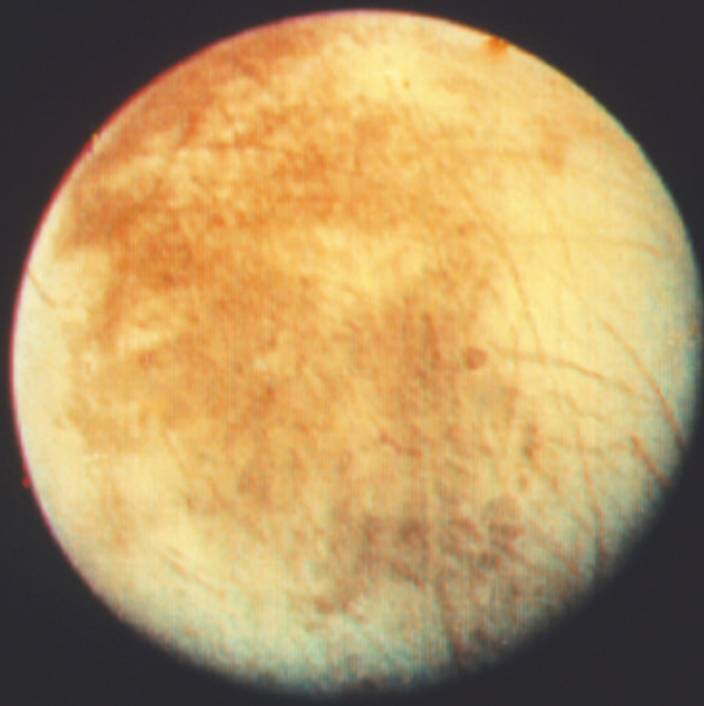


By Jupiter: the frosty satellite Europa features frequently in mission wish lists.



NASA/JPL

Designs on Europa unfurl

Mission designers at NASA may have found a way to explore Jupiter's moon Europa without busting the agency's budget — by flying past Earth first.

Europa has long been of interest to planetary scientists because of the ocean that is thought to lie beneath its icy crust, which may be a possible habitat for life. The National Academy of Sciences and other advisory groups have consistently listed Europa among the top destinations for future space missions.

But sending a spacecraft there is complicated by Europa's harsh radiation and the large amount of rocket fuel needed to brake into orbit. An earlier mission design from NASA's Jet Propulsion Laboratory (JPL) in California foundered in 2001 owing to cost and technical difficulty. And plans for a more ambitious nuclear-powered mission, the Jupiter Icy Moons Orbiter, have also been scrapped — at least for the foreseeable future.

But a study completed by JPL this summer has broken some of the previous barriers to visiting Europa. Work on the suspended nuclear mission led to progress in building radiation-resistant spacecraft components. And in setting ground rules for JPL's study, NASA eased a key restriction that was born of political concerns: mission designers were

allowed to send their plutonium-powered spacecraft past Earth and Venus to pick up propulsive energy before heading into the outer Solar System. NASA has come under fire from activist groups in the past for launching radioactive material into space.

The addition of Venus and Earth 'gravity assists' makes the trip to Jupiter longer, but allows a heavier spacecraft, with a substantial scientific payload, to launch on a single rocket. The Delta IV rocket in the study would still be an expensive ride — any Europa mission is expected to cost upwards of \$1 billion. But the mission may now fit within NASA's target budget for the first time.

The Europa Geophysical Explorer, as the concept is dubbed, could launch as early as 2012, carrying 150 kilograms of payload, including an ice-penetrating radar, a suite of remote sensing instruments and perhaps a small lander. The spacecraft would take more than six years to reach Jupiter and then spend a year-and-a-half orbiting the planet, including close fly-bys of Europa, Callisto and Ganymede, before ending with a 30-day intensive exploration of Europa. That would be long enough to map the subsurface ocean and

examine Europa's icy face at high resolution from orbit.

Scientists who have been lobbying for a Europa mission after the cancellation of the Jupiter Icy Moons Orbiter (see *Nature* 433, 342; 2005) hope the Europa Geophysical Explorer will make it into NASA's budget request as early as next year. This would allow work to begin in 2007.

That may be optimistic, given competing financial demands from the beleaguered space shuttle, the Moon-Mars astronaut programme and other science projects that have run into money troubles.

But the mission could get backing from NASA administrator Mike Griffin, who told a Senate committee in May that "You may look forward, in the next year or maybe even sooner, to a proposal for a Europa mission as part of our science line."

And international participation could help. Expectations are still high that any Europa mission will be done jointly with the European Space Agency (see *Nature* 434, 551; 2005). This is especially so after the successful cooperation on the Cassini-Huygens mission to Saturn. ■

Tony Reichardt

"NASA has eased a key restriction that was born of political concerns."