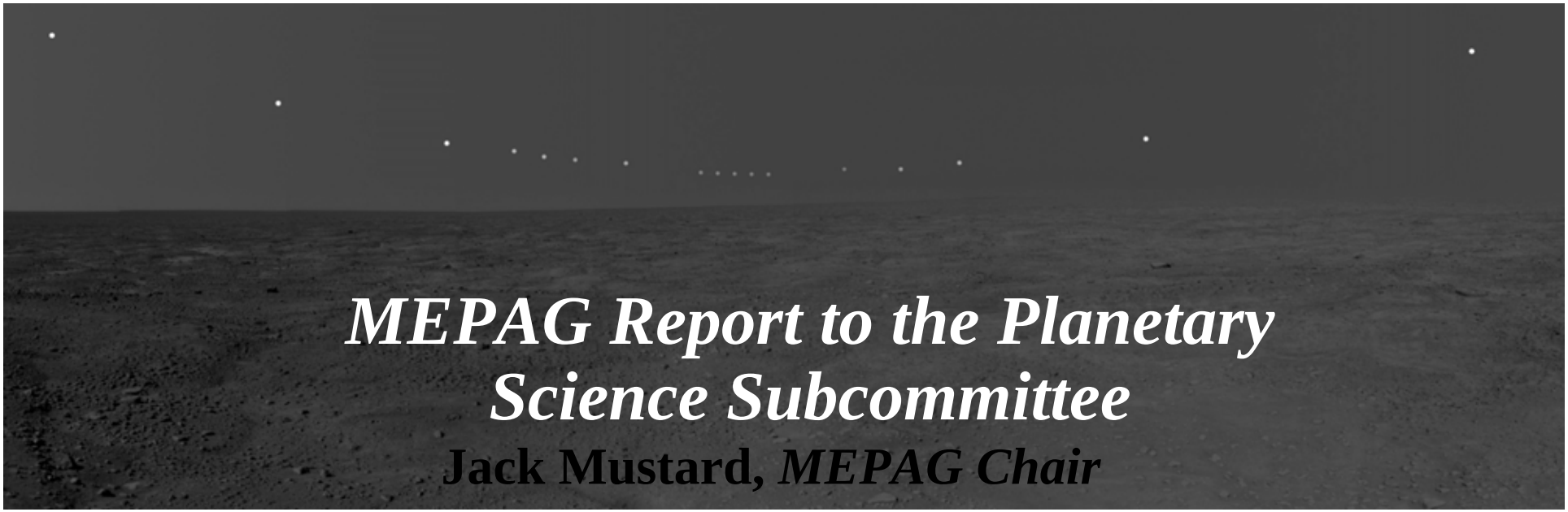
Mars Exploration Program Analysis Group (MEPAG)

chartered by NASA HQ to assist in planning the scientific exploration of Mars



MEPAG Report to the Planetary Science Subcommittee

Jack Mustard, *MEPAG Chair*

Developments in Mars Exploration Since June PSS Meeting

- **Phoenix mission has achieved many significant science goals**
- **Mars Science Laboratory continues development and still on track for 2009 launch but cost and schedule are major concerns**
- **Mars Atmosphere and Volatile Evolution Mission (MAVEN) selected as the Scout for 2013 (B. Jakosky PI)**
- **Architecture planning for the next decade**
  - International Mars Architecture for Sample Return (IMARS)
  - Mars Architecture Tiger Team (MATT, P. Christensen, Chair)
  - International Meeting on Mars Sample Return
- **Rover concepts in development for the 2016 opportunity**
- **3rd Mars Science Laboratory Landing Site Workshop**

MEPAG Meeting Monrovia September 2008

- **Updates on the Mars Exploration Program**
- **Reports and discussion on:**
  - Phoenix
  - Mars Atmosphere and Volatile Evolution Mission (MAVEN)
  - MSL
  - Mars Architecture Tiger Team
  - International Mars Architecture for the Return of Samples (iMARS)
  - 2016 opportunity planning

