A UNIQUE MARS/EARLY MARS ANALOG ON EARTH: THE HAUGHTON IMPACT STRUCTURE, DEVON ISLAND, CANADIAN ARCTIC.

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Haughton is a 20 km-diameter impact structure located on Devon Island, N.W.T., Canada. The structure formed 23 million years ago, and is the highest-latitude terrestrial crater known (~75°N,90°W). It lies in the "frost rubble zone", in an environment similar in several respects to that prevailing at the surface of Mars at present and/or on Early Mars, if wetter and warmer conditions existed then (Squyres and Kasting 1994). Locales on the Earth where similar, predominantly cold, relatively dry, windy, and unvegetated conditions prevail serve as valuable "Mars analogs" (e.g., Gibson et al. 1983, McKay et al. 1985, NASA and NSF 1990). They (i) provide insight into the various geologic and possibly biologic processes that may have operated or still operate on Mars, (ii) help interpret the meteoritical, Earth-based remote-sensing, and spacecraft data available for Mars, and (iii) help plan the next steps in the exploration of Mars.

From this perspective, Haughton is a site of exceptional interest, as (1) it is an impact structure, a common and fundamental geologic feature of the Martian surface; (2) it is currently, and has been for much of its existence (although not at the time of its formation) exposed to the present "Mars-like" and/or "Early Mars-like" environment of the terrestrial high latitudes (e.g., Hickey et al. 1988); (3) it exhibits geologic features of fluvial, periglacial, eolian, and possibly hydrothermal origin which may have analogs on Mars; (4) it formed in carbonates, a rock type believed to occur on Mars and which has been associated with the recently-proposed evidence for past life in Martian meteorites (Kahn 1985, McKay and Nedell 1988, Pollack et al. 1990, Mittlefehldt 1994, McKay et al. 1996); (5) it once contained a lake, as may have many impact craters and other basins on Early Mars (Goldspiel and Squyres 1991, Scott et al. 1992, Lee 1993); (6) its earliest post-impact paleolacustrine sediments have been preserved and retain a fossil record (Hickey et al. 1988), as might be preserved at paleo-lake sites on Mars if these ever harbored biologic activity (Wharton et al. 1987, 1995, McKay and Davis 1991). Haughton is unique in that it is the only site known on Earth where all these Mars-like conditions and features occur together.

A study of the Haughton impact structure as a Mars analog, the "Haughton-Mars 97" (HM-97) Project, will begin this year with field observations at the crater. The objective of the project is to characterize those aspects of Haughton's morphologic and physical evolution that are relevant to Mars's geologic (in particular hydrologic) and possibly biologic evolution. The study will focus on (a) fluvial, (b) periglacial, (c) paleo-lacustrine, and (d) hydrothermal features and processes, and will complement investigations carried out by the Haughton Impact Structure Study (HISS) Project (Grieve 1988). Both similarities and differences between Haughton and Mars are of interest and will be considered during HM-97. "Fluvial investigations" will include examining the nature of the drainage network at and near Haughton, in particular determining the possible role of headward sapping, a fluvial process suspected to have given rise to the small valley networks on Early Mars (e.g., Carr 1996). "Periglacial investigations" will include an inventory of periglacial formations at and near Haughton, and a comparison of these features with those attributed to periglacial processes on Mars (e.g., Lucchitta 1981, Squyres 1989, Carr 1996). Periglacial investigations will also include a study of how materials specific to the crater (e.g., its "regolith-like" allochtonous breccia) are affected by periglacial processes. "Paleo-lacustrine investigations" will include a study of the physical evolution of Haughton's paleo-lake (e.g., inference of climatic variations from the varves preserved in its paleolacustrine sediments (e.g., Hickey et al. 1988)). "Hydrothermal investigations" will include a search for evidence of hydrothermal activity in the initial post-impact stage of Haughton's history, and a attempt at determining how long this activity might have lasted.

The rationale, approach, and objectives of HM-97 will be presented in more detail during the Early Mars Conference. Ideas and suggestions for optimizing the scientific return of this study will be welcome. It is hoped that HM97 will advance our understanding of what Early Mars was like, of how Mars has evolved through time, and of how to best explore that planet in the near future. HM-97 is supported by NASA and the National Research Council.

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