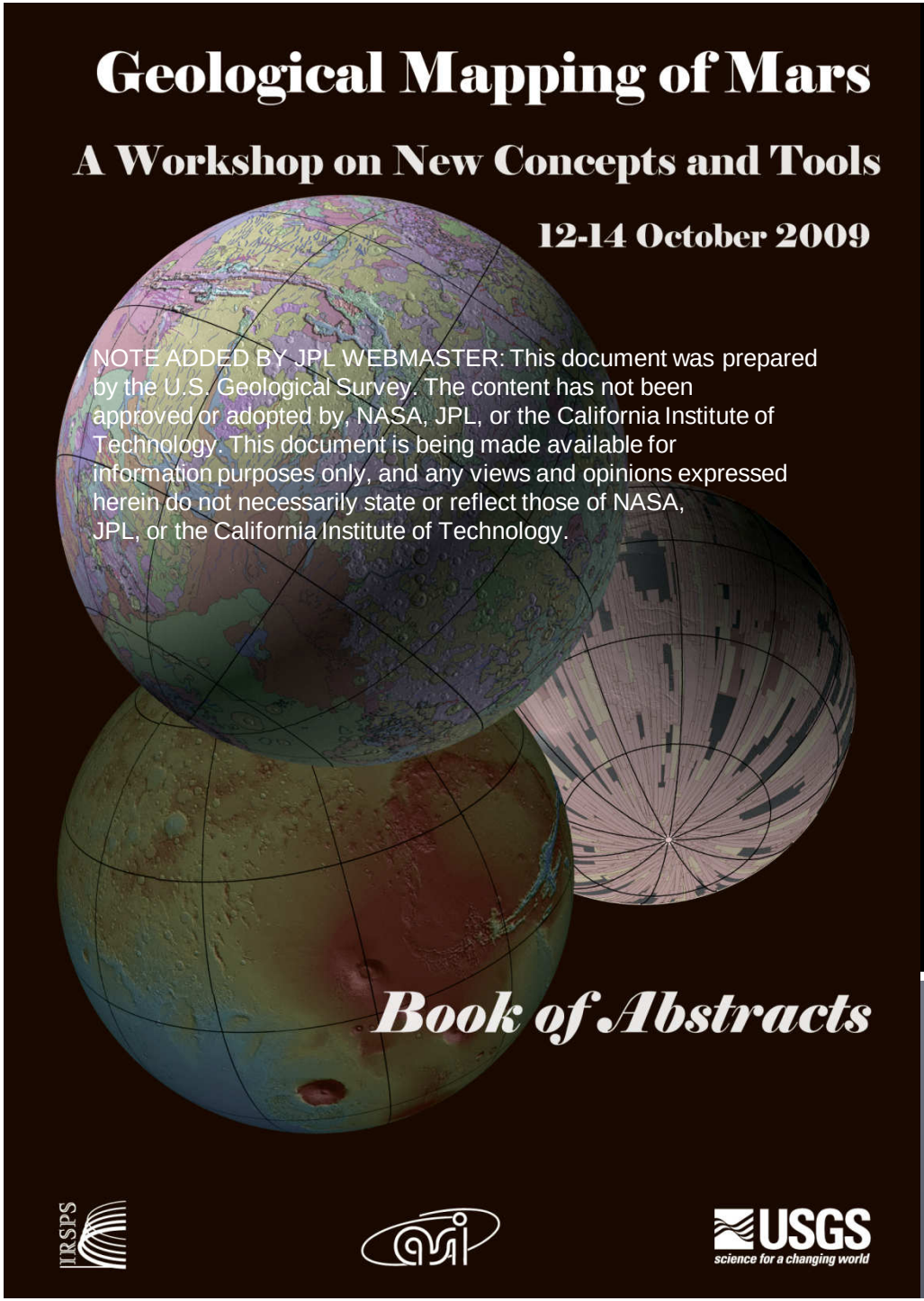
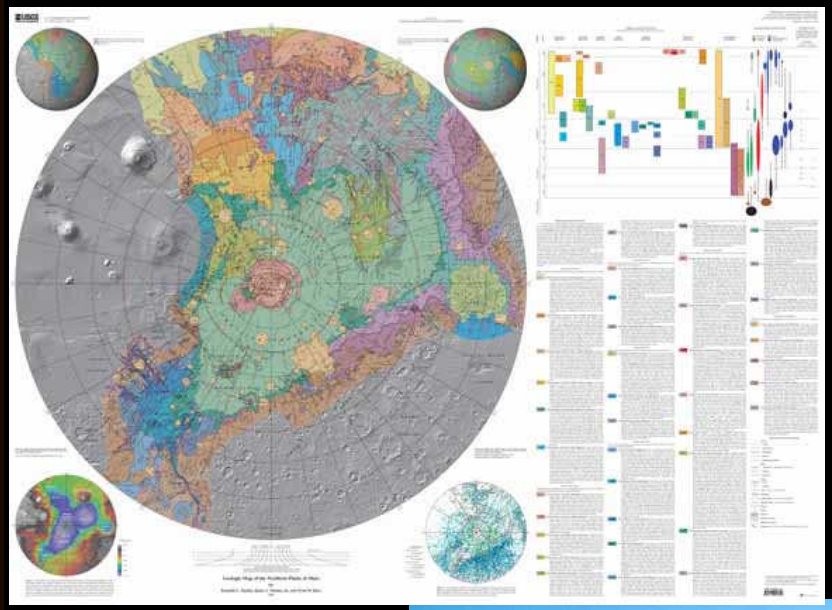
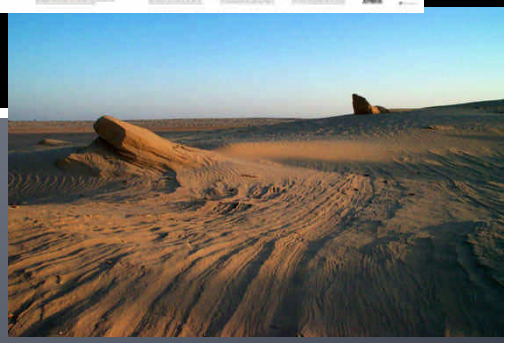


