Re: Polarized clouds on Mars, further evidence for liquid water in Solis Lacus, Mars?

Source: http://sci.tech−archive.net/Archive/sci.astro/2005−01/2033.html

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From: Robert Clark (*rgregoryclark_at_yahoo.com*)
Date: 01/13/05

Date: 13 Jan 2005 15:46:51 −0800

Seasonal Trend in Water Vapor Seen from Orbit
"The seasonal trend in the amount of water vapor in Mars' atmosphere, as observed by thermal emission spectrometer on NASA's Mars Global Surveyor orbiter, varies by latitude. This plot starts near the beginning of fall in the southern hemisphere for the year before the Mars Exploration Rover mission began and ends on August 30, 2004, slightly more than one martian year later. Purple represents no water while red represents about 50 precipitable micrometers, which is about 10,000 times less than on Earth. The units of time along the horizontal axis are given in longitude of the Sun (Ls) as measured in a Mars−centered coordinate system, a way to reflect the elliptical nature of Mars' orbit. On this scale, Mars is farthest from the Sun at about 74, which also corresponds to late fall in the southern hemisphere.
"During the period when Mars is farthest from the Sun, the migration of water vapor from the northern polar region combines with lowered atmospheric temperatures to produce conditions that allow formation of clouds such as seen in the image "Clouds over 'Endurance' on Sol 290" . Opportunity is further north than Spirit is, so there is a distinct difference in the amount of water vapor available to form water−ice clouds over the two sites. To date, Spirit has not seen any discrete, cirrus−like clouds such as Opportunity has photographed. Although water vapor is expected to reach a maximum abundance for the Opportunity and Spirit sites near spring equinox (Ls 180 or about March 2005), the atmospheric temperatures will very likely have warmed sufficiently to prevent formation of the type of clouds that Opportunity has observed recently. "
http://marsrovers.jpl.nasa.gov/gallery/press/opportunity/20041213a.html

Perhaps Spirit and Opportunity won't see the thin, cirrus clouds seen over Meridiani, but perhaps they will see thicker clouds that could hold precipitation. Below I discuss the observations from Hubble during late southern Spring on Mars in 2003 that showed clouds extending into southern, near equatorial latitudes.
This would be consistent with the observations from the HEND instrument on Mars Odyssey that found increases in near surface water during this period. Note though that since this is in late Spring into

early Summer, the ground temperatures can rise to above freezing during daytime and any water frost deposits there (or precipitated ice) would be expected to melt to liquid during the times of late morning to early afternoon.

Bob Clark

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Newsgroups: sci.astro,alt.sci.planetary,sci.physics,sci.geo.meteorology
From: rgregorycl...@yahoo.com (Robert Clark)
Date: 2 Nov 2004 18:11:37 −0800
Local: Tues, Nov 2 2004 6:11 pm
Subject: Polarized clouds on Mars, further evidence for liquid water in Solis Lacus, Mars?

At the October, 2004 40th Vernadsky−Brown Conference was presented a report that observed polarization in the refelected light from clouds on Mars by the Hubble telescope:

35 − POLARIZATION CLOUDS IN THE MARTIAN ATMOSPHERE: HUBBLE SPACE TELESCOPE OBSERVATIONS. V. Kaydash, Yu. Shkuratov, M. Kreslavsky, G. Videen, M. Wolff, J. Bell.
The 40th Vernadsky/Brown Microsymposium on Comparative Planetology.
October 11−13, 2004, Moscow Russia
http://www.geokhi.ru/~planetology/theses/35_kaydash_et_al.pdf

Polarization of light is known to be produced by round liquid water drops as opposed to randomly oriented multi−faceted ice crystals. The process is described here:

Estimate of the global distribution of stratiform supercooled liquid water clouds using the LITE lidar.
Robin J. Hogan, Mukunda D. Behera,1 Ewan J. O'Connor, and Anthony J. Illingworth
GEOPHYSICAL RESEARCH LETTERS, VOL. 31, L05106, doi:10.1029/2003GL018977, 2004
http://www.met.rdg.ac.uk/clouds/publications/lite_mixedphase.pdf

