Sorting through the extraterrestrial dust

How to Look for Life on Mars

Courtesy NASA/JPL

By CHRIS WILSON

Humankind's latest envoy to Mars, the spacecraft *Phoenix,* touched down near the planet's north pole on May 25, 2008.

[The robotic arm on the spacecraft has sprinkled Martian soil onto its robotic microscope in search of evidence that basic organisms could survive on the planet. Images from *Phoenix*'s optical microscope show nearly 1,000 separate soil particles, down to sizes smaller than one-tenth the diameter of a human hair. Scientists can see at least four distinct minerals.

The sample includes black glassy particles that could have come from ancient Martian volcanoes, and smaller reddish ones that are enriched with iron, which gives the orange material its color.]

But what exactly is *Phoenix* looking for?

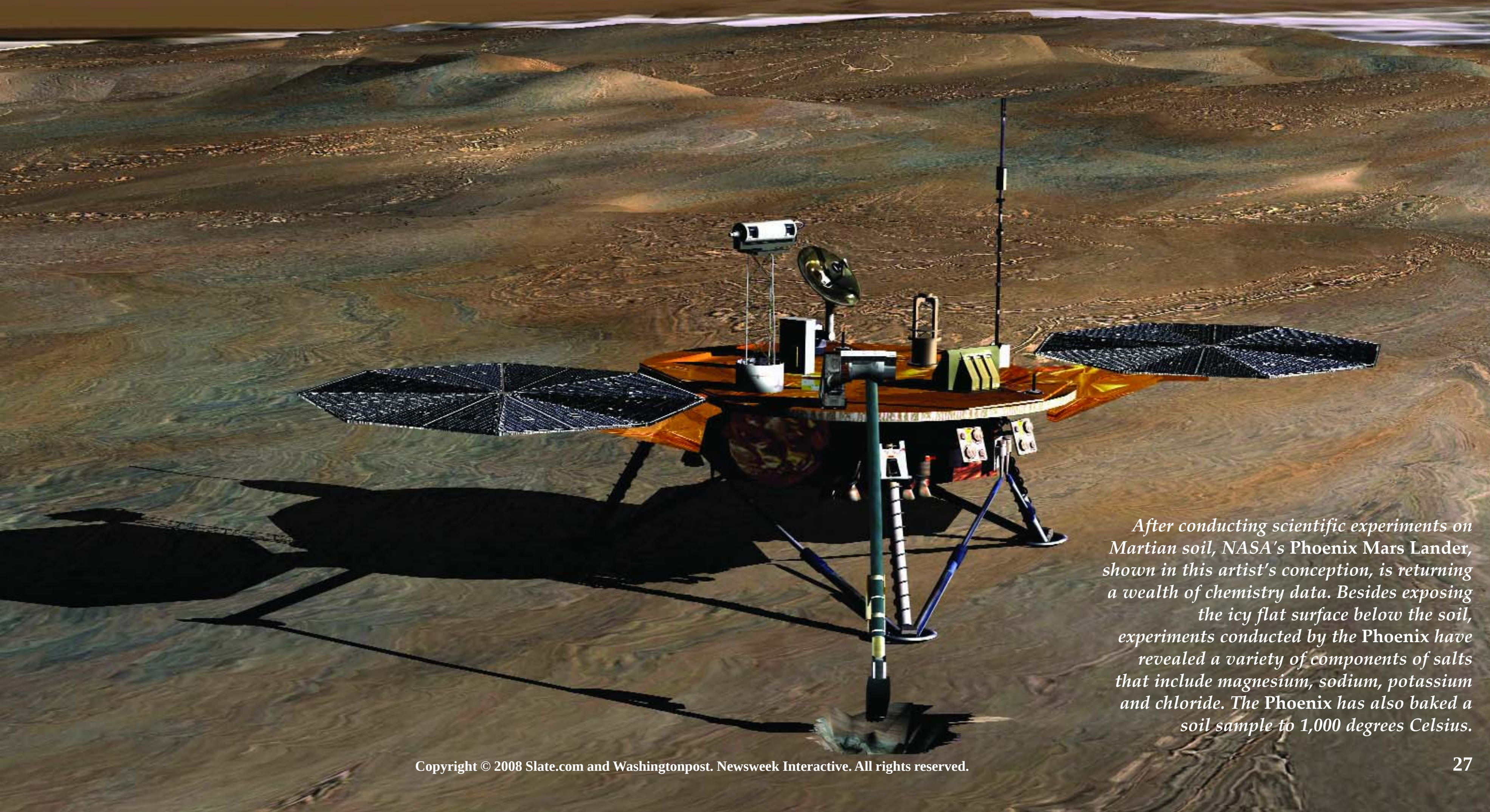
Carbon, of course, and all sorts of other things. *Phoenix* is equipped with a pair of onboard mini laboratories that can develop a detailed picture of the soil's chemical content. First of all, scientists are looking for traces of organic molecules—the fundamental building blocks of life. But *Phoenix* is also measuring things like the acidity of the soil, the presence of nitrogen, and the amount of water attached to minerals in the soil, to name a few. Together, all these data will help researchers determine whether the conditions on the planet were ever favorable for the development of life as we know it.

While scientists are interested in just about anything we can find in the Martian soil, many of their measurements will focus on carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur—a set of life's essential elements known to biologists as CHNOPS.

To assemble the data, *Phoenix* will collect soil samples with its robotic arm and feed them into the two onboard laboratories. In the Thermal and Evolved Gas Analyzer, the sample is gradually heated in a miniature oven up to 1,000 degrees Celsius. Because different molecules become liquids and gases at different temperatures, this slowly separates the different components of the soil. The separated gases are then fed into a device known as a mass spectrometer, which detects the presence of isotopes—aberrant versions of an element with an unusually heavy or light nucleus. The prevalence of isotopes in the soil samples is an important clue in determining the chemical history of the soil and the behavior of water on the planet. For example, the presence of enough "heavy" water molecules—i.e., those that carry extra neutrons—might suggest that liquid water flowed across the surface of the planet.

The second lab, known as the Microscopy, Electrochemistry and Conductivity Analyzer, measures the pH of the soil and detects minerals and salts that wouldn't show up in the oven. Using its onboard chemistry set, *Phoenix* mixes the soil with a variety of reagents to learn more about its chemical properties. The lab also contains two microscopes that are capable of analyzing the structure of the soil and how water has shaped it in the past. Researchers have already tested the lab in Antarctica and will use the results from that expedition as a reference for what they find on Mars—a process one scientist referred to as "comparative planetology."

***Chris Wilson** is an editorial assistant at Slate in Washington, D.C.*



After conducting scientific experiments on Martian soil, NASA's **Phoenix Mars Lander,** *shown in this artist's conception, is returning a wealth of chemistry data. Besides exposing the icy flat surface below the soil, experiments conducted by the* **Phoenix** *have revealed a variety of components of salts that include magnesium, sodium, potassium and chloride. The* **Phoenix** *has also baked a soil sample to 1,000 degrees Celsius.*