1. Geological Mapping of Mars workshop (Tuscany; October 2009)
2. NASA/USGS Planetary Geologic Mapping Program (June 2009)
3. Tunisia-Mars analogue site field trip (Int. Assoc. Sediment.; Sept. 2009)



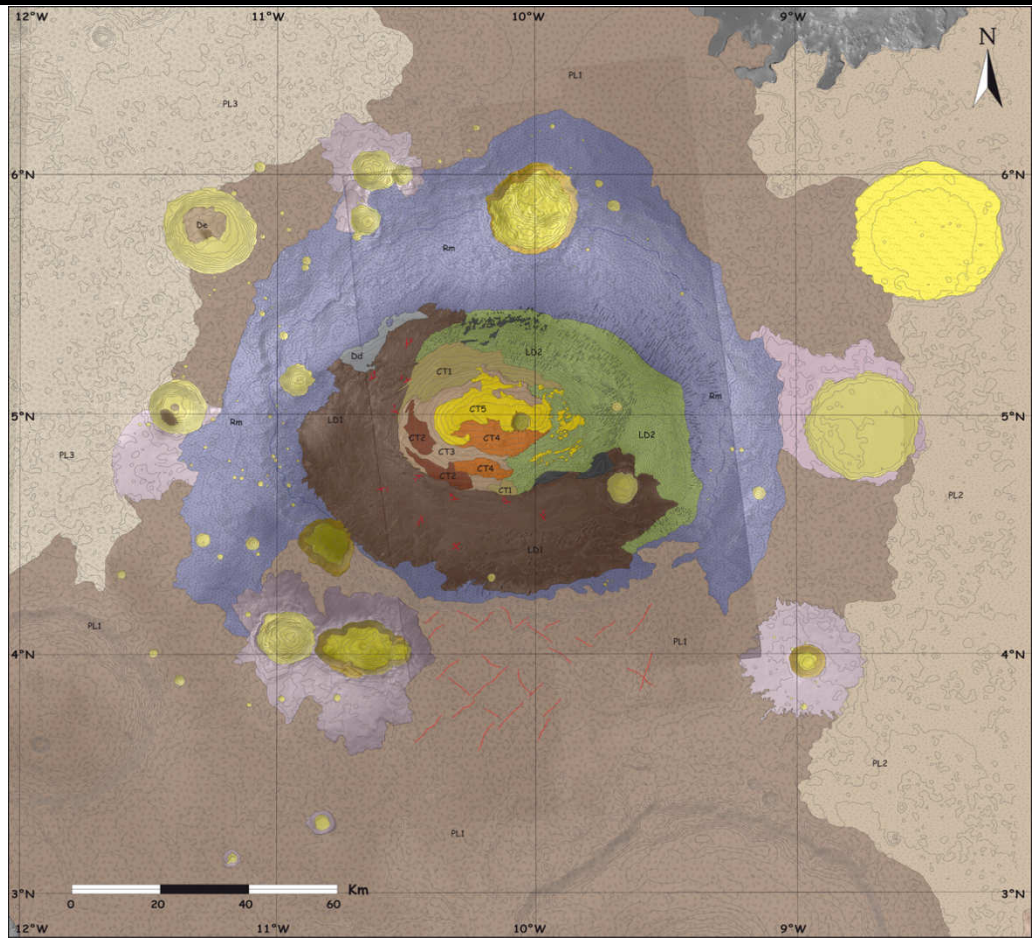
Fossil dunes being covered by active dunes (right)



Ken Tanaka (USGS) and Gian Ori (ASI)
MEPAG, 3/18/2010, Monrovia, CA

Why a Geological Mapping of Mars workshop?

- European Mars geologic mapping initiative
- High Resolution Stereo Camera and other new data, tools, approaches
- European planetary geoscience community due to MEX
- The need for coordination and collaboration with NASA/USGS Planetary Geologic Mapping Program



Organizers: International Research School of Planetary Sciences (IRSPS) and the U.S. Geological Survey (USGS)
Sponsor: Agenzia Spaziale Italiana (ASI)

Conveners

Enrico Flamini-- Agenzia Spaziale Italiana, Rome, Italy
Gian Gabriele Ori--IRSPS, Pescara, Italy
Ken Tanaka--U.S. Geological Survey, Flagstaff, Arizona, USA
Gerhard Neukum--Freie Universitat Berlin, Germany
Angelo Pio Rossi--ISSI, Bern, Switzerland

Coordinators

General--Angelo Pio Rossi, ISSI, Bern, Switzerland
GIS and imaging--Trent Hare and Jim Skinner, U.S. Geological Survey, Flagstaff, Arizona, USA, Stephan Van Gasselt--Freie Universitat Berlin, Germany
Geological Mapping--Monica Pondrelli, IRSPS, Pescara, Italy; Ken Tanaka and Jim Skinner, U. S. Geological Survey, Flagstaff, Arizona, USA
Local organization: Marinella Ercoli, ASI, Italy, Stefania Celenza, IRSPS, Italy, Adele Graziani, ASI, Italy

Organizers: International Research School of Planetary Sciences (IRSPS)
and the U.S. Geological Survey (USGS)
Sponsor: Agenzia Spaziale Italiana (ASI)

Workshop attendance

- **78 participants**
- **Most represented countries:**
  - **France**
  - **Germany**
  - **Holland**
  - **Portugal**
  - **United States**
  - **Italy**
- **Also Argentina, Australia…**

Participants

- **Geologists**
- **Physicists**
- **Engineers**

From: Universities and research institutions, space agencies, geological surveys and space industry

MEETING

New Concepts and Tools for Geological Mapping of Mars

Geological Mapping of Mars: A Workshop on New Concepts and Tools; Tuscany, Italy, 12–14 October 2009

PAGE 88

Geological mapping is a key tool for understanding the evolution of any planetary surface. The availability of ever growing data sets (e.g., multispectral and hyperspectral imaging and subsurface radar sounding) requires increasing effort in analyzing, integrating, and exploiting them for mapping purposes.

To discuss these issues, about 80 planetary geoscientists gathered in Italy at a workshop co-organized by the Italian Space Agency (ASI), the International Research School of Planetary Sciences (IRSPS), and the U.S. Geological Survey (USGS). The workshop focused on both data and concepts and covered a range of scientific and technical topics.

