

# An oasis on the moon?

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*stevejdufour\_at\_yahoo.com*

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Space Watch: An oasis on the moon?

By Robert Zimmerman

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WASHINGTON — As the human race begins the in-situ human exploration of the solar system in the coming decades, one essential ingredient to that journey will be water — not only because it will suggest where alien life might reside, but also because future explorers will need it to survive and prosper.

On Mars, the hunt for water has been intense and, in recent months, extremely encouraging. The most recent discovery was announced Wednesday when European scientists released images from the Mars Express spacecraft — which has been orbiting the red planet since Dec. 25, 2003 — showing what appears to be a frozen sea buried under a layer of volcanic ash near the Martian equator.

The images show features almost identical to the large floes of pack ice seen on Earth in places like the Arctic Ocean. The blocks look like they had broken apart and had been floating in a sea when the underlying water froze, thereby locking them into place. Subsequently, everything was coated by a layer of volcanic ash perhaps only a few inches thick.

It was this ash layer, the scientists said, that prevented the ice from sublimating away as the Martian atmosphere became dryer and colder.

What makes this discovery even more compelling is its location, just north of the equator in the planet's lowlands, just offshore in what some scientists have theorized was an ocean that once covered much of the planet's northern hemisphere. If confirmed, the frozen sea would represent strong proof that this large ocean once existed.

Nor is this extraterrestrial watery evidence unique. The results that have poured in from the twin Mars rovers, Spirit and Opportunity, as well as from a host of orbiting American probes have

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suggested repeatedly that vast and abundant amounts of liquid water once existed on or under the Martian surface.

Moreover, Mars is not the only place where spacecraft have found evidence for liquid water. The Galileo probe — which orbited the Jovian system for eight years before plunging into Jupiter's cloudtops in 2003 — collected data indicating three of the planet's largest moons — Callisto, Ganymede and especially Europa — appear to harbor a deep subterranean ocean.

Because these locations are very far from Earth, it will be many decades before human spacefarers can take advantage of the water stashed there. Mars and the moons of Jupiter must therefore take a back seat to a much closer target — our own moon, that skull-like dead world that sits only 240,000 miles away and will be without question the first place humans settle when the colonization of the planets begins.

At first glance, it seems absurd to look for water on the moon. The place has no atmosphere, appears completely barren and is as dead geologically as anyone can imagine. Or, as Apollo 8 astronaut Frank Borman put it in 1968, "It's a vast, lonely, forbidding-type existence or expanse of nothing."

Yet two American probes — Clementine in 1994 and Lunar Prospector in 1998 — found evidence that molecular hydrogen might be locked in large quantities near the moon's poles. From this data, scientists theorized water ice might exist frozen on the floors of a handful of very deep polar craters which — because of their extreme high latitude — remain always in shadow. All told, scientists have estimated that as much as 6.6 trillion tons of ice could be available.

The resolution of the data, however, was very coarse. For example, using Lunar Prospector data, scientists only could estimate the northern polar hydrogen region as an area from 3,600 square miles to 18,000 square miles, with the southern polar area about half that range. Future explorers must know the location more much precisely — if not the exact crater itself — in order for the spacefarers to obtain their water supplies quickly and without undue risk.

For this reason, both NASA and several other countries plan to send a whole suite of robot scouts to the moon over the next few years.

The first, dubbed SMART-1 and built by the European Space Agency, already is in lunar orbit. On Feb. 10, ESA officials announced they were extending SMART-1's lunar mission by one year, to August 2006.

SMART-1 is ESA's first probe to the moon and its first to use an ion engine for propulsion. As such, it took the spacecraft more than

a year to travel the relatively short distance from the Earth to its satellite — a journey that took the Apollo astronauts only three days.

During each orbit, SMART-1 would fire its ion engine, giving it a tiny push outward so its trajectory would spiral slowly away from Earth. After a year of tiny pushes, the spacecraft's orbit finally crossed into the moon's gravitational well last Nov. 15.

Since then, SMART-1 has reversed this process, slowly spiraling inward toward the moon, with an intended arrival by the end of February at its planned polar reconnaissance orbit, ranging from 186 to 1864 miles above the lunar surface.

Once there SMART-1 will begin surveying the moon's entire surface, not only taking the highest resolution pictures ever, but also using two different spectrometers — one working in X-rays and the other in the infrared range — to assay the surface make-up, search for evidence of hidden ice and, if possible, map potential landing sites where that ice would be easily accessible.

"SMART-1 is equipped with sensors to peek in the permanent night at the bottom of polar craters," Bernard Foing, ESA's chief scientist and SMART-1 project scientist, told Space.com last December.

Later this decade, NASA plans to follow with the Lunar Reconnaissance Orbiter. Intended to orbit the moon for a year, the spacecraft will carry instruments designed to precisely locate hidden hydrogen — and therefore water ice — and thus pinpoint future landing sites.

If confirmed to exist and then accurately mapped, lunar water ice would become an oasis for future lunar explorers, allowing them not only to carry less water, oxygen and fuel from Earth, but also to use those commodities to supply outbound missions.

One established at these secure outposts, astronauts will be able to explore the rest of the lunar surface relatively easily. For these new lunar explorers, all things finally will become possible.

Since the Apollo landings, the majesty of the moon's most mysterious places has been mostly forgotten, replaced with the false impression that — having sent a half dozen crews to the lunar surface — we have "been there, done that."

The truth is, we haven't been there or done that. As I wrote in "Leaving Earth," four of the six Apollo landing sites were chosen because of how boring and therefore safe they looked. With all six missions, the dozen Apollo astronauts explored less territory than a New York City cab driver sees in a day's work.

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There are as-yet-unvisited places on the moon that are not only scientifically intriguing, but also incredibly beautiful.

Consider as just one example the crater Copernicus, one of the largest and most distinct features on the lunar surface. Pictures taken from orbit show that one could easily stand on the crater's 3,000 foot-high rim and look across its floor, past the cluster of 1,300 foot central peaks, to the far rim some 60 miles away.

Such a view not only would dwarf the Grand Canyon in scale, but also — with the moon's pitch-black sky and crystal-clear view — far exceed it in grandeur.

Yet this is only one place. The far side of the moon, for example, has been barely glimpsed by a handful of humans and its detailed mapping has hardly begun.

With SMART-1 in lunar orbit and other robots soon to follow, the stage is set for the permanent return of humans to the moon in the next decade.

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Robert Zimmerman is an independent space historian and the author of "Genesis: the Story of Apollo 8." His most recent book, "Leaving Earth," was awarded the Eugene M. Emme Award by the American Astronautical Society for the best popular space history in 2003. E-mail [sciencemail@upi.com](mailto:sciencemail@upi.com)