Space News Update

— March 21, 2017 —

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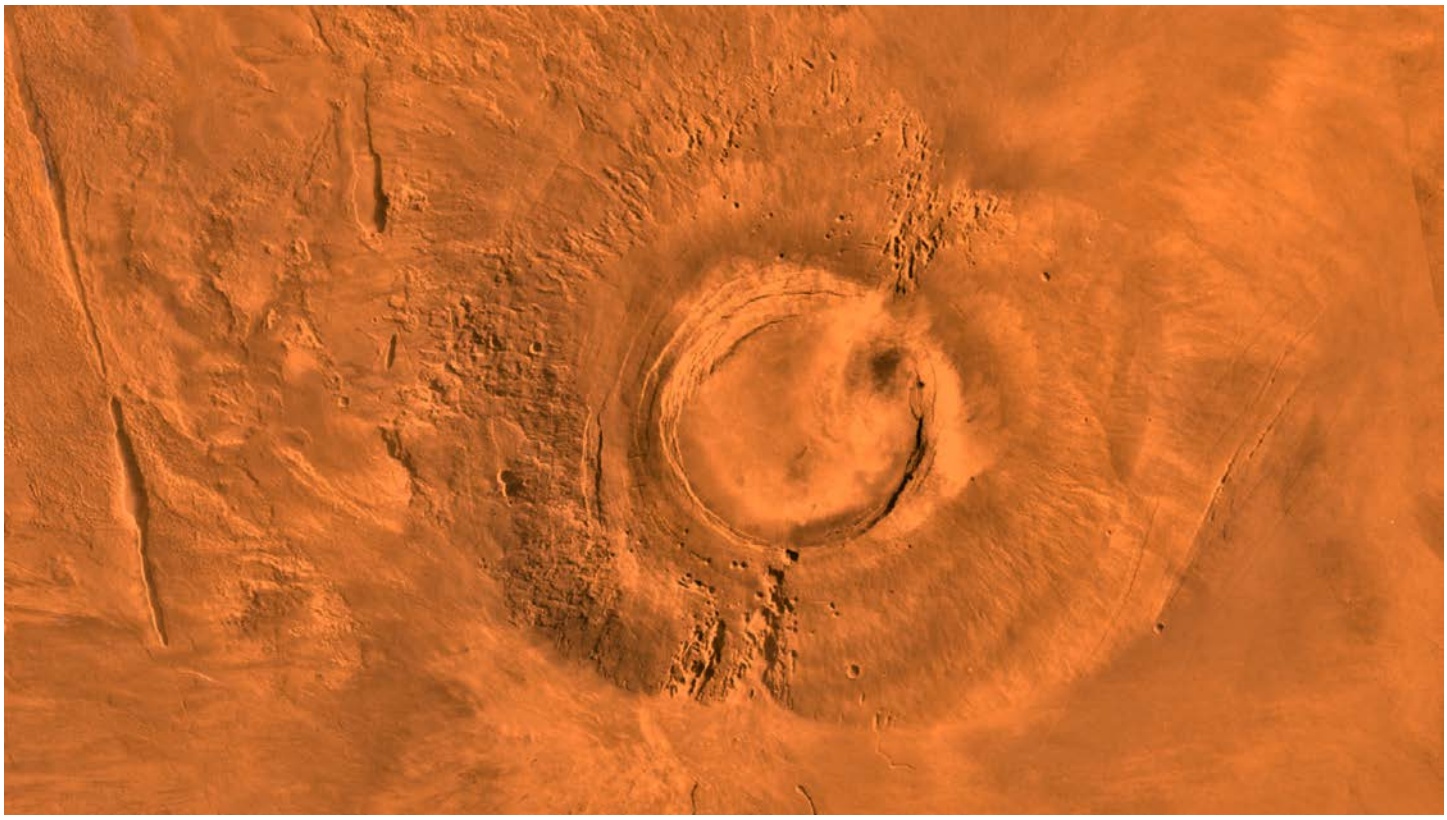
1. Mars Volcano, Earth's Dinosaurs Went Extinct About the Same Time



New NASA research reveals that the giant Martian shield volcano Arsia Mons produced one new lava flow at its summit every 1 to 3 million years during the final peak of activity. The last volcanic activity there ceased about 50 million years ago—around the time of Earth's Cretaceous–Paleogene extinction, when large numbers of our planet's plant and animal species (including dinosaurs) went extinct.