At the workshop, the importance of new data sets acquired by recent and currently orbiting Mars missions as the basis for revising previous geological mapping was stressed. Participants agreed that new mapping should involve the use and integration of hyperspectrally based surface compositional data, radar sounding–based subsurface data, topography, and imagery at multiple resolutions for describing and defining mappable geological units and other features and their relations in space and time.

Participants also pointed out that methodology, standards, and symbolization should be periodically updated to match the scientific and technical state of the art, keeping in balance standardization and scientific freedom and flexibility in mapping. Moreover, the long-standing issue of geomorphic versus geologic mapping should be tackled: How much geomorphology should be allowed in planetary maps and in the definition of geological units?

Geological mapping also provides important information for landing-site selection and characterization for current and future missions. Participants noted that diverse data sets can be integrated via thorough mapping, providing constraints on landing-site settings and potential risks. The importance of terrestrial analog mapping (from the scientific, technical, engineering, and procedural points of view) was also pointed out during the workshop.

Finally, a strong recommendation of the workshop is the need for coordination between current and future USGS mapping programs and newly emerging European geological mapping efforts, such as the ongoing Planetary Geographic Information System (PAGIS) program of the Italian Space Agency. The creation, implementation, and availability of mapping infrastructures and services can greatly improve the scientific exploitation of mission data. Participants noted several areas that would benefit by coordinated work, including cartographic and technical standards, symbology, and scientific outcome. Renewed efforts in geological mapping using state-of-the-art data sets, tools, and concepts will constitute the foundation for future international exploration of Mars.

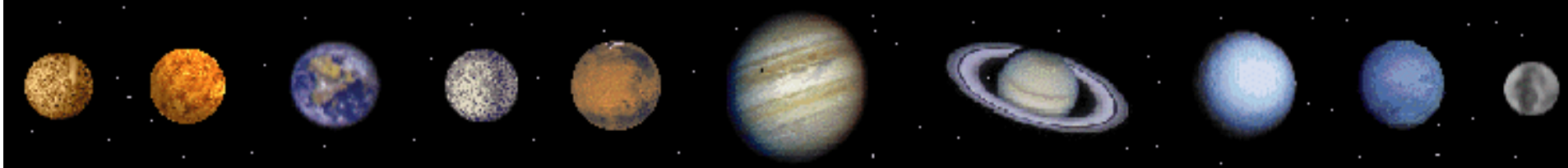
A more extended summary of the plenary discussion, compiled by chairpersons, along with a list of sessions and session chairs, is available on the workshop wiki (http://www.irsps.unich.it/education/mapping09/wiki).

—ANGELO PIO ROSSI, International Space Science Institute, Bern, Switzerland; E-mail: arossi@issibern.ch; and MONICA PONDRELLI, IRSPS, Università G. d'Annunzio, Pescara, Italy

- Articles in special issue of Planetary and Space Science

USGS
science for a changing world
Astrogeology Research Program

The NASA/USGS Planetary Geologic Mapping Program and Mars Geologic Mapping

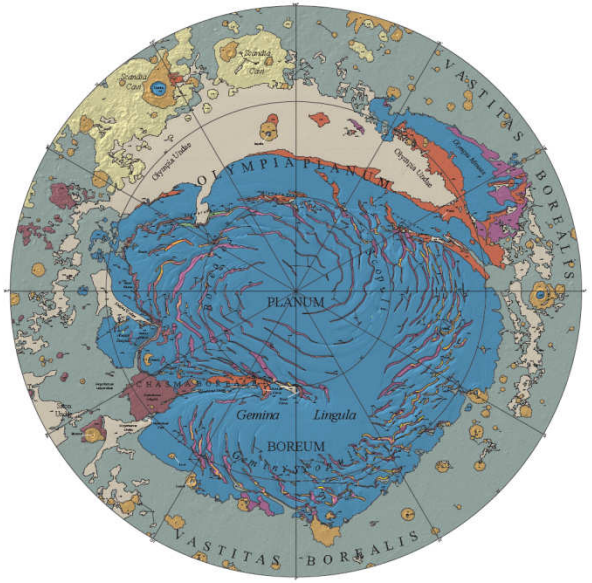


History of USGS/NASA planetary geologic map publication

- ~220 maps total published
  - Starting in 1962
  - Moon, Mars, Mercury, Venus, outer planet satellites
  - 1:25,000 to 1:25,000,000 scales
- Published Mars maps
  - 30-quadrangle series at 1:5M scale
  - Science-driven topical maps
  - Landing-site maps
  - Global maps
- Maps of Mars in progress include:
  - Global map (1:20M)
  - Polar regions (1:2M)
  - W. Candor Chasma using HiRISE stereo (1:10K)

Current USGS/NASA mapping program

- Supported by NASA Planetary Geology and Geophysics Program
  - Finances map authors and USGS work; supports 4-8 published maps per year
  - Provides guidance through PGG's Geologic Mapping Subcommittee (GEMS)
- USGS provides:
  - Map bases
  - GIS data, tools, training
  - Editorial and nomenclature support
  - Web page



NASA/USGS Planetary Geologic Mapping Program

Status

- **Mars**
  - Table
  - Chart
- **Venus**
  - Table
  - Chart
- **Moon**
  - Chart
- **Outer Planet Satellites**
  - Table
- **Earth**
  - Table

Mapping Guidelines

- PSC Author Checklist
- Venus Symbols
- Layers Example
- Venus Geologic Mappers Handbook
- Additional Guidelines
- Venus SOMUs (PDF)
- Reno Guidelines
- Use and Presentation of Magellan Quantative Data in Venus Mapping
- Planetary Geologic Map Symbols 1 (PDF)
- Planetary Geologic Map Symbols 2 (PDF)
- Astrogeology Manuscript Submittal Process
- Tips for Preparation of Astrogeology Maps

Nomenclature

- Gazetteer of Planetary nomenclature
- Images Showing Named Features
- Feature Name Request Form

