

# Space scientists ponder which Jupiter moon will reveal the most

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Yogi Berra supposedly suggested that when you come to a fork in the road, you are supposed to take it. That's just what planetary scientists studying the rich data set from the Galileo Mission to the outer solar system are doing now. They're taking the fork.

According to William B. McKinnon, Ph.D., professor of earth and planetary sciences in Arts & Sciences at Washington University in St. Louis, the community suffers from an embarrassment of riches, because each of the moons of Jupiter differs in the way that they can reveal more about planets and how they behave. But he thinks it is Europa that clearly commands the most attention.

There are four large, moons of Jupiter that in their character and behavior are more like planets than Earth's moon: Io, Europa, Ganymede and Callisto. The last three are icy.

Io's volcanic hyperactivity is well known, but there are mysteries about the temperature of its magmas and its spectacular mountains and what they might reveal about the satellite's interior processes. As for the exterior moon Callisto, how did it acquire an ocean yet not be deeply differentiated? Ganymede's liquid iron core is still generating a magnetic field. This was not predicted beforehand, and thus has much to teach planetary scientists on how magnetic fields are generated in the solar system. Then, there is Europa.

"Of the four Galilean moons, Europa is the one that has the best chance

to reveal the most about the origin of life, which is the biggest unanswered scientific question we have, bar none," he said. "With its massive body of liquid water, multiple energy sources proposed and different ways to provide carbon and other biogenic elements, the central question must be Europa's potential for life. What greater question can you ask of a planet?"

McKinnon reviewed each of the moons and their unanswered questions in his invited talk, "O Sister, Where Art Thou? The Galilean Satellites After Galileo," presented at the Fall 2006 meeting of the American Geophysical Union held Dec. 10-15, 2006, in San Francisco. All but Ganymede, a young male, are named after female Greek mythological characters. Thus, McKinnon refers to Ganymede as an honorary sister.

"Europa has been recently geologically active, but because Galileo's main antenna did not unfurl, we did not take enough images to catch any active geysering, such as seen on Saturn's itchy bitsy icy moon, Enceladus," McKinnon said. "Europa's surface appears very young and there are lots of interesting ice tectonics, and surface eruptions with weird colors and spectral signatures whose compositional implications everyone just loves to argue about."

## **'Capped' ocean**

All the accumulated evidence points to an ocean under a global shell of ice, an ocean lying no more than 10 to 20 kilometers below Europa's airless surface, McKinnon said.

"That sounds really deep to a person with a pick ax, or even a drilling rig, but in geologic terms it's really pretty close," he said. "It's basically a capped ocean. "

The existence of the ocean is related to the great amount of heat coming

up from Europa's interior.

"If you look at the surface and how deformed it is, you can tell the ice shell is relatively thin and really has been active in recent geological time, indeed is probably active today," McKinnon said.

Europa has a few, but not many, impact craters, also indicating its relative youth.

Europa's ocean begs to be studied, McKinnon said, as do the strikingly colored surface materials that Galileo images captured.

"To go into orbit around Europa with high-resolution cameras, spectral imagers and sophisticated, ice-penetrating radars of the sort mapping Mars right now, would allow us to really characterize that ocean and give us clues about the biogenic potential of the surface materials," McKinnon said. "We'd see to the bottom of the ice shell, I predict. It would be a fantastic proof of concept."

A mission to Europa is feasible, McKinnon said. It would take about 10 years if started today (six of those years being spent in reaching the satellite). And it would be expensive, "about two billion dollars, give or take," he added.

"It would also have to compete for funds with NASA's plans to establish a Moon base," he said. "The Europeans are interested as well, so maybe we could cooperate and share the cost."

NASA has committees exploring a number of options, McKinnon said, and they include returning to Europa or Titan after the conclusion of the Cassini mission or perhaps returning to the little active moon around Saturn, Enceladus.

"It's a tiny moon, but it has an active plume that, because of that moon's very low gravity, extends well out into space, so you can just fly right through it," McKinnon said. "That's a nifty way to go sampling."

Of course, Europa is a much bigger target to explore.

"It has 40 times the surface area of Enceladus — there's a lot more there there," he concluded.

Source: By Tony Fitzpatrick, Washington University in St. Louis

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