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*T*racing *H*abitability, *O*rganics, and *R*esources in the Martian Subsurface and Atmosphere

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The goal of the THOR mission (***T***racing ***H***abitability, ***O***rganics, and ***R***esources) is to investigate the present habitability of Mars.

THOR will be the first mission to access the deep subsurface of Mars. It focuses on the middle latitudes, where ice is present and liquid water has flowed in recent years. These scientifically compelling areas represent the most promising habitable zones on present-day Mars.

After launch in October 2011 and arrival at Mars in September 2012, THOR will deliver two high-velocity impactors to excavate the ground and expose subsurface water ice. Released about a week before THOR's arrival, the impactors will hit the Martian surface at 1:30 p.m. local time, moving at 5.3 kilometers (3.3 miles) per second.

Under solar warmth, ice exposed by the impacts will turn into vapor, and THOR will determine the composition and abundance of key elements within the vapor cloud. THOR will then enter Martian orbit and both monitor the craters' evolution and investigate the Martian atmosphere's composition with unprecedented precision.

Methane, a potential byproduct of life, will be measured sensitively enough to resolve unambiguously the current scientific debate over its presence, origin, and possible variations.

THOR's subsurface impact science and atmospheric observations provide a go-anywhere, low-risk approach to assess habitability on Mars. Previous surface missions have explored equatorial regions where water was once present, but is no longer stable. The Phoenix mission will investigate the polar region where subsurface water ice is present, but is too cold for life.

THOR bridges this gap, exploring potential habitable zones where liquid water exists today.

THOR Science Payload

- THOR Infrared Spectrometer (THORIS)
- Medium- and Narrow-Angle Cameras
- Impactors: 450 and 1,200 kg solid copper spheres

Science Objectives:

- Determine the abundance of water in the deep Martian subsurface where ice can be stable
- Determine the abundance and origin of key trace gases, including CH_4, SO_2, and CO
- Test models of cyclic climatic change and the recent occurrence of liquid water
- Search for organic compounds in habitable zones
- Monitor the current climate through measurements of atmospheric water, dust, and CO_2
- Study the mineralogy of aqueous environments

THOR Science Team

Philip Christensen (Arizona State Univ.) Principal Investigator; *Spectrometer Development, Subsurface Ice*
Raymond Arvidson (Washington Univ.) *Impact Site Selection*
Martin Chamberland (Telops) *Spectroscopy*
Benton Clark (Lockheed Martin Space Systems) *Geochemistry*
Jack Farmer (Arizona State Univ.) *Astrobiology*
Victoria Hamilton (Univ. Hawaii) *Surface Composition*
Susan Kieffer (Univ. Illinois) *Impact and Plume Processes*
Jonathan Lunine (Univ. Arizona) *Atmospheric Chemistry*
Michael Malin (Malin Space Science Systems) *Surface Processes*
Michael Mellon (Univ. Colorado) *Subsurface Ice Modeling*
Lynn Rothschild (NASA Ames Research Center) *Astrobiology*
Michael Smith (NASA Goddard Space Flight Center) *Atmospheric Spectroscopy*
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