Download Planetary Geologic Maps

- USGS planetary geologic maps
- Additional planetary geologic map products

NEWS

First Announcement -- Planetary Mappers Meeting and GIS workshop, Flagstaff, Arizona, June 21 - 23, 2010

The Astrogeology Team at USGS provides coordination of NASA's planetary geologic mapping program. Geologic mapping investigations of any imaged planetary body (except Earth) are proposed to *NASA's Planetary Geology and Geophysics Program* on an annual basis (generally due sometime between late April and early June) and then reviewed by the Lunar and Planetary Geoscience Review Panel. USGS map coordination is provided under the auspices of NASA's Planetary Cartography and Geologic Mapping Working Group and its Geologic Mapping Subcommittee. USGS provides (1) participation in working groups charged with developing planetary geologic mapping program plans, (2) management and coordination of individual mapping projects, (3) oversight and expertise in meeting the requirements of USGS map standards, (4) editorial support in map reviews and revisions, (5) generation of geologic base maps and databases for map investigators, and (6) prepress preparation and printing of maps in the USGS Scientific Investigations Map (SIM) Series.

Three primary programs underway now are: (1) 1:2,500,000-scale quadrangle mapping of the **Moon** using Lunar Orbiter and Clementine photomosaics, (2) 1:5,000,000- and 10,000,000-scale quadrangle mapping of **Venus** using Magellan SAR data, and (3) local (1:200,000) to regional (1:5,000,000) scale mapping of **Mars** base on medium- to high-resolution Viking and THEMIS images and MOLA topographic data. Work also progresses toward completion of the **Galilean satellites** using Voyager and Galileo images. In addition, we anticipate more geologic maps will continue to be proposed for and funded based on both existing data and that obtained by Clementine, Galileo, and Mars Global Surveyor. Geologic maps can be produced from existing map bases that are part of established map series (see the **Index of Maps of the Planets and Satellites**) or ones specifically generated for the geologic map.

Active mappers meet once a year during the early summer to present progress on planetary geologic mapping projects. Usually these meetings are held alternately at the USGS Flagstaff and other locations where a geologic field trip can be conducted. Starting in 2000, abstracts began to be accepted for meeting presentations. The following table provides access to abstracts published for given years.

Year	Description
2000	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 22-24, 2000 Flagstaff, Arizona
2001	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 18-19, 2001 Albuquerque, New Mexico
2002	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 21-22, 2002 Tempe, Arizona
2003	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 19-20, 2003 Providence, Rhode Island
2004	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 17-19, 2004 Flagstaff, Arizona
2005	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 23-24, 2005 Washington, D.C.
2006	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 29-30, 2006 Nampa, Idaho
2007	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 28-29, 2007 Tucson, Arizona
2008	Abstracts of the Annual Planetary Geologic Mappers Meeting - June 23-26, 2008 Flagstaff, Arizona

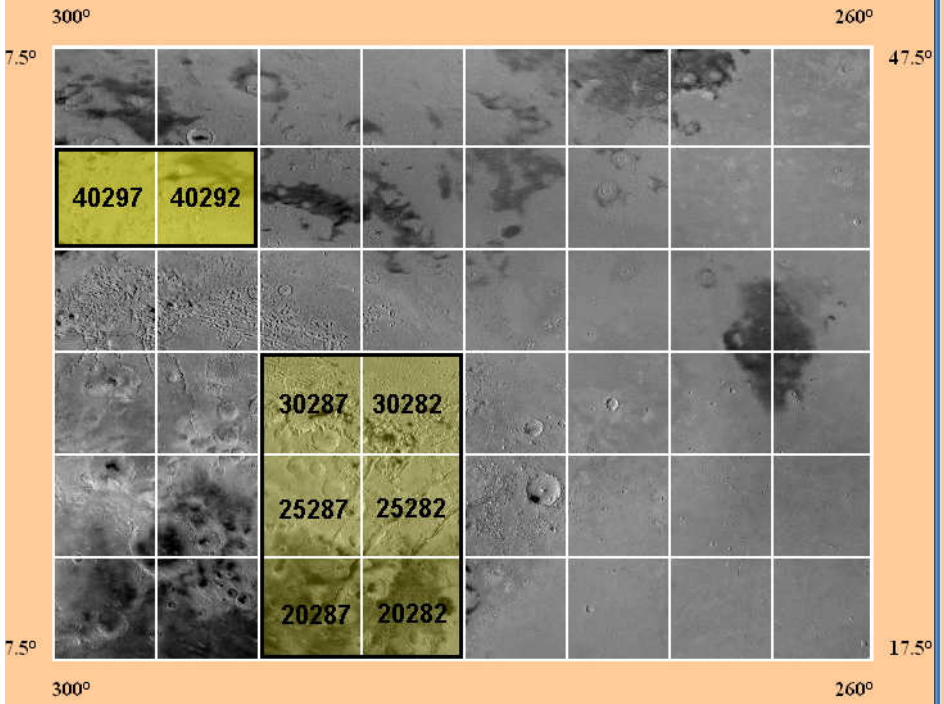
Mars Geologic Maps in Progress

Geologic Maps at 1:500K and 1:1M Scales on MTM Bases

MTM no.	Map Area	Scale	Mapper	Status - Publication Year	Map Number
85200	North pole	500K	Kenneth E. Herkenhoff	Mapping in Progress	
85080	North pole	500K	Kenneth E. Herkenhoff	Published - 2003	2753
50030, 50023, 45027, 45022	Deuteronilus	500K	Timothy Parker	Mapping in Progress	
50356, 50350, 50343, 45357, 45352, 45347	Deuteronilus	500K	Timothy Parker	in Review/Edit	
45337, 40337, 35337	Deuteronilus/Arabia	1M	Frank Chuang, David Crown	Published - 2009	3079
45332, 40332, 35332, 30332	Arabia/Deuteronilus	1M	George McGill	Published - 2002	2746
45017, 45012, 45007, 40017, 40012, 40007	North Cydonia	1M	George McGill	Published - 2005	2811
35012, 35007	South Cydonia	500K	George McGill	Mapping in Progress	
40297, 40292	Nilosyrtis Mensae	500K	Steve Williams	Mapping in Progress	
40142, 40137, 40132, 35142, 35137, 35132	Acheron Fossae	1:1M	Jeffrey Plescia	Mapping in Progress	
40092, 40087					

Mars Mapping Chart
33N280

The colored areas in the image below indicate geologic mapping in progress or completed (see legend at bottom). Select a colored quadrangle to learn more about its status.



