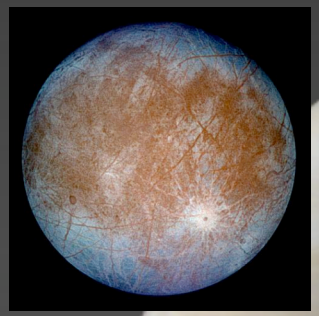
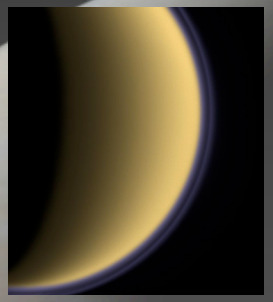
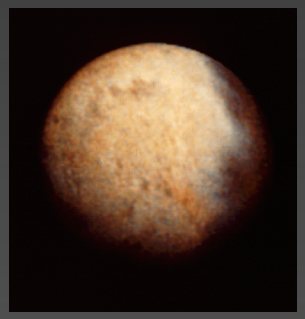
The big "H"--Habitability

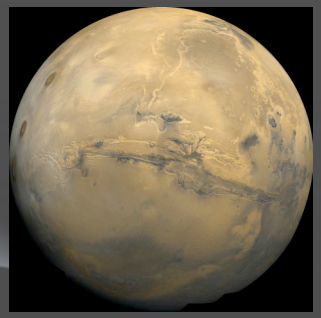
Habitability in planetary environments







How does a planetary system become habitable?



