PLANETARY NEWS: PHOENIX (2008)
PHOENIX* SHOWS MARTIAN SOIL NOT SO ALIEN, GREEN BEANS WOULD LOVE IT

By A.J.S. Rayl
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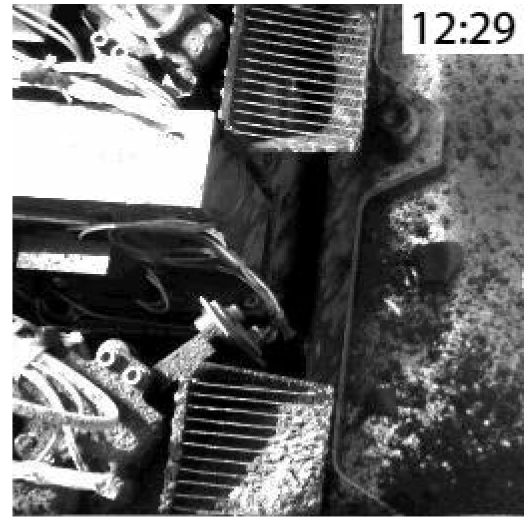
Phoenix completed its first scientific analyses on Martian soil samples this week and the surprise is not that it found something strangely extraterrestrial, rather that it found the soil was a lot like some of the soils on Earth. In fact, green beans would love it. Not to mention microbes.



Sample delivery to MECA wet chemistry cell
Phoenix captured these two images with its robotic arm camera, documenting the first delivery of a Martian soil sample into a MECA wet chemistry laboratory cell. The image taken at 12:29 local Mars time on Wednesday (June 25, 2008) shows the soil sitting in the funnel, which is covered by a grille whose wires are spaced 2 millimeters apart. At 12:35 the drawer underneath the hopper had closed, allowing a tiny amount of dark dirt to fall to the lander deck below. However, most of the sample remained stuck inside the funnel. Fortunately, plenty of sample did fall through the funnel into the waiting drawer of the wet chemistry laboratory cell. (For comparison, look at the next funnel, located at the top of the image; you can see right through it to the deck of the lander below.) Credit: NASA / JPL / UA / MPI / animation by E. Lakdawalla

"We basically have found what appear to be the requirements – the nutrients to support life – whether past, present or future," announced Phoenix co-investigator Sam Kounaves, of Tufts University, the science lead for the wet chemistry laboratory investigation, during a press conference Thursday.

"Over time, I have come to the conclusion that the amazing thing about Mars is not that it's an alien world, but it's actually very Earth-like in a lot of aspects, he added.

By performing its first wet chemistry analysis on Martian soil flawlessly Wednesday, Phoenix returned a wealth of data that for this team was like winning the lottery – again. "We were all very flabbergasted by the data we got back," Kounaves confirmed.

"We are awash in chemistry data," added Michael Hecht of NASA's Jet Propulsion Laboratory (JPL), lead scientist for the Microscopy, Electrochemistry and Conductivity Analyzer (MECA), of which the wet chemistry lab is a part.

Although they have not been able to detect a lot of the trace elements, there is nothing about this Martian dirt "that wouldn't support life and organics [therein] that would support life," Kounaves said. Life that is, as we know it.

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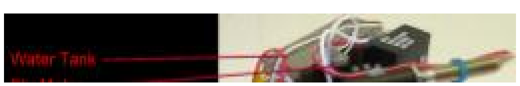
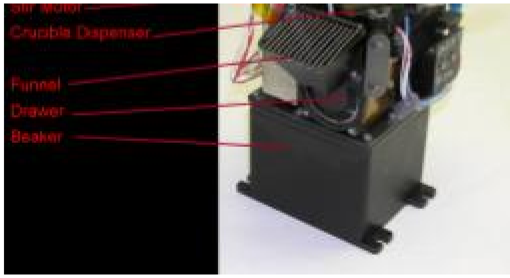
"The alkaline type of soil there is like you might have in your backyard – you might be able to grow asparagus in it really well, but probably not strawberries," Kounaves pointed out. "Green beans love alkaline soil," he added, "and microbes grow everywhere."

