Workshop report

Vicky Hipkin (CSA), Mary Voytek (NASA HQ), Michael Meyer (NASA HQ), Richard Leveille (CSA), Shawn Domagal-Goldman (NASA HQ) and Jen Eigenbrode (NASA GFSC)

and workshop participants

MEPAG, June 16-17th 2011, Lisbon

Motivation for workshop

- Upcoming missions with focus on Habitability & Seeking Signs of Life
- Well-characterised landing sites and hypotheses-driven investigations
- A perception that analogue studies are being underutilized
- A concern that field science and mission teams have only a low-level awareness of each-others challenges
- What makes a good analogue site?
- Need for communication: analogue sites inventory/database?

Workshop organisation

- Around 40 people - core group for workshop tasks
  - Instrument teams, technology/drilling, representative analogue sites/research
- Invited presentations
- Analogue site abstracts (44 submitted in advance): Questions:
  - Science merit with respect to mission objectives
  - Most important question answered by this site

  Lightning round talks
- Workshop task: a tool to assess scientific value of analogue site
  - Initial science evaluation rubric; abstract submissions
  - Four groups (Pratt/Hecht; Conrad/Doran; Ehlmann/Eigenbrode; Sumner/Newsom)
- Outputs
  - Planned special issue with workshop report (Icarus)
  - Recognition of many 'new' interesting sites - beginning of an analogue site inventory?

  http://www.lpi.usra.edu/meetings/analogues2011/abstracts.pdf

Agenda

Part I: Missions and Science Objectives

9:10 MSL: Science Objectives, Capabilities and Landing Sites	*Michael Meyer*
9:30 MSL: Landing Sites	*Dawn Sumner*
10:00 Mars 2018 and Beyond: ExoMars	*Gian Gabrieli Ori*
10:20 Mars 2018 and Beyond: MAX-C	*Lisa Pratt*
11:00 Exomars Landing Site Workshop Report	*Pascale Ehrenfreund*

Part II: Science Operations — Challenges of Robotic Science Operations

11:20 Science Operations and FIDO Lessons Learned	*Ray Arvidson*
11:40 Lessons Learned from AMASE	*Andrew Steele*

Part III: Analogs — Value to Mission Science

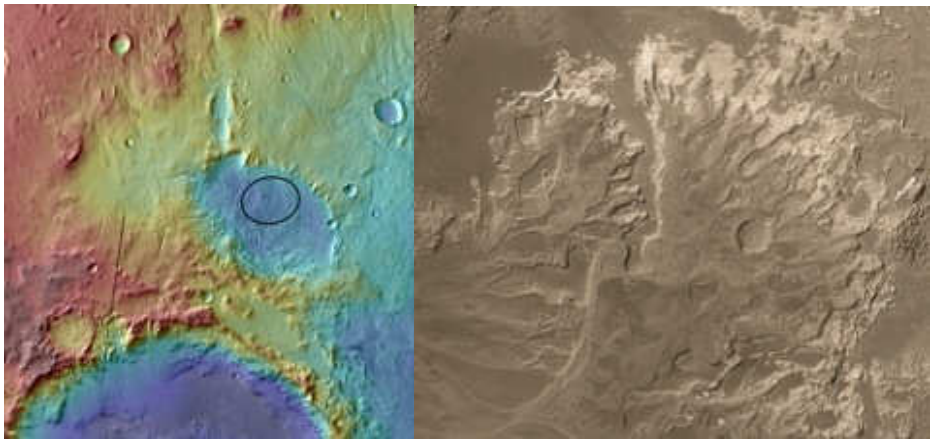
13:00 Evaluation: What Should Be Meant by a General, Good, or Excellent Analog	*Jen Eigenbrode*

13:20 Discussion
13:45 Lightning Round Talks
15:00 Lightning Round Talks Continued
16:30 Debrief, Preview of Sunday
19:00–21:00 Poster Session and Reception