Habitability in the architecture of planetary systems

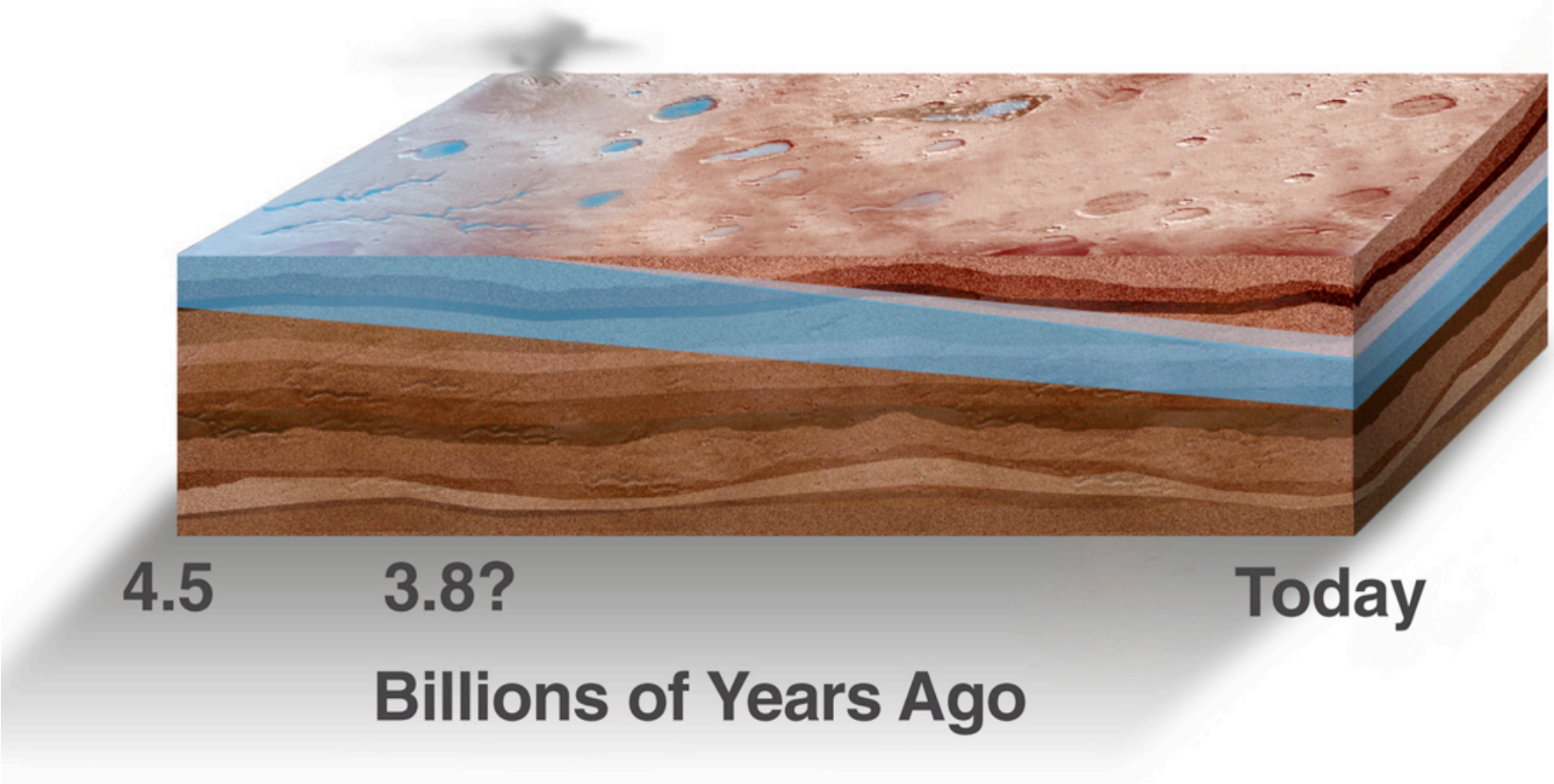
Mars Exploration Rover

Following the Water

Michael Carroll

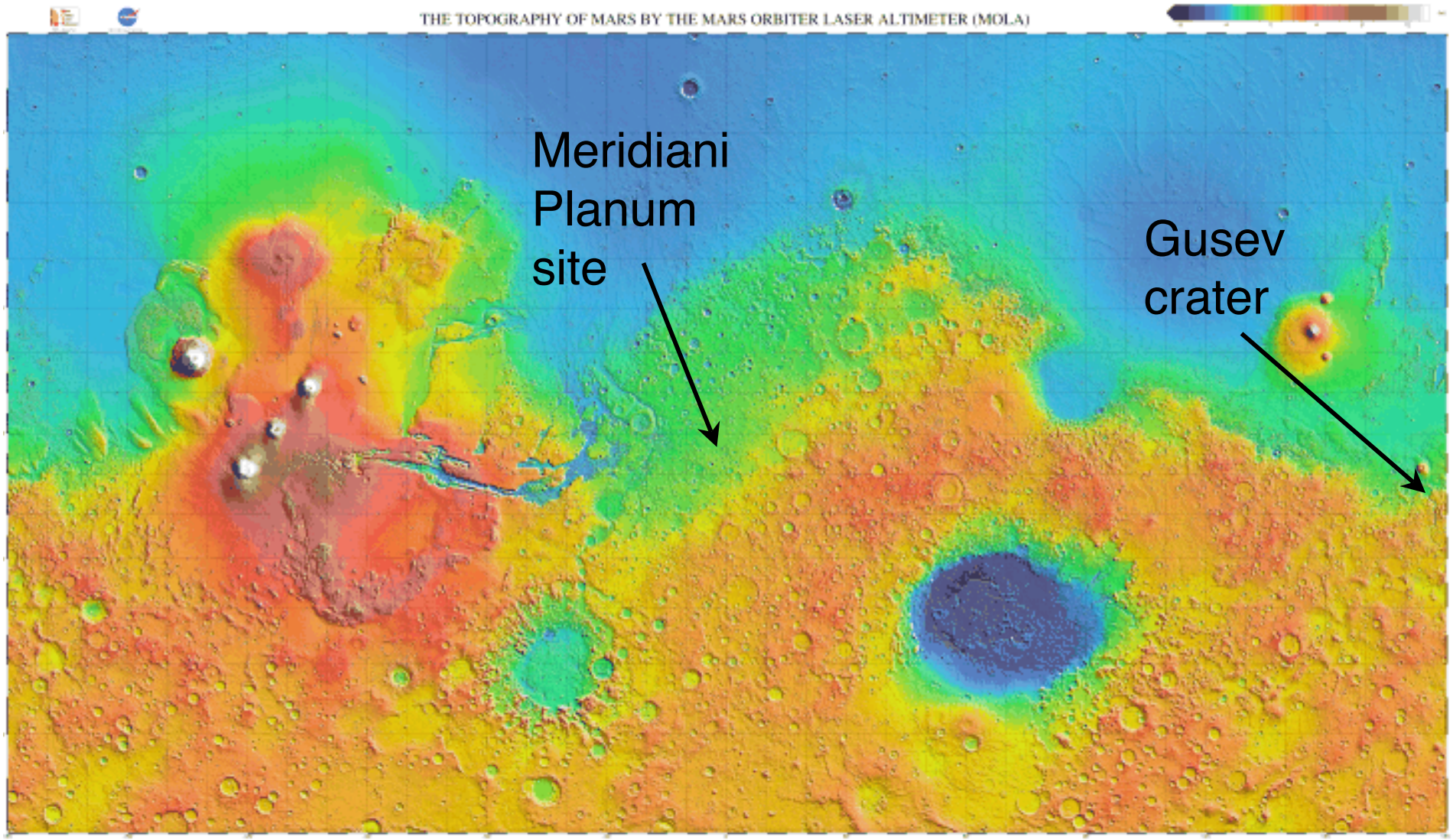
David J. Des Marais
Ames Research Center, NASA
and the Mars Exploration Rover Team

