INVESTIGATIONS OF CRYPTIC REGIONS OF THE SOUTH SEASONAL CAP, 12/2008 – 02/2009.

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Introduction: Imaging systems (Viking, MGS MOC) and thermal IR spectrometers (TES, THEMIS) have observed a dark and cold region in the south seasonal cap, the "cryptic" region, from shortly after equinox to mid-spring [1]. Observations in the near IR by OMEGA/Mex [2,3], by THEMIS and the MOC [4], have demonstrated that these dark regions correspond to increasing dust contamination of the surface of the CO_2 ice layer. In part of the cryptic region ("cryptic A"), mainly at latitudes ~ 85° S, HR images and spectral images demonstrate that the dust contamination is associated to dark spots and fans, which result from a venting process resulting from sublimation at the interface of the ice and the underlying surface [5,6]. These regions are characterized by a relatively strong signature of CO2 ice shortly after equinox, which indicates that a large fraction of photons penetrate the ice layer. At latitudes of 80°S or less, the dust layer can reach an optical thickness which prevents most photons from reaching the underlying surface (hence the CO2 ice spectral signature is weak, red regions in Fig. 1, right) while retaining an apparent temperature similar to that of the underlying CO_2 ice. There is much less widespread evidence for large scale venting ("cryptic B")

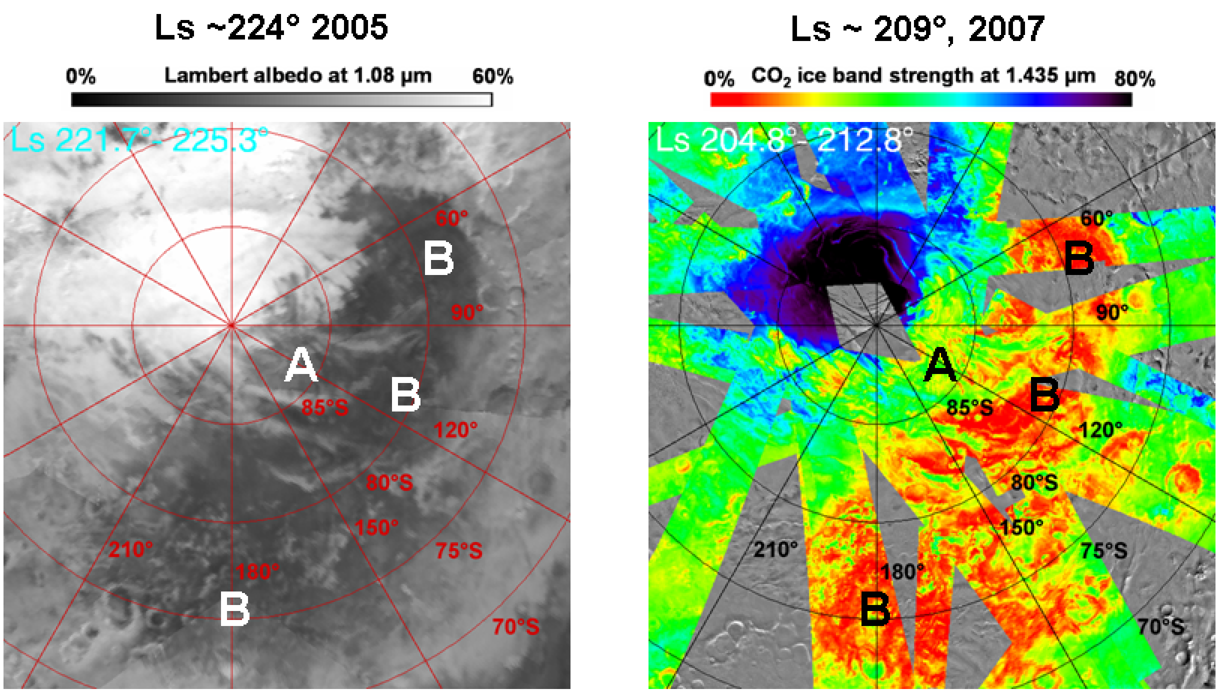

Fig. 1: Albedo in mid spring (left) and spectral signature of CO2 ice in early spring (right) of the South seasonal cap as observed by OMEGA/Mex. Regions which exhibit relatively dark albedos in mid-spring (left) correspond to a wide range of spectral signatures of CO2 ice in early spring (right). For regions of the "A" type, photons penetrate CO2 ice, which is not the case for regions of the "B" type (red tinges on the right).