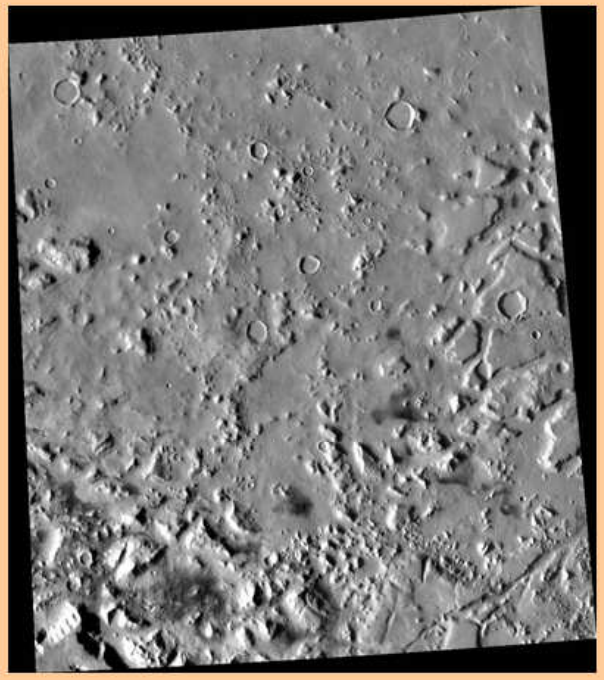
Status Color Legend		
Mapping in Progress	In Review/Edit	In Production/Printing *or* Published

vailability of planetary maps and educational outreach materials, please contact:
4
Planetary Geologic Mapping Program: Dr. Kenneth Tanaka
N. Gemini Drive, Flagstaff, Arizona 86001

USGS

Mars 1:500k Geologic Maps in Progress

30282



Nili Fossae

Mapper

Leslie Bleamaster

Contact

Leslie Bleamaster
Planetary Science Institute
1700 E. Fort Lowell Rd., ste 106
Tucson, Az 85719-2395

