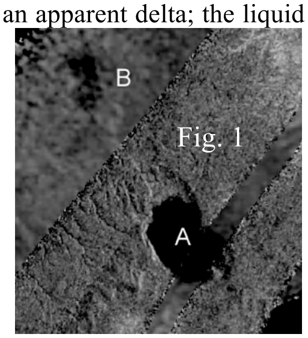
MORPHOLOGICAL EVIDENCE FOR FORMER SEAS NEAR TITAN'S SOUTH POLE. C.A. Wood[1], E.R. Stofan[2], A.G. Hayes[3], R.L. Kirk[4], J.I. Lunine[3]. J. Radebaugh[6]; and M. Malaska[7]. [1]Planetary Science Institute, Tucson, AZ 85721 & Wheeling Jesuit University, Wheeling, WV; chuckwood@cet.edu; [2]Proxemy Research, Gaithersburg, MD 20882; [3]Cornell Univ., Ithaca, NY 14853; [4]Astrogeology Science Center, USGS, Flagstaff AZ 86001; [6]Brigham Young University, Provo, UT 84602; [7]JPL, California Institute of Technology, Pasadena, CA.

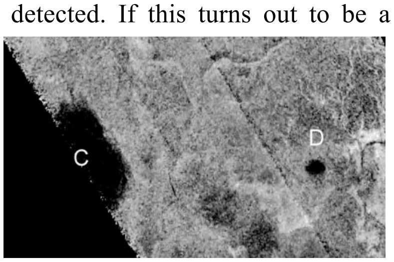
Introduction: The North Polar region of Titan has large seas and numerous small lakes of liquid. In contrast, the area around the South Pole has only one reported large lake, Ontario Lacus, and several possible small ones [1]. Geologic mapping around Titan's South Pole, and comparisons with landforms near the opposite pole, have resulted in the recognition of four smaller lakes and broad areas of likely lakebeds. If these interpretations are correct Titan's South Pole was formerly much wetter than today [2].

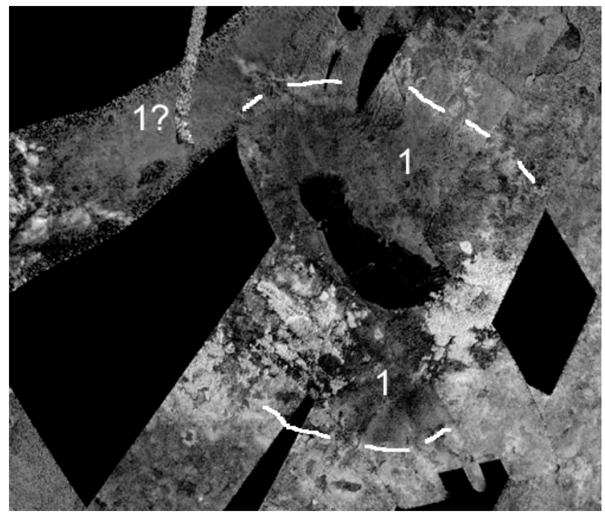
Data and Mapping: Mapping was done on all Cassini RADAR strips covering the South Polar area including T71 acquired in July 2010. In Fig. 4, red indicates areas that appear black. Larger areas, not as dark as lakes, but typically surrounding them and having relatively smooth surfaces are outlined in white. These areas are often cut by channels, as seen in shallow lakes near the North Pole. Blue outlines bright, rough-textured mountains with RADAR shadowing, indicating steep slopes/rough topography. Emerging topographic data [3] will further constrain lake basins.

Interpretations: North Polar areas with indisputable lakes and seas and associated landforms is the model for interpreting landforms near the South Pole.

Lakes (red). Ontario Lacus is a well-studied lake [4] with apparent shorelines, flooded river valleys and an apparent delta; the liquid is ethane [5] and probably methane. Smooth surfaces reflect incident radar pulses away from the spacecraft so that lake surfaces appear black. Ontario is radar dark except in places where it appears to be very shallow. A second likely lake, labeled A (Fig 1) is 35 km long and bounded by fratures and walls that rise above it. A very speculative smaller lake (B) is nearby but the quality of the image only allows its darkness to be detected. If this turns out to be a lake, a number of others exist as well. Lakes C and D (Fig 2), recognized previously [6] are very dark and have sharply defined edges. The exposed portion of C is 50 km in length, and D is a circle ~10 km in diameter. The existence of 3 definite and other possible lakes demonstrates that Ontario Lacus is not a special case; it is simply the largest remaining lake of a previously extensive collection.







Dry Lake Beds (white outlines). Surrounding Ontario is a radar dark area (Fig 3, #1) that is not black but the surface is relatively dark/smooth and is cut by channels that lead to Ontario Lacus. Based on the evidence of higher shorelines [7] indicating lake level retreat of Ontario it is reasonable to extrapolate that this broad region – about 500 km across - is a dried lake bed, previously occupied by a Greater Ontario Lacus. The southern curved shoreline may be an erosional boundary cut by previously drowned river valleys visible as elongated bright areas. The opposite side of the proposed basin has a matching arc, suggesting that Ontario is contained within a large impact crater, however the occurrence of bright mountains within the putative crater is inconsistent.

A similar partly dark, relatively smooth area (#2 in Fig. 4) is proposed to be another dried lake bed. This 225 km wide basin is centered near the South Pole and also is bounded by bright serrations that are interpreted as drowned river valleys. A dark arm extends to the upper left. The 3rd proposed lake bed is the dark feature named Mezzoramia, When the edge was first partially seen in radar images in 2005 it was tentatively interpreted as a shoreline [8], and now is proposed as a lake bed at least 500 km wide. Four other possible lake beds are identified on Figure 4 (# 4 to 7) with the higher numbered ones having a similar surface texture but being lighter in radar hue than # 1 to 3.

Rugged Mountains. On Fig. 4 blue outlines rugged mountains similar to those seen at the North Pole that are highly eroded and traversed by rivers that feed the seas. Such mountain morphology is rare elsewhere on Titan and may be a signature of mountains cut by repeated heavy rains and flowing streams. The two largest river valleys are depicted in black above and to the left of proposed lakebed #5.

Inferences: Newly recognized small lakes and extensive areas of dry lake bottoms are interpreted around the South Pole. Rugged mountains, river valleys, highly eroded terrain (possibly karst [9]) and crater-like features occur near these putative seabeds, all similar to features seen near North Polar seas.

South Polar lake beds appear to be much more extensive than previously thought – in fact, the areal coverage is comparable to lakes and seas near the North Pole. These lakebeds are consistent with proposals that Titan's hydrocarbon moisure shifts from pole to pole over times scales of tens of thousands of years due to orbital forcing of greater climate extremes [1]

Although the subdued lakebed geology is consistent with the dry lakes in the south harking back to a wetter period ~30k years ago, it will be interesting to see if they begin to refill as Titan's southern hemisphere winter develops.

References:

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Fig. 4