

STRATEGIC PLANNING FOR EXPLORATION OF THE SHALLOW MARTIAN SUBSURFACE

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Interest in exploring the martian subsurface has been steadily increasing. One of the guiding strategies of the martian exploration program is to "follow the water". It is now abundantly clear from orbital imaging that there is presently no liquid water at the martian surface. However, because of the presence of frozen water at the polar ice caps, and water vapor in the martian atmosphere, many scientists believe that there may be substantial amounts of liquid water in the martian subsurface. Critical scientific questions related to this include: Does a water table exist? If so, what is its depth? Is subsurface liquid water overlain by ice-saturated ground? Are hydrous minerals present, and does their concentration change with depth? Is there geologic evidence of standing surficial water in the past (e.g. marine sedimentary rocks, massive ice)? What are the implications of all of these questions for the biological potential of Mars? What is the depth of action of the martian oxidant, and the concentration of organic material below that?

In order to address these questions, the Mars Program is planning or considering a series of investigations which will span multiple missions. These investigations will involve geophysics, drilling, and subsurface geology/geochemistry. In 2003, the Mars Express orbiter will include a ground penetrating radar sounding instrument (MARSIS) which has the potential to detect liquid water at depths up to 5 km. This will be augmented in 2005 with a second orbital GPR which will be optimized to detect water in the 0.3-1.0 km depth range, a depth of interest because of the recently discovered gullies. A rover-based landed GPR is being seriously considered for the 2007 mission, and 1-D GPR is planned for the French Netlander mission. All of this should increase our understanding of the 3D distribution and state of water in the upper martian crust. Physical access to this region is being planned through the development of robotic martian drills. Drills with depth ranges of 1-2m, 10-20m, 200m, and 2km are under development by many different engineering teams. These drills will be considered for flight as early as 2007, and extending into the next decade. In order to support subsurface science investigations, a new set of downhole instruments needs to be developed. As on Earth, geophysical information will likely play a key role in establishing specific drilling targets.