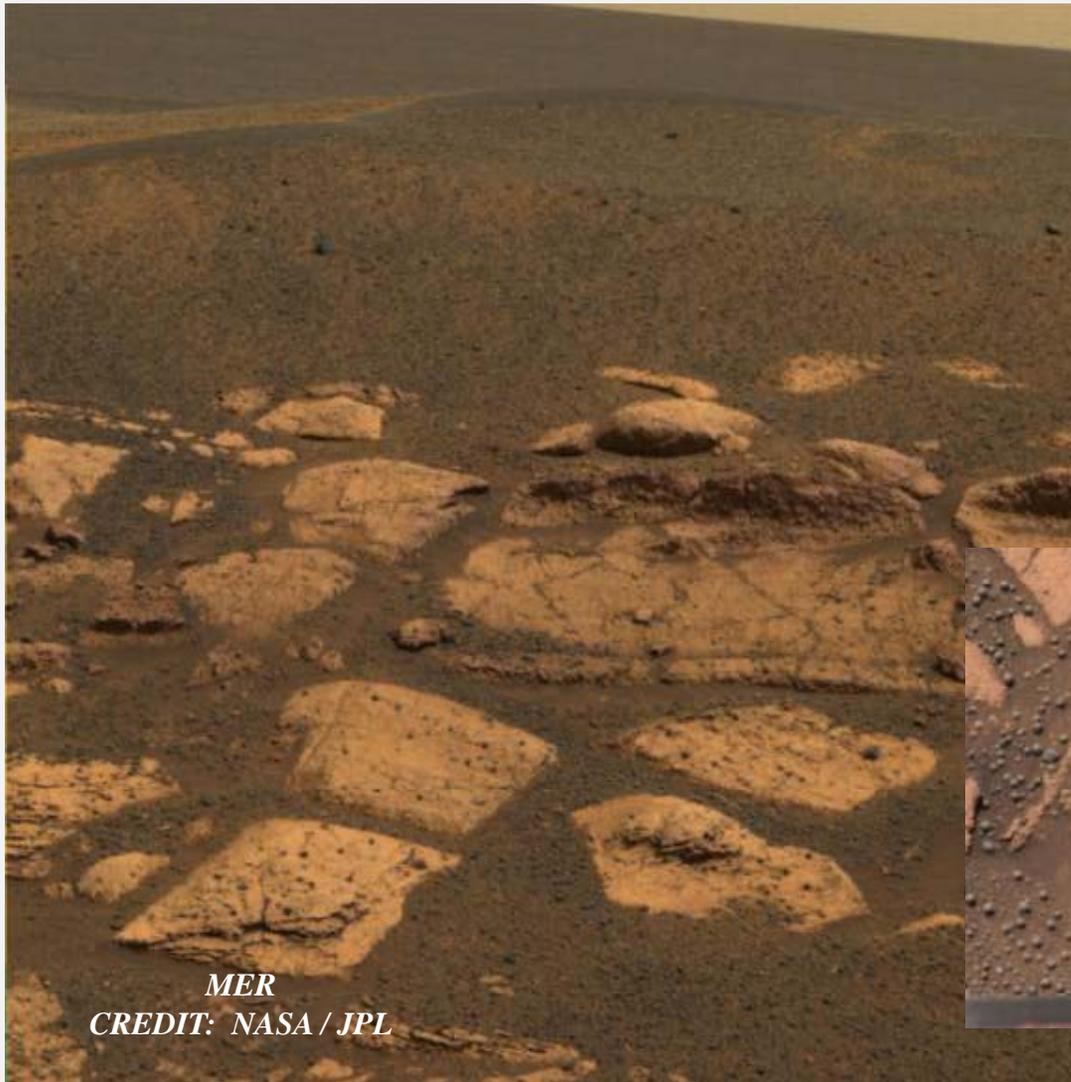


# *Opportunity: Eagle Crater*



*Solar System Exploration @ 50*



*MER*  
*CREDIT: NASA / JPL*

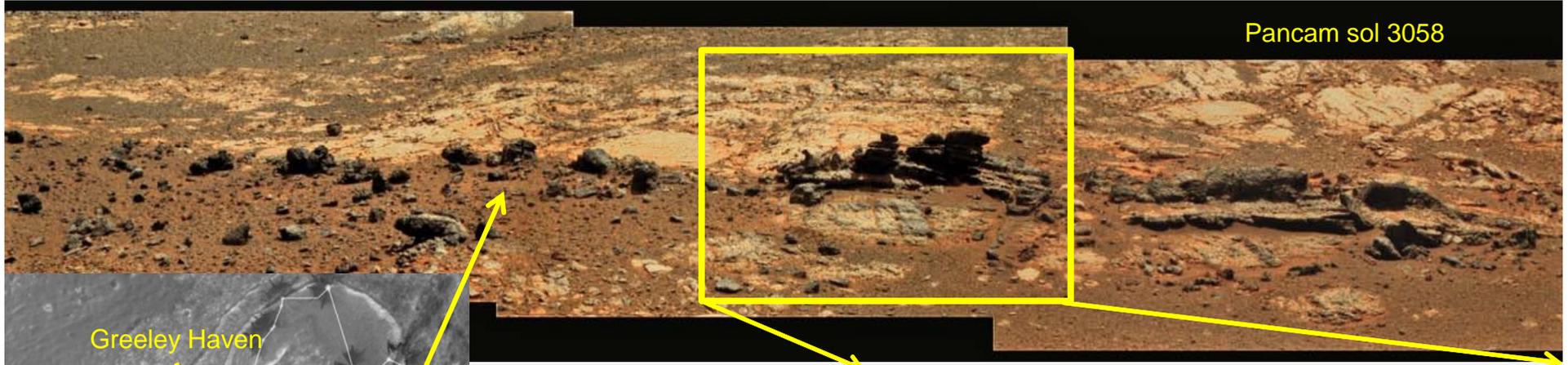
Martian  
“Blueberries”



