

STUDIES OF THE MARTIAN NORTH POLAR CAP BEFORE VERNAL EQUINOX, 1975

KYOSUKE IWASAKI,¹ TOKUHIDE AKABANE,² AND YOSHIO TOMITA³

¹Kyoto Gakuen University, Nanjyo, Sogabecho, Kameoka, Kyoto 621, Japan

²Hida Observatory, Kyoto University, Kurabashira, Kamitakara, Gifu 506-13, Japan

³Department of Astronomy, Kyoto University, Oiwakecho, Kitashirakawa, Sakyo, Kyoto 606-01, Japan

ABSTRACT

Reanalysis of the observations of Mars made at the Hida Observatory in 1975 with a new image processing method is reported. Red filter images taken in the period before vernal equinox (areocentric longitude of the sun $L_s=0^\circ$) revealed dark surface features at the northern high latitudes, while blue filter images taken at the same time showed the extensive polar hood. The latitude of the northernmost feature observed was about 67°N . An extensive north polar cap, which is predicted by most of the existing models and observed with Viking, did not exist in our reanalyzed images obtained at the Hida Observatory in 1975.

Key Words : planets, mars, polar cap

I. INTRODUCTION

Calculations using models of the deposition of CO_2 frost on the winter polar surface have predicted a northern frost cover extending to 50°N latitude or so before vernal equinox (Narumi 1979; Lindner 1993; Pollack et al. 1993). However, in our analysis of the CCD observations of Mars taken at the Catalina Station, Steward Observatory, University of Arizona in 1992 and 1994, red filter images taken before vernal equinox revealed dark surface features at northern high latitudes (about 65°N) and did not show a bright north polar cap as did red filter images taken after vernal equinox, at a time when blue filter images showed the extensive polar hood (Iwasaki et al. 1993; Iwasaki et al. 1995).

The 1975 apparition was also favorable for observing the nature of the north polar cap taken before vernal equinox. Photographic observations of Mars before vernal equinox in 1975 were carried out at the Hida Observatory. Analysis of these observations revealed dark surface features at northern high latitudes (Iwasaki et al. 1979). In order to investigate the north polar cap before vernal equinox more fully, we reexamined the data obtained at the Hida Observatory in 1975 with a new image processing system.

II. OBSERVATIONS AND MEASUREMENTS

The photographic observations of Mars were carried out with the 65-cm refractor at the Hida Observatory. The observations provided us about 5000 negatives covering the period of $L_s=306^\circ - 22^\circ$ in the 1975-1976 apparition of Mars. The red filter photographs were taken in the wavelength range of $6200\text{-}6500\text{\AA}$. The blue filter photographs were taken at 4500\AA with a half width 180\AA (Hattori et al. 1976).

We reexamined the best photographs of the red filter and blue filter pairs to study the appearance of the north polar region before vernal equinox. A new

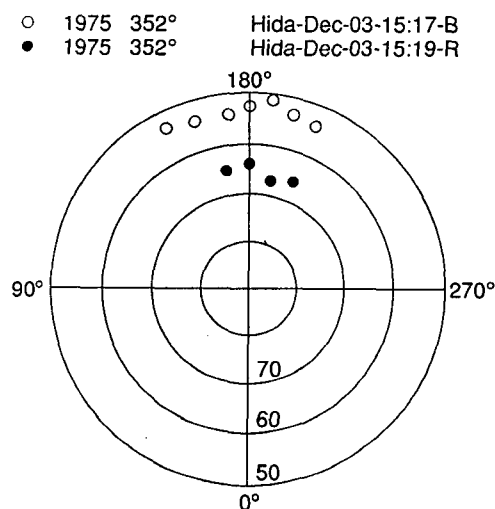


Fig. 1.— The poleward edge of the dark features (solid circles) and the equatorward edge of the north polar hood (open circles) at $L_s=352^\circ$ are shown in a polar stereographic projection of latitude and longitude on Mars.

method of measuring the dark features and polar hoods has been developed. First, photographs are digitized with a film scanner (Nikon Coolscan). Then, to improve the quality of the digitized images, we processed the digitized data with image processing systems developed by one of us (Y. Tomita). We measured the edges of the dark features and of the polar hood in the images of Mars displayed on the screen of the workstations. Sets of the longitude and the latitude of the edges of the dark features and of the polar hood are calculated from the measured data on the same workstations. They are projected onto a plane tangent to the north pole of Mars using a polar stereographic projection method.