Conditions That Could Sustain Life on Mars: Changes Over the Eons



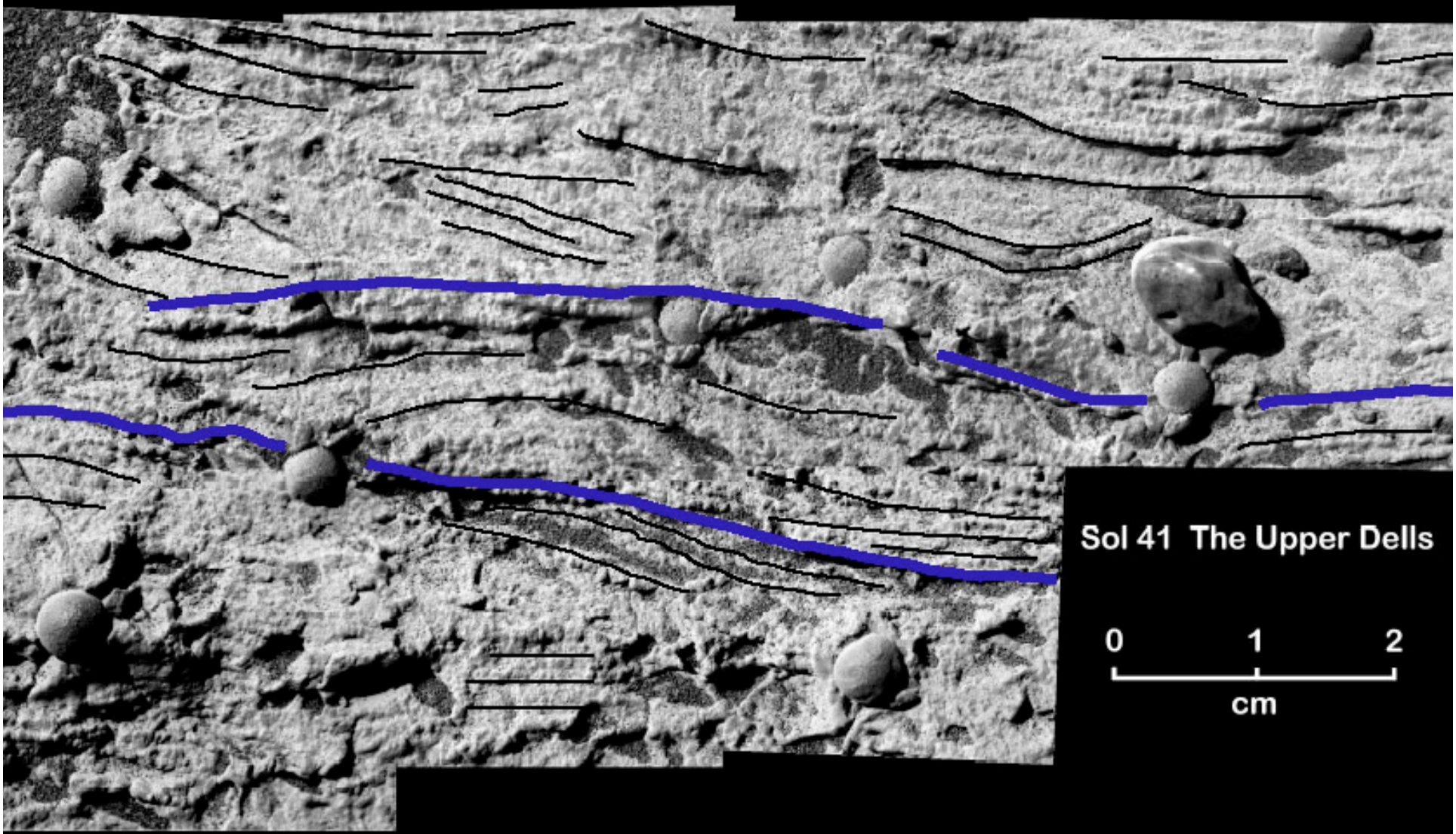
Des Marais

MOLA-based Elevation Map of Mars (Low to High)