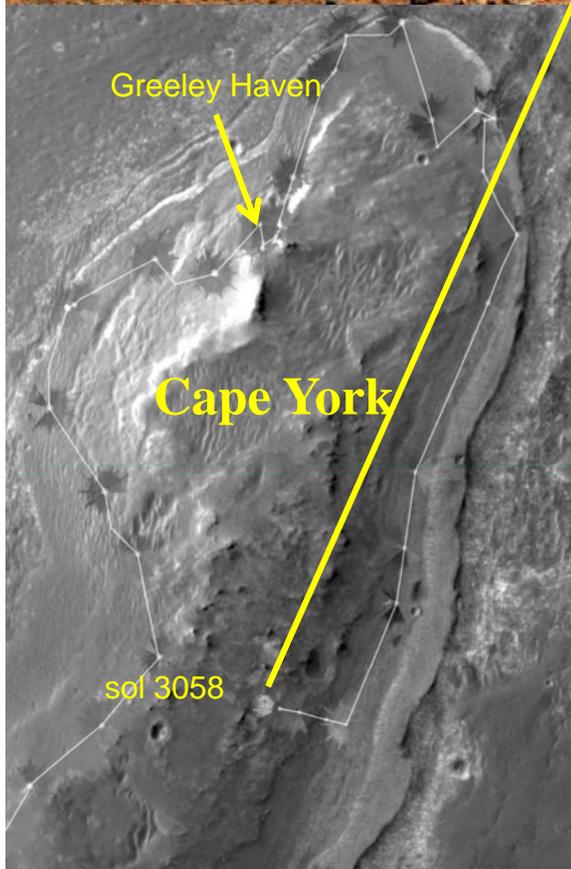
# Opportunity at Endeavour Crater



Solar System Exploration @ 50



Pancam sol 3058

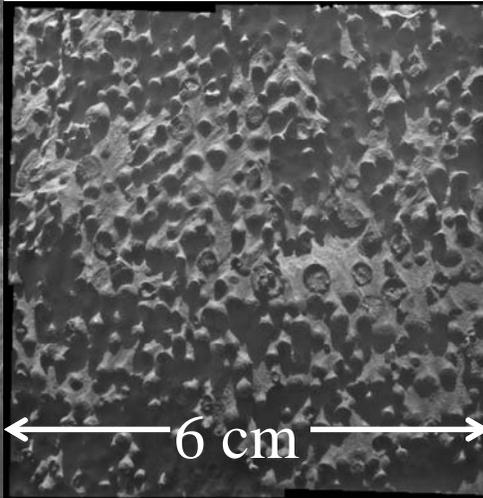


Greeley Haven

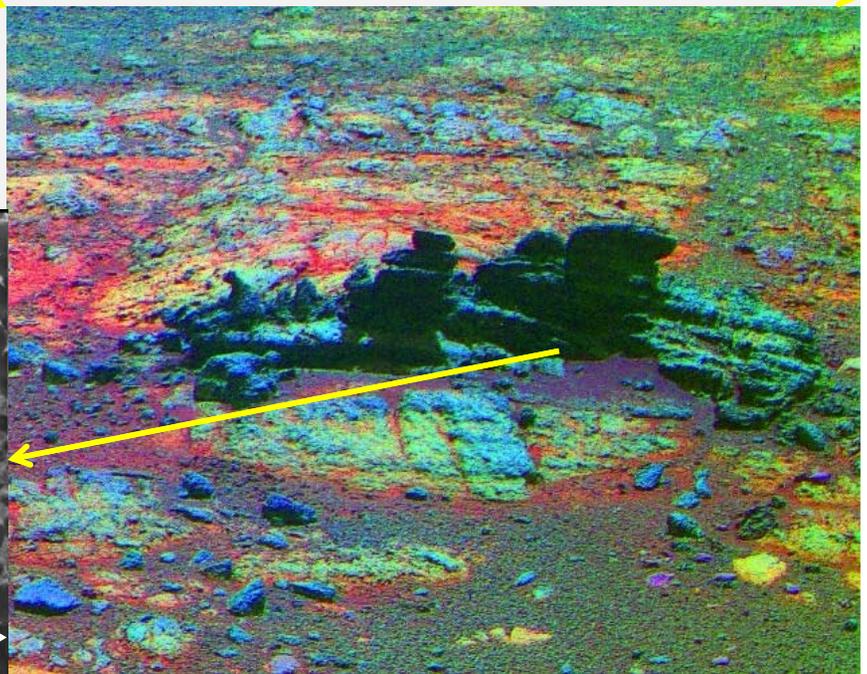
Cape York

sol 3058

**MER-B**



6 cm

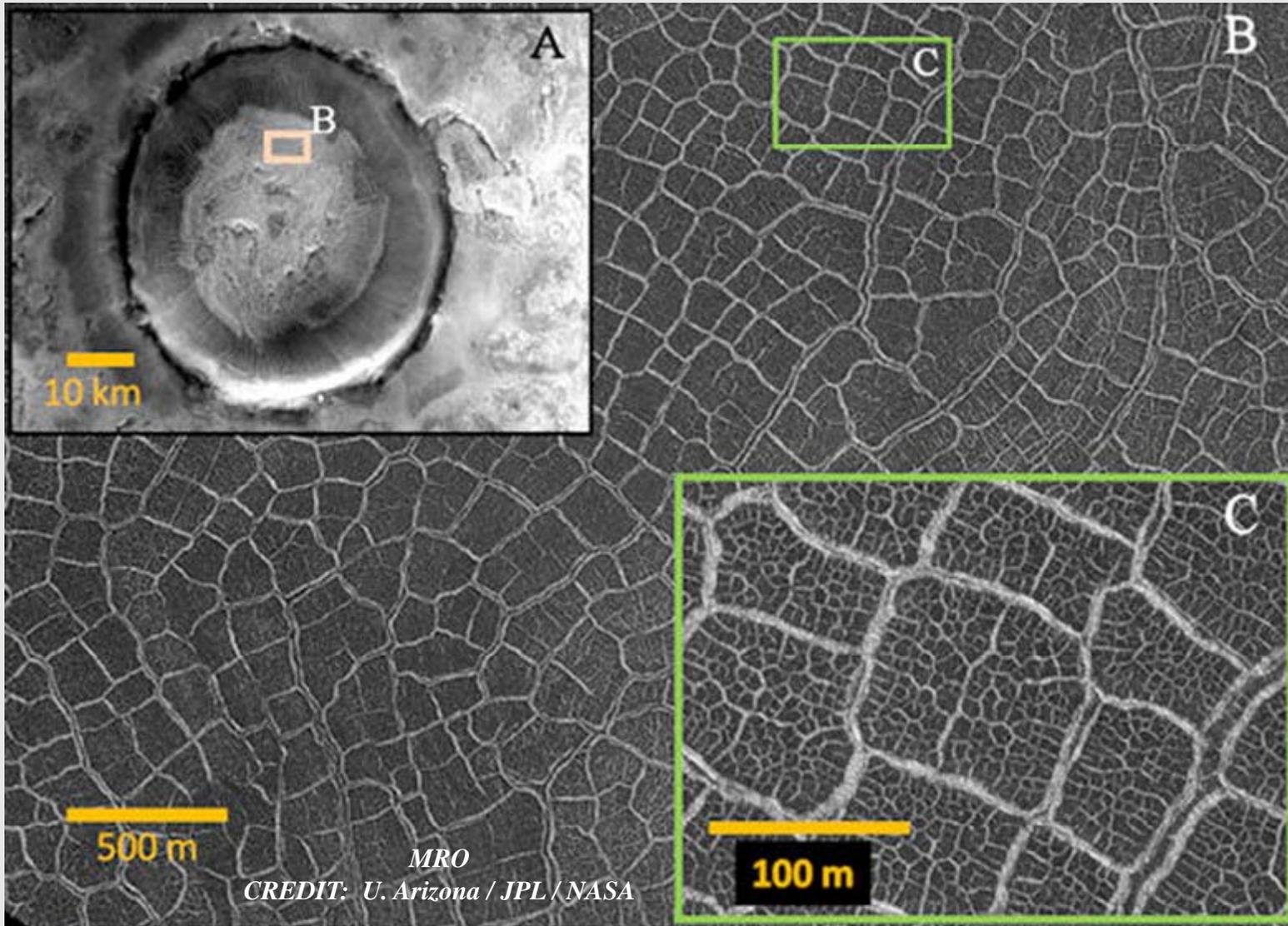


spectral principal component stretch 2

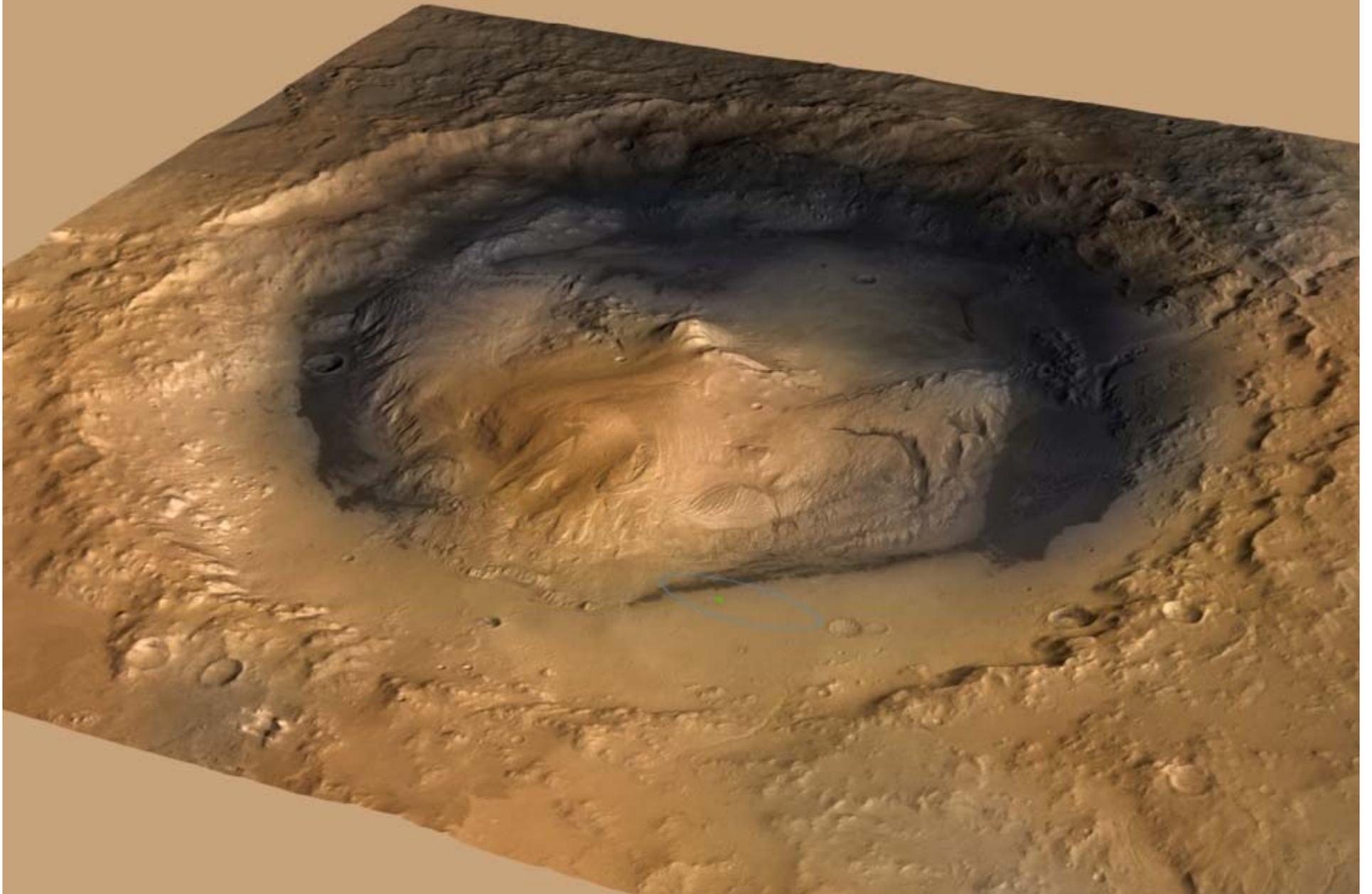
# Mars Patterned Ground



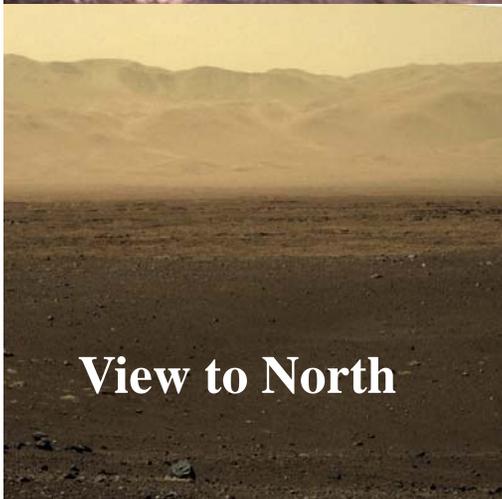