lbleamas@psi.edu

Status

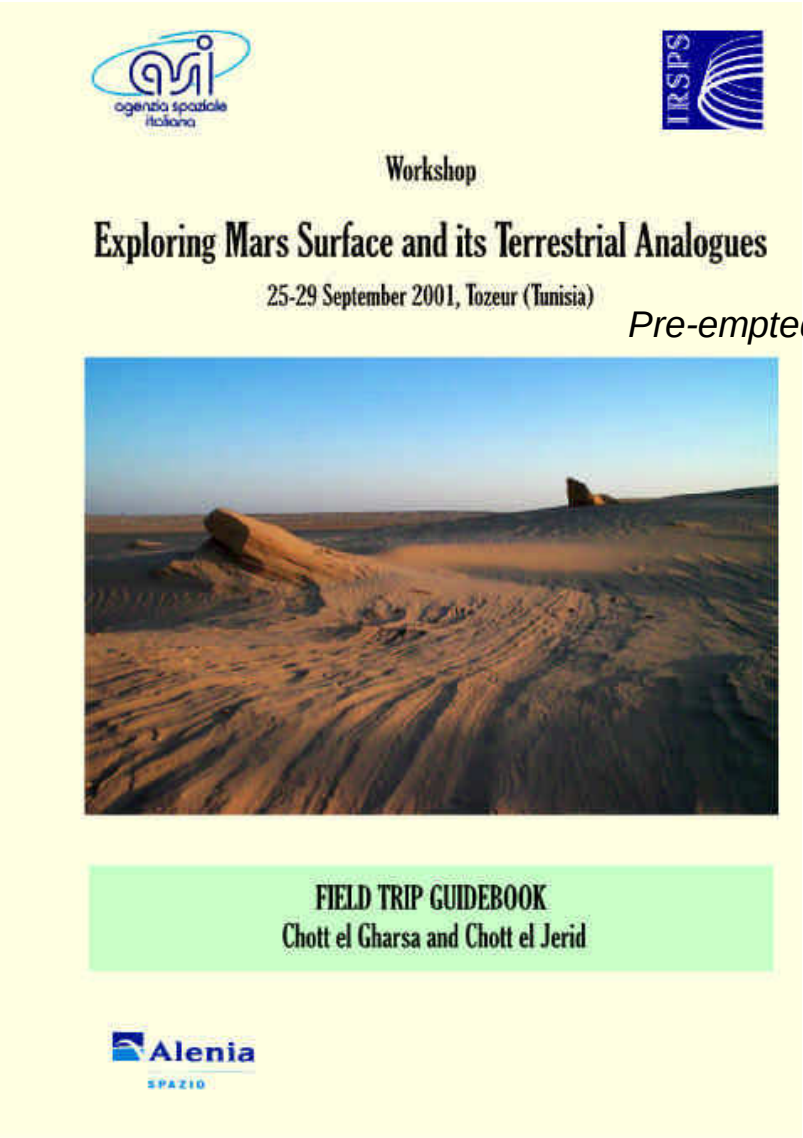
Mapping in Progress

Nomenclature

Nomenclature of Mars features

Back

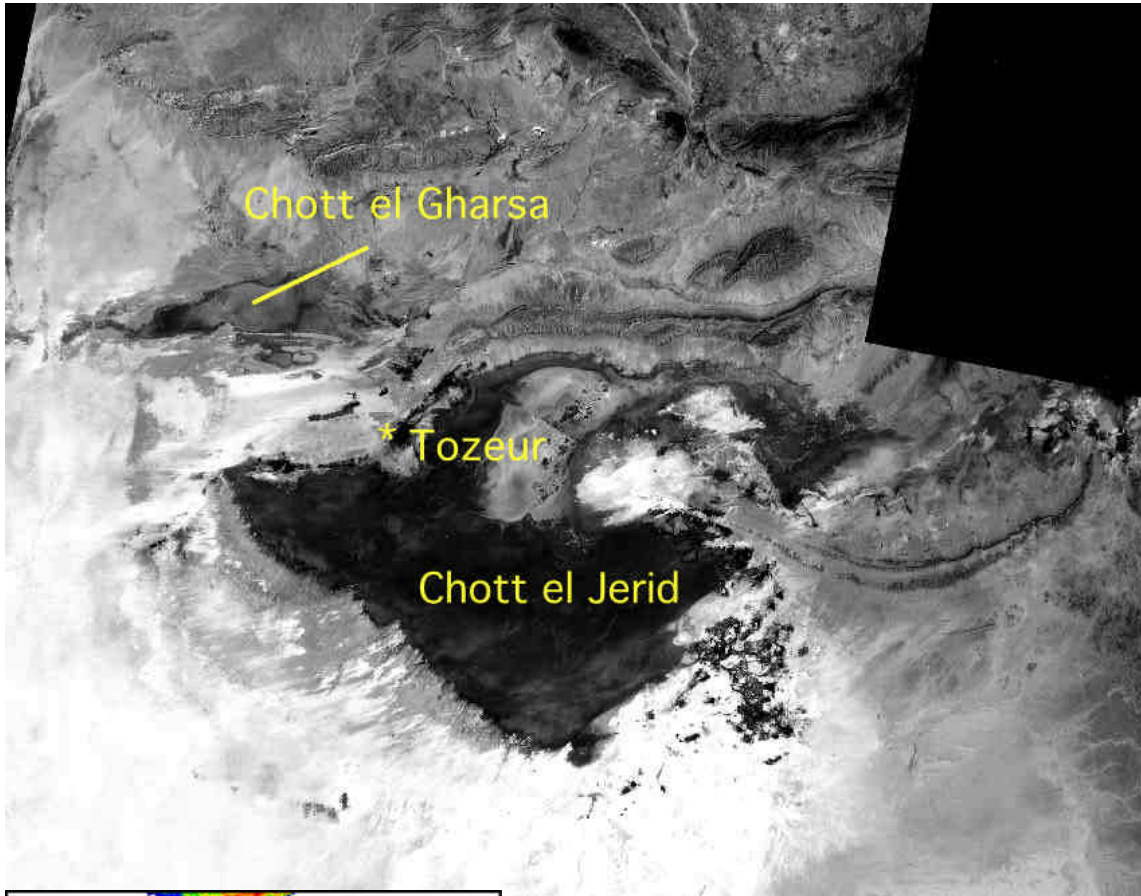
Tunisia field trip, post-IAS conference, Sept. 2009 (led by Gian Ori, ASI)

