Phoenix spacecraft lands near Mars polar icecap

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In the first successful powered landing on Mars in 32 years, the Mars Phoenix Lander touched down on the surface of the planet Sunday, May 26, near the edge of its northern polar icecap. The spacecraft completed a 422-million-mile trip in just under 300 days since its launch last August 4, with virtually flawless performance of all its complex engineering systems.

NASA scientists and mission planners targeted the area, called Vastitas Borealis, at a latitude equivalent to Alaska or northern Canada, because of the presence of subsurface ice. The ice could provide a good environment for the formation of organic molecules, the basic building blocks of life. Phoenix is the first planetary probe whose primary purpose is to investigate local water supplies—a key factor for sustaining any subsequent manned mission.

Phoenix is equipped with a long scoop arm with a heavy-duty drill, to be used to bore into the ice, extract samples, and bring them inside the spacecraft for a variety of onboard lab tests to determine chemical composition, with a particular focus on finding carbon-hydrogen-oxygen compounds.

The landing was among the most technically complex actions ever undertaken in unmanned spaceflight. The entire process had to be directed by onboard computer programs, since it takes some 15 minutes for radio signals to reach the Earth, making it impossible for ground controllers to give real-time instructions.

When Phoenix reached Mars orbit, it seems to have carried out the entire seven-minute landing sequence without a hitch: first using the thin Martian atmosphere to brake its speed, then deploying a parachute which further slowed the fall, until, only a few seconds before impact, 12 small rocket thrusters were fired to cut the speed of descent to only 5 miles per hour. Throughout this process, the lander had to maintain its orientation to the Sun in order to generate electricity through its solar panels.

Roughly half of all Mars powered landings have failed, with the spacecraft either failing to enter a proper orbit and flying past the planet, or crashing into its surface at a high rate of speed—the fate of NASA's Mars Polar Lander in 1999. The last previous successful powered landing on Mars came in 1976, when two Viking probes confirmed that the surface of the planet is cold, dusty, nearly airless and inhospitable to life.

Since the twin failures in 1999—a second spacecraft simply fell out of contact with Earth as it approached Mars, its fate still unknown—NASA and the European Space Agency have slowly rebuilt their capacity to reach and explore the planet, culminating over the last four years in a series of unprecedented scientific and technical advances.

Phoenix was given that name because it reuses components and systems from Mars missions in the earlier part of this decade that had to be scrapped after the 1999 debacle.

Two small exploration vehicles, the rovers Spirit and Opportunity, were landed at separate points along the equatorial region of Mars in 2004. Much lighter than the 900-pound Phoenix lander, they used a combination of parachutes and inflated cushions that absorbed the impact of the touch-down on the planet.

Originally intended to conduct 90 days of surface exploration, the two rovers are still operating nearly four years later, sending back massive amounts of data about the chemical composition of Mars, including evidence that surface water once existed on the planet.

Three other spacecraft, two from NASA and one from ESA, are currently in orbit around Mars, photo mapping the surface and analyzing the composition of

its atmosphere. Instruments on all three were deployed to monitor and assist in the Phoenix landing. The spacecraft communicates to the Jet Propulsion Laboratory on Earth via the two orbiting NASA satellites, Mars Reconnaissance Orbiter and Mars Odyssey. The Mars Reconnaissance Orbiter also took photographs of the landing, showing the huge parachute billowing from Phoenix, and the European Mars Express recorded the sound of the landing as well.

The tools and instruments on board Phoenix have been started up and tested without significant problems, as of three days after the landing. These include the two retractable "arms," as well as the huge solar panels which supply power. Other instruments to be used include eight small ovens, which will heat various samples of ice, sand and rock to a gaseous state to test their chemical composition, and four chemical labs.

Initial photographs confirm that Phoenix landed in a relatively flat area characterized by polygon-shaped furrows caused, NASA scientists believe, by expansion and contraction of an underground layer of water ice. The surface ice that covers the region in the Martian winter—and will likely disable the lander—is comprised of carbon dioxide ("dry ice"). Similar polygonal cracks are found in the Arctic and Antarctic regions of the Earth.

The landing zone is about 12 miles from a crater named Heimdall, and 30 miles from the nearest hills. The average temperature in the area is about minus 22 degrees Fahrenheit at midday, falling to well below minus 100 degrees Fahrenheit during the night.

The decision to target the edge of the icecap was triggered by an observation in 2002 by the Mars Odyssey that there were large quantities of ice just below the surface of the planet. If the ice thaws and refreezes, as suggested by the furrowing, this would suggest that liquid water exists underground at least for some periods of time—a critical factor in the formation of carbon-based life forms like those found on Earth.

Phoenix was aimed at a location at 68 degrees of latitude, rather than directly at the pole itself, since the surface of the icecap would be an extremely unpredictable and potentially hazardous landing.area.

Unlike the two rovers, small wheeled vehicles that have scoured miles of Martian landscape, Phoenix will stay in one place and go downwards, using the nearly eight-foot robotic arm. It will also deploy a complete small weather station—like the robot arm, built in Canada—as well as two wide solar power arrays, two stereoscopic color cameras and a mast with multiple sensors.

On Thursday the Jet Propulsion Laboratory in Pasadena, California reported that Phoenix had successfully flexed the robot arm and sent pictures of it in action.

The apparent initial success of Phoenix comes only two months after NASA hastily rescinded a proposal to cut back operations with the two rovers for budgetary reasons. NASA told JPL that $4 million was to be cut from the rover program, which would have meant putting at least one of the vehicles in hibernation—sacrificing a priceless opportunity to gather additional data on Mars.

NASA indicated that the budget cuts were needed because of cost overruns on the next generation of Mars landers, the Mars Science Laboratory, which is scheduled for service in 2010. The MSL is more like the spearhead of an invasion force than a scientific instrument package—wheeled, the size of a Hummer, equipped with a laser "gun" that can vaporize rocks at 30 feet, and powered by plutonium dioxide rather than solar cells.

It is so heavy that neither of the proven methods to land on Mars can be used, and NASA is working on a plan to lower the vehicle to the surface using ropes from a spacecraft hovering about 70 feet above. The MSL launch is now scheduled for a window between September 15 and October 8, 2009.