Solar System Exploration @ 50



# *Gale Crater and Mount Sharp*



# *Foothills of Mt. Sharp*



**View to North**

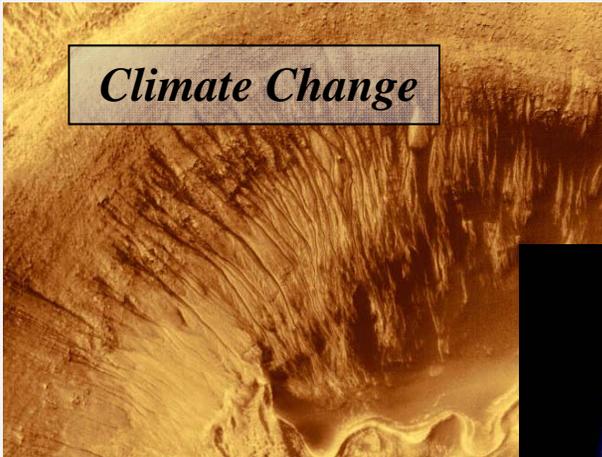
*Credit: MastCam / MSSS / JPL / NASA*

# Mars: A Complex Planet

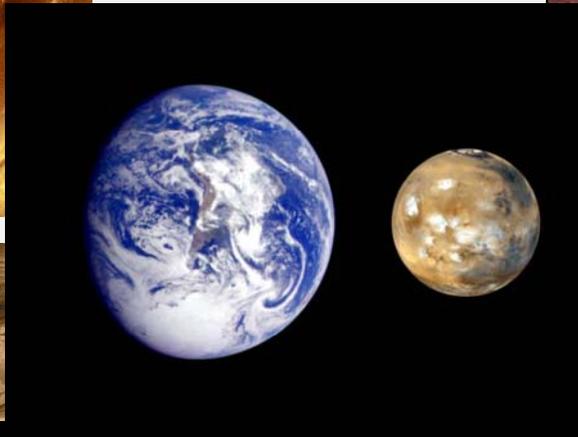


Solar System Exploration @ 50

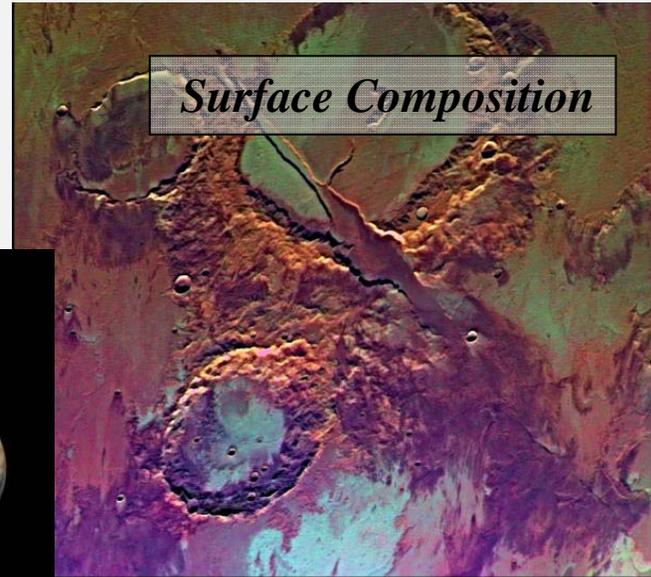
Climate Change



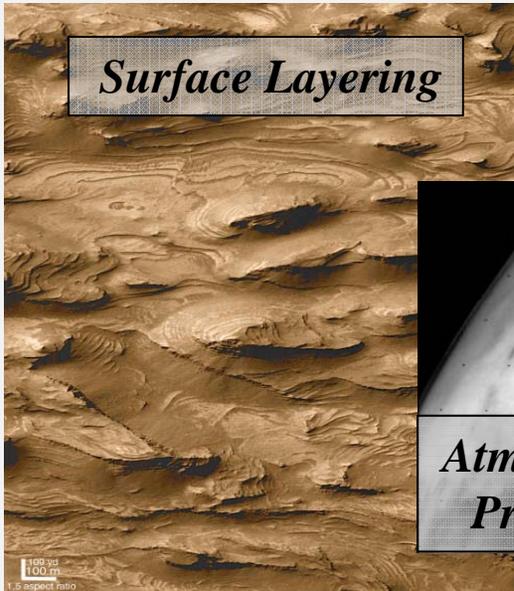
Comparative Planetology