Mars Sample Return

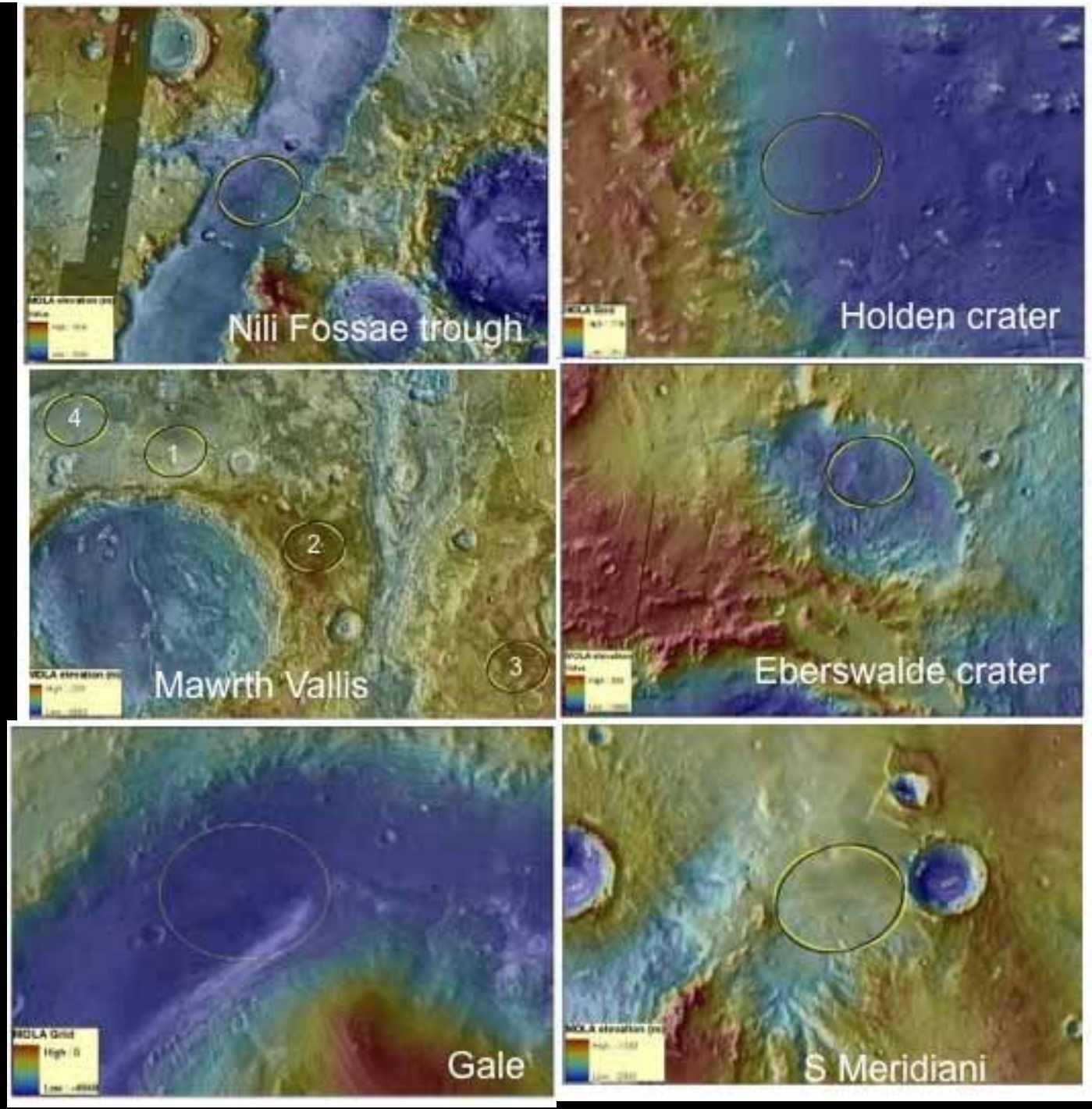
- **MEPAG and the NRC have previously concluded that MSR is essential to achieve NASA's scientific expectations for Mars**
- **During past year, MEPAG has supported iMARS in the preparation of a "potential plan" for an internationalized MSR**
  - presented at the IMEWG meeting July 8, Paris -- well received
  - Drew heavily on MEPAG's ND-SAG analysis
- **Long-lead funding for partnership-forming activity, technology development, and international coordination currently under consideration by ESA and NASA**
  - IMEWG considering extending the charter of iMARS for another year
  - Science planning is a major open issue to be worked
- **NASA developing possible architectures and feed-forward considerations leading up to MSR.**

