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Abstract

Saturn's Poles Revealed: New Visual and Near-Infrared Views of Polar Clouds, Waves, Hexagonal Features, and Vortices by Cassini/VIMS

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From its unique vantage point above Saturn's polar regions, the Visual Infrared Mapping Spectrometer (VIMS) onboard the Cassini/Huygens orbiter has mapped the depths of Saturn's poles down to the 4-bar pressure level. Images of the south pole from 0.3 to 3.5 μm sample putative ammonia hazes in reflected sunlight down to approximately the 1-bar level. Further to the red at 5 μm, thick clouds likely comprised of ammonium hydrosulfide are observed in the 2-4-bar region silhouetted against Saturn's indigenous thermal radiation upwelling from depth. Major features in the south polar region include a hurricane-like vortex feature centered at the south pole, complete with eye-wall clouds which rotate 150 m/s faster than the central eye. Outside the eyewall, from about 88 to 75 degrees planetographic latitude, the zonal winds fall nearly monotonically, nearly maintaining a constant angular momentum structure. Near the 1-bar level, two distinct compositional types of cloud are present – one type with three times the absorption of the other, perhaps indicating upwelling of cloud-forming materials from two distinct regions in the depths of Saturn. The column abundances of the disequilibrium species phosphine and arsine - both of which are created at depth near the 1000-km level and are destroyed by photolysis in the upper atmosphere - are about twice as large in the south polar region than elsewhere on the planet, a further indication of strong upwelling from great depths in the south polar region. At the north pole, Saturn's Polar Hexagon, discovered in Voyager imagery by Godfrey (Icarus 76, 335-356, 1988), is a prominent feature in 5-μm thermal images, indicating that the feature extends at least several bars of pressure down into the atmosphere. The re-acquisition of this feature near 77.5 degrees planetocentric latitude indicates that the hexagon is a multi-decade, long-lived feature which survives the Saturn seasons. A second hexagon, significantly darker at 5 micron than the brighter historical feature, is located near 74.2 degrees planetocentric latitude. The clouds in the 5-micron-bright hexagon are relatively deep: 3.5 bars compared to the 2.5-3.0-bar level of clouds in the dark hexagon. Observed three times over a 12-

day period between October 29 and November 10, 2006, both hexagonal features stay fixed in a rotational system defined by the Voyager-era radio rotation rate (Desch and Kaiser, Geophys. Res. Lett, 8, 253-256, 1981) to within an accuracy of 11 seconds per rotational period. This agrees with the stationary nature of the wave in this rotation system found by Godfrey (1988), but is inconsistent with more recent Saturn rotation rates found during the current Cassini era. Together with our new constraints on the depth of the feature, this result indicates that the feature is not linked to Saturn's radio emissions nor to auroral activity as speculated by Godfrey. (1988). Images of these and other discrete features – including the north and south polar aurarae of H_3^+ emission - will be shown and discussed.