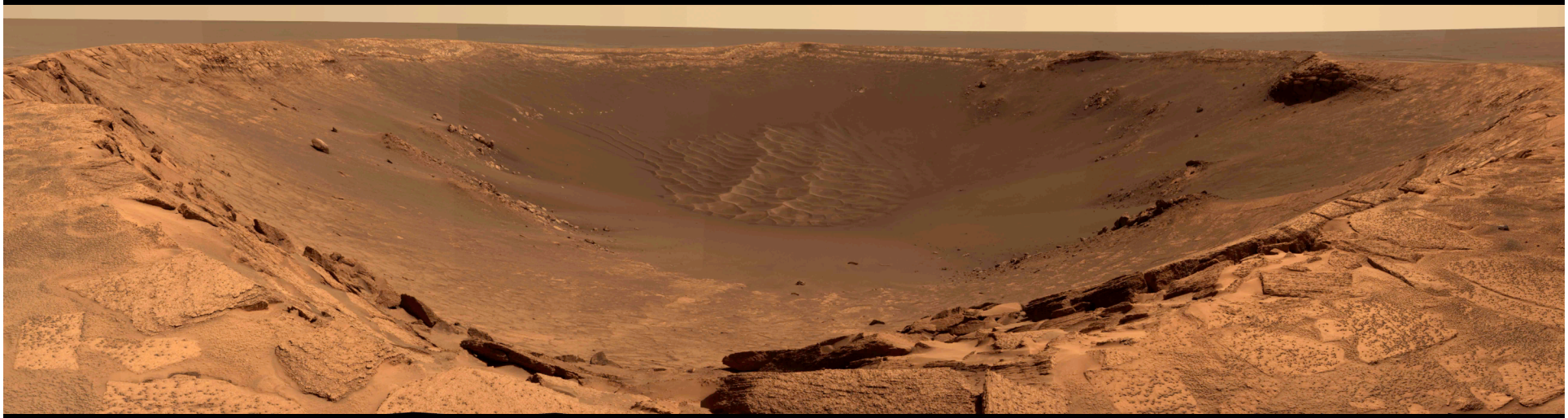
Guadalupe outcrop
1 cm

Dells MI Mosaic



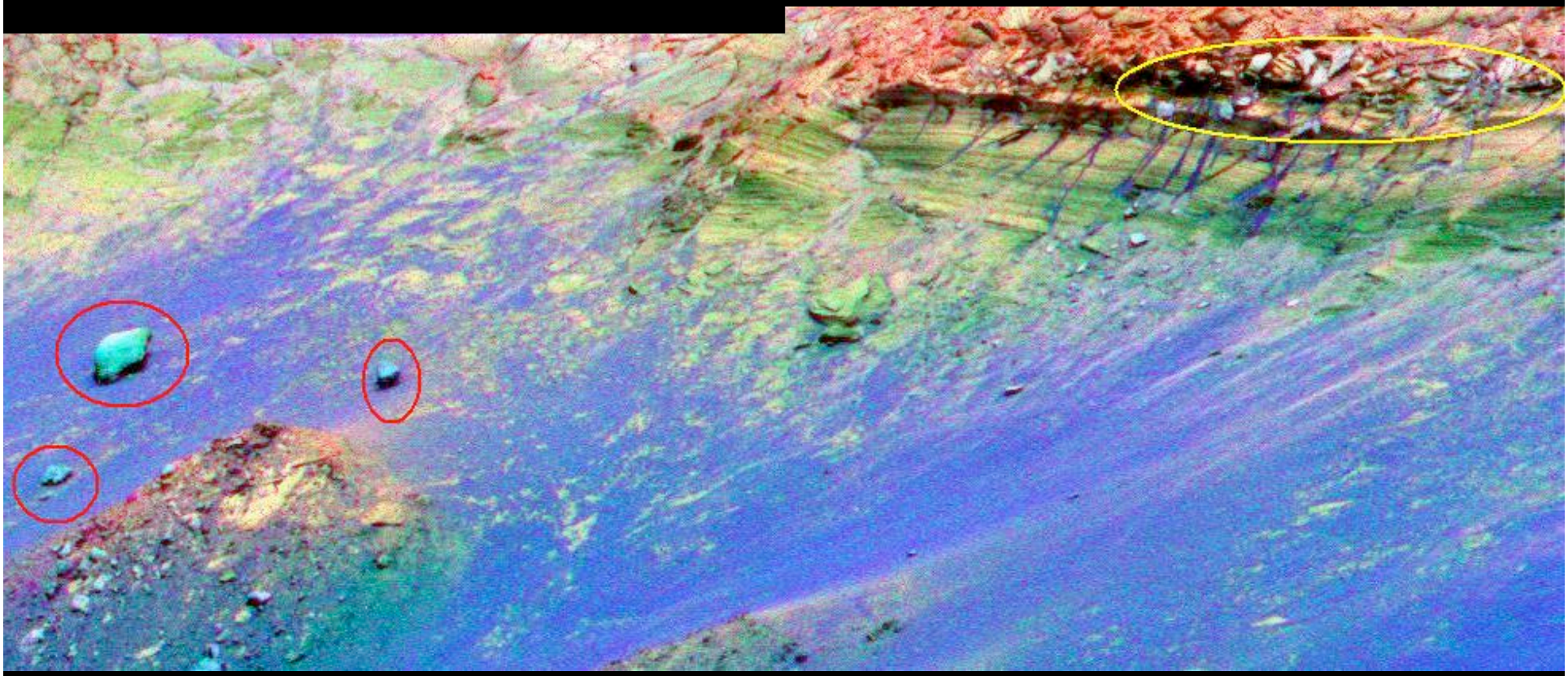
Endurance Crater Viewed from Southeast Rim

