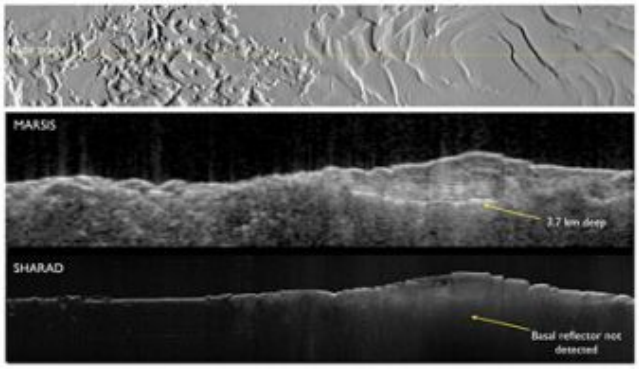
Mars radar opens up a planet's third dimension



South polar layered deposit (SPLD) on Mars. The Mars Express radar experiment, MARSIS, was designed to penetrate deep and it has delivered on its promise. The above figure shows the base of the SPLD at the deepest recorded point of 3.7 km. In contrast, The Shallow Subsurface Radar (SHARAD) on NASA's Mars Reconnaissance Orbiter designed as a high-resolution radar for a maximum penetration of 1 km has difficulty detecting the SPLD base. The two complementary instruments work together to discover hidden martian secrets. Credits: MARSIS: ESA/NASA/ASI/JPL-Caltech/University of Rome; SHARAD: NASA/JPL-Caltech/ASI/University of Rome/Washington Universtiy in St. Louis

ESA's Mars Express radar sounder, MARSIS, has looked beneath the martian surface and opened up the third dimension for planetary exploration. The technique's success is prompting scientists to think of all the other places in the Solar System where they would like to use radar sounders.

No matter how accurate a camera is, it can only map a planet's surface. To retrieve information about the underground realm, planetary scientists in the past would have thought it necessary to land on the surface and start digging. But that would only be good for a single spot on a large planet and the first few decimetres of the surface.

To get the global picture of the subsurface they need a radar sounder, such as the Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS), to find the best spots for the future landers to go and dig.

MARSIS was an experiment in every sense of the word. "It was a leap into the unknown," says Ali Safaeinili, MARSIS co-investigator at the Jet Propulsion Laboratory (JPL), California, USA.

No one had ever used a radar sounder from orbit on another planet before. So the team could not even be sure whether it would work as planned. The subsurface of the planet might have been too opaque to the radar waves or the upper levels of martian atmosphere (ionosphere) might have distorted the signal too much to be useful. Thankfully, none of this happened.

"We have demonstrated that the polar caps at Mars are mostly water ice, and produced an inventory so now we know exactly how much water there is," says Roberto Orosei, MARSIS Deputy Principal Investigator, IASF-INAF, Italy.

Armed with a better understanding of how planetary radar sounders work, the MARSIS team is beginning to look further afield in the Solar System, to other bodies that might benefit from radar investigation. One obvious target is Jupiter's icy moon, Europa.

A MARSIS-type experiment in orbit around Europa could probe its icy crust to help understand the puzzling features we see on the surface. It may even see the interface at the bottom of the ice where an ocean is expected to begin.

At Saturn's moon, Titan, penetrating radar could be used to measure the depths of the hydrocarbon lakes that the Cassini spacecraft has detected. It could also probe the structure beneath the enigmatic geysers that Cassini has observed on another one of Saturn's satellites, Enceladus. "Radar sounders are very well suited to exploring icy worlds," says Orosei.

But not just for icy moons. Asteroids and comets could be thoroughly scanned by a radar sounder, producing three-dimensional maps of their interior – perhaps exactly the data we will need if, one day, we have to nudge one out of Earth's way.

MARSIS has served as an excellent example of international collaboration between Europe and America. Increasingly, such collaborations are set to become a positive feature of our joint exploration of space.

Source: ESA