NASA’s InSight Discovers Subsurface Oceans on Mars

Description

Image not found or type unknown
Mars’ Upper and Middle Crust Below Insight Lander
A depiction of the Martian subsurface under NASA’s Insight lander. The upper crust seems dry, but recent
indicates a zone of fractured rock 11.5-20 km beneath the surface filled with liquid water — exceeding th
hypothesized for ancient Martian oceans. Credit: James Tuttle Keane and Aaron Rodriquez, courtesy of Sc
Institute of Oceanography

Geophysicists, leveraging seismic data from NASA's Insight lander, have unveiled a significant subterranean water reservoir on Mars, potentially adequate to have once sustained extensive ancient oceans.

This reservoir, ensnared in Mars' mid-crust, suggests that the planet's water did not entirely dissipate into space but permeated its crust, challenging previous notions of Martian aridity and potentially fostering a habitat conducive to life.

By employing seismic activity to explore Mars' interior, geophysicists have detected signs of a substantial underground liquid water reservoir — enough to inundate the planet's surface with oceans.

Data from NASA's Insight lander have enabled these scientists to estimate that this subterranean water volume could submerge the entire planet at a depth between 1 and 2 kilometers, or roughly a mile.

Although promising in unraveling Mars' water destiny following the disappearance of its oceans over 3 billion years ago, this reservoir remains challenging to access for sustaining a potential future Mars settlement. Situated in minute crevices and pores within rock in the middle of Mars' crust, 11.5 to 20 kilometers below the surface, drilling to such depths presents a formidable task, even on Earth.

Image not found or type unknown
NASA Mars InSight
This illustration depicts NASA’s Mars InSight lander on the Martian surface. Credit: NASA

Implications for Martian Settlement and Astrobiology

While this discovery signifies a promising area to investigate Martian life if access to the reservoir is viable, it primarily provides answers regarding the planet's geological narrative.

“Comprehending Mars' water cycle is paramount to deciphering the planet's climate, terrain, and subterranean structure,” commented Vashan Wright, a former UC Berkeley postdoctoral fellow now serving as an assistant professor at UC San Diego's Scripps Institution of Oceanography. “A logical starting point involves identifying water locations and quantities.”

Wright, in collaboration with Michael Manga of UC Berkeley and Matthias Morzfeld of Scripps Oceanography, elucidated their findings in a forthcoming article in the journal *Proceedings of the National Academy of Sciences*.

Methodologies and Hypotheses: Unveiling Martian Geology

Through a sophisticated mathematical model of rock physics, akin to Earth's methodologies for mapping subterranean aquifers and oil fields, investigators have inferred that the seismic data from Insight best align with a deep layer of fractured igneous rock saturated with liquid water. Igneous rocks are solidified magma, such as the granite found in the Sierra Nevada range.

“Corroborating the existence of a vast liquid water reservoir offers insights into past and potential Martian climate,” remarked Manga, a UC Berkeley professor specializing in earth and planetary science. “Given water's vital role in sustaining life, the underground reservoir could constitute a habitable environment. Analogously, Earth's deep mines and ocean depths harbor life. While we await evidence of life on Mars, we have pinpointed a plausible habitat to nurture life.”

Manga was Wright's postdoctoral mentor, while Morzfeld, formerly a postdoctoral fellow at UC Berkeley's mathematics department, now serves as an associate professor of geophysics at Scripps Oceanography.

Traces of Ancient Water and Mars' Geologic Evolution

Multiple indicators — including river networks, deltas, lake sediments, and water-influenced rocks — support the premise of past water flow on Mars' surface. However, this aqueous phase ended over 3 billion years ago when Mars underwent atmospheric loss. Deciphering what transpired to this water, its timing, and the potential existence of Martian life remain focal points for planetary scientists on Earth.

The recent findings propose that a significant portion of the water didn't dissipate into space but percolated downward into the crust.