At least biologists have been finding microbes everywhere on Earth during the last several decades, even in the most unlikely of places, from deep-sea thermal vents to dark, lightless caves. Of course, whether or not there are Martian microbes carousing around the polar terrain remains the $64,000,000 question and one that Phoenix isn't exactly charged with answering. Its mission objective is to find the signs of habitability and it appears that it's fast on its way to meeting that goal.

The analyses of soil samples will help researchers determine whether ice beneath the soil ever has melted, and whether the soil has other qualities favorable for life.



As of Thursday, about 80 percent of Phoenix's first, two-day wet chemistry experiment was complete. The MECA instrument features three more wet-chemistry cells for use later in the mission.



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A wet chemistry laboratory cell
Phoenix's MECA instrument includes four of single-use wet chemistry laboratory cells.
Credit: NASA / JPL / UA / MPI

Basically, Phoenix takes a frozen block of water brought from Earth, heats it, melts it and dispenses it into a beaker. "The beaker is the bottom half of these chemistry cells – a sleek unadorned black box with sensors in bottom," described Hecht. "We then dispense a little cup of a calibration solution into a crucible in there and we're ready to make Martian mud." Once the wet chemistry lab stirs up that Martian mud, it measures it with sensors and determines its composition.

"This is very preliminary data, but this soil appears to be a close analog to surface soils found in the upper dry valleys in Antarctica," Kounaves said. "The alkalinity of the soil [here] is definitely striking. At this specific location, one inch into the surface layer, the soil is very basic, with a pH of between eight and nine. We also found a variety of components of salts that we haven't had time to analyze and identify yet, but that include magnesium, sodium, potassium and chloride."

They still have work to do. "We will be doing the analysis on sulfate in next couple of days," Kounaves said. "And there are hidden species in this set that we're still working on. But we appear to have gotten what we were looking to get. This is more evidence for water, because salts are there. We also found a reasonable number of nutrients, or chemicals needed by life as we know it."

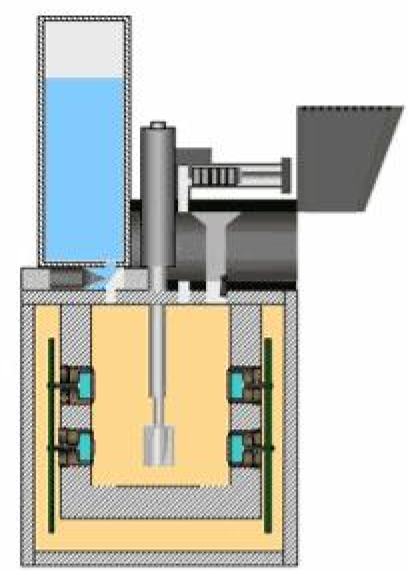
Being able to describe the soil on Mars in an informed way is "a huge step forward," said Hecht. "This is the sort of thing what we're after. We're trying to understand what is the chemistry of wet soil on Mars, what's dissolved in it, how acidic or alkaline it is. With the results we received from Phoenix yesterday, we can begin to tell what aspects of the soil might support life."

The Thermal and Evolved-Gas Analyzer – more simply known by its acronym TEGA – has finished baking its first soil sample and in recent sols heated it up to 1,000 degrees Celsius (1,800 degrees Fahrenheit). "This is really first time anyone ever heated part of a planet up to such high temperatures," said Phoenix Co-Investigator William Boynton of the University of Arizona, lead TEGA scientist.

As Boynton previously reported, they found no ice in this first surface sample, but then they hadn't expected to find ice. "This was a surface sample and it was sitting over the TEGA oven for several days while we were working to get it through the screen," he recounted. Further baking, however, released small amounts of carbon dioxide and water vapor. "This is what we were hoping to see," Boynton said. "We were expecting the samples might have interacted with water and carbon dioxide in the past and indeed we were successfully able to show that."

It will probably take several more weeks of analysis to be really sure of what they got, Boynton added. "At this point, it is rather difficult to quantify exactly how much carbon dioxide and water vapor was given off or to do the mineral identification. What we can say now is that the soil clearly has interacted with water in past. But we don't know whether that has taken place here in polar region or whether it happened some place else and blew up here as dust."