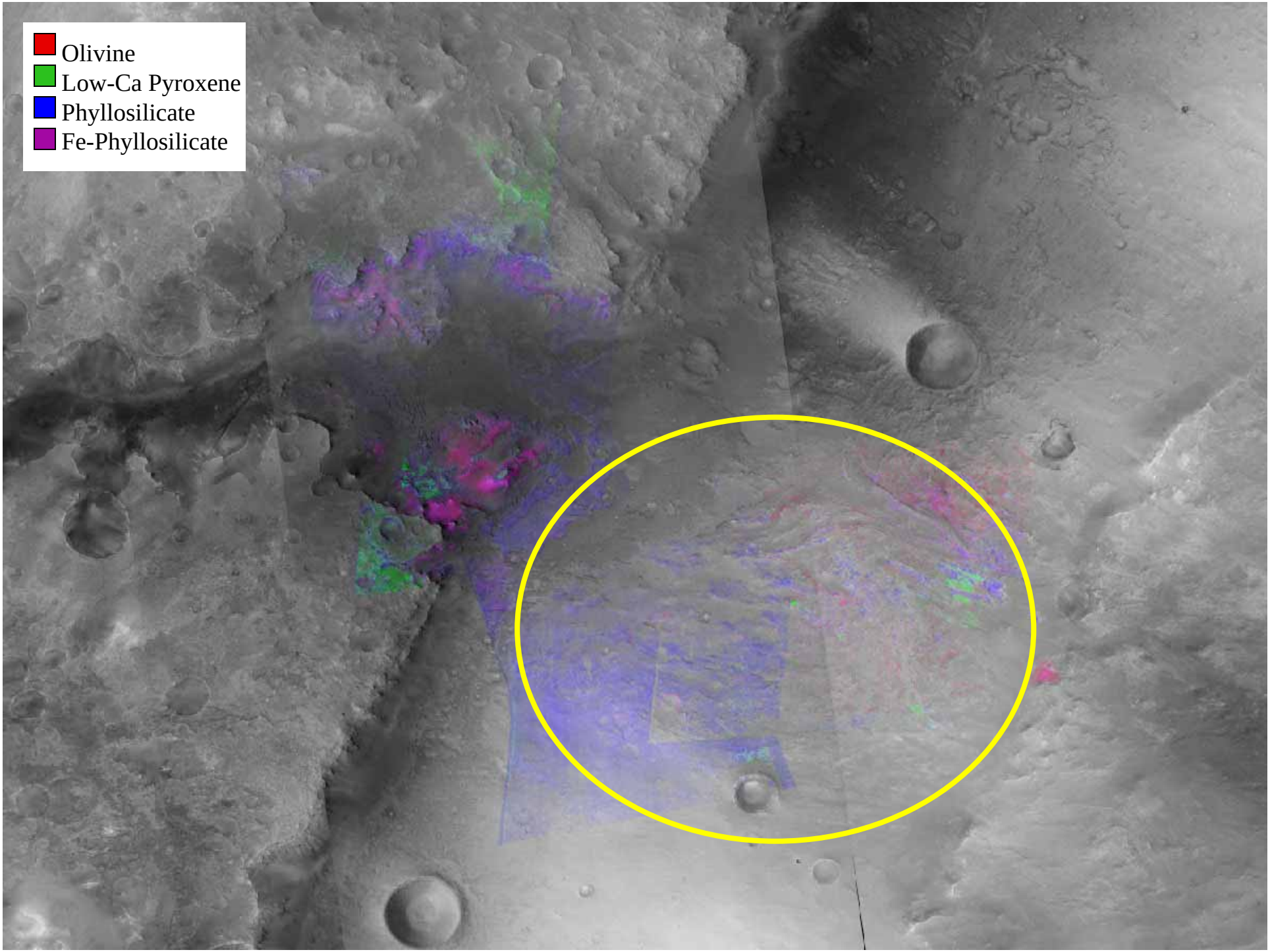
Mars Science Laboratory

- **MSL landing site workshop**
  - Community-based process, heavily supported by MEPAG. Workshop showed multiple compelling sites that could support the mission's scientific objectives (which in turn are crucial to NASA's strategic plan). Excellent cross-mission support between orbital and landed teams showed that a program of missions is more valuable than the sum of its parts.
- **MSL cost overruns**
  - MSL cost overruns are negatively affecting not just ALL aspects of the Mars program, but also other sectors of PSD. MEPAG has not been asked to comment on this, but the negative consequences are obvious, including painful budget reductions to on-going limited-lifetime operating missions. MEPAG recognizes that the project team is doing everything it can to manage both cost and schedule, and encourages it to keep pressing for the 2009 launch window (the consequences of not making this timing are worse).
