AT THE OUTER LIMITS

Working with NASA, two Indiana University scientists are playing a major role in the Curiosity rover's exploration of **Mars**.

By Janet Mandelstam

IU geology professors David Bish and Juergen Schieber watched the launch from Cape Canaveral on November 26, 2011. They, along with all the scientists who had been working for years on the NASA Mars Science Laboratory's Curiosity rover, gazed skyward as an Atlas V rocket lifted off with the rover riding atop it. Then came the nearly year-long wait as Curiosity made its way to Mars.

The scientists gathered again at the Jet Propulsion Laboratory (JPL), at the California Institute of Technology in Pasadena, on August 6, 2012, for the anticipated landing. They knew that as soon as Curiosity entered the Mars atmosphere, it would lose contact with Earth for seven long minutes. That set the tense scene as Bish and Schieber waited with hundreds of other scientists.

"It was seven minutes of terror," Bish recalls, echoing the phrase used by JPL. And then the words came out through the audio feed with scientific detachment from Mission Control: "Touchdown confirmed."

"It was the most incredible moment," says the ebullient Bish. "We blew the roof off the place. Within a minute we got a picture, and we're hugging each other and jumping up and down." Or, as the equally pleased but cooler Schieber puts it, "It's what people do when they have too much pent up emotion."

This computer-generated image from NASA shows the surface of Mars at the edge between darkness and daylight. *Courtesy of NASA/JPL-Caltech*

Mission Control, where scientists and technology experts monitor the Mars expedition from the Jet Propulsion Laboratory in Pasadena, California. *Courtesy photo*

IU geologists Juergen Schieber (left) and David Bish each contributed geological and technological know-how to the Curiosity rover. *Chris Meyer/ IU Communications*

Searching for building blocks of life

The Indiana geologists were members of teams that developed two of the ten scientific instruments Curiosity carried to Mars on a mission to assess whether the building blocks of life as we know them had ever existed on the planet. Had the landing gone awry, they were prepared to return to Bloomington and their regular routines, but with the success of the mission, they spent the next 90 days at JPL testing the instruments on the rover and analyzing photos and rock samples.

"We worked on Mars time where the day is 24 hours, 39 minutes, and 35 seconds," says Bish. The first day began at 8 am, the second at 8:39 am. "After a couple of weeks we were going to work at 1 am. It was like perpetual jet lag."

Schieber, a specialist in sedimentary geology, was part of a team that built Curiosity's three types of cameras. There's a close-up, focusable, color camera at the end of the rover's robotic arm "that can be put next to rock" and wide-angle cameras that sit on top of the rover. These are "the work-horse cameras and the geologic eyes of the team," he explains. A third camera photographed the descent onto the surface of Mars—pictures that were received at JPL overnight.

IU geologist David Bish worked for two decades to help NASA miniaturize an X-ray diffraction device from the size of a double-wide refrigerator to shoebox proportions—small enough to fit inside the rover. *Courtesy photo*

Bish, whose specialty is mineralogy, worked on CheMin, a miniature X-ray diffraction instrument, for 20 years. In a laboratory, the instrument—"a tool we can use to tell us about how atoms are arranged in solids"—is the size of a double-wide refrigerator and weighs 1,000 pounds. His team of scientists built a couple of miniature prototypes "and JPL put the instrument together from our design. It's now the size of a shoe box."

The instrument is one of two inside the body of the rover. Curiosity is programmed to use its robotic arm to scoop up a sample from the surface of Mars and put it in the instrument "and then we use X-ray diffraction to see what it's made of," explains Bish.

An intriguing dune of dust

Last October the rover encountered a dune of dust and sand that intrigued the scientists, and Curiosity scooped up a sample. "It's not like a dune on Earth," Bish says. The dunes on most Earth beaches are quartz. On Mars, the scientists found ground-up basalt, material similar to what makes up the flanks of the dormant volcano Mauna Kea on the island of Hawaii. "Whenever we look at the surface of Mars, we are looking through a thin cover of dust. Now we know what it is. This is the first time in history that we obtained X-ray diffraction information outside of Earth."

The dune samples contained both minerals and glassy material. There was no evidence of water in the minerals, Bish says, and there is "no liquid water on Mars." But scientists did conclude that water molecules are present in the glassy material and the dust.

