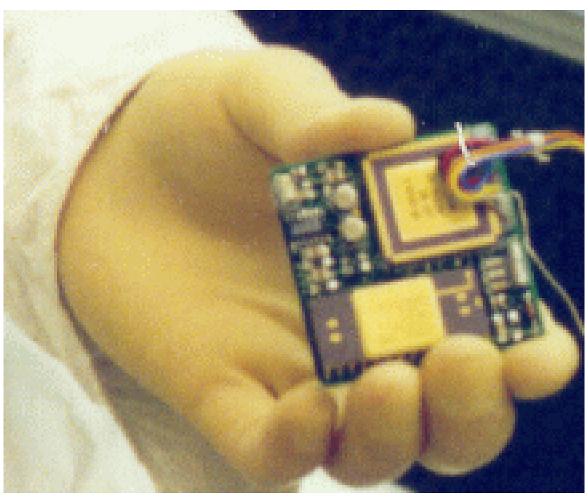
The Mars Microphone: Ready to Go

by Greg Delory

Ever wonder what it sounds like on Mars? When the next lander in NASA's program to explore the Red Planet touches down in 1999, we will all have the chance to find out. Onboard the Mars Polar Lander will be a small recording device, the Mars Microphone, whose job is to sample sound while the rest of the probe studies the soil, weather, and atmospheric dust.

The idea for the Mars Microphone started with Janet Luhmann of the University of California, Berkeley and David Juergens of the Jet Propulsion Laboratory, who proposed to the Planetary Society that a sound-recording device would be easy to include on a Mars mission. Society Executive Director Louis Friedman investigated the possibility of incorporating a microphone in the Mars Polar Lander mission.



Above: The Mars microphone, less than 5 cm on a side, fits easily into the human palm.

At that time, mission planners had just selected a Russian instrument to be put aboard the spacecraft (the first Russian instrument included on a US planetary mission). Under the direction of Viacheslav Linkin of the Space Research Institute in Moscow, the lidar will use a laser to study the distribution of dust in the Martian atmosphere. Linkin offered a place on the lidar for the microphone, which could operate without requiring any mass, power, volume, or data-rate adjustments on the lander.

Friedman and Society President Carl Sagan then requested NASA approval to include the microphone in the Mars Polar Lander payload, stipulating that there would be no cost to NASA. NASA Associate Administrator for Space Science Wes Huntress agreed.
The Planetary Society formed a team with the Space Sciences Laboratory at Berkeley, and together we developed a low-cost implementation plan that enabled us to build the instrument with funding solely by the Planetary Society.

The Mars Microphone will be the first instrument funded by a membership organization to fly to another world. It was designed, constructed, and tested under Luhmann's direction at the Space Sciences Laboratory.

Are There Sounds on Mars?

Given that sound waves need an atmospheric medium through which to travel, many people are surprised to learn that any sounds at all can be heard on Mars. The atmospheric pressure on the surface of the Red Planet is small, amounting to less than 0.1 percent of the Earth's sea level pressure. But even at Mars' low pressure, acoustic signals within the frequency range of the human ear can be detected. And while the atmosphere of Mars is very different from Earth's, consisting mostly of carbon dioxide, there are similarities between these environments that should make the sound data worthwhile.

For example, there is weather on Mars, including winds, sandstorms, and dust devils,

which are little tornadoes caused by local weather patterns. The Mars Microphone may be able to hear these winds and perhaps even a type of lightning within sandstorms. The microphone will also record noises made by the lander, such as the sound of the robotic arm digging for soil samples.
However, the most exciting sounds are likely to be ones that we don't even know about yet. Experience has demonstrated that whenever a new instrument is developed and flown in space, we learn something new about extraterrestrial environments, and therein lies the true spirit of the Mars Microphone concept.

The instrument will bring the public closer to Mars exploration. The sounds picked up by the Mars Microphone will be available on a World Wide Web page during the mission so that anyone will be able to hear for themselves what it sounds like on Mars.

Building and Testing on a Shoestring

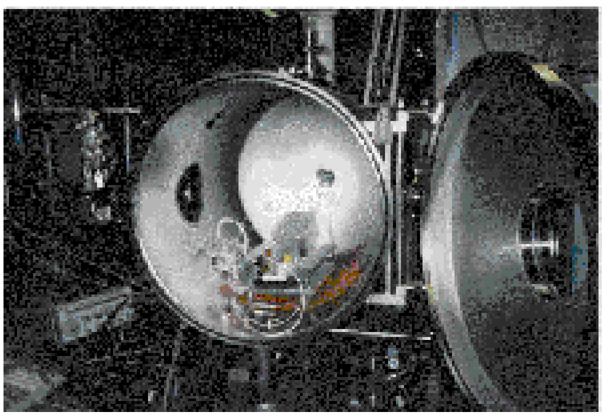
The Mars Microphone is a small device, roughly 5 centimeters on a side and one centimeter thick (2 x 2 x 0.5 inches), weighing less than 50 grams (1.8 ounces) and using a small amount of power, less than 0.1 watt during its most active times. In addition to the microphone, the instrument contains digital electronics to acquire and store sound samples. Because the rate at which we can acquire data will be limited, it will take several days, maybe even a week, to retrieve one 10-second sound clip. The device has internal memory, similar to the RAM in your home computer, which will store sounds for transmission to Earth along with other lander data.

In the construction of the Mars Microphone, we relied on commercial, off-the-shelf technology, meaning that very few of the components were developed specifically for this mission. Most are readily available commercially. Our sound processor chip, for example, is also used in talking toys and educational computers that listen and respond to spoken words. The microphone itself is typically used in hearing aids. The entire program, including design, construction, and testing, cost roughly $50,000, a bargain for an instrument on a planetary probe.

Above: Chris Scholz of the Space Sciences Laboratory works on the Mars Microphone.

The Mars Microphone has since passed several tests to show it can withstand the rigors of a planetary mission. Radiation levels in space and on Mars are higher than what we are used to on Earth, and, like humans, the electronic components in the microphone are sensitive to radiation damage. We exposed the microphone and the sound processor chip to levels of radiation that they would receive during the mission, and there were no failures or degradation of performance. We also conducted thermal tests with temperature ranges of -100 to +20 degrees Celsius (about -150 to +70 degrees Fahrenheit), and detected no malfunctions.

Finally, we performed pressure tests to ensure that the microphone could actually hear noises at the low pressures of the Martian atmosphere. Although sound level diminishes substantially with decreased pressures, we were still able to hear sounds by increasing the gain of the amplifiers within the microphone. The microphone was integrated onto the Mars Polar Lander last October at Lockheed Martin in Denver, Colorado. We verified that the microphone worked properly on the lander and even listened to the technicians conversing as they tended to the craft.



Above: A vacuum chamber at the Space Sciences Laboratory used to test the Mars Microphone.

The next phase of testing will occur this summer, when the entire lander plus microphone will undergo thermal and vacuum tests to simulate the journey through space and operations on the Martian surface. During this time the microphone will practice listening to the movements of the lander's robotic arm.

For the latest on the Mars Microphone project and more details about the experiment, visit the Mars Microphone home page at http://sprg.ssl.berkeley.edu/marsmic.

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