Finding Puts Mars Exploration on Front Burner

It is rare enough for a scientific discovery with no practical applications to draw an enthusiastic response from politicians, but it is almost unheard-of for House Speaker Newt Gingrich (R–GA) and U.S. Vice President Albert Gore to agree on the need for more government spending. The startling claim that a meteorite, consisting of a chunk of Mars rock, bears evidence of ancient life has provoked just such a reaction, however: Both political leaders told NASA Administrator Daniel Goldin separately in recent days that they are willing to find more money to beef up the agency's Mars exploration effort. If that happens, the first hints of extraterrestrial life could jump-start the struggling U.S. space science program.

NASA is already starting to re-evaluate its plans for Mars exploration. Jurgen Rahe, head of NASA's solar system exploration division, says researchers planned to convene this week at NASA headquarters in Washington, D.C., to come up with a draft plan and price tag for a revamped Mars program. High on the list of topics is whether to speed up an attempt to return samples from the planet's surface by several years. That session will feed into a high-level reassessment: On 7 August, President Bill Clinton announced that Gore will organize a White House meeting before the end of the year to map out a bipartisan course for the U.S. space program and focus on the issues raised by the new findings. "I am determined that the American space program will put its full intellectual power and technological prowess behind the search for further evidence of life on Mars," he said.

Goldin told reporters on 7 August that scientists, not engineers or politicians, will shape whatever emerges from these deliberations. "We will be driven by the science process, and not by a rush to go to Mars," he promised. But the prospect of politicians unleashing a flood of new money makes some scientists uneasy. "We don't want to move too fast," says Joseph Burns, a Cornell engineer and astronomer who recently chaired the National Research Council's (NRC) committee on planetary and lunar science exploration. "We can't rush it just to get something up there." The worry is that good science could get lost in the shuffle.

In the past 2 years, space science as a whole has labored under serious budget constraints. NASA's $2 billion space science program would drop to a $1.8 billion effort under Clinton's 1997 budget request, and the decline would continue for at least 5 years under his long-term plan to eliminate the deficit (*Science*, 22 March, p. 1660). In spite of those constraints, NASA had been planning to spend about $100 million a year over the next decade to launch a series of Mars-bound spacecraft every 2 years starting this November, culminating in a 2005 flight that would return soil and rock samples to Earth. Unlike the $1 billion instrument-packed behemoths that flew in the past, the new generation consists of small spacecraft, costing about $150 million apiece, that rely on miniaturized technology. Some will feature tiny rovers crawling around a mother ship on Mars' surface, while others will circle above, mapping the planet.

This plan for stripped-down probes has won grudging approval from planetary scientists. But a report by the NRC committee chaired by Burns—which was coincidentally released on 6 August, the same day that the news about possible life on the planet broke—notes that there remain serious concerns with the Mars program. First, the cost and weight caps that had been imposed by Goldin will limit the range of the surface rovers and the data they can gather—a point that the NRC study calls "a major shortcoming" in NASA's blueprint. The panel also raises concerns about whether the Mars-bound instruments have been adequately tested, and criticizes NASA for focusing on building smaller spacecraft rather than on miniaturizing instruments as well. That could "seriously undermine" the scientific results of the missions, the NRC study finds.

If the new findings loosen the purse strings, both the rover and instrumentation problems could be eased, says Rahe. Representative Jerry Lewis (R–CA), who chairs the House panel that oversees NASA funding, says he supports increasing the agency's budget to accommodate more aggressive exploration. But Goldin warned that the pressure to reduce the deficit could force NASA ultimately to cut other programs to expand Mars efforts.

Even if new funds do emerge, there are likely to be disagreements over just how much the Mars program should be speeded up. A central part of the discussion at this week's meeting, says Rahe, was to be the pros and cons of moving up the sample return mission. While some NASA officials say a 1998 launch is conceivable, Rahe says that would require a huge and fast infusion of money, given the mission's $500 million price tag. A more likely scenario is that NASA will propose it for 2001, according to several researchers. "You need precursor missions to know where to go," says Burns. "You can't just go up and grab something and come back."

But despite those cautionary words, it is clear that the controversial Mars findings are already breathing new life into solar system exploration.

–Andrew Lawler

Meteoriticist John Kerridge of the University of California, Los Angeles, agrees "they've done a reasonably good job" of showing that "at least some of the PAHs are indigenous to the meteorite." But even then there are plenty of explanations for their presence that don't require life, he says. "Decomposition could certainly produce polycyclic aromatic hydrocarbons, but there are dozens of other mechanisms for making PAHs." They could have formed from simpler compounds on Mars that never evolved chemically to living organisms, he notes.

McKay agrees but offers other, independent lines of evidence to strengthen the case. One consists of the mix of microscopic mineral deposits that his group and others have mapped within fractures in ALH84001. The most abundant mineral, carbonate, forms "globules" about 50 micrometers across, which McKay and his colleagues liken to carbonate globules that others have reported forming in the laboratory and in a freshwater pond as bacteria alter the environment. In addition, they note that the larger globules have manganese-containing cores and concentric rings of iron carbonate and iron sulfides. That structure implies that the chemical environment changed as the globules were deposited, perhaps because of bacterial metabolism.

"None of this [can] distinguish between biology and chemistry," cautions Kenneth Nealson of the University of Wisconsin at Milwaukee. Nealson, whose work on bacterial carbonate precipitation is cited by McKay and colleagues, notes that warm fluids circulating through the Martian crust might have deposited the same sequence of minerals without any help from organisms. Indeed, a group led by meteorite specialist Jim Papike at the University of New Mexico analyzed grains of pyrite—iron disulfide—in the same fractures, looking for the skewed ratio of sulfur isotopes that is a signature of biological activity on Earth. They came up empty. "I don't think the McKay group should be bent out of shape" by this negative result, says Papike, "but it doesn't help them either."

But two other minerals that the group found on the carbonate globules tip the balance toward a biological explanation, McKay and his colleagues say: the iron oxide called magnetite and an iron monosulfide called pyrrhotite, both of which form particles less than 100 nanometers in diameter. The highly mag-