

Third International Conference on Early Mars Meeting Summary, Steve Clifford (LPI, Houston, TX, clifford@lpi.usra.edu), Mike Carr (USGS (ret.), Menlo Park, CA, carr@usgs.gov), and Dave Des Marais (NASA Ames Research Center, Moffett Field, CA, David.J.DesMarais@nasa.gov).

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On May 21-25, 2012, about one hundred scientists gathered at the Hyatt Regency in Lake Tahoe, Nevada to participate in the Third International Conference on Early Mars: Geologic and Hydrologic Evolution, Physical and Chemical Environments, and the Implications for Life – a location that was chosen because of its proximity to Mono Lake, which was the focus of the all-day mid-conference field trip (led by Jack Farmer).

The influx of new data received from recent spacecraft missions, the study of Martian meteorites, recent progress in early climate modeling, the growing evidence for abundant water, and the rapid pace of new discoveries about the origin and diversity of life on Earth, have reinvigorated interest in both the conditions that prevailed on Mars during its first billion years of geologic history and their potential implications for the development of life.

These issues were first discussed at the First Early Mars Conference, which was held in Houston, Texas, in April 1997 and then again at the Second Early Mars Conference, which was held in Jackson Hole, Wyoming, in October 2004.

Like its predecessors, the Third Early Mars Conference placed a strong emphasis on interdisciplinary discussion and debate, bringing together scientists from fields as diverse as planetary geology, atmospheres, climate, meteoritics, microbiology, and molecular biochemistry, to focus on the conditions that prevailed on the Earth and Mars during their first billion years of geologic history.

The purpose of the conference was twofold:

1. to consider how impacts, volcanism, the presence of abundant water, and the nature of the early terrestrial and Martian climates affected the physical and chemical environments that existed on both planets >3.7 Ga — especially with regard to the geologic and mineralogical evolution of their surfaces, their hydrologic cycles, the development of life, and the preservation of its signature in the geologic record; and
2. to discuss the investigations that might be conducted by present and future missions to test the hypotheses arising from (1).

Some of the specific issues and questions that were addressed at the meeting included those identified as Key Questions at the Second Conference (as discussed by Beaty et al., 2005, http://mepag.jpl.nasa.gov/workshop/Beaty_etal_2005.pdf):

To ensure enough time to rigorously assess our current understanding of early Martian environments, promote the exchange of new ideas, and address some of the most critical and controversial issues in Mars research, approximately 50% of the total program (which consisted of a mix of invited and contributed talks, panel discussions, poster presentations, several special sessions, a conference dinner, and a mid-conference field trip to Mono Lake) was reserved for discussion and debate.

The Conference concluded with an extended discussion to update the “Key Questions and Needed Observations” identified at the previous Conference, which was led by Mike Carr and David Des Marais -- questions that will serve as the Conference input into the next revision of the MEPAG Science Goals and Objectives document.

Key Science Questions from the Third Conference on Early Mars

A. How is the early history of the inner solar system related to Mars?

- A1 How did early bombardments shape the martian crust and climate?
- A2 How were the tectonics of early Earth and Mars similar; how were they different?
- A3 How did changes in solar luminosity affect the martian atmosphere and climate?

B. What was the nature of the geophysical evolution of early Mars?

- B1 How did the formation, initial composition, and differentiation of Mars affect the evolution of its crust, mantle and core?
- B2 What processes and consequences were associated with the origin, duration and demise of the martian magnetic dynamo?
- B3 How did volcanism evolve and affect the martian crust and climate?

C. How did the early Martian environment evolve with respect to its physical, geochemical and mineralogical attributes?

- C1 Did early water-related climatic events occur episodically; what were their causes and characteristics?
- C2 What was the nature of early hydrologic cycles, and what were the processes and timing associated with the sources and sinks of water?
- C3 What is the detailed stratigraphic record and chronology of aqueous mineral deposits?
- C4 How completely and accurately have accessible geologic deposits on Mars recorded its early environmental history?
- C5 How can numerical models enhance our understanding of early martian climate?
- C6 How can Earth-based investigations in laboratories and in Mars-analog environments enhance our exploration and understanding of early martian environments and processes?

D. Did prebiotic chemistry and life occur on early Mars?

- D1 What were the nature, distribution and duration of any early habitable environments?
- D2 Did prebiotic evolution occur on Mars; if so, how did it resemble that on Earth?
- D3 Which potential landing sites and deposits hold the greatest potential for having preserved a record of habitable environments and any fossils?
- D4 How can potential biosignatures be sought and recognized in the ancient record?

A special section of JGR-Planets has been organized to capture the scientific output of the Conference – and attendance at the meeting is not required to submit a manuscript. The due date for submission is December 14, 2012.

The program and abstracts for the Conference can be found at:

<http://www.lpi.usra.edu/meetings/earlymars2012/pdf/program.pdf>