THE ICEBREAKER MISSION TO SEARCH FOR LIFE ON MARS C. Stoker[1], C. McKay[1], W. Brinckerhoff[2], A. Davila[3] V. Parro[4], R. Quinn[3] ,[1]NASA Ames Research Center, CA, USA, [2]NASA Goddard Space Flight Center, [3]SETI Institute, CA, USA, [4]Centro de Astrobiología Madrid, Spain

Introduction: The search for evidence of life on Mars is the ultimate motivation for its scientific exploration. The results from the Phoenix mission indicate that the high N. latitude ice-rich regolith at low elevations is likely to be a recently habitable place on Mars [Stoker et al., 2010]. The near-surface ice likely provided adequate water activity during periods of high obliquity, 3 to 10 Myr ago. Carbon dioxide and nitrogen are present in the atmosphere, and nitrates may be present in the soil. Together with iron in basaltic rocks and perchlorate in the soil they provide carbon and energy sources, and oxidative power to drive metabolism. Furthermore, the presence of organics is possible, as thermally reactive perchlorate would have prevented their detection by Viking and Phoenix.

The Mars Icebreaker Life mission [McKay et al., 2013] focuses on the following science goals: (1) Search for biomolecular evidence of life; (2) Search for organic matter from either exogeneous or endogeneous sources using methods that are not effected by the presence of perchlorate; (3) Characterize oxidative species that produced reactivity of soils seen by Viking; and 4) Assess the habitability of the ice bearing soils. The Icebreaker Life payload (Figure 1) includes a 1-m rotary percussive drill that brings cuttings samples to the surface where they are delivered to three instruments (Fig. 1), the Signs of Life Detector (SOLID) [Parro et al., 2011] for biomolecular analysis, Laser Desorption Mass Spectrometer (LDMS) [??? 2015]) for broad spectrum organic analysis, and Wet Chemistry Laboratory (WCL) [Hecht et al., 2009] for detecting soluble species of nutrients and reactive oxidants. The Icebreaker payload fits on the Phoenix spacecraft and can land at the well-characterized Phoenix landing site in 2020 in a Discovery-class mission.

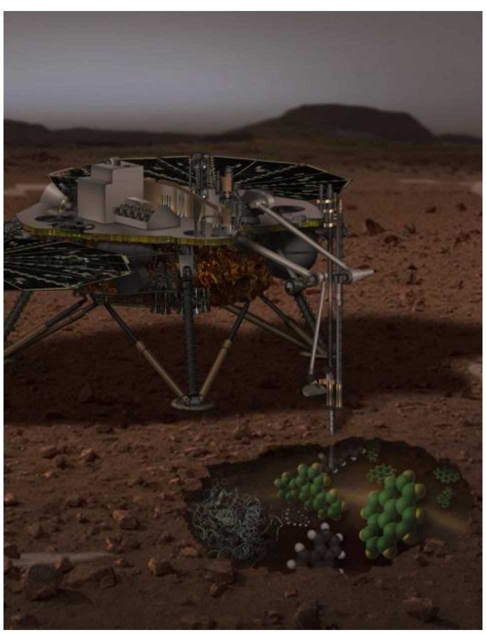

Figure 1. Artist concept of the Icebreaker lander sampling the martian subsurface

Habitable Conditions at the Phoenix Landing Site on Mars: The Phoenix landing site on Mars is arguably the most likely site to support life during recent periods of high obliquity, 3 to 10 Myr ago: 1. Pressure above the triple point of water; 2. Ice near the surface as a source of liquid water; 3. High summer insolation at orbital tilts >35º (present 25º), equivalent to levels of summer sunlight in Earth's polar regions at the present time.

Terrestrial permafrost communities are an example of possible life in the ice-rich regolith. Studies in permafrost have shown that microorganisms can function in ice-soil mixtures at temperatures as low as -20°C, living in the thin films of interfacial water. In addition, it is well established that ground ice preserves living cells, biological material, and organic compounds for long periods of time, and living microorganisms have been preserved under frozen conditions for thousands and sometimes millions of years . Smilar biomolecular evidence of life could have accumulated in the ice-rich regolith on Mars.

References: Stoker et al. (2010) J.G.R. XXXX; McKay et al. (2013) Astrobiology, 13, 334-353. Parro et al. (2011) Astrobiology 11: 15-28. Hecht et al. 2009 XXXX; LDMS ; Gilichinsky et al. (1992) Adv. Space Res. 12, 255-263