Candidate processes for surface dust contamination in cryptic region B include:
- venting similarly to region A, but on smaller spatial scales which prevent the formation of spots, fans and spiders
- direct dust sedimentation on the surface
- scavenging of airborne dust by condensation of H2O frost

Previous OMEGA observations have indeed shown that deposition of H2O frost can be highly inhomogeneous (see Fig. 2), with a possible link to topography (updrafts). Furthermore, a comprehensive study of the evolution of the optical thickness of aerosols over seasonal ice [7] has demonstrated that seasonal ice [7] has demonstrated that regions corresponding to H_2O frost deposition are depleted in aerosols when compared to a well-mixed model for the lower 10 km of the martian atmosphere.

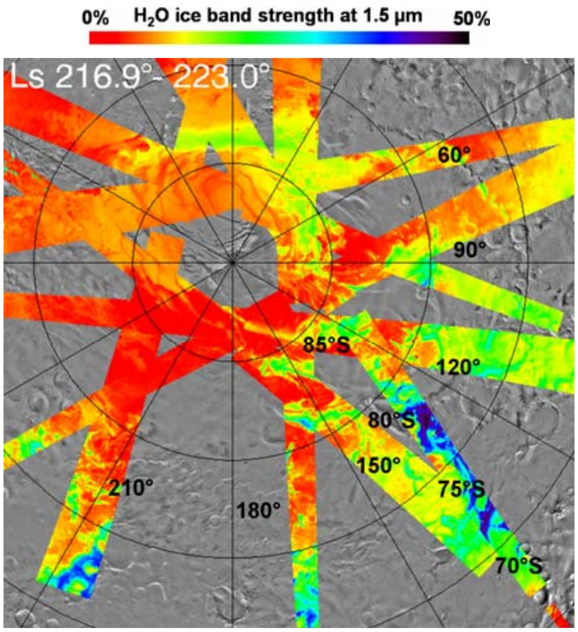

Fig. 2: spectral signature of H2O frost (grain size < 100 µm) in mid-spring. There is extreme heterogeneity, which can be correlated with wind patterns and relief.

The observation campaign of late December 2008 to February 2009: This period corresponds to a range of Ls from 190° to Ls 220°, which corresponds to the rise in contrast (hence in dust contamination) of the cryptic region. For OMEGA, this will be the 3rd martian year of observations of the retreat of the South Seasonal cap. Due to the evolution of the elliptical orbit of Mars Express, the observation altitudes will range from 250 to 500 km, much lower than that in early 2007 (1500 km to 2000 km) and 2005 (> 5000 km). This configuration corresponds to the best possible spatial resolution with OMEGA IFOV ~300 m), which becomes comparable with that provided by the push-broom mode of CRISM.

A collaborative set up has been put together so as to combine investigations by a wide range of instruments. The present contribution will focus on the regions of interest identified for this purpose from OMEGA observations in cryptic region type B and in regions corresponding to frost deposits.

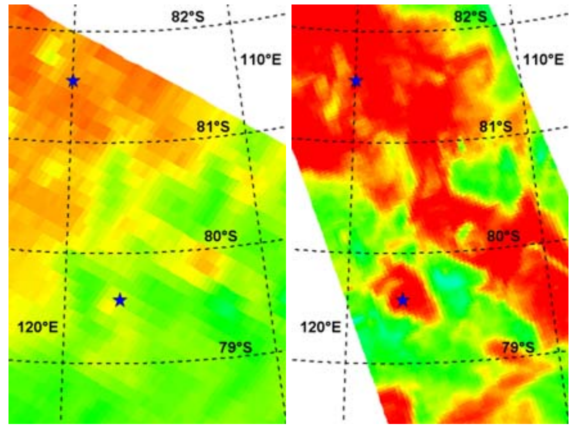

Fig. 3: CO2 ice signature observed in early 2007 for Ls 190° (left) and Ls 225° (right). The highly heterogeneous increase in surface dust contamination until mid-spring is readily apparent. Two ROI's (blue stars) corresponding to "cryptic B" areas have been selected for combined observations

The two selected ROI's (blue stars in Fig. 3) for cryptic region type B have been targeted for observations by HIRISE, which will provide clues on the structure of regions appearing relatively homogeneous on scales of several km when observed with an IFOV of 30 cm, providing clues on whether a small scale venting process is or has been at work in these areas. OMEGA (IFOV 300 m in 2009) and CRISM (IFOV 200 m for push-broom, 20 m for HR) will provide a range of spatial resolutions. Observations by THEMIS on these or equivalent "cryptic B" areas will make it possible to check the temperature evolution of thes areas. When combined together, this information should help unraveling the mystery of the extreme heterogeneity of surface dust contamination in mid spring in regions where little evidence for an active venting process has been observed.

References

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