Located just south of Mars' equator, Arsia Mons is the southernmost member of a trio of broad, gently sloping shield volcanoes collectively known as Tharsis Montes. Arsia Mons was built up over billions of years, though the details of its lifecycle are still being worked out. The most recent volcanic activity is thought to have taken place in the caldera—the bowl-shaped depression at the top—where 29 volcanic vents have been identified. Until now, it's been difficult to make a precise estimate of when this volcanic field was active.

"We estimate that the peak activity for the volcanic field at the summit of Arsia Mons probably occurred approximately 150 million years ago—the late Jurassic period on Earth—and then died out around the same time as Earth's dinosaurs," said Jacob Richardson, a postdoctoral researcher at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "It's possible, though, that the last volcanic vent or two might have been active in the past 50 million years, which is very recent in geological terms."

Richardson is presenting the findings on March 20, 2017, at the Lunar and Planetary Science Conference in The Woodlands, Texas. The study also is published in Earth and Planetary Science Letters.

Measuring about 68 miles (110 kilometers) across, the caldera is deep enough to hold the entire volume of water in Lake Huron, and then some. Examining the volcanic features within the caldera required high-resolution imaging, which the researchers obtained from the Context Camera on NASA's Mars Reconnaissance Orbiter.

The team mapped the boundaries of the lava flows from each of the 29 volcanic vents and determined the stratigraphy, or layering, of the flows. The researchers also performed a technique called crater counting—tallying up the number of craters at least 330 feet (100 meters) in diameter—to estimate the ages of the flows.

Using a new computer model developed by Richardson and his colleagues at the University of South Florida, the two types of information were combined to determine the volcanic equivalent of a batting lineup for Arsia Mons' 29 vents. The oldest flows date back about 200 million years. The youngest flows probably occurred 10 to 90 million years ago—most likely around 50 million years ago.

The modeling also yielded estimates of the volume flux for each lava flow. At their peak about 150 million years ago, the vents in the Arsia Mons' caldera probably collectively produced about 1 to 8 cubic kilometers of magma every million years, slowly adding to the volcano's size.

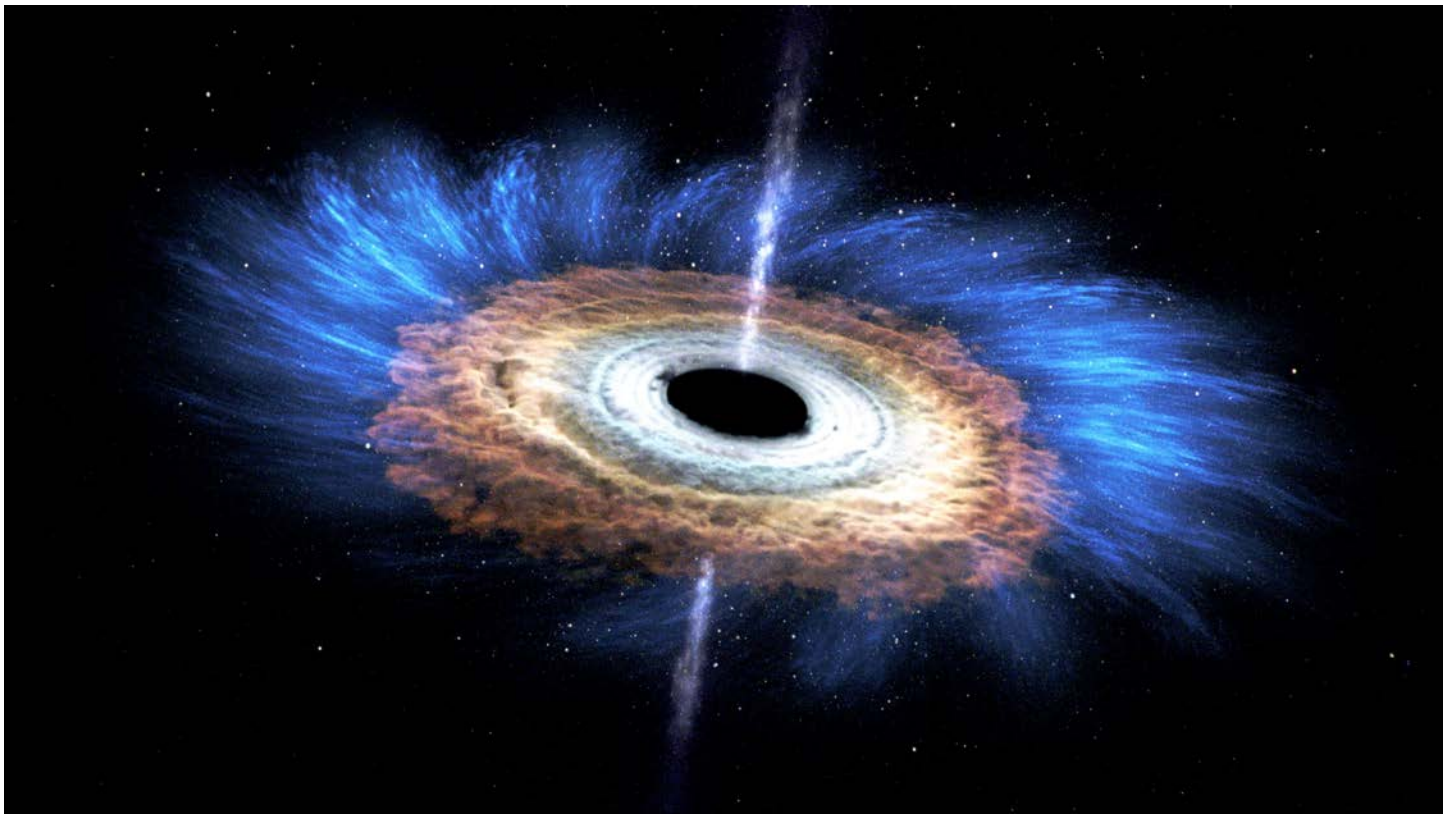
"Think of it like a slow, leaky faucet of magma," said Richardson. "Arsia Mons was creating about one volcanic vent every 1 to 3 million years at the peak, compared to one every 10,000 years or so in similar regions on Earth."