~160 meters in diameter, 15 meters deep



170 m diameter

Endurance Crater:
Visible - Near-IR Spectral Analysis

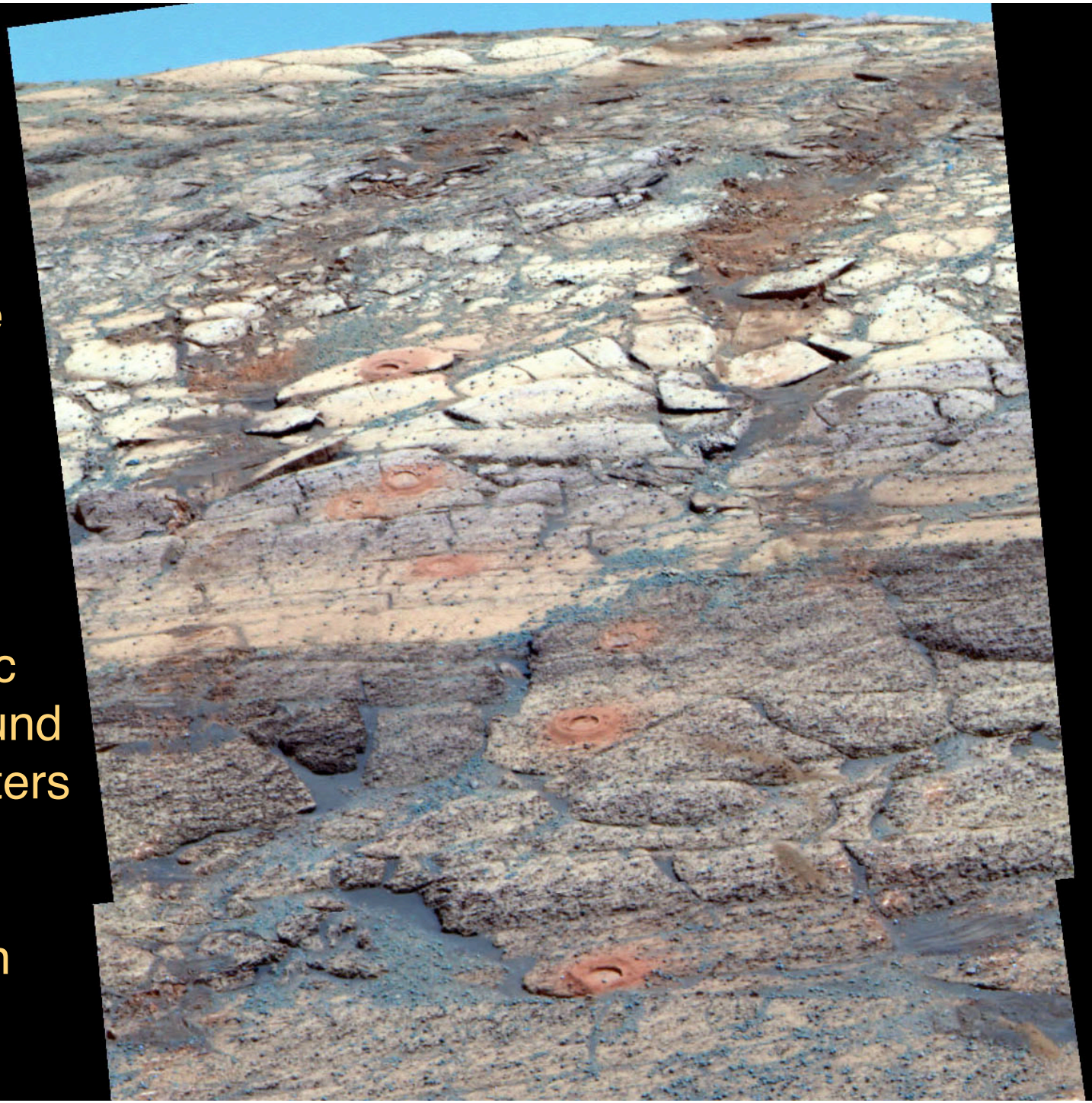


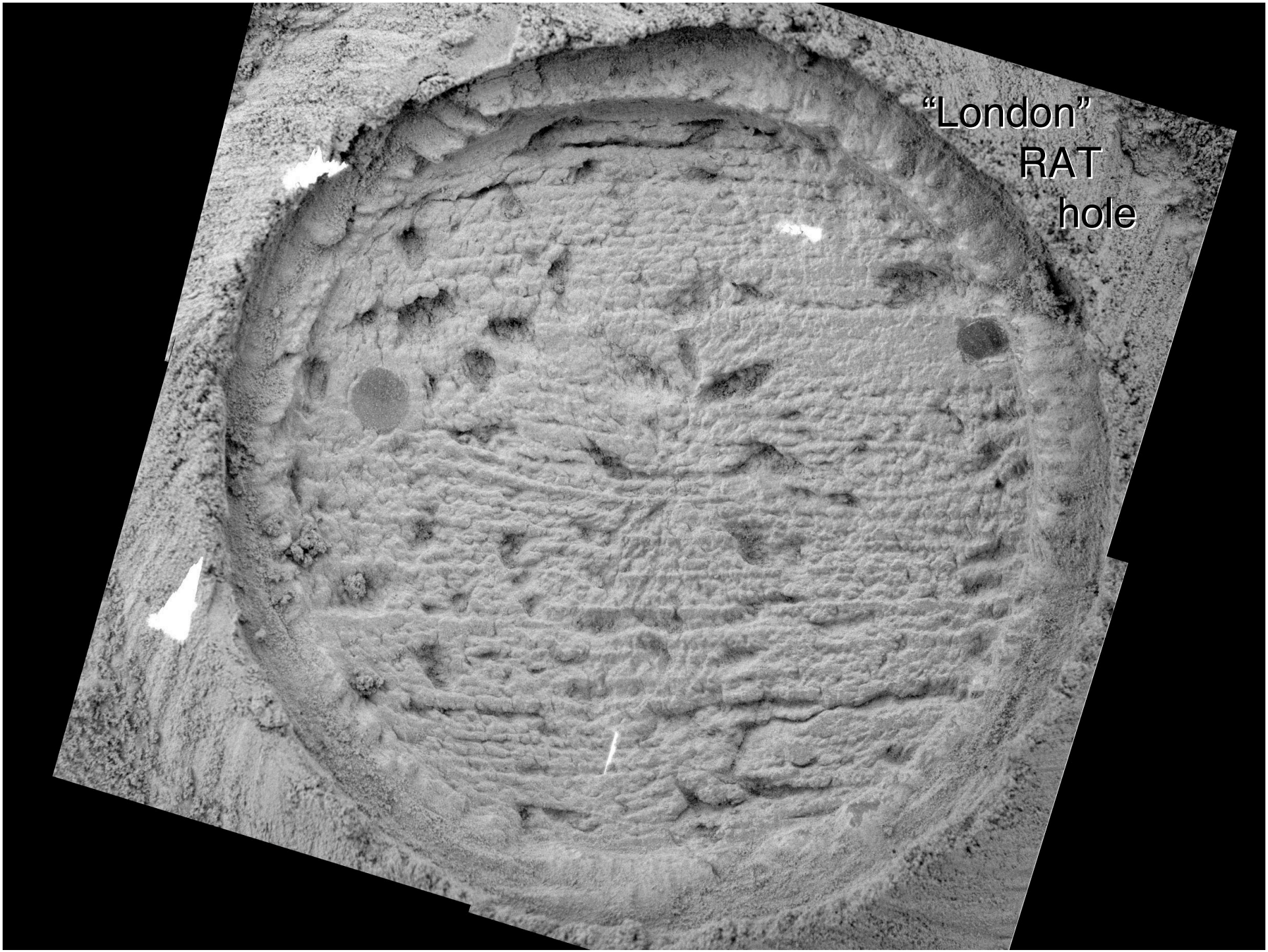
"False-color" blue surfaces display a strong 1-um band; consistent with basalt

