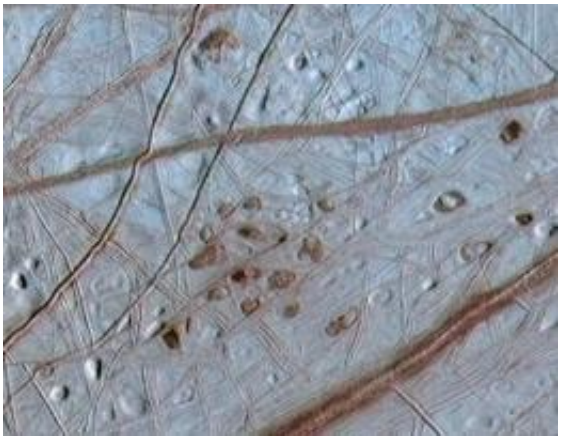
Europa on Earth

March 25 2010, by Charles Q. Choi



The surface of Europa. Sulfur-rich materials there are concentrated along geological features and may reflect the composition of the subsurface ocean. Image from the Solid-State Imaging instrument onboard Galileo. Credit: NASA/JPL/University of Arizona/University of Colorado

Cracks in the icy shell of Jupiter's moon Europa contain sulfur-rich material. An expedition to a sulfur spring in the Arctic could help solve some mysteries about Europa - including its potential for life.

Extraordinarily rare springs high above the rest of the world in the Arctic could serve as Earth's own little version of Europa, helping scientists picture what life might face on the mysterious Jovian moon.

Europa is covered with sulfur-rich materials concentrated along cracks and ridges on its icy surface, which could hold the only clues we

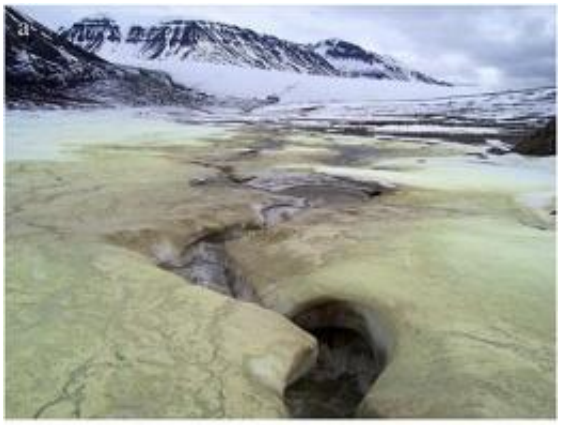
currently have about the composition of its hidden underground ocean. These compounds in the ice might even contain organic material that migrated upward from the sea below.

"Europa's liquid water layer contains twice the volume of all the Earth's oceans combined, an enormous potentially habitable environment, not billions of years in the past but at the present day," said astrobiologist Damhnait Gleeson at NASA's Jet Propulsion Laboratory. "The composition of the ocean directly controls our view of the habitability of the environment, our understanding of whether microbial life could survive there, and if so, what metabolic pathways or geochemical gradients it could utilize to gain energy."

The Galileo space probe's spectrometers captured near-infrared signals from Europa — a "spectral fingerprint" that could help identify what these substances are, just as a specific mix of colors might help identify a painting. However, so far it remains uncertain what exact blend of compounds matches up with this fingerprint.

To help identify the mystery compounds on Europa, Gleeson and her colleagues investigated potential copycats here on Earth. Combinations of sulfur-rich springs and glacial ice are very rare on Earth, but the researchers found one at Ellesmere Island in the Canadian High Arctic, where springs at the Borup Fiord Pass stain the surrounding glacier yellow with sulfur, gypsum and calcite.

"We're pretty limited when we're looking for terrestrial analogs of something like Europa, since the environments are so different, but the site they found is probably as close to something as we're going to find," said geologist Ed Cloutis at the University of Winnipeg, who researches Mars analogs.



Deposits of sulfur, gypsum and calcite from springs on glacial ice. Credit: Damhnait Gleeson

In a two-week expedition to the site in the summer of 2006, the researchers analyzed samples from these springs in near-freezing temperatures with backpack spectrometers, flown to the valley in a small plane and shuttled out to their camp by helicopter.

"The first three days it rained non-stop, but after that it cleared up nicely -- much to our relief -- and I was able to haul my spectrometer up to the glacier," Gleeson recalled.

"I'm not sure how much the spectrometer weighed on my back — it was 70 pounds in the box — but all I know is that when I lost my balance while wading through waist deep snow with it on, it was close to impossible to get up again. Entertaining for the others to watch me, though."

The scientists not only examined samples out in the field, but also investigated how these materials appear at different scales, from orbital remotely-sensed data to high-resolution laboratory analysis. The spectral properties of the glacial ice proved similar to those of materials seen on

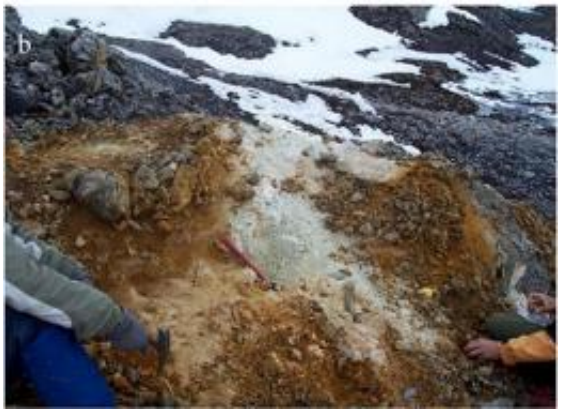
Europa.

"These results represent the first data on the detection of sulfur minerals on ice in a terrestrial setting," Gleeson said. "These new data improve our ability to correctly identify these minerals in other locations."

Minor constituents of the glacial ice seen through lab analysis, such as gypsum and calcite, went partially or completely undetected in satellite data, findings that must be taken account when interpreting spectra collected during planetary missions, Gleeson said.

"Technology under development for future missions could benefit from field-testing in this Europa-relevant environment," she noted.

This arctic location is not a perfect analog for Europa — the temperatures at the pass are higher, the radiation is far lower, and oxygen is everywhere, influencing the chemistry. Collecting spectra of the arctic materials under very low temperatures could make them more useful as Europa analogs, Gleeson noted, while subjecting them to radiation could help determine whether they represent likely precursors to Europa's non-ice materials.



Gypsum deposits surrounded by carbonates mark a potential ancient spring site.

Credit: Damhnait Gleeson

Any mission to determine the potential habitability of Europa requires spacecraft that can both operate independently of Earth, given the incredible distances involved, and spot ideal places on the surface to explore. If there is life on Europa, this arctic site could give vital clues as to what to focus on with the limited resources any probe sent there would have.

"We can take a look at whether and what kind of biology can survive on that island, which is one of the nastier environments around," said Cloutis, who did not take part in this study. "Seeing how life survives and how biology interacts with the geology gives clues to what to look for in Europa."

The findings of the Borup Fiord Pass expedition were detailed online March 6 in the journal *Remote Sensing of Environment.*

Source: Astrobio.net