A better understanding of when volcanic activity on Mars took place is important because it helps researchers understand the Red Planet's history and interior structure.

"A major goal of the Mars volcanology community is to understand the anatomy and lifecycle of the planet's volcanoes. Mars' volcanoes show evidence for activity over a larger time span than those on Earth, but their histories of magma production might be quite different," said Jacob Bleacher, a planetary geologist at Goddard and a co-author on the study. "This study gives us another clue about how activity at Arsia Mons tailed off and the huge volcano became quiet."

Source: NASA Return to Contents

2. Swift Maps a Star's 'Death Spiral' into a Black Hole



Some 290 million years ago, a star much like the sun wandered too close to the central black hole of its galaxy.

Intense tides tore the star apart, which produced an eruption of optical, ultraviolet and X-ray light that first reached Earth in 2014. Now, a team of scientists using observations from NASA's Swift satellite have mapped out how and where these different wavelengths were produced in the event, named ASASSN-14li, as the shattered star's debris circled the black hole.

"We discovered brightness changes in X-rays that occurred about a month after similar changes were observed in visible and UV light," said Dheeraj Pasham, an astrophysicist at the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, and the lead researcher of the study. "We think this means the optical and UV emission arose far from the black hole, where elliptical streams of orbiting matter crashed into each other."

This animation illustrates how debris from a tidally disrupted star collides with itself, creating shock waves that emit ultraviolet and optical light far from the black hole. According to Swift observations of ASASSN-14li, these clumps took about a month to fall back to the black hole, where they produced changes in the X-ray emission that correlated with the earlier UV and optical changes.

Astronomers think ASASSN-14li was produced when a sun-like star wandered too close to a 3-million-solar-mass black hole similar to the one at the center of our own galaxy. For comparison, the event horizon of a black hole like this is about 13 times bigger than the sun, and the accretion disk formed by the disrupted star could extend to more than twice Earth's distance from the sun.

When a star passes too close to a black hole with 10,000 or more times the sun's mass, tidal forces outstrip the star's own gravity, converting the star into a stream of debris. Astronomers call this a tidal disruption

event. Matter falling toward a black hole collects into a spinning accretion disk, where it becomes compressed and heated before eventually spilling over the black hole's event horizon, the point beyond which nothing can escape and astronomers cannot observe. Tidal disruption flares carry important information about how this debris initially settles into an accretion disk.

Astronomers know the X-ray emission in these flares arises very close to the black hole. But the location of optical and UV light was unclear, even puzzling. In some of the best-studied events, this emission seems to be located much farther than where the black hole's tides could shatter the star. Additionally, the gas emitting the light seemed to remain at steady temperatures for much longer than expected.