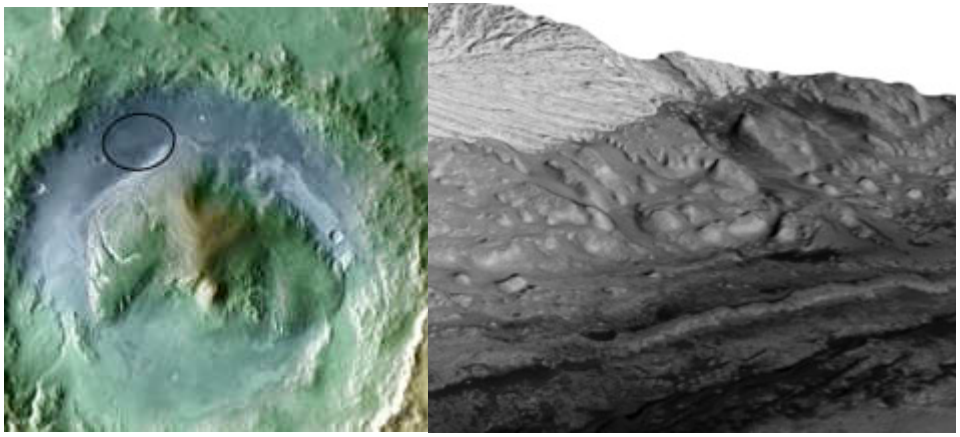
Part IV: Bringing Everything Together

09:00 Break Out Groups I — Developing an Analog Site Evaluation Rubric
10:45 Group Report Out and Discussion — A Consensus Rubric?
13:00 Break Out Groups II — Applying the Rubric to Example Analogue Sites
14:00 Discussion on Workshop Product

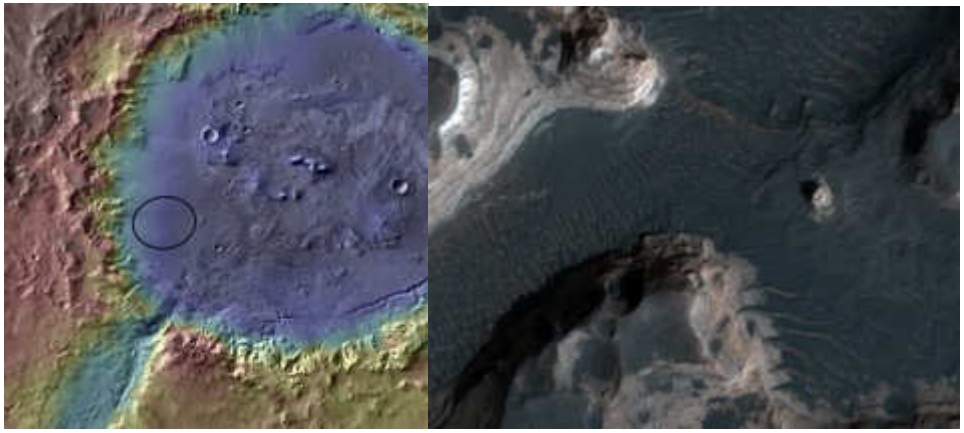
Part I: Missions



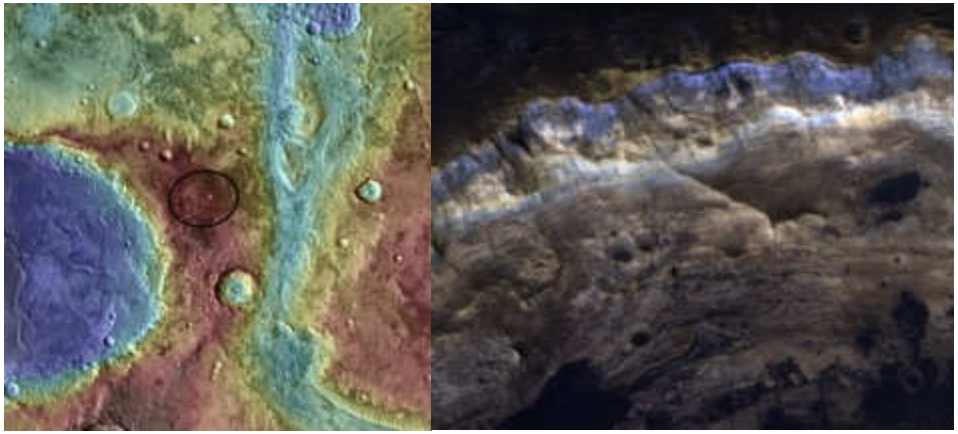
Eberswalde Crater (24°S, 327°E, -1.5 km) contains a clay-bearing delta formed when an ancient river deposited sediment, possibly into a lake. **Analogs are particularly well understood**



Gale Crater (4.5°S, 137°E, -4.5 km) contains a 5-km sequence of layers that vary from clay-rich materials near the bottom to sulfates at higher elevation. Mixed clay and sulfate analogs needed: preservation of biosignatures in mixed sulfates/clays with diagenesis & recrystallization



Holden Crater (26°S, 325°E, -1.9 km) has alluvial fans, flood deposits, possible lake beds, and clay-rich sediment. Analogs moderately well understood



Mawrth Vallis (24°N, 341°E, -2.2 km) exposes layers within Mars' surface with differing mineralogy, including at least two kinds of clays. Analogs needed: Habitats & preservation with impacts. Deep hydrothermal systems

Part II: Science operations: value of analogues in learning *how* to investigate on Mars

- This workshop was NOT about value of analogues for science operations planning and training - IMPORTANT – but, not THIS focus

- Talks included to illustrate science operations constraints
  - Need to design Mars investigation, NOT typical Earth fieldwork..