- **<u>MSL cache</u>. MEPAG has been asked to comment on the scientific usefulness of the MSL cache.**

Sample Cache for Mars Science Laboratory

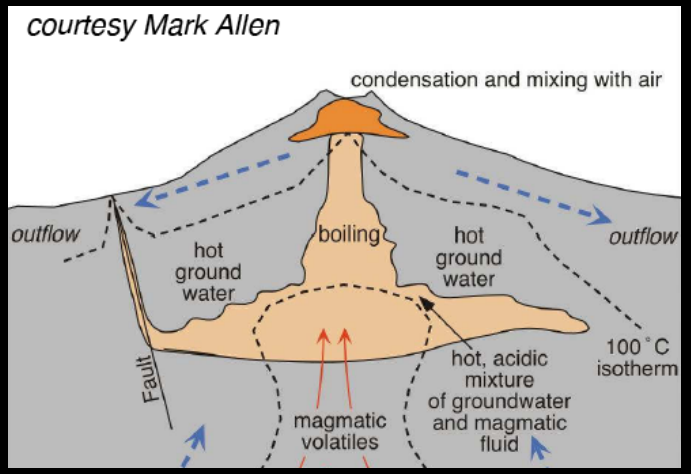
- **In response to a Mars Exploration Program requested for community input regarding the scientific impact if the cache were to be deleted from MSL, the MEPAG Executive committee deliberated on the topic drawing strongly from two recent SAGs:**
  - Joint NAI / MEPAG Mars Science Laboratory Caching Working Group: A. Steele Chair
  - Science Priorities for Mars Sample Return: D. Des Marais and L. Borg, Chairs
- **The key findings are:**
  - The cache was added late and not designed as a technical solution to MSR and is not adequately designed to meet planetary protection requirements
  - The MSL cache samples would be of low scientific quality.
  - The existence of the MSL cache would not bring a meaningful benefit to the design of MSR
  - The MSL cache presents significant risks to meeting the science goals of MSL itself