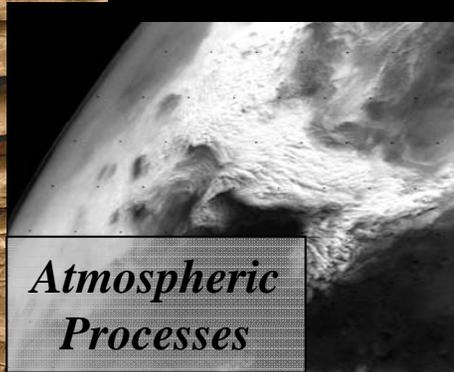
Surface Composition



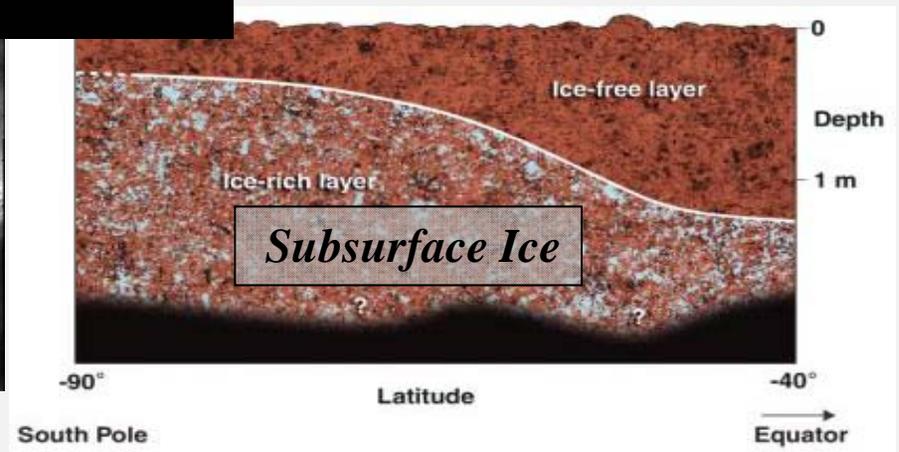
Surface Layering



Atmospheric Processes



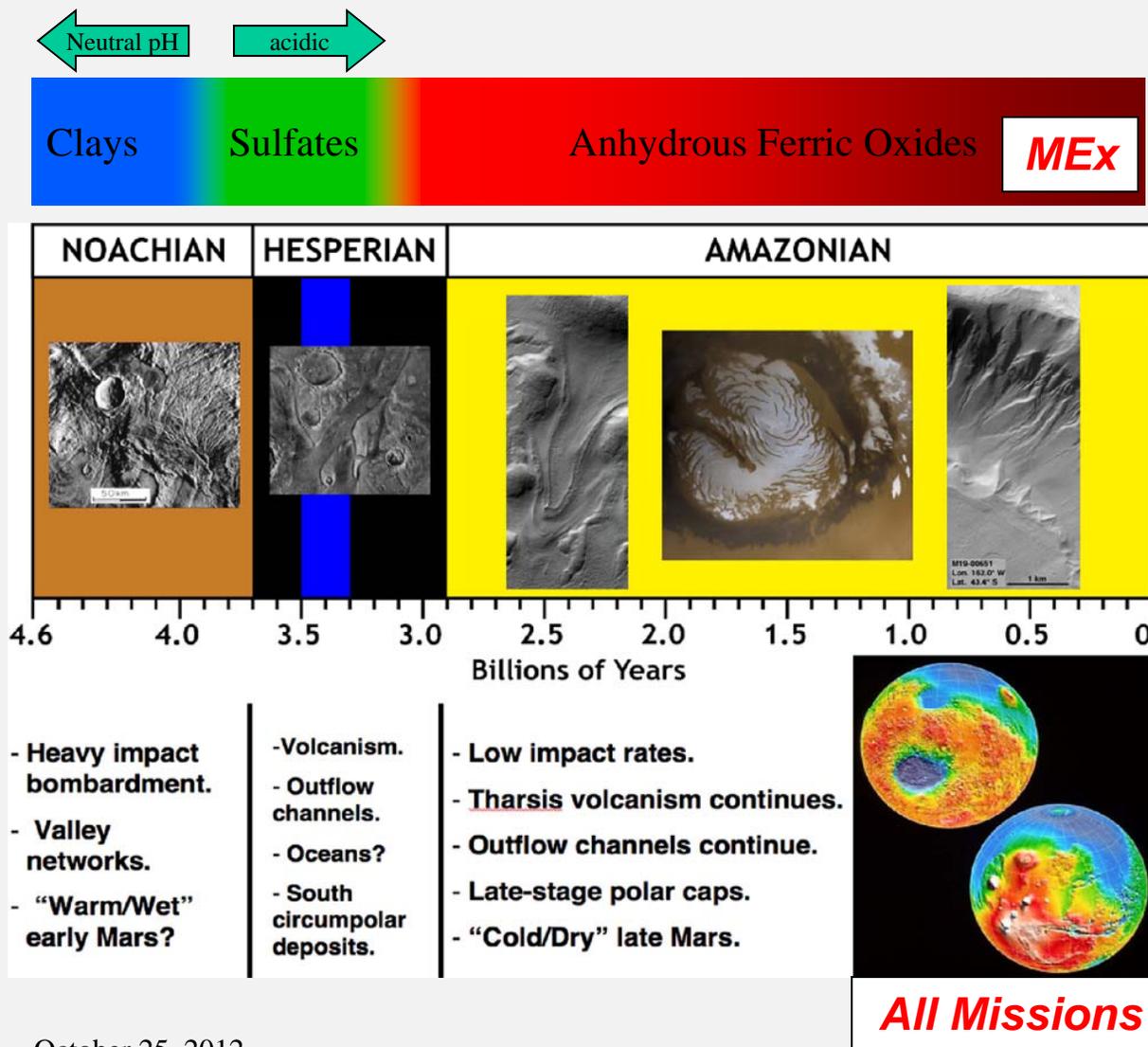
Subsurface Ice



# Mars Planetary Evolution



Solar System Exploration @ 50



## Hydrous Mineralogy Changed Over Time

- Phyllosilicate minerals (smectite clay, chlorite, kaolinite...) formed early
- Evaporates dominated by sulfate formed later with opal/hydrated silica