Depolarization ratio
http://lidar.ssec.wisc.edu/papers/pp_thes/node20.htm

The figures shown in the Vernadsky/Brown report show the clouds with the high polarization extend over the Solis Lacus region. The observations were taken in southern Summer on Mars in 2003. Earlier Viking evidence had shown this seasonal period may be when water is released in Solis Lacus:

From: Robert Clark (rgregorycl...@yahoo.com)
Subject: Will Mars Odyssey prove liquid water in Solis Lacus, Mars?
Newsgroups: sci.astro
Date: 2003−08−08 21:51:54 PST

http://groups−beta.google.com/group/sci.astro/msg/20791dcf09a0317e

Images from Mars Express have also shown autumn clouds or fogs in Solis that may contact the ground and form liquid water:

From: Robert Clark (rgregorycl...@yahoo.com)
Subject: Further on liquid water in Solis Lacus, Mars.
Newsgroups: sci.astro, alt.sci.planetary, sci.physics, sci.geo.meteorology
Date: 2004−10−09 13:39:43 PST
http://groups−beta.google.com/group/sci.astro/msg/094907a1d49c5b84

Bob Clark

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Newsgroups: sci.astro, alt.sci.planetary, sci.physics, sci.geo.geology, sci.geo.meteorology
From: "Robert Clark" <rgregorycl...@yahoo.com>
Date: 25 Dec 2004 12:58:34 −0800
Local: Sat, Dec 25 2004 12:58 pm
Subject: More on "Frost on the rover solar panels".

Imaging at the Opportunity rover landing site in Meridiani Planum confirms observations using the HEND instrument on Mars Observer that water/ice is deposited near the equator seasonally on Mars:

Space Sciences
Whoa! Frost on the solar panels?
Posted by Robert Clark on 12/14/2004 7:32:38 AM
In Reply to: Sabkha or playa, take your pick... posted by Nick Hoffman on 12/13/2004 6:23:08 PM
http://habitablezone.com/space/messages/360805.html

However, the HEND instrument shows the greatest amount is deposited during southern Summer:

47 − EVIDENCE OF THE SEASONAL REDISTRIBUTION OF WATER IN THE SURFICIAL MARTIAN REGOLITH BASED ON ANALYSIS OF THE HEND MAPPING DATA.
R.O. Kuzmin, E.V. Zabalueva, I.G. Mitrofanov, M.L. Litvak, A.V. Parshukov, V.Yu. Grin'kov, W. Boynton, R.S. Saunders.
"As it well seen from fig.1b,c,d, two distinctive "hollows" of neutrons flux reduction have been appeared in the northern hemisphere during northern summer at Ls=130°−170° and in first half of northern winter at Ls=270°−330°, being extended from high to low latitudes. At that, later "hollow" (Ls=270°−330°) is characterized by much stronger reduction of the neutrons flux and it traces from northern polar region up to low latitudes in the southern hemisphere. The first "hollow" is related with periods of the northern middle summer, while the second one − with of the southern middle summer. In both case the residual polar caps serve as main source of the water in the Martian atmosphere."

p. 2
http://www.geokhi.ru/~planetology/theses/47_kuzmin_et_al.pdf

Opportunity landed just barely after this time in southern Summer at
about LS 340° (LS stands for solar longitude and indicates Mars
position in its orbit.)
However, it is notable that Spirit did land near the end of the time
period of Ls=270°−330°. Spirit is closer to the southern pole and
this may explain how could experience deposition during this period
while apparently not during the current northern Summer. Then the
controversial indications of mud at the Spirit landing site early in
the mission may indeed have been indications of this summer−time water
deposition.
Opportunity has observed clouds during the current water deposition
period and since the amount of atmospherically deposited water is
greater during southern Summer, we would expect the cloud density to be
even greater then. Indeed it could be of sufficient density to allow
precipitation which could reach the ground as rain.
The next Ls=270°−330° period begins in August, 2005.

Come on Opportunity!
Bob Clark

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