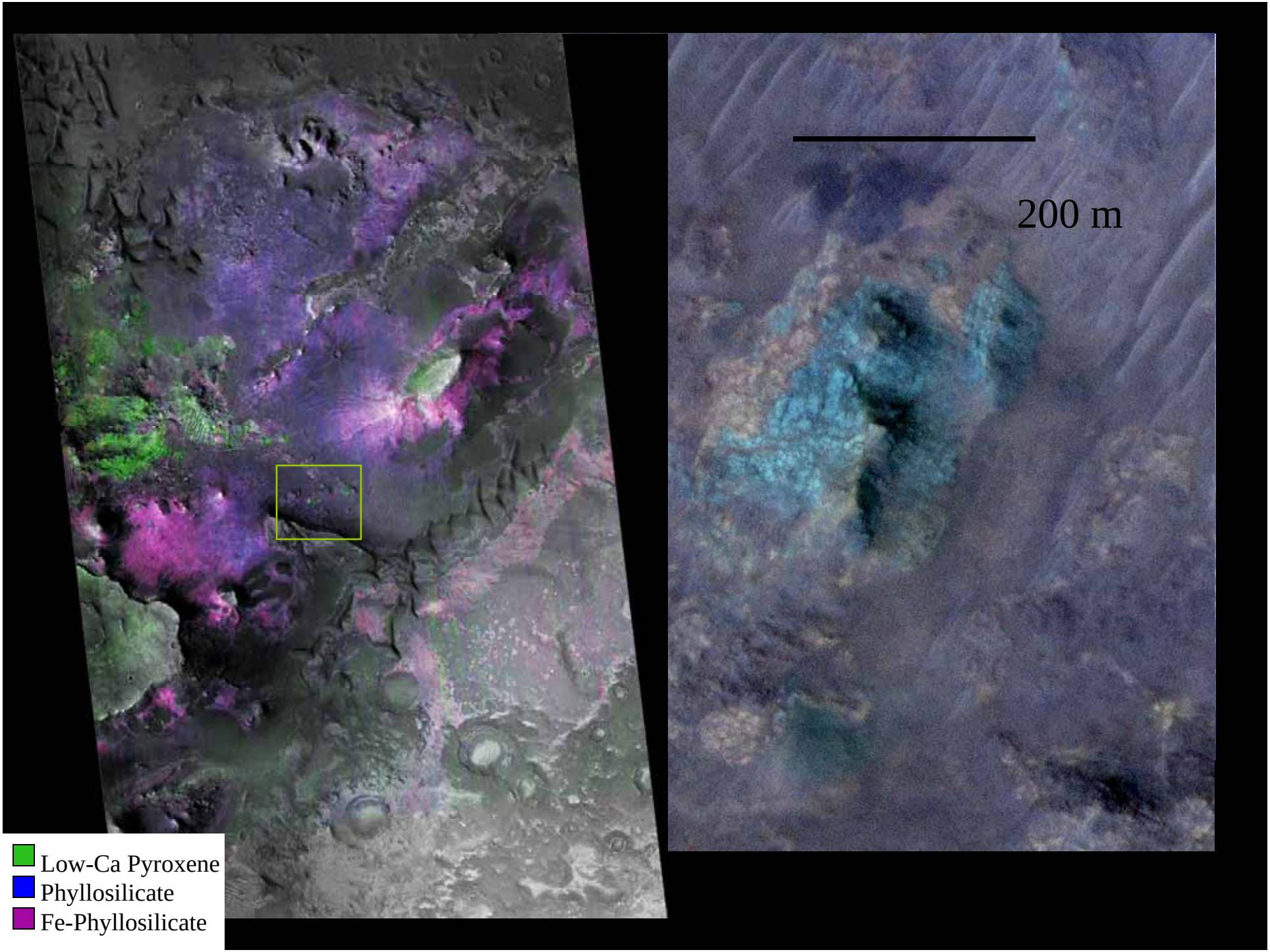

Nili Fossae trough
Holden crater
4
1
2
3
Mawrth Vallis
Eberswalde crater
Gale
S Meridiani


Olivine
Low-Ca Pyroxene
Phyllosilicate
Fe-Phyllosilicate

Multiple, Distinct Environments

- **Noachian is when phyllosilicate formation was most intense: Access to the source environments**
- **Hydrothermal system**
  - Fractures as transport pathways for water, mineralization in fractures
  - No mounds, spring deposits, but those are surface features and not expected to survive to the present
- **Sedimentary units**
  - Infill of trough, formation of sapping channel
  - Regionally, layered units in crater floors, troughs
  - Erosion in go-to site leaves outcrops of remnants of these processes
- **Subsurface groundwater or shallow crustal environment**
  - Protected from destructive radiation environment
  - Abundant chemical energy sources
  - Fluid flow in the crust/groundwater transported nutrients/energy




