# INTERANNUAL VARIABILITY OF ABALOS MENSA IN THE NORTH POLAR REGION OF MARS

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Abalos Mensa is a small outlier of often-bright water ice frost located on the periphery of the Residual North Polar Cap at (80.8°N, 288°E). The interesting seasonal behavior of the ice cover (albedo) of this feature was discussed in Cantor et al. (Icarus 208, 2010).

Abalos Mensa is an especially interesting feature in which to study interannual changes because of the extensive record of comparable observations dating back to Mariner 9, which acquired a useful image of Abalos shortly after summer solstice ($L_s$=95.6°) in MY 10. Viking Orbiter 2 viewed Abalos at fairly high resolution in at $L_s$ = 119° in MY13 (Figure1). MOC Wide Angle imaging of Abalos Mensa at a scale of ~ 500 m/pixel commenced at $L_s$ = 104° in MY 24 and continued until around $L_s$=120° in MY 28, overlapping MARCI by about a month. Yearly observations of Abalos by MARCI have continued at a scale of 800 m/px and will again occur in MY 32 starting in February, 2014. In addition to these orbiter data, there is an HST image of the polar cap acquired at Ls = 97.7 in MY 23 (Cantor et al, Icarus 136, 1998).

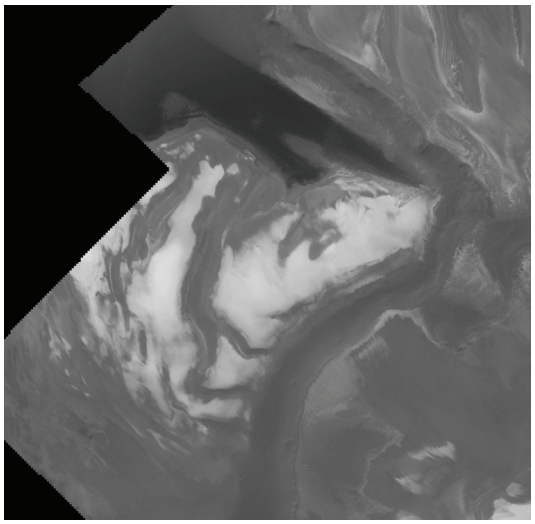

Figure1: Mosaic of Viking images acquired in 1978 at 100 m/px.

Interannual variability of Abalos Mensa during summer can be broken into two observationally distinct types: variation in the seasonal behavior near solstice and final ice configuration near the end of summer. Figure 2 shows the seasonal behavior in MY 29. Figure 3 shows that the behavior was different in MY 31, when Abalos was frosted during the entire period around solstice. Inspection of all of the images available during the relevant season around solstice suggests that the apparent frost cover is lost in about half of the years. Recondensation of water on Abalos shortly after solstice seems energetically unlikely. The totality of imaging data, including CTX images, suggests to us that the bright to dark to bright variation is explained by precipitation of a few microns od dust on Abalos before solstice with subsequent removal of dust by katabatic winds.

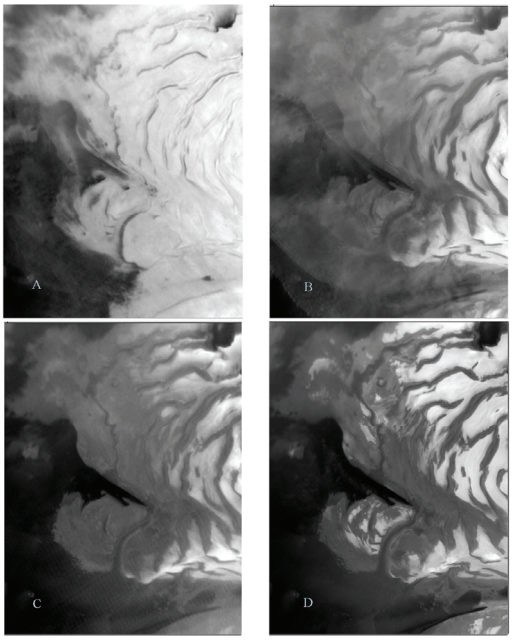


Figure 2: Frames A-D, acquired in MY 29, respectively show Abalos at $L_s$ = 72°, as $CO_2$ was disappearing, at $L_s$= 87° when the feature still shows some bright water frost, at $L_s$ = 95° when the albedo of Abalos is similar to unfrosted regions, and at $L_s$ = 117° when bright frost has reappeared.

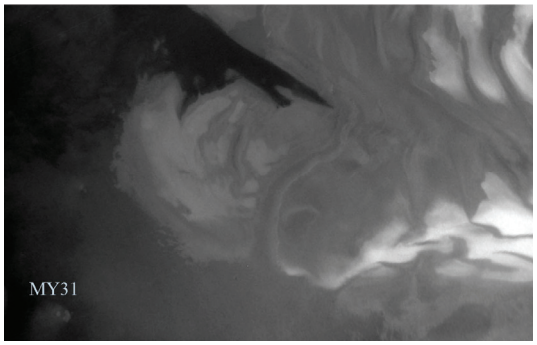

Figure 3: Image of Abalos at $L_s$ = 94° in MY 31.