W. Farrand

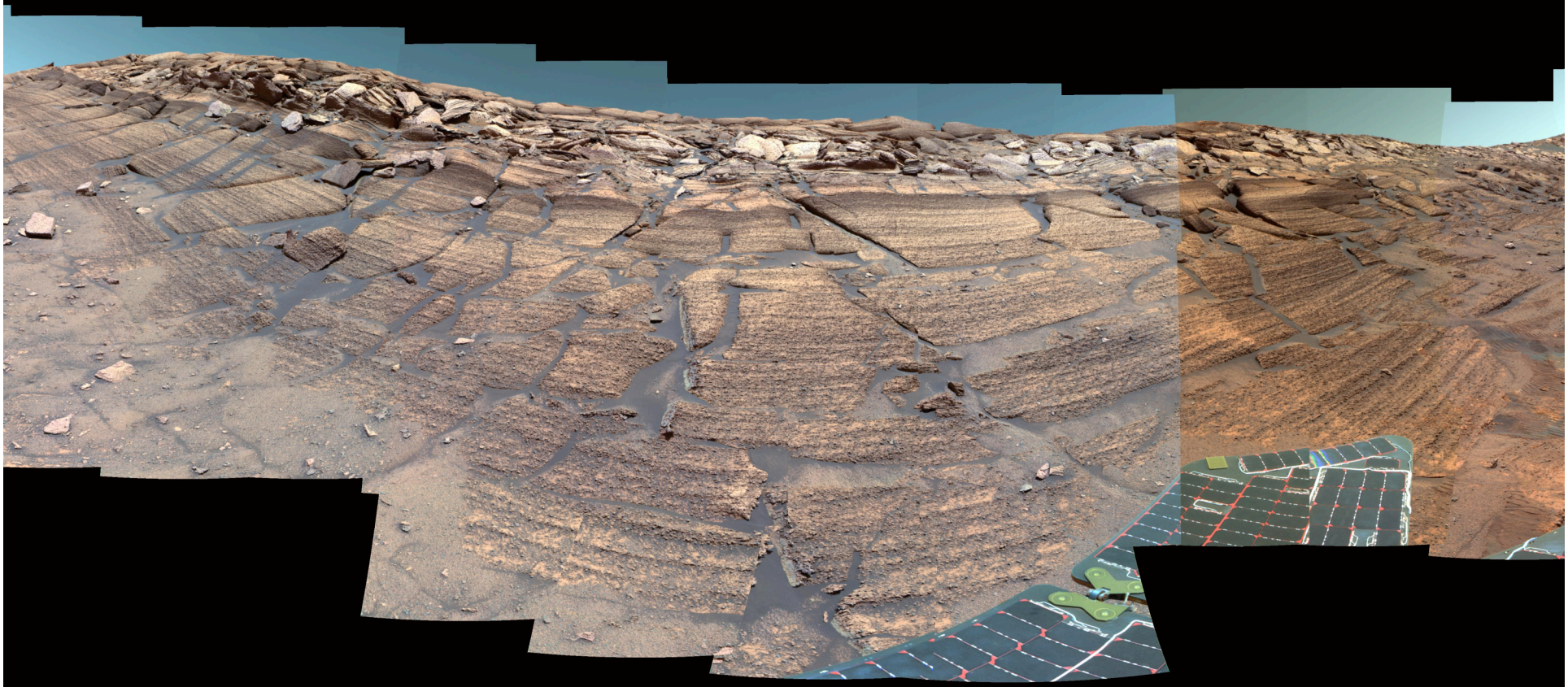
Karatepe section, Endurance crater, Meridiani Planum

“RAT hole” stratigraphic analysis found several meters of uniform bedrock composition

