Hard-nosed Advice to Lunar Prospectors

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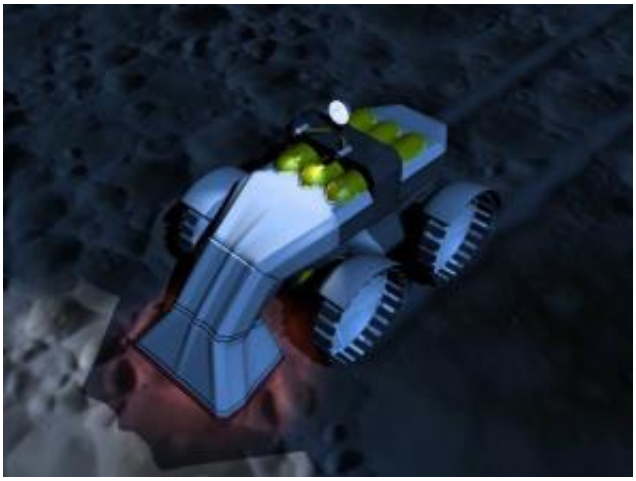
Lunar mining, an artist's concept.

Long before David Beaty became associate Chief Scientist for NASA's Mars Program, he was a prospector. Beaty spent 10 years surveying remote parts of Earth for precious metals and another 12 years hunting for oil. And this qualifies him to work for NASA? Precisely.

Beaty has the kind of experience NASA needs as the agency prepares to implement the Vision for Space Exploration. "Mining and prospecting are going to be key skills for settlers on the Moon and Mars," he explains. "We can send them air and water and fuel from Earth, but eventually, they'll have to learn to live off the land, using local resources to meet their needs."

On the Moon, for instance, mission planners hope to find water frozen in the dark recesses of polar craters. Water can be split into hydrogen for

rocket fuel and oxygen for breathing. Water is also good for drinking and as a bonus it is one of the best known radiation shields. "In many ways," notes Beaty, "water is key to a sustained human presence." Ice mining on the Moon could become a big industry.



Robotic ice miner, an artist's concept. Credit: NASA/John Frassanito & Associates.

Beaty has learned a lot from his long career prospecting, exploring and mining on Earth. Now, with an eye on other worlds, he has distilled four pieces of wisdom he calls "Dave's Postulates" for prospectors working anywhere in the solar system:

Postulate #1: "Wishful thinking is no substitute for scientific evidence."

"On Earth, banks won't lend money for less than proven reserves. From a bank's viewpoint, anything less than proven is not really there. This lesson has been learned the hard way by many a prospector," he laughs.

For NASA the stakes are higher than profit. The lives of astronauts

could hang in the balance. "Proven reserves on the Moon can perhaps be thought of as having enough confidence to risk the lives of astronauts to go after it."

What does it take to "prove" a reserve—that is, to know with confidence that a resource exists in high enough concentration to be produced?

"That depends on the nature of the deposit," explains Beaty. "Searching for oil on Earth, you can drill one hole, measure the pressure and calculate how much oil is there. You know that oil probably exists 100 feet away because liquids flow. However, for gold you must drill holes 100 feet apart, and assay the concentration of gold every five feet down each hole. That's because the solid earth is heterogenous. 100 feet away the rocks may be completely different."

Deposits on the Moon aren't so well understood. Is lunar ice widespread or patchy, deep or shallow? Does it even exist? "We don't know," says Beaty. "We still have a lot to learn."

Postulate #2: "You cannot define a reserve without specifying how it can be extracted. If it can't be mined, it's of no use." Enough said.

Postulate #3: "Perfect knowledge is not possible. Exploration costs money, and we can't afford to buy all the information we want. We have to make choices, deciding what information is critical and what's not."

He offers the following hypothetical example:

"Suppose we decide to send a robot with a little drill and an onboard laboratory into Shackleton Crater, a place on the Moon with suspected ice deposits. We're going to have to think pretty carefully about that lab. Maybe it can contain only two instruments. What are the two things we most need to know?"

"Suppose further that someone on Earth has invented a machine that can extract water from lunar soil. But it only works if the ice is close to the surface and if the ice is not too salty." The choice is made. "We'd better equip the robot with instruments to measure the saltiness of the ice and its depth in the drill hole."

Finally, **Postulate #4:** "Don't underestimate the potential effects of heterogeneity. All parts of the Moon are not alike, just as all parts of Earth are not alike. So where you land matters."

Ultimately, says Beaty, if geologists and engineers work together applying these rules as they go, living off the land on alien worlds might not be so hard after all.

Source: Science@NASA, by Trudy E. Bell and Dr. Tony Phillips