200 m
Low-Ca Pyroxene
Phyllosilicate
Fe-Phyllosilicate

Revision of MEPAG Goals Document

- **Jeff Johnson (USGS), Chair**
- Goal I: Life **[Andrew Steele (*Rotating off*; Carnegie), Frances Westall (NEW, CNRS) ,Tori Hoehler (NEW, NASA Ames)]**
- Goal II: Climate **[Scot Rafkin (SWRI), Paul Withers (NEW, Boston Univ.)]**
- Goal III: Geology **[Vicky Hamilton (Univ. Hawaii), Jeff Plescia (APL/JHU)]**
- Goal IV: Human Exploration **[Abhi Tripathi (JSC), Jennifer Heldmann (NASA Ames)]**

Goal document location: http://mepag.jpl.nasa.gov/reports/index.html

- **2008 MEPAG Goals Document revision status**
  - *Community input provided via*:
    - 7th Mars Conference (July, 2007)
    - On-line survey via LPI (August--September, 2007)
    - 18th MEPAG meeting splinter sessions (February, 2008)
  - Goal I: Minor rewrites
  - Goal II: Reorganized (present, recent, ancient climate; polar layered deposits)
  - Goal III: Reorganized and reprioritized
  - Goal IV: Changes to be made this Fall (after Design Reference Architecture document completed)

Activities Since the last PSS Meeting

- **Finishing the update activities for the MEPAG Goals Document**
- **Strong participation in the MATT**
- **Participation in the International Mars Architecture for the Return of Samples (iMARS) process**

Mars Architecture Tiger Team Report

MATT looking at architectures to fill the gap between the previous two architectures and align the science architecture with potential budgets (at some level of augmentation over FY09 President's budget)

Previous two types of architectures:

1) A science-driven architecture based on the SMD plan and the recommendations of the NRC Decadal Survey, the MEPAG Goals committees, and the MEPAG Science Analysis Groups over the past 5 years
2) Budget-driven architectures based on the released President's 5-year budget (FY09-FY13).

Mission Scenarios

Preferred Scenarios

Option	2016	2018	2020[#2]	2022[#2]	2024	2026	Comments
2018a[#1]	MSR-O	MSR-L	MSO	NET	Scout	MPR	Funded if major discovery?
2018b[#1]	MSO	MSR-L	MSR-O	NET	Scout	MPR	Restarts climate record early; trace gases
2018c[#1]	MPR	MSR-L	MSR-O	MSO	NET	Scout	Gap in climate record; telecom?
2020a	MPR	MSO	MSR-L	MSR-O	NET	Scout	MPR helps optimize MSR
2020b	MPR	Scout	MSR-L	MSR-O	MSO	NET	Gap in climate record, early Scout
2022a	MPR	MSO	NET	MSR-L	MSR-O	Scout	Early NET; MPR helps MSR
2022b	MSO	MPR	NET	MSR-L	MSR-O	Scout	Early NET, but 8 years between major landers (MSL to MPR)
2024a	MPR	MSO	NET	Scout	MSR-L	MSR-O	Early NET; 8 years between major landers; late sample return

MSO = Mars Science Orbiter

MPR = Mars Science Prospector (MER or MSL class Rover with precision landing and sampling/caching capability)

MSR = Mars Sample Return Orbiter (MSR-O) and Lander/Rover/MAV (MSR-L)

NET = Mars Network Landers ("Netlander") mission

FOOTNOTES:

#1 Requires early peak funding well above the guidelines (see back-up slides for rough costs)

#2 Celestial mechanics are most demanding in the 2020 and 2022 launch opportunities, but ATLAS V-551 capabilities presently appear to be adequate

Future Planning

- **Evaluation, assessment of the science priorities for the 2016 opportunity**
  - For lander/rover options:
    - Characterize the science opportunities enabled by precision landing (± 3 km) and evaluate science priorities for mission concepts
    - Assess surface/subsurface sampling and caching
    - Telecom implications if the MPR (Prospector) is the choice for 2016
- **Initiative in Comparative Planetary Climate (Venus, Earth, Mars) and Center for Mars Climate**
- **Assessment of the outcomes of the MATT activity and Red Team reviews**
- **Next MEPAG Meeting: March 3, 4 2008 Washington DC**