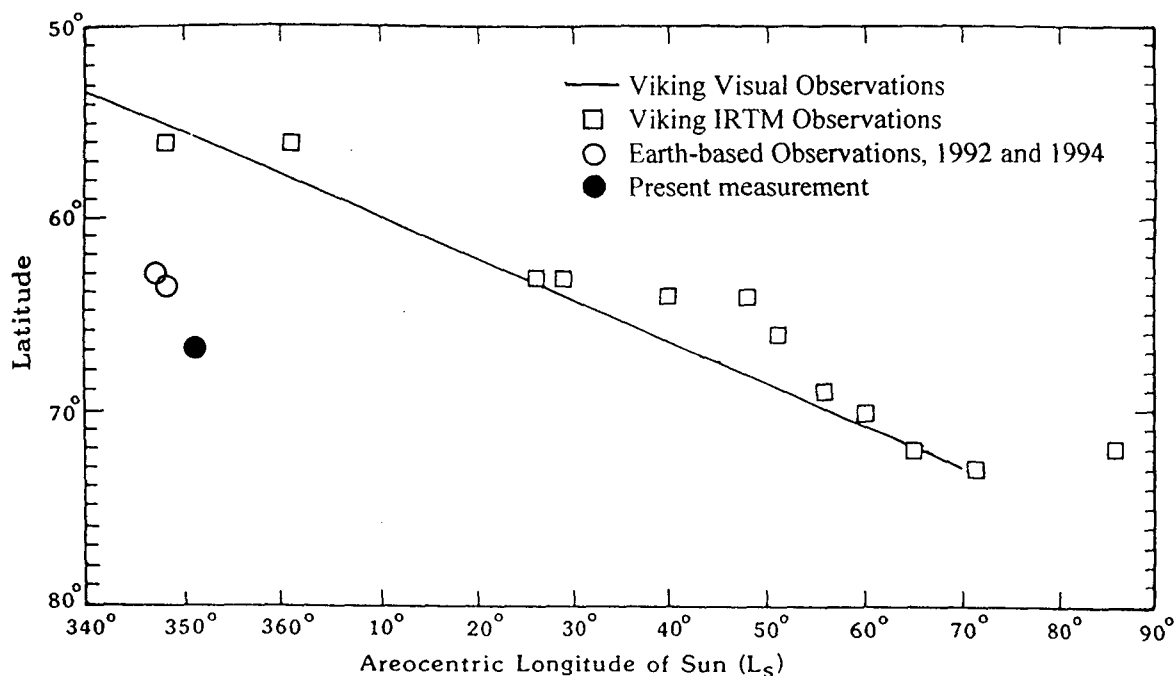


Fig. 2.— Comparison of the present measurement of dark features (solid circle) with measurements made with Viking visual observations by James [1982](solid line), with Viking IRTM observations by Christensen and Zurek [1984](squares), and with earth-based observations by Iwasaki et al. [1993, 1995](open circles).

III. NORTH POLAR REGION BEFORE VERNAL EQUINOX

Red filter images observed at $L_s=352^\circ$ in 1975 revealed dark surface features at northern high latitudes, when blue filter images show the extensive polar hood (figure 1). The latitude of the northernmost dark feature observed is plotted in figure 2 and are compared with other observations. As can be seen in figure 2, the latitude of the northernmost dark feature observed was about 67°N . Similar to our observations in 1992 and 1994, a wide spread north polar cap, which was predicted by most of the existing models and by Viking observations (James 1982; Christensen and Zurek 1984), was not observed in the observations taken at the Hida Observatory in 1975.

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