Science goals of the Phoenix Scout Mission

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Phoenix truly 'follows the water' by landing on an ice-rich region and digging up to a meter into the icy soil. The Odyssey Gamma Ray Spectrometer (GRS) team announced in Spring 2002 the discovery of large amounts of water ice poleward of -60 degrees latitude within a few 10s of centimeters of the surface. Recently, the ice abundance in the northern plains during summer has been measured and mapped; it appears to contain an even higher abundance of near surface ice than the southern pole. Mellon and Jakosky and other scientists had predicted for some time that ice would be stable near the surface in balance with water vapor diffusion through an overburden of regolith. The actual measurement of ice with 3 independent instruments allowed the GRS team to estimate the depth and abundance of ice with a simple two-layer model. The amount of ice is on the border of being too large for vapor diffusion appearing more like a dirty-ice layer than icy dirt.

Of all the accessible sources of water on Mars this near surface icy layer represents the greatest potential for finding evidence of near surface liquid water. Recent work has verified our hopes that periodically, through variations in obliquity and precession of the polar axis, the temperature of the ice-soil boundary exceeds –20 C and melting can occur. The influence of liquid water on the soil chemistry and mineralogy should be measurable by Phoenix instruments.

Granted the melting may only produce a monolayer of water on crystalline surfaces, but this is enough to allow mobility and maintenance in biologic communities on Earth. Higher temperatures will allow reproduction and growth.

Goal #1: Study the history of water in all its phases in the northern polar region. Phoenix will land in the northern near-polar region and dig through the dry regolith searching for an ice-soil boundary. Instruments on the deck will receive samples and analyze the chemistry, the volatile inventory, isotopic ratios, and grain morphologies. Altered minerals created through the weathering of the soil grains in a periodically moist environment will be measured as a function of depth beneath the surface. Samples taken at several depths will also be mixed with water to test the aqueous chemistry of the wet soil. Knowledge of the wet chemistry allows creating similar environments in Earth laboratories and at analog field sites to help understand the properties of the Martian soil.

Goal #2: Assess the biologic potential of the subsurface environment. Although there are no "life-detection" instruments on board, we suspect that a long term active biological community will leave observable signatures in the soil horizons and chemical tracers in the ice. The TEGA instrument can detect small abundances of organic molecules in the gases that are driven off samples as they are heated above 300° C. The association of organic compounds with subsurface layers will indicate the likely origins of these compounds. In addition, the wet chemistry of the soils will test whether any hazards exist that preclude a habitable zone at these latitudes.

To summarize, our goals are to understand the near surface chemistry, hydrology, climatology, and geology of a polar landing site. We will examine the ice-soil boundary for periodic melting and biologic potential, our goal is to detect an accumulation of organic molecules. The hazards to life that exist in the ice layer, particularly salts and oxidants, will be quantified. Finally, we will characterize the polar weather throughout northern summer and fall with particular attention to the distribution of water in all its phases.