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First Stages of the Formation of the South Seasonal Cap in Early Southern Winter as Observed by OMEGA/Mex

Y. Langevin (1), M. Vincendon (2), J-P. Bibring (1), B. Gondet (1), and F. Poulet (1)

(1) Institut d'Astrophysique Spatiale, CNRS / Univ. Paris-Sud 11, Orsay, France (yves.langevin@ias.u-psud.fr, +33 1 69858675), (2) Brown University, Providence, Rhode Island USA

Observations in the visible [1] demonstrated that the retreat of the southern seasonal is very asymmetrical from Ls 230° to Ls 300°, ice extending much further North over a range of longitudes (270° E to 0° E) corresponding to the "bright cap". Observations by TES demonstrated that the bright regions corresponding to the visible cap are at the equilibrium temperature of CO2 ice, as well as the cryptic region, which exhibits low albedos (0.2 – 0.25) close to mid southern spring (Ls 225°). Observations by OMEGA/Mex have Mars Express have demonstrated that the Southern seasonal cap is indeed spectrally dominated by CO2 ice [3, 4]. The low albedo of the cryptic region results from dust contamination on the surface [3] most likely linked to a venting process [5] when CO2 ice sublimates in contact with the underlying surface. OMEGA observed that the very high albedos are linked to large equivalent grain sizes on the bright cap (270°E to 0°E) [4]. These characteristics have been associated with global climate evolution models [6, 7] with a major role played by the two large southern basins, Hellas and Argyre, in the circulation patterns [6]. A possible interpretation of the long lasting cap over the "bright cap" range of longitudes is that the CO2 deposit on the surface is initiated by the sedimentation of small CO2 ice grains or H2O ice grains on the surface followed by the condensation of a layer CO2 directly from the atmosphere. If this is the case, the surface underlying the bright cap regions is protected from photons penetrating the overlying large-grained CO2 layer, which inhibits the venting process, delaying the sublimation of the CO2 ice layer until late spring.

Observations by OMEGA close to the southern terminator in early winter (Ls 15°) at high latitudes (70°) obtained in April 2004 and November 2009 correspond to very high incidences ($\sim$ 85° or more). This requires a careful evaluation of the aerosol contribution, at the limit of the range of validity of a plane-parallel model [8], and a 3-D model taking into account the curvature of the planet [9]. The first conclusions are that the optical depth of dust is highly variable both spatially and temporally. At longitudes corresponding to the bright cap (e.g. 350° - 0°), the retrieved surface albedos are very high (60% or more), with a spectral signature corresponding to nearly pure, relatively fine-grained CO2 ice (H2O ice content < 10 ppm). High optical depths correspond to very low contrast related to topography. In such regions, the CO2 ice signature is still observed, with a strong blue slope indicating that very fine-grained aerosols (0.5 μm in size or less) are present. OMEGA/Mex observations support the formation of ice grains in the atmosphere before sedimentation early in southern winter, either from homogeneous condensation or from heterogeneous condensation on very fine grained H2O ice. These results support the concept that a thin layer of small CO2 ice grains sedimenting from the atmosphere in early southern winter is at the origin of the long-lasting "bright cap" region of the southern seasonal cap.

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