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Titan: The case for CO_2 on the surface

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We are analyzing the Cassini-Huygens' Visual and IR Mapping Spectrometer (VIMS) spectra of Titan for information on the surface composition in two ways: 1) searching for absorptions within the spectral windows, and 2) using all seven methane windows in the VIMS IR spectral range as independent spectrophotometric passbands that sample the spectral nature of the Titan surface, and our approaches and results are described in McCord et al. (2006, 2008a. This report is focused on spectral evidence for CO_2 on the surface of Titan. McCord et al. (2007a,b; 2008a) reported the discovery of an absorption band near 4.92 μm in Tui Regio, and pointed out that it is consistent with CO_2 of small grain size. For the same location, they pointed out that CO_2 of the same grain size could also explain the enhanced spectral contrast across the 2.8-μm double methane window, compared to most of Titan's surface, for this surface feature. We recently reported (McCord et al., 2008b) on the discovery of additional locations where the 4.9-μm-feature exists along with the enhanced 2.8-μm double window contrast. We noted also that using the Multiple-Endmember Linear Spectral Unmixing Model (MELSUM, Combe et al., 2008) and the reflectance at all seven IR methane windows indicates that CO_2 could be a widespread component of the surface but at lower concentration than at Tui and Hotei Regio (McCord et al., 2007ab, 2008ab). These sites, where CO_2 frost seems present, may be fresh cryovolcanic sites where CO_2 and perhaps other materials have vented recently or are currently venting (Hayne et al., 2008). This is consistent with models of the interior development of Titan. Further, there is a requirement for the atmosphere to be refreshed over geologic time, due to lose of methane from photolysis, requiring a source. This report reviews the

evidence, reports on new evidence, and explores the implications of the observations.