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## Probing Mars's Hidden Glaciers

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by J. Kelly Beatty

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Mars Express, built by the European Space Agency, has been orbiting Mars since December 2003. Its payload includes a stereo camera, an infrared spectrometer, and the MARSIS ground-penetrating radar system.

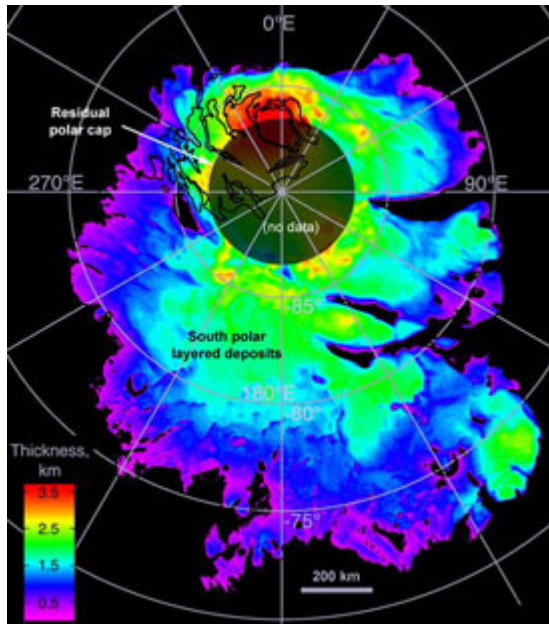
*European Space Agency*

Planetary scientists agree that the Red Planet has plenty of water, but the big question remains: where *is* it? Both Martian poles are capped by bright, enduring ice caps that contain frozen water. But given the vast flood channels that have been carved into the planet's ancient terrain, there must be far more water ice stashed elsewhere.

Since mid-2005 the European Space Agency's Mars Express orbiter has been probing beneath the planet's landscape, hunting for hidden reservoirs of frozen ice. By this time last year its radar sounder, dubbed MARSIS (for Mars Advanced Radar for Subsurface and Ionosphere Sounding), had identified [vast slabs of relatively pure ice](#) buried beneath the broad plains (known as layered deposits) surrounding both poles.

Now the MARSIS team has refined its estimates of just how much polar ice exists. In the [online edition](#) of *Science* for March 15th, Jeffrey J. Plaut (Jet Propulsion Laboratory) and 23 colleagues describe how the instrument's radar energy encountered little attenuation as it penetrated the plains surrounding the south pole, an indication that the subsurface ice layer contains no more than 10% dust. This vast buried glacier extends to depths of up to 3.7 kilometers (2.3 miles) — roughly twice the thickness of the ice mass that underlies the north pole. All told, the south polar layered deposits hold an estimated 1.6 million cubic kilometers of ice — 130 times the volume of Lake Superior. That's enough water to

cover the entire planet to a depth of about 11 meters (36 feet).

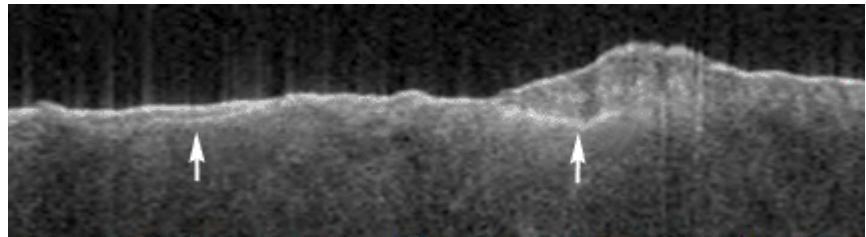


Radar soundings by Mars Express have shown that the planet's white south polar cap (outlined in black) is literally just the tip of the iceberg. Colored areas show where ice is buried under the surrounding plain to depths of up to 3.7 kilometers. Click on image for a more detailed view.

*J. J. Plaut and others / Science*

At a meeting of planetary scientists in Texas last week, Plaut offered details about a second stash of ice near the south pole. This additional find, which underlies the enigmatic plain known as Dorsa Argentea, likewise runs clear and deep, perhaps totaling another million cubic kilometers of buried ice. "Apart from the south polar layered deposits," Plaut told his audience, "this is our best and most widespread detection to date." Moreover, he adds, the Dorsa Argentea formation is billions of years old, suggesting that its ice deposits could have been emplaced rather early in Martian history.

Geologists now have another means of probing these deposits besides MARSIS, which stands for Mars Advanced Radar for Subsurface and Ionosphere Sounding. On board NASA's Mars Reconnaissance Orbiter, which reached the Red Planet last year, is SHARAD (short for Shallow Subsurface Radar). The two systems complement each other: [MARSIS](#) can penetrate to depths of up to 5 km (3 miles) but can't see fine-scale layering; [SHARAD](#) can probe distinguish individual ice and high-density rock layers within 300 meters (1,000 feet) of the surface and as thin as 15 meters (50 feet).



Radar soundings have allowed scientists to create this vertical slice through Mars's south polar region, which shows the high-standing south polar ice cap (at right) and the lower boundary of the massive ice deposit beneath it (right arrow). Recently scientists found a second buried glacier (left arrow) that may be billions of years old. The scene is 1,000 kilometers wide, and vertical relief has been greatly exaggerated.

*J. J. Plaut and others / Science*

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