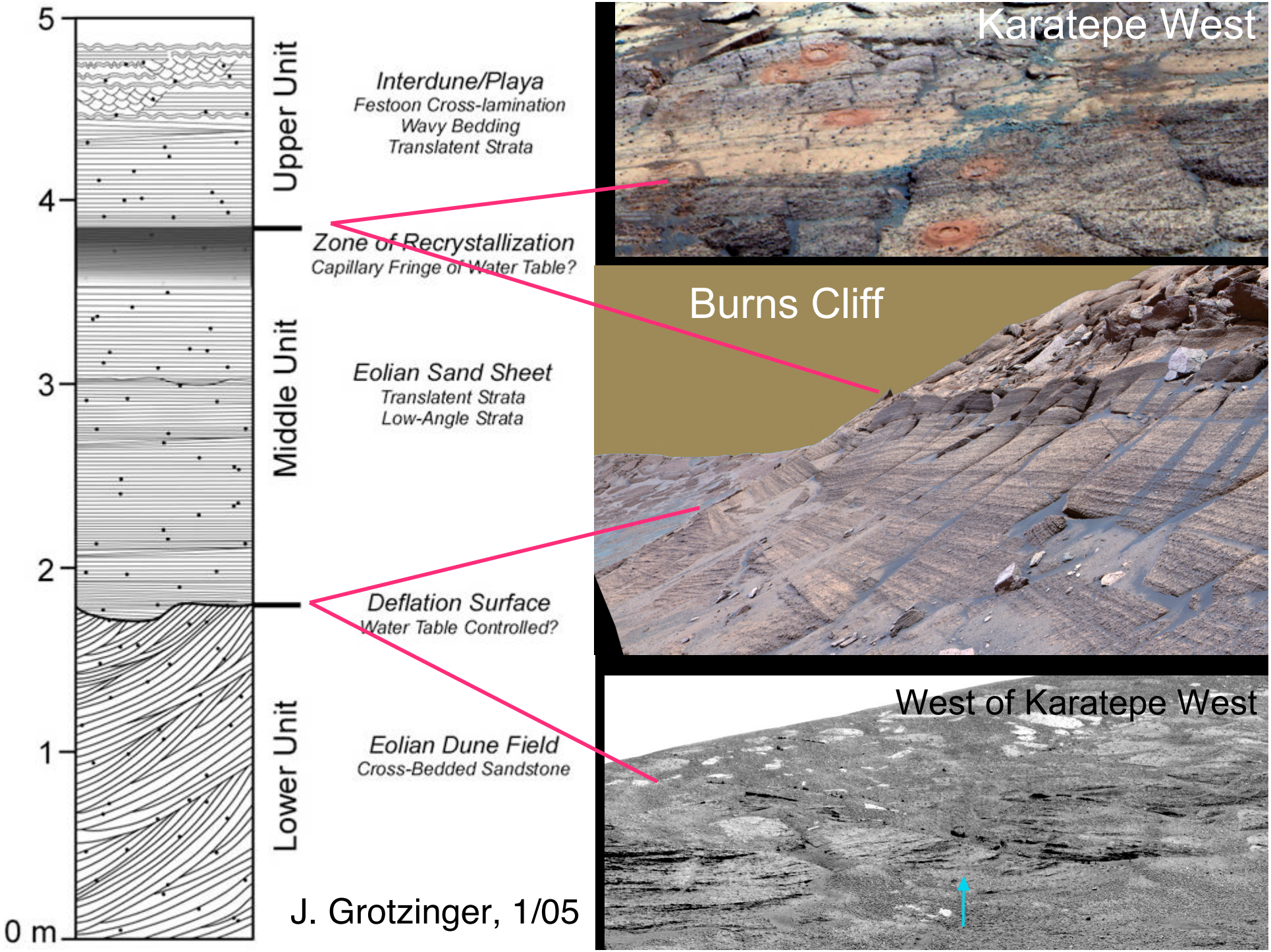



“London”
RAT
hole

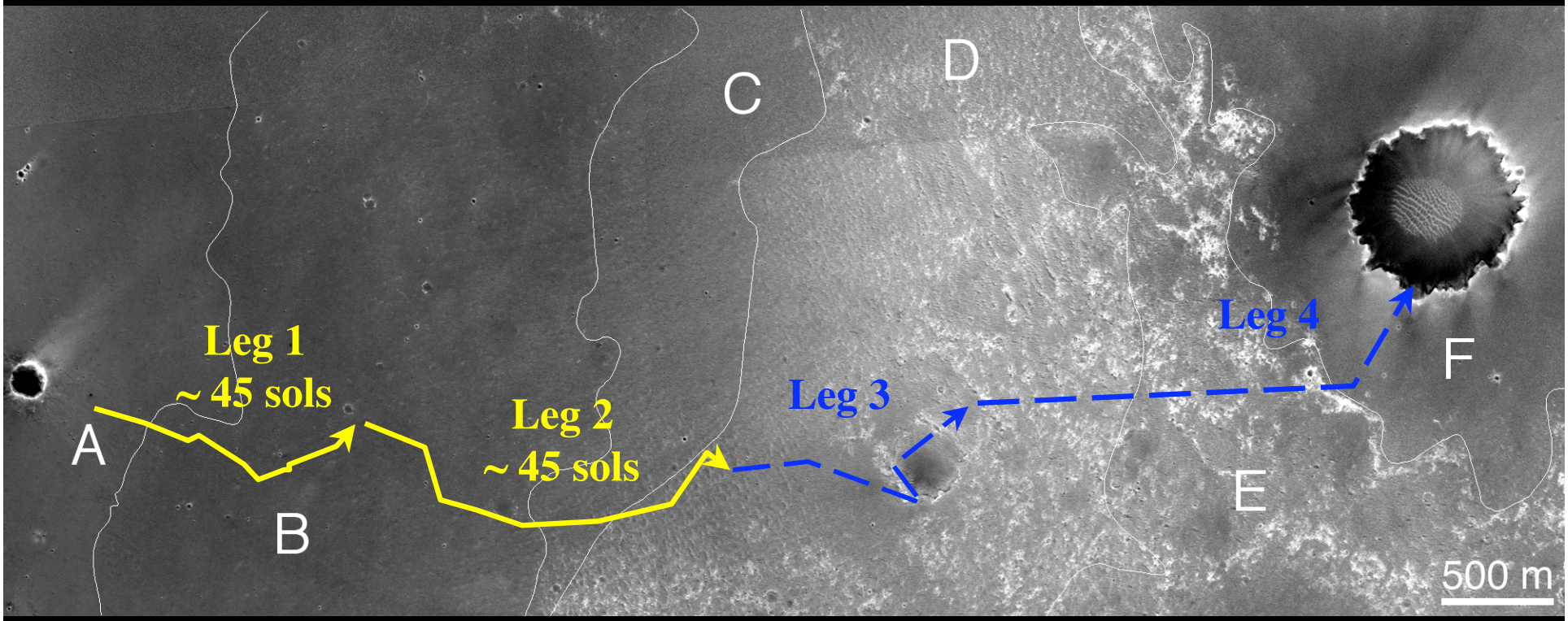
Burns Cliff, Endurance crater, Terra Meridiani