ASASSN-14li was discovered Nov. 22, 2014, in images obtained by the All Sky Automated Survey for SuperNovae (ASASSN), which includes robotic telescopes in Hawaii and Chile. Follow-up observations with Swift's X-ray and Ultraviolet/Optical telescopes began eight days later and continued every few days for the next nine months. The researchers supplemented later Swift observations with optical data from the Las Cumbres Observatory headquartered in Goleta, California.

In a paper describing the results published March 15 in The Astrophysical Journal Letters, Pasham, Cenko and their colleagues show how interactions among the infalling debris could create the observed optical and UV emission.

Tidal debris initially falls toward the black hole but overshoots, arcing back out along elliptical orbits and eventually colliding with the incoming stream.

"Returning clumps of debris strike the incoming stream, which results in shock waves that emit visible and ultraviolet light," said Goddard's Bradley Cenko, the acting Swift principal investigator and a member of the science team. "As these clumps fall down to the black hole, they also modulate the X-ray emission there."

Future observations of other tidal disruption events will be needed to further clarify the origin of optical and ultraviolet light.

Check out an animation of the process here.

Source: SpaceRef.com Return to Contents

3. New Hubble mosaic of the Orion Nebula

In the search for rogue planets and failed stars astronomers using the NASA/ESA Hubble Space Telescope have created a new mosaic image of the Orion Nebula. During their survey of the famous star formation region, they found what may be the missing piece of a cosmic puzzle; the third, long-lost member of a star system that had broken apart.

The Orion Nebula is the closest star formation region to Earth, only 1400 light-years away. It is a turbulent place—stars are being born, planetary systems are forming and the radiation unleashed by young massive stars is carving cavities in the nebula and disrupting the growth of smaller, nearby stars.

Because of this ongoing turmoil, Hubble has observed the nebula many times to study the various intriguing processes going on there. This large composite image of the nebula's central region, combining visual and near-infrared data, is the latest addition to this collection.

Astronomers used these new infrared data to hunt for rogue planets—free-floating in space without a parent star—and brown dwarfs in the Orion Nebula. The infrared capabilities of Hubble also allow it to peer through the swirling clouds of dust and gas and make the stars hidden within clearly visible; the unveiled stars appear with bright red colours in the final image. Among these, astronomers stumbled across a star moving at an unusually high speed—about 200 000 kilometres per hour. This star could be the missing piece of the puzzle of a star system that had been broken apart 540 years ago.

Astronomers already knew about two other runaway stars in the Orion Nebula which were most likely once part of a now-defunct multiple-star system. For years it was suspected that the original system contained

more than just these two stars. Now, by virtue of accident and curiosity, Hubble may have found the missing third piece of this cosmic puzzle.

Whether the new star is indeed the missing—and the last—piece of the puzzle will require further observations. So will the answer to the question of why the original star system broke apart in the first place. While there are several theories—interactions with other, nearby stellar groups, or two of the stars getting too close to each other—none can be ruled out or confirmed yet.

And while the astronomers are looking for the answers to these questions, who knows what mystery they will find next?

Source: Phys.org Return to Contents

The Night Sky

Tuesday, March 21

• Arcturus, the "Spring Star," now rises above the east-northeast horizon just around the time the stars come out. How soon can you spot it? Brighter Jupiter comes up somewhat later (depending on your latitude), 30° to Arcturus's right.

Wednesday, March 22

• For skywatchers not far from 40° north latitude, now is the best day, or night, to try for a rare *dual sighting* of Venus — extremely low in the west-northwest shortly after sunset, *and* extremely low in the east shortly before sunrise. Binoculars will help. See the March *Sky & Telescope*, page 46.

Thursday, March 23

• Draw a line from Castor through Pollux high overhead, follow it farther out by a big 26° (about 2½ fist-widths at arm's length), and you're at the dim head of Hydra, the Sea Serpent. In a dark sky it's a subtle but distinctive star grouping, about the size of your thumb at arm's length. Binoculars show it easily through light pollution.

Friday, March 24

• This is the time of year when the dim Little Dipper (Ursa Minor) juts to the right from Polaris (the Little Dipper's handle-end) during late evening. The much brighter Big Dipper curls over high above it, "dumping water" into it.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Tue Mar 21, 5:20 AM	3 min	38°	24° above NNW	26° above E
Wed Mar 22, 4:30 AM	< 1 min	17°	17° above ENE	17° above ENE
Wed Mar 22, 6:03 AM	5 min	44°	15° above WNW	11° above SSE
Thu Mar 23, 5:13 AM	3 min	64°	64° above SE	11° above SE
Fri Mar 24, 5:57 AM	2 min	18°	18° above SW	11° above S

Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights

(all times Eastern Daylight Time)

2 p.m., Wednesday, March 22 - ISS Expedition 50 Spacewalk Preview Briefing (all channels)

5 p.m., 8 p.m., Wednesday, March 22 - Replay of the ISS Expedition 50 Spacewalk Preview Briefing (all channels)

1 p.m., Thursday, March 23 - "What's On-Board" Science Briefing for Orbital ATK CRS-7 Mission (all channels)

4 p.m., Thursday, March 23 - Orbital ATK CRS-7 Mission Pre-Launch Briefing (all channels)

6:30 a.m., Friday, March 24 - Coverage of ISS Expedition 50 U.S. Spacewalk # 40 (Kimbrough and Pesquet; spacewalk begins at appx. 8 a.m. ET; will last appx. 6 ½ hours) (all channels)

Watch NASA TV on the Net by going to the NASA website.

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Space Calendar

- Mar 21 - SGDC-1/ Koreasat 7 Ariane 5 Launch
- Mar 21 - NEW [Mar 19] Apollo Asteroid 2017 FJ Near-Earth Flyby (0.005 AU)
- Mar 21 - NEW [Mar 20] Apollo Asteroid 2017 FO Near-Earth Flyby (0.031 AU)
- Mar 21 - NEW [Mar 21] Amor Asteroid 2017 FL1 Near-Earth Flyby (0.046 AU)
- Mar 21 - Asteroid 20403 Attenborough Closest Approach To Earth (2.120 AU)
- Mar 21 - Halton Arp's 90th Birthday (1927)
- Mar 21 - Maurice Farman's 140th Birthday (1877)
- Mar 21 - 315th Anniversary (1702) - Maria Margarethe Kirch Becomes 1st Woman to Discover a Comet (C/1702 H1)
- Mar 22 - Cassini, Distant Flyby of Pan
- Mar 22 - Comet P/2003 T12 (SOHO) Closest Approach To Earth (2.783 AU)
- Mar 22 - Asteroid 175 Andromache Occults HIP 20533 (6.3 Magnitude Star)
- Mar 22 - NEW [Mar 21] Amor Asteroid 2017 FC1 Near-Earth Flyby (0.040 AU)
- Mar 22 - Asteroid 10377 Kilimanjaro Closest Approach To Earth (2.738 AU)
- Mar 22 - Neptune Trojan 316179 (2010 EN65) At Opposition (25.253 AU)
- Mar 22 - 35th Anniversary (1982), STS-3 Launch (Space Shuttle Columbia)
- Mar 23 - Cassini, Distant Flyby of Titan
- Mar 23 - Comet 73P-AI/Schwassmann-Wachmann At Opposition (0.538 AU)
- Mar 23 - Comet P/2015 Q1 (Scotti) At Opposition (3.101 AU)
- Mar 23 - Dwarf Planet Ceres Occults TYC 0647-00586-1 (9.6 Magnitude Star)
- Mar 23 - Amor Asteroid 2017 CR32 Near-Earth Flyby (0.074 AU)
- Mar 23 - Asteroid 3831 Pettengill Closest Approach To Earth (1.344 AU)
- Mar 23 - Centaur Object 31824 Elatus At Opposition (15.242 AU)
- Mar 23 - Dwarf Planet 136472 Makemake At Opposition (51.606 AU)
- Mar 23 - Wernher von Braun's 105th Birthday (1912)
- Mar 23 - Emmy Noether's 135th Birthday (1882)
- Mar 23 - Richard Proctor's 180th Birthday (1837)
- Mar 24 - HOT [Mar 20] CRS-7 (OA-7 - S.S. John Glenn)/ Violet/ SUSat/ UNSW-EC0/ i-INSPIRE 2/ ZA-AeroSat/ nSIGHT 1/ QARMAN/ 14-BISa/ YUsend-QB50/ Ex-Alta 1/ BUSAT 1/ LilacSat 1/ NJUST 1/ Aoxiang 1/ SOMP 2/ QBITO/ Aalto 2/ X-CubeSat/ EntrySat/ IP2SAT/SpaceCube/ DUTHSat/ UPSat/ Hoopoe/ ANUSAT 2/ LINK/ SNUSAT 1/SNUSAT 1b/ GAMASAT 1/ RoBiSAT 1 & 2/ SamSat-QB50/ qbee50-LTU-OC/ BeEagleSat/ HAVELSAT/ Phoenix/ PolyITAN-2-SAU/ QBUS 1/ QBUS 2/ QBUS 3/ QBUS 4/ IceCube (Earth 1)/ HARP/ CSUNSat 1/ CXBN 2/ OPEN Atlas 5 Launch (International Space Station)
- Mar 24 - Comet 133P/Elst-Pizarro Closest Approach To Earth (2.297 AU)
- Mar 24 - NEW [Mar 20] Amor Asteroid 2017 FT Near-Earth Flyby (0.074 AU)
- Mar 24 - Asteroid 17473 Freddiemercury Closest Approach To Earth (1.316 AU)
- Mar 24 - Asteroid 8250 Cornell Closest Approach To Earth (2.574 AU)
- Mar 24 - 25th Anniversary (1992), STS-45 Launch (Space Shuttle Atlantis, ATLAS-1)
- Mar 24 - Krafft Ehricke's 100th Birthday (1917)
- Mar 24 - Sidney Fox's 105th Birthday (1912)

