Mars orbiter seeks future landing sites

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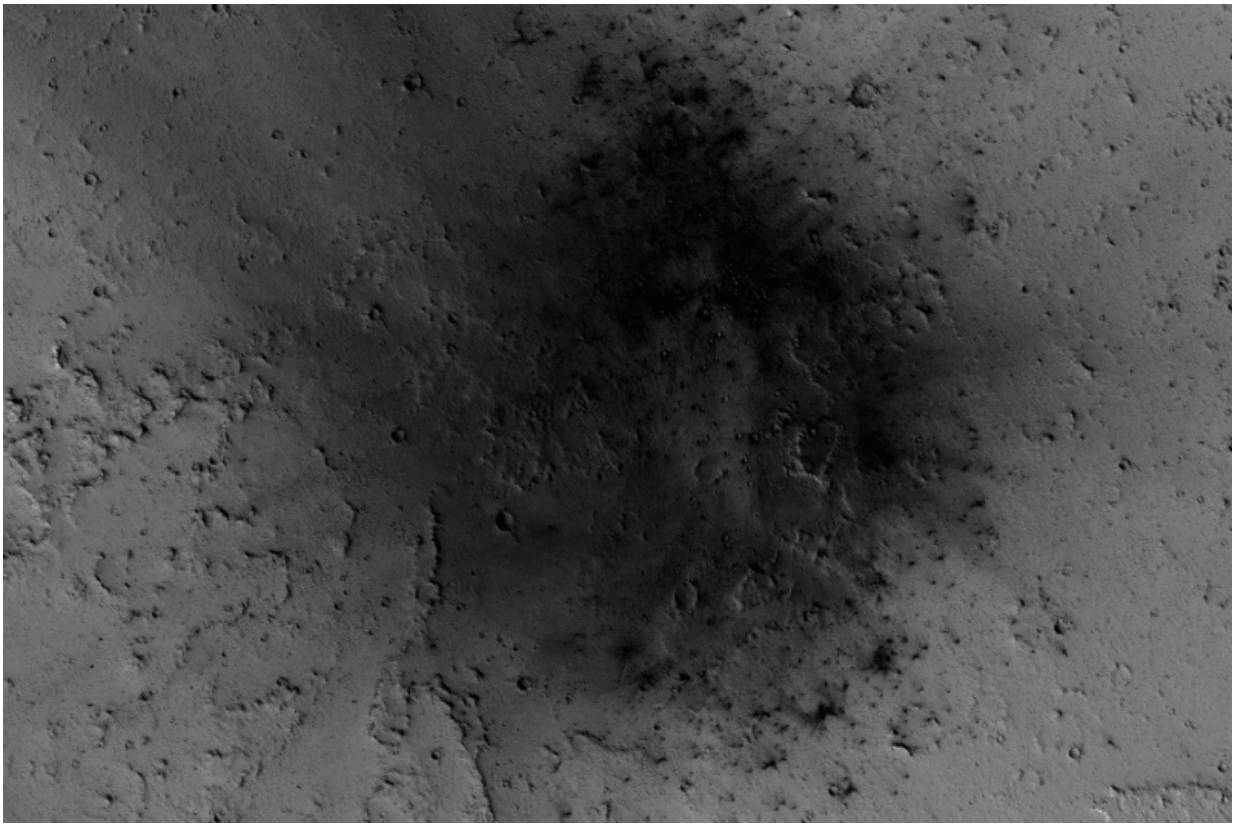

NASA's Mars Reconnaissance Orbiter has been observing Mars since 2006, enabling it to document many types of changes, such as the way winds alter the appearance of this recent impact site. Credit: NASA/JPL-Caltech/Univ. of Arizona

At an international workshop this week about where NASA's next Mars rover should land, most of the information comes from a prolific

spacecraft that's been orbiting Mars since 2006.

Observations by NASA's Mars Reconnaissance Orbiter (MRO) provide the basis for evaluating eight candidate landing sites for the Mars 2020 rover mission. The landing site workshop this week in Monrovia, California, will narrow the Mars 2020 candidate list to four or fewer sites. MRO observations have been used to identify, characterize and certify past landing sites and are also in use to assess possible sites for future human-crew missions.

