

# Meridiani Base: The 2<sup>nd</sup> Mars Expedition Planning Workshop

Hosted by the Association of Mars Explorers  
and Mars Society Canada

Who: Members of the space science and exploration community.

Where: University of British Columbia, Vancouver, BC, Canada

When: August 6 and August 7, 2005.

## ***Program Committee:***

- Oliver Angerer, European Space Agency / ESTEC
- Penny Boston, New Mexico Tech
- Bill Clancey, NASA Ames Research Center
- Charles Cockell, CEPSAR, Open University
- Graham Mann, Murdoch University
- Chris McKay, NASA Ames Research Center
- Rocky Persaud, University of Toronto (Program Chair)
- Andrew Schuerger, University of Florida
- John Spray, University of New Brunswick
- James Rice, Arizona State University

## ***Call for Submissions:***

The Association of Mars Explorers is sponsoring a workshop to define a 500-day Design Reference Surface Expedition Campaign for a Human Base constructed in the vicinity of Meridiani Planum in the year 2019. (The location is loosely defined, so that it just means that at some point in the 500 day mission, Meridiani will be visited. **The base should be within 500 to 1000 km of Meridiani, depending on the furthest extent of exploration possible by assumed mobility options.**) This is the first call for papers (extended abstracts) for the presentation sessions of the workshop. Print-only extended abstracts will also be accepted for each of the session topics.

This workshop is structured so that the outputs from the presentation sessions are used as inputs for the discussion sessions. To facilitate the creation of the Meridiani Campaign, there are two sets of submission deadlines. Presentation Session papers (extended abstracts) will be due March 31<sup>st</sup>, covering topics giving a necessary background in several areas. The chairs of the Presentation Sessions will produce a synthesis paper distilling the ideas of all accepted abstracts, and then make the collection of accepted abstracts and the synthesis paper available as background material for the basis of Discussion Session papers, due May 31<sup>st</sup>. Discussion Session papers will be discussed during the workshop to provide the basis for the Meridiani Campaign. The Meridiani Design Reference Science Expedition Science

Campaign will then be published in a volume along with select extended abstracts and synthesis papers.

***Rationale:***

Mission architectures from the earliest Von Braun plans to the most recent European Space Agency Aurora Program reference mission do not describe the surface mission of a Mars expedition in any great detail. The purpose of the 2<sup>nd</sup> Mars Expedition Planning Workshop is to address the aspects of science campaigning on the Martian surface for human expeditions. More specifically, the workshop considers a scenario of a human base in the vicinity of the Meridiani Planum region of Mars and gives the workshop participants the task of designing a science campaign for 500 days in the year 2019, completely with an EVA schedule for several types of exploration, and maps of areas to reconnoiter and investigate.

The objective of the Workshop is to describe how those 500 days will be spent in science-directed exploration, geological mapping, and site-specific investigations.

***Assumptions:***

1. The currently scheduled slate of Mars robotic missions have been successfully accomplished, and that public-private efforts have advanced the timeline of a first human expedition to 2019, sooner than NASA and ESA is currently expecting.

This date is deliberately chosen because it gives the workshop participants a framework for discussions about what we will know about Mars prior to a human landing. The foreseeable future of Mars robotic missions culminates with Mars Sample Return towards the end of the next decade. Therefore, we can only engage in planning a Meridiani Expedition with humans by neglecting what research could be accomplish robotically beyond Sample Return.

2. Papers, presentations and discussion are restricted to what science-campaigning is done on Mars.

Orbital dynamics and Earth-to-Mars transit mission architectures are not of interest to these proceedings. Neither is the specific technology complement or architectural design of the base. Surface stay is between 550 to 700 days, but all time in excess of 500 days is used for base set-up upon arrival and preparation time prior to departure for Earth. Therefore, the entirety of the remaining 500 days is used for science campaigning.

Exploration from the Meridiani Base to distant areas should be limited to what is possible by technology for the 2019 date, considering only surface traverses in pressurized or non-pressurized rovers to 500km – 1000km distances. Exploration to sites beyond human reach either via autonomous or teleoperated robots shall be considered.

3. Papers should state what other additional assumption may be made, but for the purposes of the workshop the program committee may choose to ignore / eliminate a proposed assumption, or introduce new restrictions.

**Publication:**

Papers will be invited for presentation at the workshop and/or publication in the subsequent MEP 2005 volume that would serve to archive both the workshop proceedings (synthesis papers plus session extended-abstracts) as well as print-only papers.

**Timeline:**

Release of first call for papers: February 1 ; deadline for submission of presentation session extended abstracts : March 31, 2005. Deadline for pre-workshop discussion session extended abstracts: May 31, 2005.