- Lessons learned: Analogue missions, as well as studies, are needed to -
  - Evaluate instrumentation and payload synergy in ways not possible in laboratory settings
  - Evaluate mobility systems and path planning approaches for terrains that are comparable (soils, bedrock, slopes) to planetary surfaces
  - Train and condition science team on what is possible and for remote robotic operations (time, bits, power, mobility, instrumentation)
  - Begin integration of science and engineering teams
  - Test data product generation and archiving approaches
  - Offer educational opportunities beyond the laboratory
  - Foster development for both landed assets and sample receiving laboratories: should encompass data and sample curation.
- Recommendation: Develop an effective forum to feed forward relevant mission critical data and innovations from analogue missions to space agencies
- Recommendation: Community access to facilities: Rent a FIDO?

Part III: Summary of workshop discussions

What is a planetary analogue?

There is no perfect analogue of Mars on Earth

(1) The value of an analogue site should be assessed with respect to a specific scientific question or hypothesis.

- Need good assessment of the relevance of a site with rigorous attention to its Earth-based limitations
  - Earth = abundant water, high biomass, tectonics etc
  - limitations will have different impact depending on the question under study

(2) Scientific investigations at analogue sites should be designed to understand specific <u>processes</u> and <u>features</u>.

- Its cold and relatively dry ≠ Mars..
- Even - phyllosilicates ≠ Mars..

What is the need and target audience for an analogue evaluation tool?

Concerns were expressed at the task –

Too challenging? How will it be used? How will it influence funding?

However, positives also:

1) **Scientists: framework will help scientists plan their study, communicate its relevance, and increase the fidelity of the science**
   - Esp. useful for young scientists and those new to the field.
2) **Reviewers: ensuring key information about an analogue study is easily found and in a format that can be compared with other proposals**.
   - Onus is on the proposal PI to provide clear justification of relevance
3) **Community and public: format for a public database to communicate current activities and results, and expand the use of and interest in analogues.**
   - Requirements to make site information, results and data public placed at the end of a funding cycle rather than its start

Group discussion on evaluation tool

A list of categories of features and processes is a useful concept to structure thinking about analogue sites.

- One group felt that there would be value pursuing this towards a full taxonomy of features.

Categories should include 'Other' to provide flexibility to novel types of features and processes.

- 'Other' should not be a catch-all for non-geoscience disciplines - to undermine the relative importance of such research.

Assigning scores is not felt to be an effective way to extract important information about the scientific relevance and value of the site.

- Too coarse a tool, difficult to apply and easily misunderstood

Workshop output: draft evaluation framework

Table of features

Rank	Category of Feature or process	Applicability
Mineralogy/Petrology		
Chemistry		
Sedimentology		
Stratigraphy		
Geomorphology		
Hydrology		
Biology		
Ecology		
Geological Setting		
Environmental Setting		
Gradients		
Fluxes and transport		
Metabolism		
Other_____		

Study site: _____

Science Question /Hypothesis: *~one sentence description*

Evaluation by feature or process (rank top 3 or more from Table)

- **Category of feature or process**
- **Detailed Feature or Process**
- **How Expressed at Study Site**
- **How Expressed on Mars**
- **Similarity / Relevance**
- **Limitations**
- **Mission Impact**

Rationale for evaluation tool fields

Detailed feature or process:

- Broad categories help identify salient features
- Detailed feature or process helps in generating a rigorous understanding of relevance.

How expressed at study site/Mars:

- Records the primary information needed for assessment of similarity/relevance/limitations.

Similarity/Relevance *and* Limitations:

- Separate fields for similarity and limitations allow both strengths and weaknesses to be highlighted.

Mission Impact:

- Clearly important – but how this should be assessed is left to a follow on exercise.

Application of tool to example sites

Groups chose example sites from list of ~ 40 abstracts:

- Golden Deposit, Northwest Territories, Canada; Basque Lakes, BC, Canada; McLaughlin Reserve, CA, USA

Time not sufficient to complete exercise

However..

The act of applying the tool was felt to be (surprisingly) useful –

Thought process: *rigorous listing and ranking of features and processes, looking specifically at how these are manifested at site/Mars..* **..New views possible of site and research..**

Workshop felt to be productive and timely – some similar discussions as in International Mars Habitability Conference

Follow up

Planned follow up activities:

- **Icarus special issue**
  - **Workshop report**
  - **Critical mass of proposed papers (Oct submission date)**
  - **Abstracts as supplementary material**
- **Abstracts currently available at:**
  http://www.lpi.usra.edu/meetings/analogues2011/

Feedback from this group…?

Comments on the need for a framework?

Comments on the draft evaluation tool?

Suggestions for follow up workshops or activities?

Other planetary analogue initiatives eg, COSPAR PEX..