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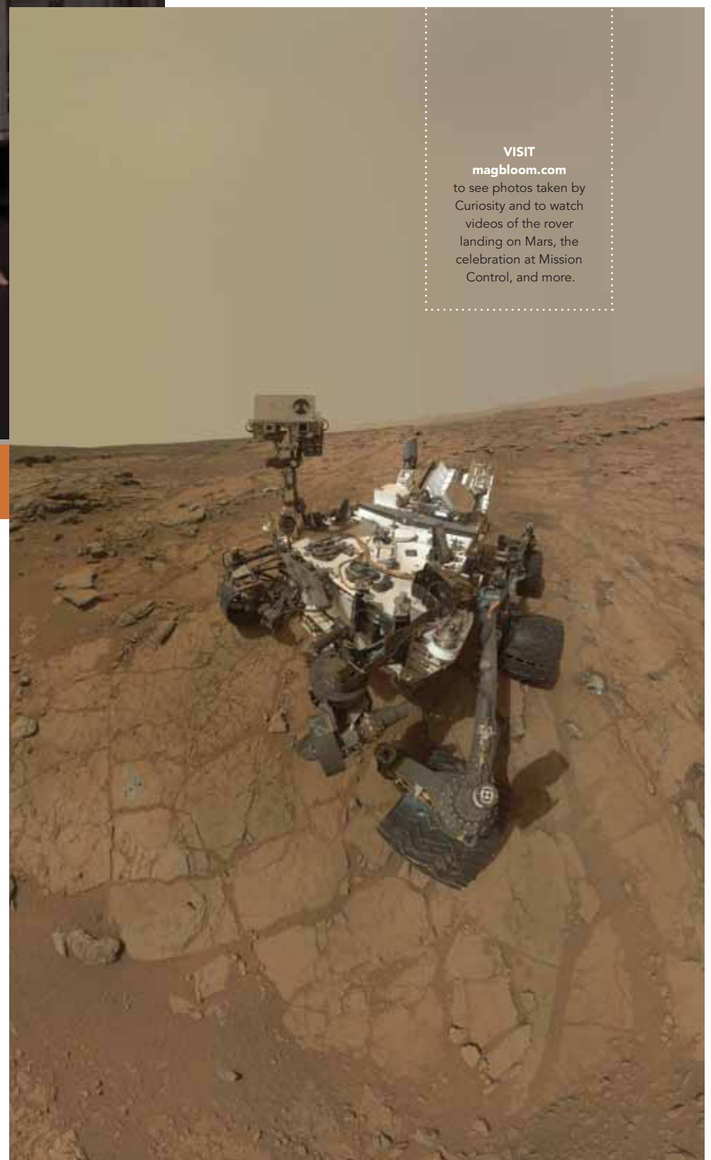
VISIT magbloom.com to see photos taken by Curiosity and to watch videos of the rover landing on Mars, the celebration at Mission Control, and more.



NASA produced a "self portrait" of the Curiosity rover on the Mars surface by combining elements of several images taken by the rover's many cameras into a mosaic. *Courtesy of NASA/JPL-Caltech/MSSS*

Gonna climb that mountain

Curiosity is now slowly making its way to the 18,000-foot Aeolis Mons, or "Mount Sharp," which it is predicted to reach by the middle of 2014. It will then climb the mountain and take photos and samples of its many layers of rock. "As it goes up, it may take a picture every minute," says Schieber. "What we've seen is that most rocks are sedimentary in origin: sandstone, mudstone, and shale. Who knows," he jests, "we might even find oil or gas some day."

Analyzing rocks from photos—even close-focus photos—poses its own challenges. "On Earth," says Schieber, "you can handle a rock, take a hammer to it. It's another thing to see a rock from two meters. There's a lot of interpretation involved in how the material is weathered by wind." Schieber has set up a lab in the geology building at IU to simulate conditions on Mars and study wind erosion on sedimentary rocks.

The professors continue to receive and analyze data from the rover. The mission is designed to last for two years, but Schieber says that "from a practical standpoint it could last ten years or more." Some instruments may degrade over time, he adds, "but even if the rover is demobilized, it may sit there and still take pictures"—providing ever more data for scientists to analyze.

IU has received high praise for its contributions to NASA. One of the agency's top officials, planetary scientist Chris McKay, during a 2011 visit to the campus, called Indiana University "one of the leading centers in the country for astrobiology research." ✲