

DESTINATION: MARS

Phoenix is en route to the Red Planet, which in recent years has become crowded with spacecraft.

NASA / JPL-CALTECH

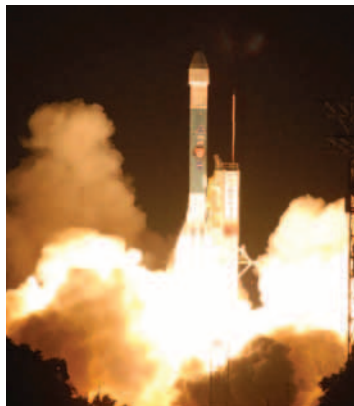
KRISTINA GRIFANTINI

THE UNITED STATES completely abandoned sending spacecraft to Mars for two decades following the arrival of twin Viking orbiters and landers in 1976. But it's been a very different story since the mid-1990s.

In fact, exploration of the Red Planet has been going on more or less continuously since Mars Pathfinder thumped onto Ares Vallis in mid-1997. On its heels came Mars Global Surveyor, an orbiter that spent 10 years rewriting the book on Martian geology. It was joined in 2001 by NASA's Mars Odyssey, in 2003 by the European

ABOVE: After its solar-cell panels fan out to either side, Phoenix will use its long arm to dig into the ice-rich ground. A laser-equipped weather station will monitor dust and clouds in the atmosphere.

RIGHT: NASA's latest mission to Mars rocketed from Florida's Cape Canaveral on August 4th and should land near the Red Planet's north pole next May 25th.



NASA / KENNEDY SPACE CENTER

Space Agency's Mars Express, and in 2006 by NASA's Mars Reconnaissance Orbiter. Meanwhile, the Mars Exploration Rovers, Spirit and Opportunity, have been making tracks for more than 3½ years.

Each mission has heaped new findings on a growing mountain of data suggesting that our ruddy neighboring world was a busy place in its youth but settled into geologic retirement billions of years ago. With the August 4th launch of the Phoenix lander and more missions in the works, soon we'll know even more about the Red Planet's evolution, particularly whether life once existed there.

The exploration of Mars has gone hand in hand with intrigue about extraterrestrial life, giving birth to the field of astrobiology. The Viking landers (the first spacecraft to function successfully on the surface) stewed, brewed, and incubated scoopsful of Martian soil, looking for signs of metabolic activity. The results, though contested by a few team members, were negative. The British-built Beagle 2, equipped to look for fossil organisms, hitchhiked aboard Mars Express but mysteriously failed as it descended to its landing site on December 25, 2003.

Since these attempts, NASA has focused on finding evidence of habitability, such as carbon compounds and liquid water, instead of hunting for life directly. Phoenix

continues NASA's follow-the-water theme for exploring Mars, which has been "very successful," says NASA associate administrator Alan Stern. "Now it's 'follow the carbon.'"

The Phoenix Rises

Named for the mythological firebird that resurrects itself from its ashes, the \$420 million Phoenix utilizes technology from two previous lost or canceled missions and is the first Mars effort run by a university (University of Arizona). On May 25, 2008, the 18-by-5-foot, three-legged, solar-powered lander will touch down near the Martian arctic, where scientists predict sheets of water ice lie just inches beneath the surface. Phoenix will use its nearly 8-foot-long arm — equipped with two blades and a powerful drill — to dig trenches up to 3 feet deep in the hard-as-concrete ice.

The craft carries several novel instruments to analyze what it scoops out. A wet lab will test for properties like acidity and the presence of carbon or sulfur. A high-power microscope will examine the structure of soil particles down to 10 nanometers. And eight tiny, one-use-only ovens will slowly heat pinches of ice and dirt to 1,800°F (1,000°C) and "sniff" for released gases, including any organic compounds, according to mission scientist William Boynton (University of Arizona). All the while, a stereo camera will record the lander's surroundings.

The science team expects Phoenix to carry out its studies for three months before Martian winter sets in and the polar atmosphere freezes, encasing the lander Han Solo-style in frozen carbon dioxide (dry ice).

Six Wheels with Attitude

NASA's next big step is the billion-dollar Mars Science Laboratory, which should launch in 2009. MSL will be a geological and geochemical lab on wheels, the "Rolls Royce of rovers," quips team member Oded Aharonson (Caltech). Nine feet (2.7 meters) long and weighing 1,800 pounds (800 kg), the super rover will hunt for evidence that water — and life — once permeated the Martian soil.

MSL will be bigger than its predecessors, "the size of a Mini Cooper," says Matthew Golombek (Jet Propulsion Laboratory). It will also travel farther, 600 feet or more each day, and be able to climb over large obstacles.

The suite of onboard instruments will be supersized as well. Not only will MSL drill deeply for samples, it will

HIDDEN ICE The landing site for Phoenix is a relatively flat area near the Martian north pole, equivalent in latitude to northern Alaska. Red areas indicate high-standing terrain (including large volcanoes), while blue denotes lowland plains.



SUPER ROVER An engineering prototype of the Mars Science Laboratory, nicknamed the "scarecrow," undergoes mobility testing at the Jet Propulsion Laboratory in Pasadena, California.

also be packing heat: a laser powerful enough to vaporize rock surfaces up to 10 meters (33 feet) away. The resulting puffs of superheated gas should reveal whether the rocks contain water or organic compounds, such as proteins or amino acids, that may be left over from past living creatures. "That's a dramatic improvement in our ability to characterize habitability," says Golombek.

MSL may also take the first step in bringing samples of Mars back to Earth. Terrestrial laboratories would reveal much more about Martian rocks than rovers and landers could ever tell us. Given just a few grains of grit, scientists on Earth could figure out a rock's exact makeup and, more importantly, the date of its origin. "A sample return would be an amazing exploration achievement and a science bonanza," says Golombek. Such an expensive undertaking, costing \$3 to \$4 billion, could be attempted before 2020, according to Stern.

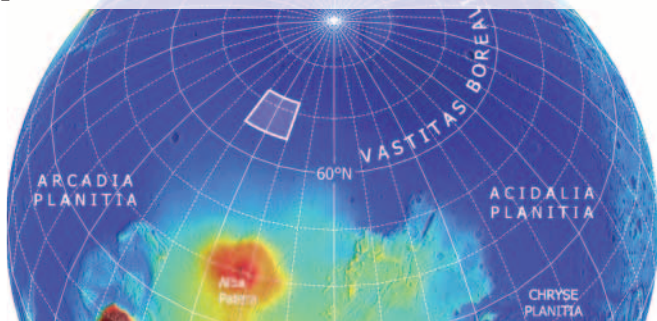
Check SkyandTelescope.com for updates on Phoenix and other missions to Mars.

While MSL won't be able to send back any rocks, it may be tasked to gather up to a half dozen small rock chips and store them for a later robot to retrieve. "We are working now on a plan to incorporate a small cache, about the size of a hockey puck," says John Grotzinger (Caltech), the project's lead scientist.

All of these missions — Phoenix, MSL, and a sample return — are precursors to human exploration, says Stern. Also in the launch queue are another NASA orbiter (2011) and the European Space Agency's Exo-Mars mission (2013), which will focus on atmospheric studies.

Spirit and Opportunity have demonstrated that there are always surprises when we get to Mars, says Aharonson. "They taught us we need instruments that are versatile and able to analyze the unknown." ♦

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