After the doors to that first oven – #4 – failed to open all the way, and then the initial dumped scoop seemed to sit like a rock on the screen protecting the entryway into the tiny oven, these results are the best of all possible news. "We're very happy to report the scientific data coming out of instrument is spectacular, Boynton said. "The instrument is working very well."



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Analyzing sample in the wet chemistry lab

TEGA's problems are not over though. When doors for the next TEGA oven were commanded open last week, oven #5's doors opened only partway, just like those on the first oven, #4. The team has determined that mechanical interference may be

Phoenix's Microscopy, Electrochemistry, and Conductivity (MECA) instrument includes four "wet chemistry" cells, in which a sample of Martian soil is dropped into water carried from Earth as ice. MECA then stirs up the cell and analyzes the chemistry of the species that dissolve into the water.
Credit: NASA / JPL / UA

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Phoenix engineering model
This image shows the Phoenix engineering model that is set up in a Mars yard at the University of Arizona's Science Operations Center in Tucson. All of the rocks in the yard were rearranged to duplicate the polar site on Mars where the real Phoenix will dig in and look for water-ice. The UA is the first public university to lead a NASA mission.
Credit: The Planetary Society / A.J.S. Rayl

preventing doors on that oven – #5 – and three others from opening fully, according to Phoenix Project Manager Barry Goldstein, of JPL. While that interference is still being investigated, the remaining three ovens are expected to have one door that opens fully and one that opens partially, as was the case with the first oven used, he said.

"The tests we have done in our test facility during the past few days show the robotic arm can deliver the simulated Martian soil through the opening with the doors in this configuration," Boynton added. "We plan to save the cells where doors can open wider for accepting ice samples."

Scientists believe the first soil sample delivered to TEGA with a single dump of the scoop was so clumpy that soil particles clogged the protective screen over the opening. Four days of vibration eventually succeeded at loosening particles from the clumpy soil and getting them to fall through the screen. However, engineers now believe the use of a motor to create the vibration may also have caused a short circuit in wiring near that oven. Concern about triggering other short circuits has prompted the Phoenix team to be cautious about the use of other TEGA cells.

As was decided several weeks ago, all future soil samples to TEGA – as well as the other instruments – will be delivered by sprinkling the soil rather than dumping the whole scoop.

The wet chemistry and TEGA soil analyses come one-third of the way through Phoenix's three-month primary mission. Beyond these soil studies, the polar lander has also analyzed two samples in its optical microscope (another part of the MECA instrument), and used its cameras to confirm that white chunks exposed during trench digging were frozen water-ice because they sublimated, or vaporized, over a few days. It has also completed about 55 percent of its three-color, 360-degree, Stereo Surface Imager (SSI) panorama of the landing site and has been collecting daily data on clouds, dust, winds, temperatures and pressures in the atmosphere, as well as taken first nighttime atmospheric measurements.

In recent sols, Phoenix has used its robotic arm to dig and sample at the Snow White trench in the center of a polygon in the polar terrain and will continue work at the site. "We believe this is the best place for creating a profile of the surface from the top down to the anticipated icy layer," Phoenix project scientist Leslie Tamppari said. "This is the plan we wanted to do when we proposed the mission many years ago. We wanted a place just like this where we could sample the soil down to the possible ice layer.

* Configuration derived from the scientific mind of Michael Hecht.

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Attempt to open TEGA door 5
Two images were taken of the TEGA instrument on Sol 25, before and after an attempt to open the doors of oven #5, adjacent to oven #4, which had been opened previously and used for the first sample. The left-hand door of oven #4 never opened properly. It now appears that neither door on oven #5 has opened properly. The doors are not motorized; they are connected to springs and latches, and should spring open completely when the latch is released. There is no mechanism within TEGA to attempt to push the doors open any further. The TEGA team has conducted ground

tests and despite the door difficulties is cnfident they will be able to deliver their samples. Credit: NASA / JPL / UA / animation by E. Lakdawalla