**Presentation Sessions:**

Each presentation session will be 1.5 hours long, consisting of three to five presentations per session. The session chair may allocate time within that timeframe. Presentations may be invited or proposed by submission of an extended abstract on the following subjects:

1. Field Science for Meridiani Planum and Surrounds
2. Expedition Mobility, Exploration Technology and Tactics
3. Human Factors and Mobile Communications
4. Mars Analog Studies on the Earth and the Moon.
5. Exploration Ethics and Planetary Protection

See the Outputs section for more detailed information on specifics of each session.

**Discussion Sessions:**

Each discussion session will be 1.5 hours long. The program chair will introduce each session and take 5 minutes or less to set out the goals at the beginning of every session, including expected session outputs.

1. Field Science Instruments and Operations
2. Expedition Scheduling
3. Crew-Center Operations and Performance
4. Meridiani Analogs and Simulations
5. Risk Mitigation for Planetary Protection and Crew Safety

See the Outputs section for more detailed information on specifics of each session.

A discussion session task group would be comprised of the authors for all the accepted abstracts.

Each discussion session task group would work to synthesize their pre-workshop extended abstracts into one discussion session paper that addresses all the issues brought up during

the discussion session. The session chair will be aided by a session secretary to document the discussion. The session chairs and program chair will ultimately be responsible for producing the synthesis papers.

For the purposes of workshop logistics, the requirements of the pre-workshop extended abstracts are quite strict: Papers may duplicate information or discussion from other workshop papers, or papers published elsewhere, but must strictly focus on expeditions based on the workshop scenario. Extended abstracts must not address issues outside of the discussion session topics. One extended abstract per discussion session may be submitted per workshop participant.

## **Outputs:**

### **Presentation Session 1 (PS1) – Field Science for Meridiani Planum and Surrounds –**

Extended abstracts are due March 31<sup>st</sup>. This session will cover the background on Meridiani Planum in specific detail, with invited speakers from the MER team. Its surrounding terrains will be discussed in more general detail. For this session the chair will seek out speakers on the subject of science goals and specific investigations to do on site, including geophysical, geochemical / petrological, and astrobiological experiments, sampling, and mapping. A synthesis paper would be produced by the session chair by May 31<sup>st</sup>. First output should be a list of regions to visit during the 500-day science campaign (accompanied by images, maps, etc.). The second output should be the entire list of goals to pursue and experiments to conduct in each region over the course of the science campaign.

### **Discussion Session 1 (DS1) – Field Science Instruments and Operations –**

Pre-workshop discussion session extended abstracts are due May 31<sup>st</sup>. This session takes the list of experiments from PS1 and sketches a list of hand-held field instruments for each, and plan the logistics for how each experiment is conducted or instrument is used. The focus is on the field operations for single EVAs. The output for this should be an expansion of the presentation session list to include information necessary for expedition planning: number of measurements or samples, areal configuration of sites (single site, linear array of sites, 2D or 3D sampling sites for each experiment), density of measurements or samples, number of EVAs, data sampling rate (frequency of measurements or sampling), dwell time per site, etc. for each experiment and instrument on the field science list. Next this session will discuss work processes to optimize the conduct of field operations during an EVA. Example EVAs may be produced for use as a reference scenario. The session chair will produce a preliminary synthesis paper from the submitted abstracts by July 30<sup>th</sup>, and during the discussion session revise it based on discussions of the day. The final synthesis paper will be submitted to the program chair by August 31<sup>st</sup>.

### **Presentation Session 2 (PS2) – Expedition Mobility: Exploration Technology and Tactics –**

Extended abstracts are due March 31<sup>st</sup>. This session will consider the short and long-distance strategies for traverses that may be done from Meridiani Base, and the exploration technology for mobile exploration used to aid investigations (excluding hand-held field instruments from DS1, but allowing consideration of hand-held devices not used for science data acquisition). A synthesis paper would be produced by the session chair by May 31<sup>st</sup>. First output should be a map that specifies the potential traffic paths, topographic barriers, and geographic extent of exploration. Next output should be a list of a suite of exploration technologies that might be used to conduct the investigations.

### **Discussion Session 2 (DS2) – Expedition Scheduling –**

Pre-workshop discussion session extended abstracts are due May 31<sup>st</sup>. Discussion will take the regions from the PS1 and determine which field investigations may be pursued in each, which traverse strategies from PS2 to use in each, and then determine the number of EVAs required to fully explore each region with the instruments and procedures from DS1 and PS2. If the total duration required exceeds 500 days, then the investigations will have to be pared down to what is possible for the given time. Output will be an outline for a 500-day expedition science campaign schedule. The session chair will produce a preliminary synthesis paper from the submitted abstracts by July 30<sup>th</sup>, and during the discussion session revise it based on discussions of the day. The final synthesis paper will be submitted to the program chair by August 31<sup>st</sup>.

