Phoenix descending

NASA's Mars strategy goes from "follow the water" to "arrive at the ice".

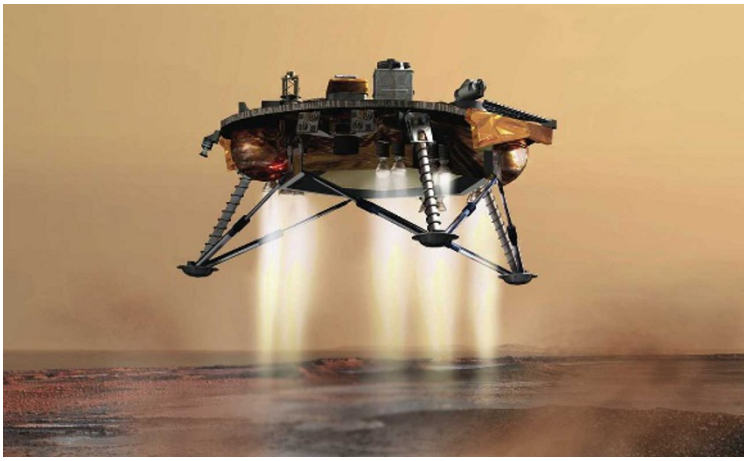
Since 2001, the slogan for NASA's Mars programme has been "follow the water".

With Phoenix, a US$420-million mission to the edge of the planet's north ice cap, the agency hopes to finally touch its quarry, in the form of dirty water ice scraped from the subsurface and melted in the probe's on-board ovens.

If all goes as planned, Phoenix will reach the end of its 680-million-kilometre, 10-month-long journey on 25 May. Its landing site is in a region where NASA's orbiting Mars Odyssey spacecraft has detected gamma-ray and neutron signatures suggesting a significant amount of hydrogen — thought to be a constituent of frozen water — near the surface. Soon after unfurling twin solar arrays, the lander will extend a robotic arm to dig down as far as half a metre in search of that ice.

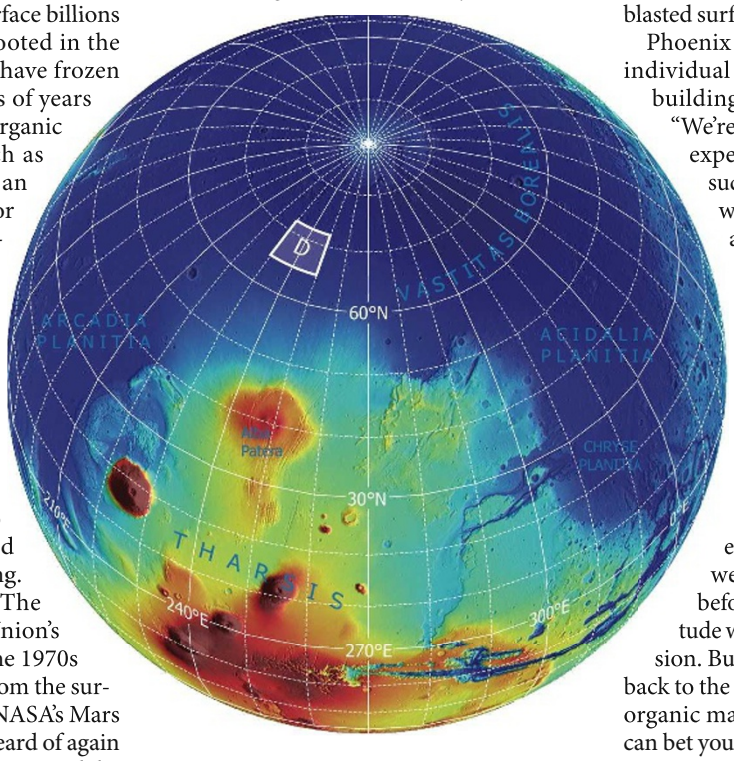
Older missions, including the rovers Spirit and Opportunity, have shown that there was water at and near the planet's surface billions of years ago. Phoenix will be rooted in the present, sampling ice that may have frozen in place mere tens of thousands of years ago and also sifting the soil for organic chemicals and substances, such as sulphur, that life might use as an energy source. "Phoenix will, for the first time, give us the opportunity to directly assess habitability," says Doug McCuistion, NASA's Mars-exploration programme director.

Before that, though, it has to get down safely. Five NASA spacecraft have landed successfully on Mars in the past: two 1976 Viking landers, the 1997 Pathfinder and the two rovers that arrived in 2004 and are, remarkably, still going strong. But there have been misfires. The most successful of the Soviet Union's various attempts at landing in the 1970s sent back only seconds of data from the surface — but that was better than NASA's Mars Polar Lander, which was never heard of again after entering the atmosphere in 1999, and the British-run Beagle 2, lost in 2003.



NASA

Phoenix, a 350-kilogram lander, inherited hardware from the Mars Surveyor Lander, a mission cancelled in 2000 after the failure of the Mars Polar Lander, with which its design had much in common. As a result of its sibling's demise, Phoenix's principal investigator Peter Smith of the University of Arizona in Tucson and his team eliminated more than two dozen flaws that might have conceivably led to failure from hardware and software. "We may not succeed, but we deserve to succeed," he says.



Phoenix hopes for a picture-perfect landing (top) on Mars's northern plains (above).

Engineers at the Jet Propulsion Laboratory in Pasadena, California, which runs most of NASA's planetary missions, will have their last chance to tweak the trajectory on 24 May. The next day, Phoenix is expected to use the planet's atmosphere, and its own heat shielding, parachutes and retrorockets, to slow itself down from an orbital speed of 20,000 kilometres per hour to a soft, safe landing at just 2.4 metres per second.

Smith and his team hope that the ice and soil samples they will study with the spacecraft's mass-spectrometer and chemical analysis systems will contain hints of organic molecules, of which the Viking landers found no trace at lower latitudes. The polar environment might be more hospitable to persistent organics — either from incoming meteorites or primordial to Mars — than the corrosive and radiation-blasted surfaces which the Vikings scratched.

Phoenix can measure salts, pH levels and individual chemicals, but can't analyse the building blocks of life, such as proteins. "We're an ideal stepping stone for more expensive and sophisticated missions such as the Mars Science Laboratory, which can really look at molecules and say, 'This is DNA'," says Smith, referring to the Cadillac of NASA Mars missions — a long-duration rover weighing 850 kilograms and budgeted at nearly $2 billion — which is due for launch next year to one of a shortlist of six sites closer to the planet's equator.

By August, Phoenix will have used up its ovens and laboratory equipment. It will hang on as a polar weather station for a few months before the severe cold of the high-latitude winter in all likelihood ends its mission. But its results may lure other probes back to the poles. "If we find an abundance of organic matter in this ice," Smith says, "you can bet your bottom dollar there'll be another mission going there someday." ■

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