- Few hydrated mineral deposits since

## Evolution of Aqueous, Fluvial and Glacial, Morphology with Time

- Valley networks, lake systems
- Gullies
- Viscous flow, glaciers, latitude dependant mantle

# Mars: A Planet Changing Today



Solar System Exploration @ 50

*Possible Brine Flows?*



*Global Dust Storm*



June 26, 2001



September 4, 2001

*New Gully Flows*



*Polar Cap Extent*

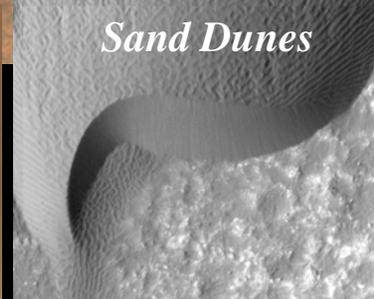


March 1999



January 2001

*Sand Dunes*



*Polar Cap Landslides*



Credits: HST / MRO STSci / U. Arizona / JPL / NASA

# Why Mars?



*Solar System Exploration @ 50*

- ***Mars: An Abode for Life?***
  - Mars is in the “habitable zone” with an early climate that had liquid water and sunlight on its surface, with basic elements to utilize
  - If life originated there, does it still exist? If life did not originate there, why not?
- ***Mars: Comparative Study with Earth***
  - The climate of Mars has changed profoundly over time
  - The record of that change is preserved in its surface morphology and composition. Mars was once wetter--and possibly warmer--with a much more active hydrological cycle
- ***Mars: A destination?***
  - Of all the planets, Mars is the most accessible
  - Astronauts could walk on its surface by-mid century

# Robots and Humans

*3<sup>rd</sup> Wave of Space Exploration?*

DISCOVERY

EXPLORATION

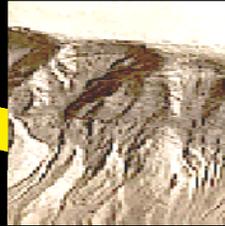
Climate History



Sample Selection



Ancient Water



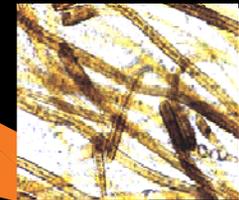
Validate Paleo-Life



Resources



Extant Life?



ROBOTICS ROBOTICS ROBOTICS HUMANS ROBOTICS & HUMANS



Reconnaissance



Site Selection



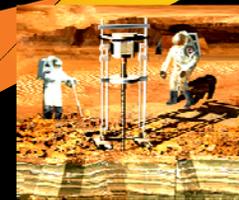
Sample Selection



Return Sample



Field Studies



Deep Drilling