"From the point of view of evaluating potential landing sites, the Mars Reconnaissance Orbiter is the perfect spacecraft for getting all the information needed," said the workshop's co-chair, Matt Golombek of NASA's Jet Propulsion Laboratory, Pasadena, California. "You just can't overstate the importance of MRO for landing-site selection."

Engineers use MRO data to evaluate the safety of a candidate landing site. For example, stereoscopic 3-D information can reveal whether slopes are too steep, and some detailed images can show individual boulders big enough to be a landing hazard. Scientists use MRO data to evaluate how well a site could serve the research goals of a mission, such as the distribution of minerals that may have originated in wet environments.

"Missions on the surface of Mars give you the close-up view, but what you see depends on where you land. MRO searches the globe for the best sites," said MRO Deputy Project Scientist Leslie Tamppari of JPL.

Images, terrain models and mineral maps from the orbiter help the teams that operate NASA's two active Mars rovers plan driving routes. The Mars 2020 team has already used MRO data to evaluate driving options in the eight candidate sites for that rover, which is on track for launch in the summer of 2020 and landing in early 2021. The site evaluations even

use MRO's capability to study the atmosphere above each site and probe underground features with ground-penetrating radar.

In the progress toward selecting a landing site for a future human mission to Mars, NASA is using MRO data to evaluate about 45 suggested sites that could support human exploration zones, which are areas that could support astronauts as they explore up to a 60-mile radius.

Still, the hundreds of MRO observations targeted specifically for study of potential landing sites make up a small fraction of all the data the mission has provided about Mars. MRO has acquired more than 224,000 images and millions of other observations during its nearly 50,000 orbits around Mars. This month, the mission will reach and pass a milestone of 300 terabits of total science data sent to Earth from the orbiter. That tops the combined total from all other interplanetary missions, past and present. It is more data than would be included in four months of nonstop high-definition video.

"Whether it is looking at the surface, the subsurface or the atmosphere of the planet, MRO has viewed Mars from orbit with unprecedented spatial resolution, and that produces huge volumes of data," said MRO Project Scientist Rich Zurek of JPL."These data are a treasure trove for the whole Mars scientific community to study as we seek to answer a broad range of questions about the evolving habitability, geology and climate of Mars."

One of the orbiter's six instruments has provided images of 99 percent of Mars—equivalent to 97 percent of Earth's land area—in resolution sufficient to show features smaller than a tennis court. One-fifth of this coverage area has been imaged at least twice, providing stereo, 3-D information. Another instrument has returned several multi-spectral data sets for mapping surface composition, including one covering nearly 85

percent of Mars.The highest-resolution camera onboard has returned images revealing details as small as a desk in swaths covering a carefully chosen 2.8 percent of Mars's surface. That's more than the areas of Texas, California, and all the states east of the Mississippi River combined.

Other instruments on MRO have provided daily weather maps of the entire planet since 2006, more than 20,000 radar-observing strips to examine subsurface layers of ice and rock, and more than 8.8 million atmospheric profiles of temperatures, clouds and dust.

New discoveries flow from the copious MRO data. Some are:

- Minerals mapped by MRO indicate a diversity of ancient water-related environments, many apparently habitable.
- There is enough carbon-dioxide ice buried in the south polar cap that, if released, it could more than double the planet's present atmosphere.
- Mars is a dynamic planet today, with dust storms, moving sand dunes, avalanches, new gullies and fresh impact craters.
- Reservoirs of buried water ice that are remnants of past climates, including buried glaciers, have been confirmed and discovered.
- Dark flows that appear in warm seasons on some slopes suggest brine activity, though they are still enigmatic and hold scant water at most.
- Mars' north polar cap is geologically young—about five million years old—and contains unequally spaced layers of dust and ice that are apparently related to cyclical changes in the planet's tilt.
- Large dust storms during southern spring and summer appear to have a pattern of three types, in sequence.
- Seasonal surface changes at mid to high latitudes appear related to freezing and thawing of carbon dioxide.

In addition to MRO's observations, whether for landing-site assessment or direct science investigations, the orbiter also provides communication relay service for robots on the Martian surface, whether mobile or stationary. This month, MRO will reach and pass a milestone of 6,000 relay sessions for Mars-surface missions.

More information: For additional information about MRO, visit nasa.gov/mro

Provided by Jet Propulsion Laboratory