Analog studies in preparation for human exploration of Mars

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What are the Questions?

Key question
- How will humans and machines work together doing field science and exploration on Mars?

Other questions
- How is the intrinsic scientific merit of analog biology and geology best applied to human space exploration?
- How are the human factors issues associated with long-term human exploration of space best studied?
- What role can analog studies on Earth play in outreach and education towards building public support for humans in space?
- How can analog studies pioneer collaborative human exploration activities between established research organizations and NGO or commercial funding sources?
Can we do field science on Mars the way we do it on Earth?

Many field scientists think the answer to that question is YES. If so, what are the implications for new technologies and operations protocols, and how will they evolve?

An alternative view is humans merely teleoperating machines from the surface or orbit of Mars (“nearby”)
Solution

• Evolution to solution requires a balanced, strategic, empirical approach
• It takes trial and error, time, and lots of experience to learn how to use new technology in field exploration
• Examples:
  – Airplanes and helicopters revolutionized field work on Earth
    • Transportation
    • Perspective (aerial photography, surveying)
  – GPS technology is in the process of fundamentally altering the way field science is done

New Technologies

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• Information Technology - What are the high-leverage areas for IT? How will the interaction really work? Will field scientists let machines make autonomous science decisions?

• Rovers - FIDO? Lunar rover? Pressurized ‘Winnebago’, or combination of all?
Existing Analog Studies

- Numerous analog studies in Arctic, Antarctic, desert, undersea, underwater, etc., most either pure science or focused on specific technology demonstration (e.g. Nomad, TROV, Marsokhod, Dante, FIDO)
- New technologies have been tested primarily in the lab or in the ‘back lot’
- NASA Haughton-Mars Project is the first attempt at a comprehensive integrated field science and exploration research program in the context of advancing overall understanding of human scientific exploration beyond low earth orbit

NASA Haughton-Mars Project

- Field science at the Haughton Impact Crater and surroundings on Devon Island, Canada (High Arctic), since summer 1997
- International, interdisciplinary team (up to 30 separate investigations per field season, typically 20-30 field participants at a time)
- Research program: Field science, and opportunistic exploration research experiments in support of field science (www.arctic-mars.org):
  - SCIENCE PROGRAM
    - To characterize those aspects of the local geology and biology that might be relevant to Mars’s geologic (in particular hydrologic) and possibly biologic evolution
    - To further our understanding of the effects of impacts on Earth through studies of the formation and evolution of Haughton Crater over time
    - To further our understanding of the possibilities of life in extreme environments
  - EXPLORATION RESEARCH PROGRAM
    - Operations: Simulated Mission Control operations (JSC)
    - IT: Intelligent systems and mobile exploration communications tools
    - Tools: EVA, Balloons, rovers, airplanes, helicopters, hoppers, weather stations
    - Other: Human factors, human centered computing, food science
What next, and where?

- It’s not too soon to begin integrated field science and exploration research projects
- Continue with projects like HMP
  - No single site on Earth is a true Mars analog
  - Constraints on size (environmental, logistical)
  - Many other sites of intrinsic scientific interest on Earth
- “Missions to Extreme Environments Program” in Astrobiology may provide opportunity for similar integrated field science and exploration research projects