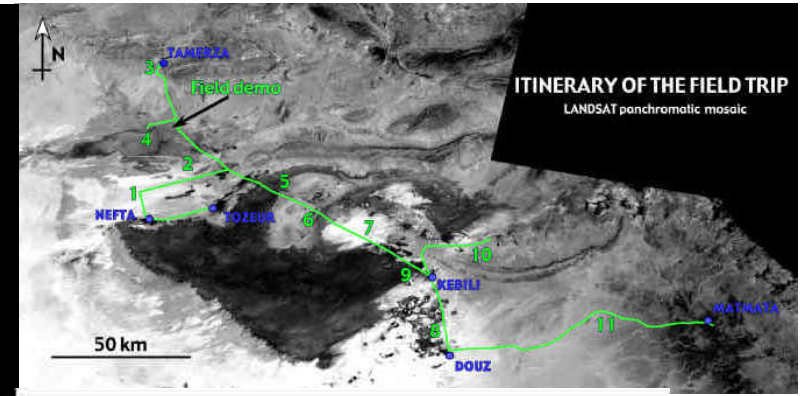


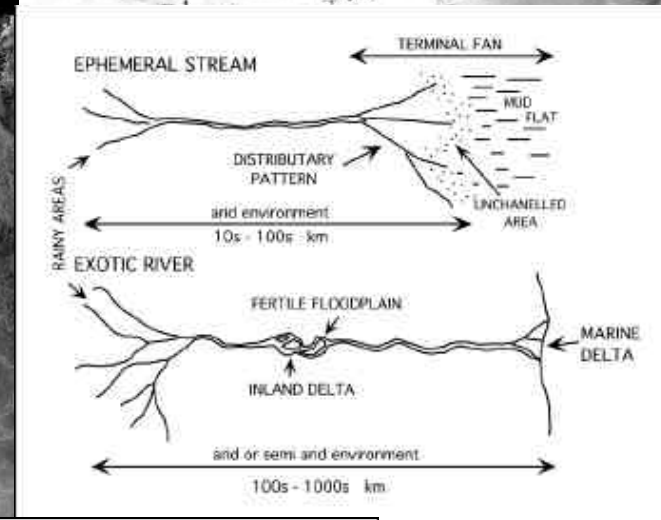
Pre-empted by 9-11

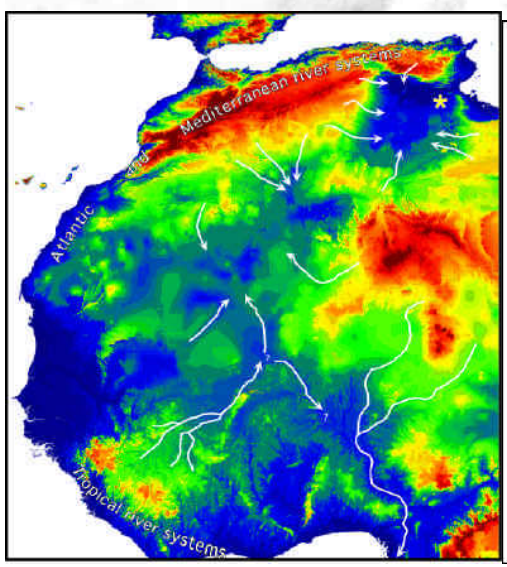
Fossil dunes—seen by millions

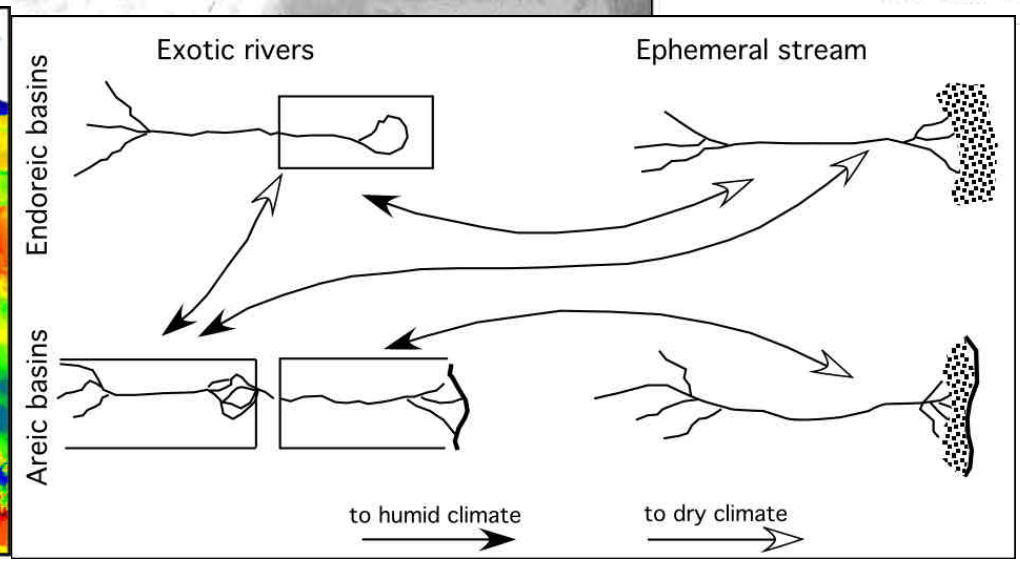
Scenes from “Star Wars Episode 1: The Phantom Menace”

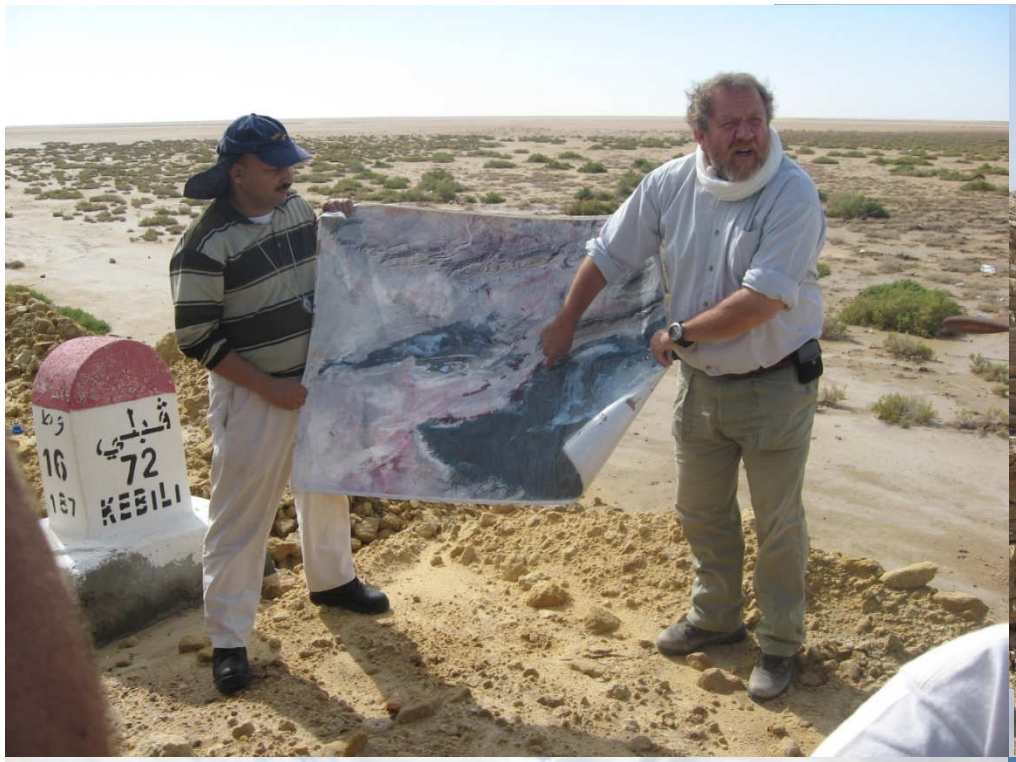

Chott el Gharsa
* Tozeur
Chott el Jerid


N
ITINERARY OF THE FIELD TRIP
LANDSAT panchromatic mosaic
TAMERZA
Field demo
NEFTA
TOZEUR
KEBILI
DOUZ
WATMAYA
1
2
3
4
5
6
7
8
9
10
11
50 km

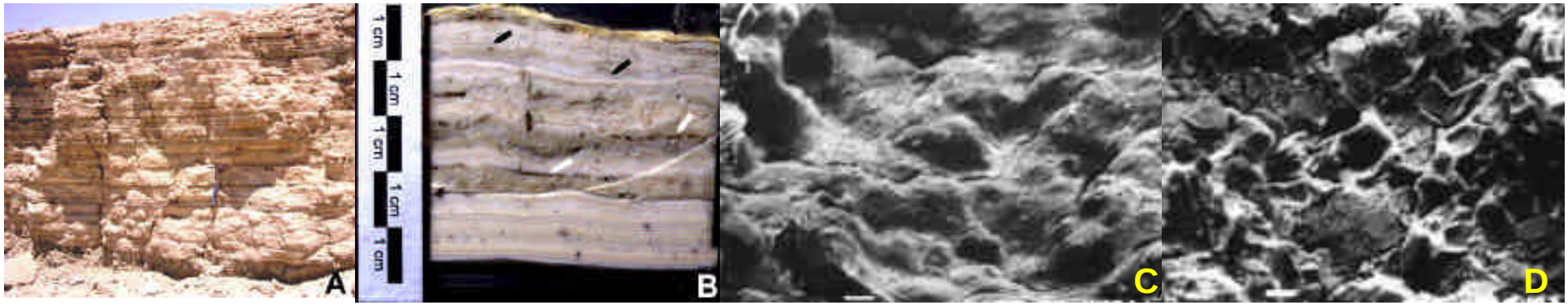

EPHEMERAL STREAM
TERMINAL FAN
MUD FLAT
DISTRIBUTARY PATTERN
UNCHANELLED AREA
RAINY AREAS
arid environment
10s - 100s km
EXOTIC RIVER
FERTILE FLOODPLAIN
MARINE DELTA
INLAND DELTA
arid or semi arid environment
100s - 1000s km


