The landing-site specialist

October 19 2011, by Elizabeth Zubritsky

Gale crater, the landing site for the Mars Science Laboratory (MSL) mission. The ellipse indicates the intended landing area on an alluvial fan. It may take the MSL rover several months to a year to drive to the base of the mound, depending on where the rover lands in the ellipse and how many stops are made along the way.

(PhysOrg.com) -- Gale crater has been sitting just below the equator of Mars, minding its own business, for at least three and half billion years. But in August 2012, a capsule is going to come screaming out of the sky, then brake its fall by popping a parachute and engaging rocket thrusters. After that, the "sky crane" inside the capsule will activate to lower the subcompact-car-sized Curiosity rover on tethers, suspending it beneath the rest of the craft until the whole assembly descends onto a carefully chosen patch of ground at the northwestern end of the 96-mile-diameter crater.

This is how Goddard's Jim Rice describes the arrival of NASA's Mars Science Laboratory (MSL) at Mars. "This region of Mars has no idea what is coming its way," he laughs. "It doesn't know that once the rover arrives, nothing will ever be the same."

Rice, a planetary geologist, has been thinking about MSL's landing because he participated in the process of choosing where the spacecraft will touch down. That meant attending a series of site-selection workshops, along with researchers from across the planetary science community, to consider nearly 60 potential landing sites. It also meant paying special attention to exactly how flat, how high, how windy, how dusty and how rocky certain regions of Mars are, as well as evaluating how interesting the geology is in those places.

He advocated for Eberswalde crater, which he favored because of its delta. Though it's been dry for eons, the delta resembles the mouth of a river here on Earth. Because the goal of MSL is to assess whether Mars was ever a habitable environment, Rice explains, every potential landing site "had to have a water story-some evidence that water was involved in the formation of the landscape and in the rock deposited there."

A site also had to have the potential to preserve biomarkers, the telltale indicators that organic material was once present. Any regions that didn't satisfy these two science objectives were eliminated. Once the list of candidates was pared down to half a dozen, the competition got tough.

"When you suggest a site at these meetings, you get grilled by the project engineers, the mission's science team and other scientists who are proposing alternative sites," says Rice. "You have to defend your choice through all kinds of ups and downs. It's a lot of work but a lot of fun."

Rice, now a veteran of the site-selection process, got his first taste in 1994 with NASA's Mars Pathfinder mission. "I was just a graduate

student then, and I can't tell you how excited I was," he says. "It was the first mission to land on Mars in more than 20 years, and my site was chosen for the landing!"

When Pathfinder landed at Ares Vallis, the site he helped propose, he was hooked. He participated in site selections for the Mars Polar Lander and Phoenix as well as Spirit and Opportunity, the two vehicles of the Mars Exploration Rover (MER) mission. With MSL, he will have been involved in six missions that landed, or will soon land, on Mars.

By 2008, Eberswalde was hanging tough as one of MSL's final four, along with Gale crater, Holden crater and Mawrth Vallis. From data gathered by NASA's Mars Reconnaissance Orbiter, researchers knew that all four sites had clays called phyllosilicates, which meant the ancient water had to stick around long enough to break down rock. All four sites were also given the thumbs-up by engineers as being safe.

But ultimately, Gale crater, with its mysterious mound that rises higher than Mount Rainier near Seattle, won out.

"That mound is so enigmatic," says Rice. "We know that there are clays in it and also sulfates, another indication of water. But how did that mound get there? Did volcanic ash and dust blow in and contribute to the buildup of the mound? How and why did the area around it erode away? When water was there, where did it come from?"

To look for answers, the rover will drive at least partway up the mound, which Rice likens to exploring the Grand Canyon, but backwards. "As you hike down into the Grand Canyon, you go through all these rock layers. Every step takes you back in time," he explains. "But at Gale, we'll be climbing up through the layers instead."

Not deterred by Eberswalde's narrow defeat, Rice is already thinking

about a landing site for a possible 2018 Mars mission: the Columbia Hills region in Gusev crater, which was first explored by the Spirit rover. "Thanks to Spirit," he says, "we now know that the Columbia Hills contain carbonate rock, which means there was water present in an environment that is friendly to life as we know it, and we know there are silica deposits, which formed in an ancient geyser-like area similar to Yellowstone. Best of all, we know precisely where these geological goodies are located."

"No matter where you go on Mars, it's an exciting experience," Rice adds. "No doubt Gale crater will be full of surprises when we land. But the best part is that we'll get to know it. It will become a neighborhood that we roam in, just like Gusev crater and Meridiani Planum, where the Spirit and Opportunity rovers landed. And just like them, Gale will become an extension of our human consciousness."

Provided by NASA's Goddard Space Flight Center