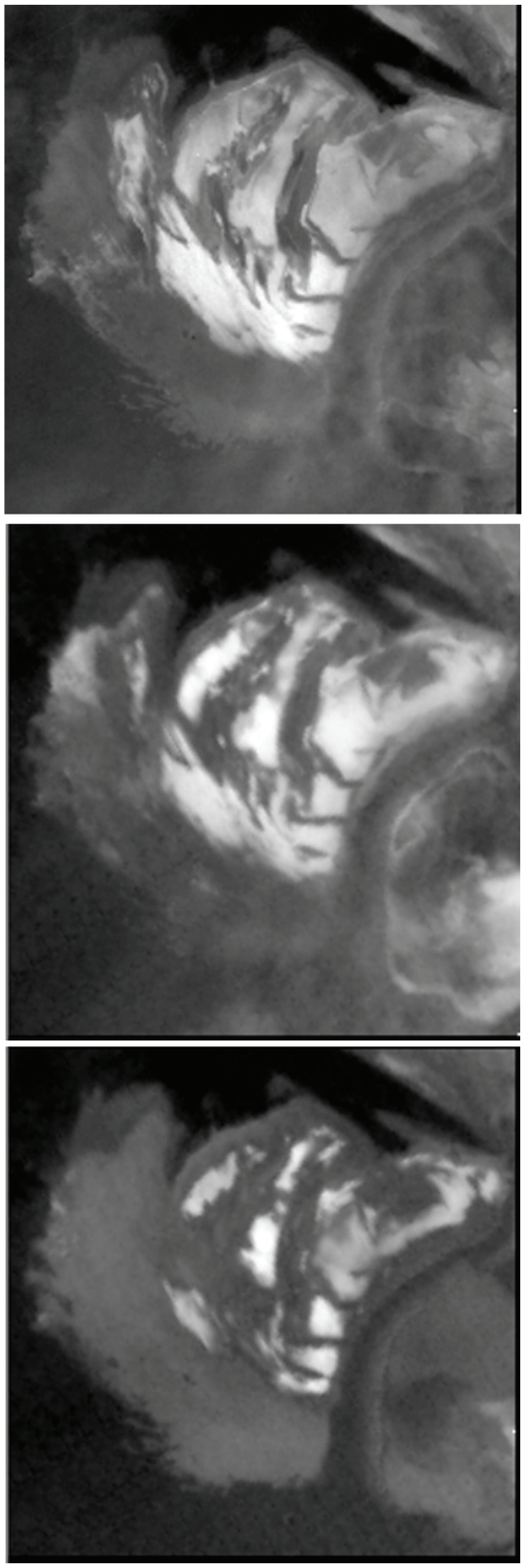

Figure 4: Abalos Mensa at Ls =137° in MY 28 – 30.

The distribution of bright frost on Abalos Mensa remained relatively constant in all years from $L_s$= 115° until onset of the large dust storms that occur after $L_s$ = 140°. MOC and MARCI imaging from MY 24- My 30 showed that the are occupied by this late summer frost diminished steadily until Abalos was almost almost clear of ice frost in MY 30. This trend reversed in MY 31, and the extent of frost was greatest since MY 24 (Figure 5).

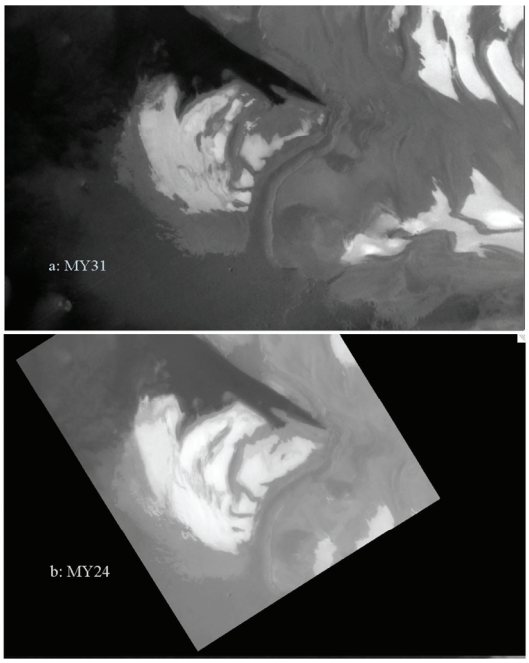


Figure 5: Images of Abalos Mensa at Ls =137° in MY 31 (top) and MY 24.

There are three boundary conditions for interpreting this large seasonal and interannual variability in Abalos Mensa: Abalos Mensa, even without bright frost, is still composed mainly of water ice contaminated with dust (Feldman et al, GRL 34, 2007; Calvin et al., JGR 114, 2009); Abalos is located near to Chasma Borealis and is subject to variable dust activity generated therein as well as to katabatic winds from the NPC; and $CO_2$ disappears from the North Polar Cap in late spring, around $L_S$=75° (Langevin et al., Science 307, 2005). But it is still difficult to explain both the seasonal and interannual variability without invoking different initial amounts and distributions of bright frost uncovered by $CO_2$ sublimation. Initial conditions include the amount of ice deposited during winter and the amount of dust contamination. We await new data from MY 32.

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