**Presentation Session 3 (PS3) – Human Factors and Mobile Communications –**

Extended abstracts are due March 31<sup>st</sup>. This session will consider human factors and mobile communications issues. Given the set of investigations to be conducted over the science campaign, this symposium will address the various human social, psychological, cognitive, and performance issues associated with the campaign, and various methods of mobile communications to aid the efficient production of scientific and human value from the experiences of the crew. Output will be a set of recommended operations, strategies and technologies for aiding common expedition tasks. A synthesis paper would be produced by the session chair by May 31<sup>st</sup>.

**Discussion Session 3 (DS3) – Crew-Centered Operations and Performance –**

Pre-workshop discussion session extended abstracts are due May 31<sup>st</sup>. This session will synthesize the concept of crew-centered operations, including crew size & roles, activity cycles with earth teams, and tools that facilitate collaborative planning, scheduling, science analysis, and documentation. The session chair will produce a preliminary synthesis paper from the submitted abstracts by July 30<sup>th</sup>, and during the discussion session revise it based on discussions of the day. Output will be a list of requirements for crew size, performance and skills for the expedition plan's set of EVAs determine during DS2. The final synthesis paper will be submitted to the program chair by August 31<sup>st</sup>.

**Presentation Session 4 (PS4) – Mars Analog Studies on the Earth and the Moon –**

Extended abstracts are due March 31<sup>st</sup>. This session will consider ideas for conducting Mars analog studies on the Earth and the Moon. Output would be a list of analog studies addressing the range of issues regarding science campaigning in the Meridiani region. A synthesis paper would be produced by the session chair by May 31<sup>st</sup>.

**Discussion Session 4 (DS4) – Meridiani Analogs and Simulations –**

Pre-workshop discussion session extended abstracts are due May 31<sup>st</sup>. This session will consider what analog studies and simulations of the Meridiani Expedition can be done, where and how. The session chair will produce a preliminary synthesis paper from the submitted abstracts by July 30<sup>th</sup>, and during the discussion session revise it based on discussions of the day. The final synthesis paper will be submitted to the program chair by August 31<sup>st</sup>.

**Presentation Session 5 (PS5) – Exploration Ethics and Planetary Protections –**

Extended abstracts are due March 31<sup>st</sup>. This session will consider the planetary protection issues and the ethics of exploration. Output will be strategies for preventing the contamination. A synthesis paper would be produced by the session chair by May 31<sup>st</sup>.

**Discussion Session 5 (DS5) – Risk Mitigation for Planetary Protection & Crew Safety –**

Pre-workshop discussion session extended abstracts are due May 31<sup>st</sup>. This session will consider risk mitigation tactics for planetary protection and crew safety. Output will be an analysis of the expedition plan highlighting the risk areas, and strategies and tactics to reduce them. The session chair will produce a preliminary synthesis paper from the submitted abstracts by July 30<sup>th</sup>, and during the discussion session revise it based on discussions of the day. The final synthesis paper will be submitted to the program chair by August 31<sup>st</sup>.

**Proposed Schedule:**

<b>Time</b>	<b>Saturday, August 6, 2005</b>	<b>Sunday, August 7, 2005</b>
8:00-8:30	Registration and Refreshments	Refreshments
8:30-9:00	Welcome and Introduction (Chair: Rocky Persaud)	Workshop Recap (Chair: Rocky Persaud)
9:00-10:30	Presentation Session 1: Field Science for Meridiani Planum and Surrounds (Chair: Jim Rice and Chris McKay)	Presentation Session 4: Mars Analog Studies on Earth and the Moon (Chair: John Spray And Penny Boston)
10:30-10:45	Break	Break
10:45-12:15	Discussion Session 1: Field Science Instruments and Operations (Chair: Jim Rice and Rocky Persaud)	Discussion Session 4: Meridiani Analogs and Simulations (Chair: Penny Boston and Charles Cockell)
12:15-1:30	Lunch	Lunch
1:30-3:00	Presentation Session 2: Expedition Mobility: Exploration Technology and Tactics (Chair: Graham Mann)	Presentation Session 5: Exploration Ethics and Planetary Protection (Chair: Charles Cockell and Andrew Schuerger)
3:00-3:15	Break	Break
3:15-4:45	Discussion Session 2: Expedition Scheduling (Chair: Rocky Persaud)	Discussion Session 5: Risk Mitigation for Planetary Protection and Crew Safety (Chair: Andrew Schuerger and Graham Mann)
4:45-5:00	Break	Break
5:00-6:30	Presentation Session 3: Human Factors and Mobile Communications (Chair: Bill Clancey and Oliver Angerer)	Workshop Summary and Synthesis Group Work (Chair: Rocky Persaud)
6:30-8:00	Discussion Session 3: Crew-Centered Operations and Performance (Chair: Bill Clancey and Oliver Angerer)	6:30-7:00: Discussion on the 3 <sup>rd</sup> Mars Expedition Planning Workshop
8:00-10:00	Dinner – Address from ASE President, Keynote Speaker: TBD.	