The Insight lander embarked on its Mars mission in 2018 under NASA's aegis to scrutinize the planet's crust, mantle, core, and atmosphere while offering invaluable insights into Mars' interior before concluding its mission in 2022.

“The mission surpassed my expectations significantly,” reflected Manga. “Analyzing the seismic data collected by Insight, researchers deduced the crust thickness, core depth, core composition, and even gleaned insights into mantle temperatures.”

Insight's discoveries encompassed Mars quakes up to a magnitude of 5, meteorite impacts, and volcanic tremors, all generating seismic waves that facilitated geophysicists in delving into the planet's internal composition.

An earlier report indicated the absence of water ice in the upper crust above a 5-kilometer depth, diverging from Manga's expectations. This implies limited accessible frozen groundwater beyond the planet's polar regions.

The latest study focused on the deeper crust and concluded that the "available data are best explained by a water-saturated mid-crust" beneath Insight's position. Assuming crust uniformity across Mars, the team inferred a greater water presence in this mid-crust region compared to the volumes envisioned for ancient Martian oceans.

For further insights on this revelation, refer to the article "Did We Just Find Liquid Water on Mars? NASA InSight Lander's Surprising Data."

Reference: “Liquid Water in the Martian Mid-Crust” 12 August 2024, *Proceedings of the National Academy of Sciences*.
DOI:10.1073/pnas.2409983121

The Canadian Institute for Advanced Research, the National Science Foundation, and the U.S. Office of Naval Research provided support for this research.

Vocabulary List:

1. **Subterranean** /ˌsʌb.təˈreɪ.ni.ən/ (adjective): Existing situated or operating below the surface of the earth.
2. **Reservoir** /ˈrɛz.ər.vwɑːr/ (noun): A place where water is stored especially a large natural or artificial lake.
3. **Permeated** /ˈpɜːr.mi.eɪ.tɪd/ (verb): Spread throughout something; pervaded.
4. **Geophysical** /ˌdʒiːəˈfɪzɪkl/ (adjective): Relating to the physics of the Earth and its environment.
5. **Elucidated** /ɪˈluːˌsɪ.deɪ.tɪd/ (verb): Made something clear; explained.
6. **Inundate** /ˈɪn.ʌn.deɪt/ (verb): Overwhelm someone with things or people to be dealt with; flood.

Comprehension Questions

Multiple Choice

1. What recent discovery has geophysicists made regarding water on Mars?

   Option: A. Detection of underground oil fields
   Option: B. Identification of a giant water reservoir in Mars’ mid-crust
   Option: C. Unveiling of frozen water on the Martian surface
   Option: D. Confirmation of ancient ocean remnants

2. How deep is the subterranean water reservoir on Mars estimated to be?

   Option: A. 5-10 kilometers
   Option: B. 15-20 kilometers
   Option: C. 1-2 kilometers
   Option: D. 30-40 kilometers

3. Which scientific equipment provided data for detecting the subterranean water reservoir on Mars?

Option: A. Kepler Space Telescope
Option: B. Hubble Space Telescope
Option: C. NASA’s Insight lander
Option: D. Mars Rover Curiosity

4. What role does Vashan Wright play in the Mars water discovery research?

Option: A. Lead investigator
Option: B. Former postdoctoral fellow
Option: C. Data analyst
Option: D. Astrobiologist

5. What rock type is suggested to be saturated with liquid water beneath Mars according to geophysicists?

Option: A. Basalt
Option: B. Granite
Option: C. Limestone
Option: D. Sandstone

6. How long ago did Mars undergo atmospheric loss ending its ancient water flow?

Option: A. 100 million years ago
Option: B. 1 billion years ago
Option: C. 2 billion years ago
Option: D. Over 3 billion years ago

Answer

Multiple Choice: 1. B. Identification of a giant water reservoir in Mars’ mid-crust 2. C. 1-2 kilometers 3. C. NASA’s Insight lander 4. B. Former postdoctoral fellow 5. B. Granite 6. D. Over 3 billion years ago

Vocabulary quizzes

Multiple Choice (Select the Correct answer for each question.)

