

Triton Fun Company

Science Newsletter July 2009

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July 2009

Ice and Snow on Mars

N. Heavens

Special points of interest:

Winter wonderland..

Triton Fun stuff

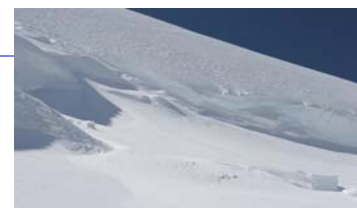
Superfluous questions

You might remember this bit of verse from Elton John and Bernie Taupin's song, "Rocket Man", "Mars ain't the kind of place to raise your kids/ In fact it's cold as hell." That's a fair point. Mars has an average temperature comparable to the interior of Antarctica (during the winter). On the warmest day of the year on the warmest part of the planet, you still need a heated spacesuit. Mars is **cold**. But does it snow?

Mars has two ingredients necessary for snow: water vapor in its atmosphere and cold temperatures. But there's not a lot of water vapor. If you condensed a column of the most water-rich martian air known, you would get enough for 1/250 of an inch of snow. It's possible that more water-rich parcels of air exist, though. Snow, however, is not simply frozen water. It is an aggregate of ice crystals, as opposed to sleet, which is effectively a raindrop frozen solid. If you have lived through enough snowy winters, you might notice that snow itself has many forms. There is *wet snow* forming at near-freezing temperatures which falls as large, dense flakes. As the temperature at which they form grows colder, snowflakes typically become less dense and pack with more air between them. In other words, they're *fluffier*. Indeed, as temperature decreases, the amount of water vapor that the air can hold in

decreases, so fewer and fewer ice crystals form. Eventually, the only "snow" is very small individual ice crystals known as "diamond dust," which often occurs in Antarctica as a fog on the ground. Based on what is known about the weather conditions on Mars, "diamond dust" is the most likely form of snow there.

Recent observations by NASA's **Mars Phoenix Lander** now suggest that martian snow isn't all quite so boring. Phoenix, which is presently dormant (likely permanently so) near the north pole of Mars, has an instrument called a **lidar** (light detection and ranging). Just as radar sends out and receives radio waves to detect clouds or aircraft or other objects, Phoenix's lidar sent out a laser beam and detected clouds by measuring the light scattered or reflected back to the lidar. By observing up to ~10 km immediately above the instrument at frequent intervals over the span of a few hours, Phoenix's lidar created images of clouds moving over the lander. Some of these clouds were made of water ice. Others were made of dust. But generally the particles in these clouds stayed in the clouds. However, the lidar occasionally saw little tails emerging from the bottom of water ice clouds. In other words, particles of water ice were falling from the sky.



Snow season

Winter comes to all planets, including Mars.

However, these ice particles probably weren't reaching the ground. They were sublimating to water vapor before they reached the surface, creating a precipitate called *virga*. But they were large enough to fall quickly, making them somewhat larger than "diamond dust." One possibility is that they were dust particles with a coating of ice, allowing them to fall faster than air was rising into the cloud. In that case, despite NASA's enthusiastic press releases about snow, Phoenix really detected something more like sleet than snow: more of an icecube than a snowball.

But the story of snow on Mars is not limited to water ice. Another solid condenses on Mars, and the atmosphere is about 95% composed of its vapor: carbon dioxide (CO₂). Like the Earth, Mars has polar ice caps, and the top portion

continued, pg 2 —>

We are always looking for **contributors** to the Science Newsletter. If you would like to write an article about a science subject you are excited about, or contribute a superfluous question, or if you would like to be on our **mailing list** for future newsletters, please e-mail us at:

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Snowing on Mars: *continued*

Photos/Info: NASA/JPL/mars.spherix.com/SPIE98

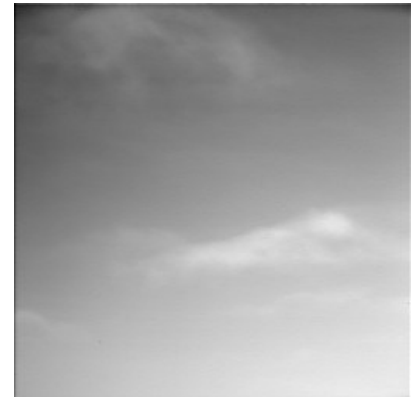
of the ice caps during the winter is anywhere from a few centimeters to several meters of carbon dioxide ice. But this ice easily can form by direct deposition on the surface. No snow storm is required. Yet there is now a growing body of evidence that CO₂ snow is a frequent occurrence at the south pole of Mars during the winter (and possibly the north pole, too).

The south pole during the winter seems to be covered by thick clouds. On the Earth, satellites “see” thick clouds by measuring their temperature. High, thick clouds like those in thunderstorms are colder than the surface, because the cloud is effectively radiating heat as a thick layer similar to the loss of heat from a surface, but at a lower temperature high in the atmosphere. On Mars, the surface temperature of the winter polar cap should be the temperature at which CO₂ is deposited on the surface. But the temperatures in some spots on the cap observed by satellite are often colder than this temperature by many degrees. These “cold spots” also appear to move around. Models of Mars’ atmosphere agree better with observations if the heat radiated from the surface is calculated by adding high clouds as the cold spots. Most definitively of all, one satellite sent to Mars, the Mars Global Surveyor (MGS – launched 1996), also had a lidar. This lidar was designed to measure the topography of Mars, but it also detected thick clouds above the south pole.