Source: JPL Space Calendar

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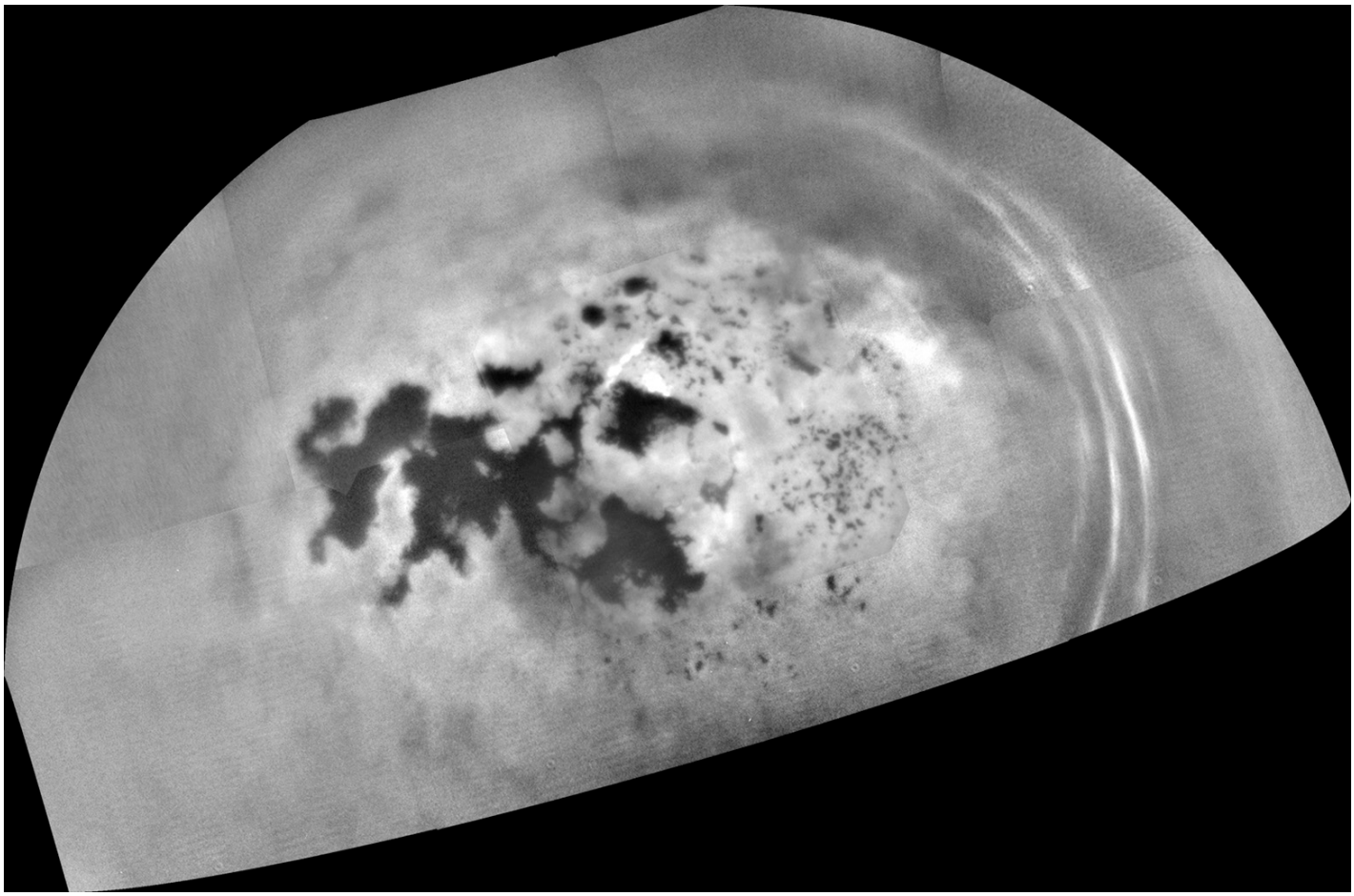
Food for Thought

Experiments Show Titan Lakes May Fizz with Nitrogen



A recent NASA-funded study has shown how the hydrocarbon lakes and seas of Saturn's moon Titan might occasionally erupt with dramatic patches of bubbles.

