residual cap outline.

For example, a Mariner 9 image (center: 80.1 N, 265.6 W) taken at $L_S=97$ has less bright frost than that in a Viking mosaic (center: 82 N, 265 W) at $L_S=117$ and $L_S=134$ (Figures 1, 2). The darkest regions in the figures are sand, while the intermediate areas constitute polar layered deposits, and the brightest regions are composed of exposed water ice. Clearly, the Viking orbiter image has substantially more bright frost than the Mariner 9 image. Further, the Mariner 9 photo shows less bright frost on the plateaus and also in the troughs than the Viking mosaic. The faint outline of frost in the lower right-hand corner of the Viking image (Figure 2) is also interesting to note, as the similar although brighter feature is visible in the earlier Mariner 9 photo. The differences are quite pronounced, leading to the questions of whether dust has been deposited on top of the ice or whether the ice has sublimed, exposing a fresh surface. An extended database of frost distribution differences should provide answers to these questions.

References

- [1] James, P. B. and Martin, L. (1985) *Bul. Amer. Astron. Soc.*, 17, 735.
- [2] Kieffer, H. H. (1990) *JGR*, 96, 1481-1493.
- [3] Paige, D. A. *et al.* (1994) *JGR*, in press.

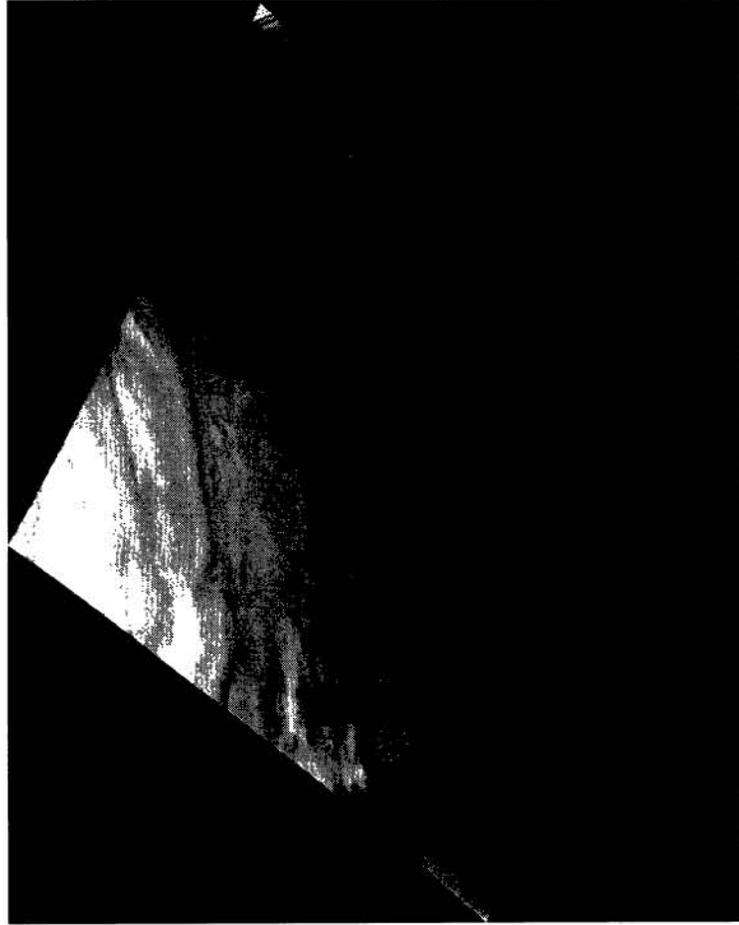


Figure 1. A high resolution Mariner 9 B camera image (picno 675b07) centered at 80.1 N, 265.6 W ($L_s=97$). Image projection is polar stereographic and shows a region of approximately 440 km by 286.5 km. The dark regions are dune material, the intermediate is polar layered deposits, and the bright regions in the lower left-hand corner are comprised of frost. Image shows less bright frost coverage at cap edge when compared to Viking image taken at approximately the same season three Mars years later.



Figure 2. Viking mosaic of two images from orbits 765A ($L_s=117$) and 801A ($L_s=134$) in the same region as Figure 1. Mosaic polar stereographic projection centered at 82 N, 265 W. Image shows significantly more bright frost than Figure 1. Also note faint outline of frost outlier in lower right-hand corner.