Mediterranean river systems
Atlantic
Tropical river systems
*

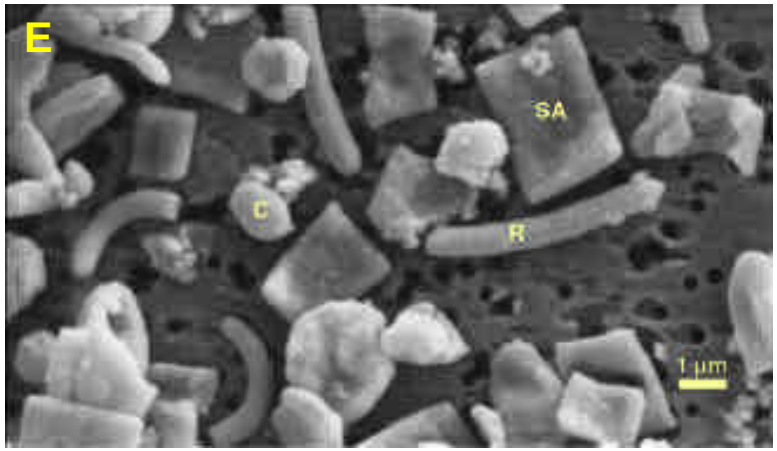

Exotic rivers
Ephemeral stream
Endoreic basins
Areic basins
to humid climate
to dry climate



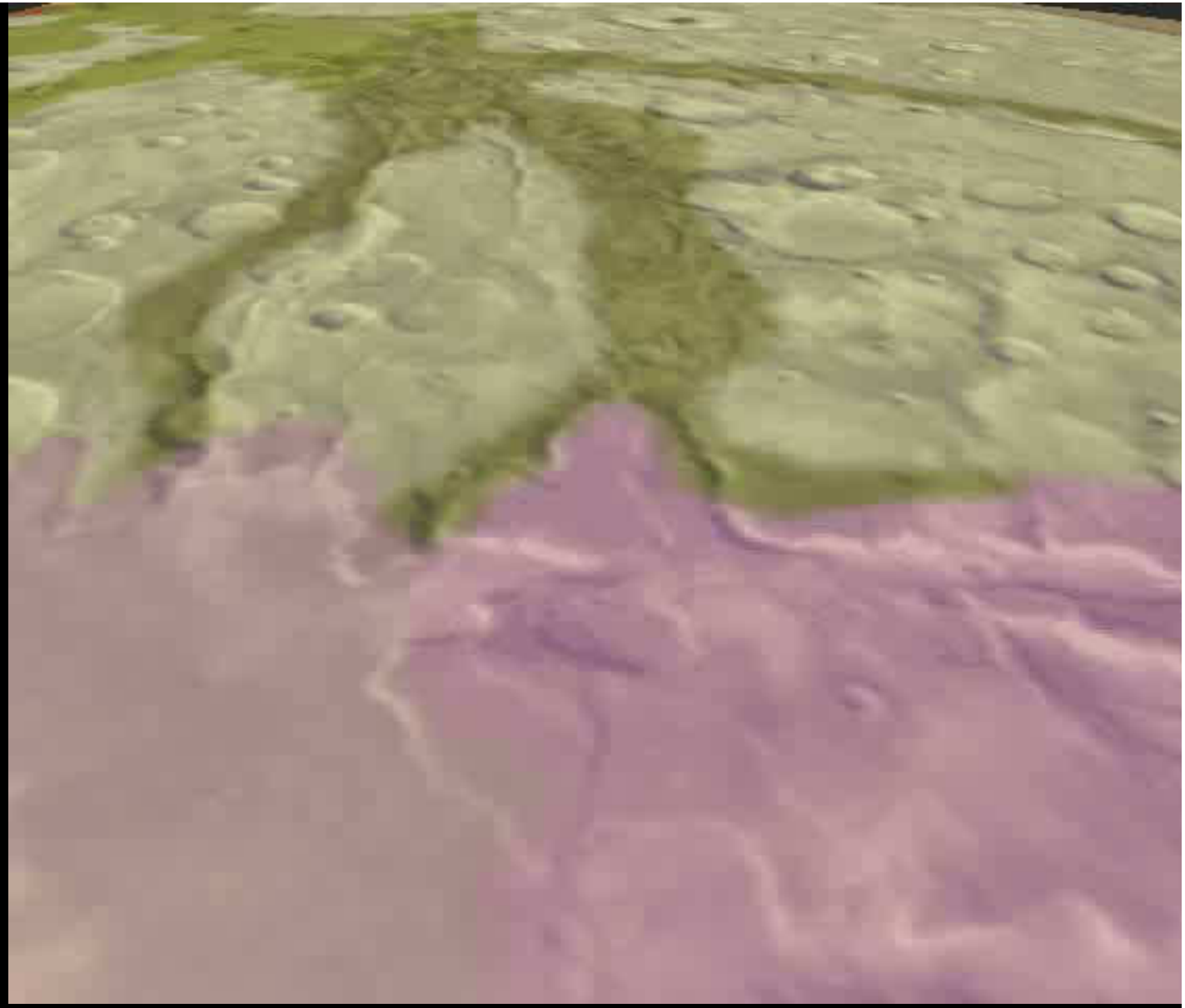
Photos courtesy of Ralph Lorenz



- A. Gypsum evaporites, Chott el Gharsa
- B. Cut section of irregular laminae from outcrop
  - Cavities from subaerial exposure (white arrows)
  - Microbial mats along discontinuities (black arrows)
- C. Microbial map on top of gypsum lamina
- D. Desiccated microbial mat
- E. Extreme halophiles



1. Geological Mapping of Mars Workshop
2. NASA/USGS Planetary Geologic Mapping Program
3. Mars analogue site field trip, Tunisia



Questions?