For the study, researchers at NASA's Jet Propulsion Laboratory in Pasadena, California, simulated the frigid surface conditions on Titan, finding that significant amounts of nitrogen can be dissolved in the extremely cold liquid methane that rains from the skies and collects in rivers, lakes and seas. They demonstrated that slight changes in temperature, air pressure or composition can cause the nitrogen to rapidly separate out of solution, like the fizz that results when opening a bottle of carbonated soda.

NASA's Cassini spacecraft has found that the composition of Titan's lakes and seas varies from place to place, with some reservoirs being richer in ethane than methane. "Our experiments showed that when methane-rich liquids mix with ethane-rich ones -- for example from a heavy rain, or when runoff from a methane river mixes into an ethane-rich lake -- the nitrogen is less able to stay in solution," said Michael Malaska of JPL, who led the study.

The result is bubbles. Lots of bubbles.

The release of nitrogen, known as exsolution, can also occur when methane seas warm slightly during the changing seasons on Titan. A fizzy liquid could also cause problems, potentially, for a future robotic probe sent to float on or swim through Titan's seas. Excess heat emanating from a probe might cause bubbles to form

around its structures -- for example, propellers used for propulsion -- making it difficult to steer or keep the probe stable.

Magic Island Mechanism?

The notion of nitrogen bubbles creating fizzy patches on Titan's lakes and seas is relevant to one of the more enchanting unsolved mysteries Cassini has investigated during its time exploring Titan: the so-called "magic islands." During several flybys, Cassini's radar has revealed small areas on the seas that appeared and disappeared, and then (in at least one case) reappeared. Researchers proposed several potential explanations for what could be creating these seemingly island-like features, including the idea of fields of bubbles. The new study provides details about the mechanism that could be forming such bubbles, if they are indeed the culprit.

"Thanks to this work on nitrogen's solubility, we're now confident that bubbles could indeed form in the seas, and in fact may be more abundant than we'd expected," said Jason Hofgartner of JPL, who serves as a co-investigator on Cassini's radar team and was a co-author of the study.

Freezing Fizz and Breathing Lakes

In characterizing how nitrogen moves between Titan's liquid reservoirs and its atmosphere, the researchers also coaxed nitrogen out of a simulated ethane-rich solution as the ethane froze to the bottom of their tiny, simulated Titan lake. Unlike water, which is less dense in its solid form than its liquid form, ethane ice would form on the bottom of Titan's frigid pools. As the ethane crystalizes into ice, there's no room for the dissolved nitrogen gas, and it comes fizzing out.

While the thought of hydrocarbon lakes bubbling with nitrogen on an alien moon is dramatic, Malaska points out that the movement of nitrogen on Titan doesn't just move in one direction. Clearly, it has to get into the methane and ethane before it can get out.

"In effect, it's as though the lakes of Titan breathe nitrogen," Malaska said. "As they cool, they can absorb more of the gas, 'inhaling.' And as they warm, the liquid's capacity is reduced, so they 'exhale.'"

A similar phenomenon occurs on Earth with carbon dioxide absorption by our planet's oceans.

Results of the study were published online in February by the journal Icarus.