Based on the dryness of the atmosphere of the south pole of Mars during the winter and temperature observations that suggest CO₂ could condense above the surface, these thick clouds are probably CO₂. Whether or not these clouds cause snow to fall is more controversial. CO₂ *snow* should produce fluffy CO₂ ice on the polar cap made up of relatively small particles. CO₂ *ice* deposited directly at the surface would form big blocks.

These two types of ice would appear to be of different brightnesses, so it has been proposed that variability in the brightness of the southern polar cap is due to some areas receiving more snow than others.

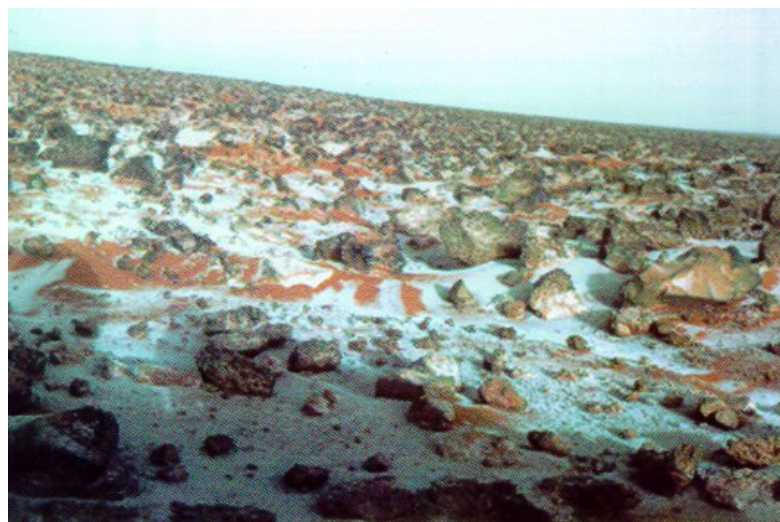
Whatever the merit of this last argument, the possibility of CO₂ snow should be exciting to anyone interested in extreme weather. CO₂ clouds on Mars will derive much of their energy from the heat released by the transition from vapor to solid, just like thunderstorms do on Earth. Thus, CO₂ clouds could be quite large and produce intense precipitation. One researcher is investigating the possibility that the condensation of CO₂ ice in large quantities might produce a sound like thunder. The winter poles of Mars already are known to be cold, bleak and dangerous places. Could the rumbling of an advancing *thundersnowstorm* be the first sound on Mars some future explorer will ever hear?



Clouds in the polar regions

The Phoenix lander which set down in the north polar region of Mars in 2008 saw clouds floating by. The daily temperature minimums in that part of Mars range from:

-110 to -130F (-79 to -90 C) (= cold !).



A Snowy Scene on Mars
Snow at Viking 2 lander site

Two Viking spacecraft (Viking 1 and Viking 2) were launched by NASA to land on Mars in 1976 and do scientific studies of the surface. As winter came to the Viking 2 site, heavy frost formed near the lander on a cold day. Mars has real winter.

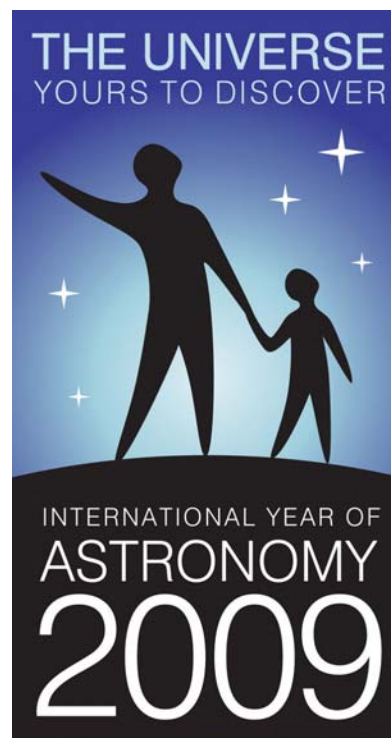
TRITON FUN PRODUCTS

2009 has been declared the "International Year of Astronomy". Events and activities to further the excitement of astronomy are being planned by IYA committees in over 100 countries. The logo for the IYA2009 is shown below. For more info on upcoming IYA2009 events, go to: <http://www.astronomy2009.org>

Triton Fun is an authorized distributor of T-shirts, sweatshirts and long-sleeve tees sporting this new logo. Part of the proceeds from the sale of these shirts will go to support astronomy clubs and astronomy activities connected with IYA2009 in California.

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** Send us your superfluous questions for a future issue ! They can be on any subject. The funnier, the better. M.D., our editor, appreciates the help and will send you a free Triton Fun coffee mug as compensation for your question. Or write an article for us and be read by professional and amateur astronomers and scientists in the U.S. and Canada ! **

Superfluous Questions:

- 1) Brass is an alloy of copper and *what* other element ?
a) lead b) aluminum c) iron d) zinc
- 2) Bronze is an alloy of copper and *what* other element ?
a) carbon b) tin c) chromium d) cobalt
- 3) Sterling silver is an alloy of silver and *what* other element ?
a) gold b) tin c) copper d) vanadium
- 4) Stainless steel is an alloy of iron and *what* other element ?
a) tin b) aluminum c) carbon d) chromium

→ ANSWERS in next months issue of the Science Newsletter ! ←---

** ANSWERS to June's Superfluous Questions: 1. a) Z. Janssen 2. d) Cardinals-Yankees 3. c) new car 4. a) Alberta