1. Which term describes something existing occurring or done under the surface of the earth?

Option: Subterranean
Option: Reservoir
Option: Permeated
Option: Inundate

2. Which term is related to the physics of the earth and its environment?

Option: Geophysical
Option: Elucidated
Option: Landscape
Option: Emergence

3. What does the term "consumption" refer to?

Option: Consumption
Option: Paradigm
Option: Transitioning
Option: Celestial

4. What is described as related to the sky or the heavens?

Option: Celestial
Option: Inundation
Option: Ethereal
Option: Acclimate

5. What term describes the state of being able to see or be seen?

Option: Visibility
Option: Celestial
Option: Optimal
Option: Anticipated

6. What is the term for becoming accustomed to a new climate or to new conditions?

Option: Acclimate
Option: Modest
Option: Phenomenon
Option: Anticipated

7. Which term refers to a typical example or pattern of something?

Option: Paradigm
Option: Transitioning
Option: Congregate
Option: Dazzling

8. What term means extremely impressive beautiful or skillful?

Option: Dazzling
Option: Paradigm
Option: Consumption
Option: Ethereal

9. Which term describes the visible features of an area of land its landforms and how they integrate with

natural or man-made features?

Option: Landscape
Option: Engaging
Option: Consumption
Option: Geophysical

10. What is the term for the process of becoming visible after being concealed?

Option: Emergence
Option: Inundate
Option: Ethereal
Option: Modest

Gap-Fill (Fill in the blanks with the correct word from the vocabulary list.)

11. The city was _____ by heavy rainfall causing severe flooding.

12. The aroma of fresh bread _____ the entire bakery making everyone crave a snack.

13. To achieve _____ health it is important to maintain a balanced diet and exercise regularly.

14. The dancer moved across the stage with an _____ grace captivating the audience.

15. As the bell rang students began to _____ in the courtyard for the morning assembly.

16. Despite his wealth he lived in a _____ house and preferred simple belongings.

17. The new movie release was highly _____ with fans counting down the days until it premiered.

18. The teacher used _____ activities to hold the students' attention throughout the lesson.

19. The sudden appearance of the rare bird species was a natural _____ that amazed researchers.

20. The scientist _____ the complex theory in a way that even non-experts could

understand.

Matching Sentences (Match each definition to the correct word from the vocabulary list.)

21. The caterpillar is into a butterfly in a fascinating process of metamorphosis.
22. Astronomers study the movements and positions of bodies such as stars and planets.
23. The dam created a large of water that supplied the surrounding villages.
24. The heavy rains led to the of the low-lying areas causing a flood.
25. Getting enough rest is crucial for performance both physically and mentally.
26. The music had an quality that seemed to transport listeners to another world.
27. The scent of flowers the garden creating a pleasant atmosphere.
28. The increase in food during the holiday season resulted in a higher demand for groceries.
29. The study of earthquakes and fault lines falls under the field of science.
30. The unexpected of a rare flower in the garden surprised botanists.

Answer

Multiple Choice: 1. Subterranean 2. Geophysical 3. Consumption 4. Celestial 5. Visibility 6. Acclimate 7. Paradigm 8. Dazzling 9. Landscape 10. Emergence
Gap-Fill: 11. inundated 12. permeated 13. optimal 14. ethereal 15. congregate 16. modest 17. anticipated 18. engaging 19. phenomenon 20. elucidated
Matching sentence: 1. transitioning 2. celestial 3. reservoir 4. inundation 5. optimal 6. ethereal 7. permeated 8. consumption 9. geophysical 10. emergence

CATEGORY

1. Sci/Tech - LEVEL6

Date Created
2024/08/14
Author
aimeeyoung99