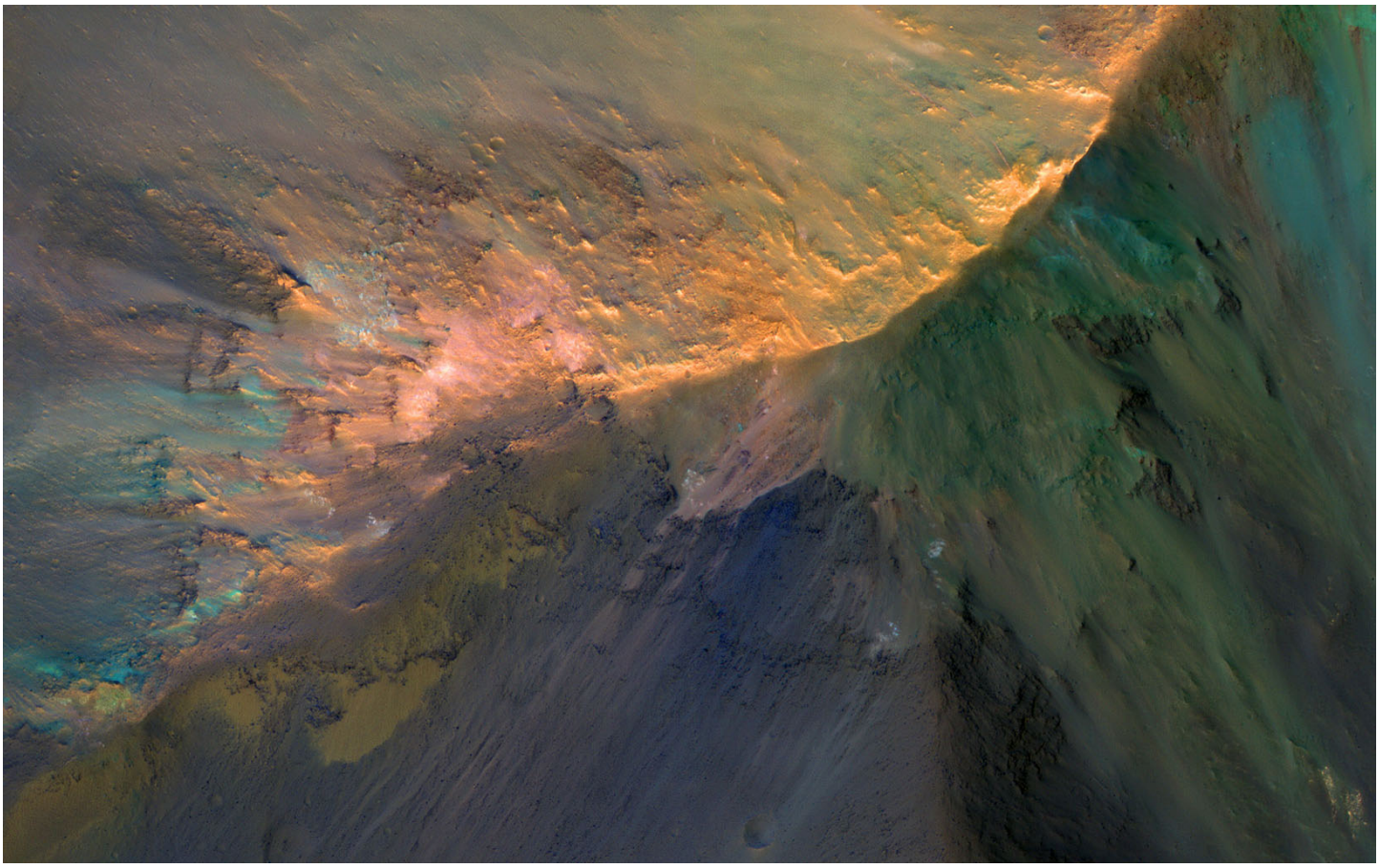
Final Titan Flyby Nears

Cassini will make its final close flyby of Titan -- its 127th targeted encounter -- on April 22. During the flyby, Cassini will sweep its radar beam over Titan's northern seas one final time. The radar team designed the upcoming observation so that, if magic island features are present this time, their brightness may be useful for distinguishing between bubbles, waves and floating or suspended solids.

The flyby also will bend the spacecraft's course to begin its final series of 22 plunges through the gap between Saturn and its innermost rings, known as Cassini's Grand Finale. The 20-year mission will conclude with a dive into Saturn's atmosphere on Sept. 15.

Source: JPL Return to Contents

Space Image of the Week



The Hills are Colorful in Juventae Chasma

There are many hills about 1 kilometer high in Juventae Chasma, which is located north of the main Valles Marineris canyon system. The floor of the canyon is covered by a sea of sand, but the hills rise above the sand.

A few adventuresome sand dunes have slowly climbed up on the hills, like that near the upper left of the enhanced-color cutout. The color diversity here is exceptional, due to varying mineral compositions and good exposures.

The map is projected here at a scale of 50 centimeters (19.7 inches) per pixel. [The original image scale is 53.6 centimeters (21.1 inches) per pixel (with 2 x 2 binning); objects on the order of 161 centimeters (63.4 inches) across are resolved.] North is up.

Source: JPL

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