(P227* series mosaic)
L257 false color


5
4
3
2
1
0 m
Upper Unit
Middle Unit
Lower Unit
Interdune/Playa
Festoon Cross-lamination
Wavy Bedding
Translatent Strata
Zone of Recrystallization
Capillary Fringe of Water Table?
Eolian Sand Sheet
Translatent Strata
Low-Angle Strata
Deflation Surface
Water Table Controlled?
Eolian Dune Field
Cross-Bedded Sandstone
J. Grotzinger, 1/05
Karatepe West
Burns Cliff
West of Karatepe West

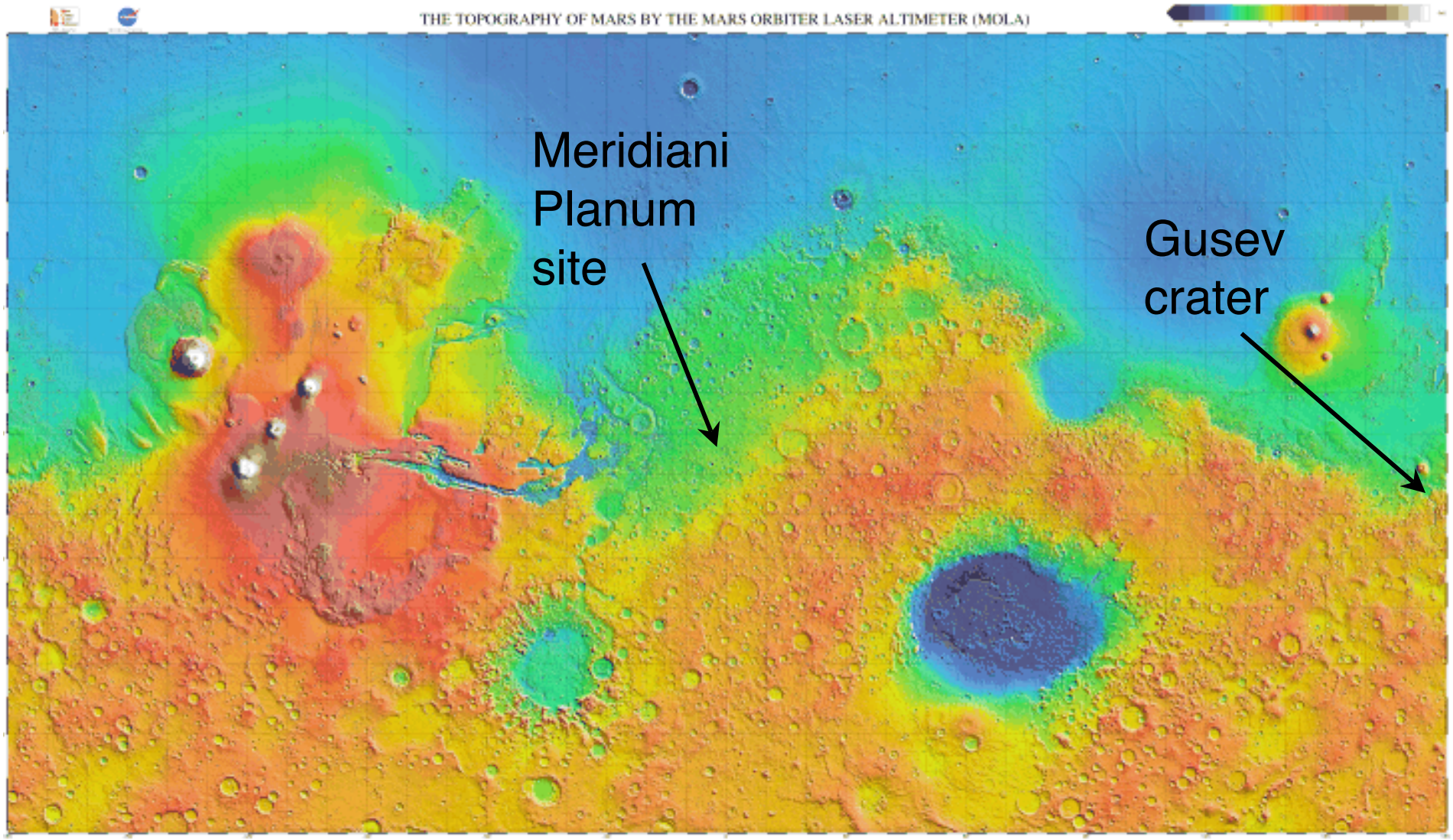
Planned Route to the South

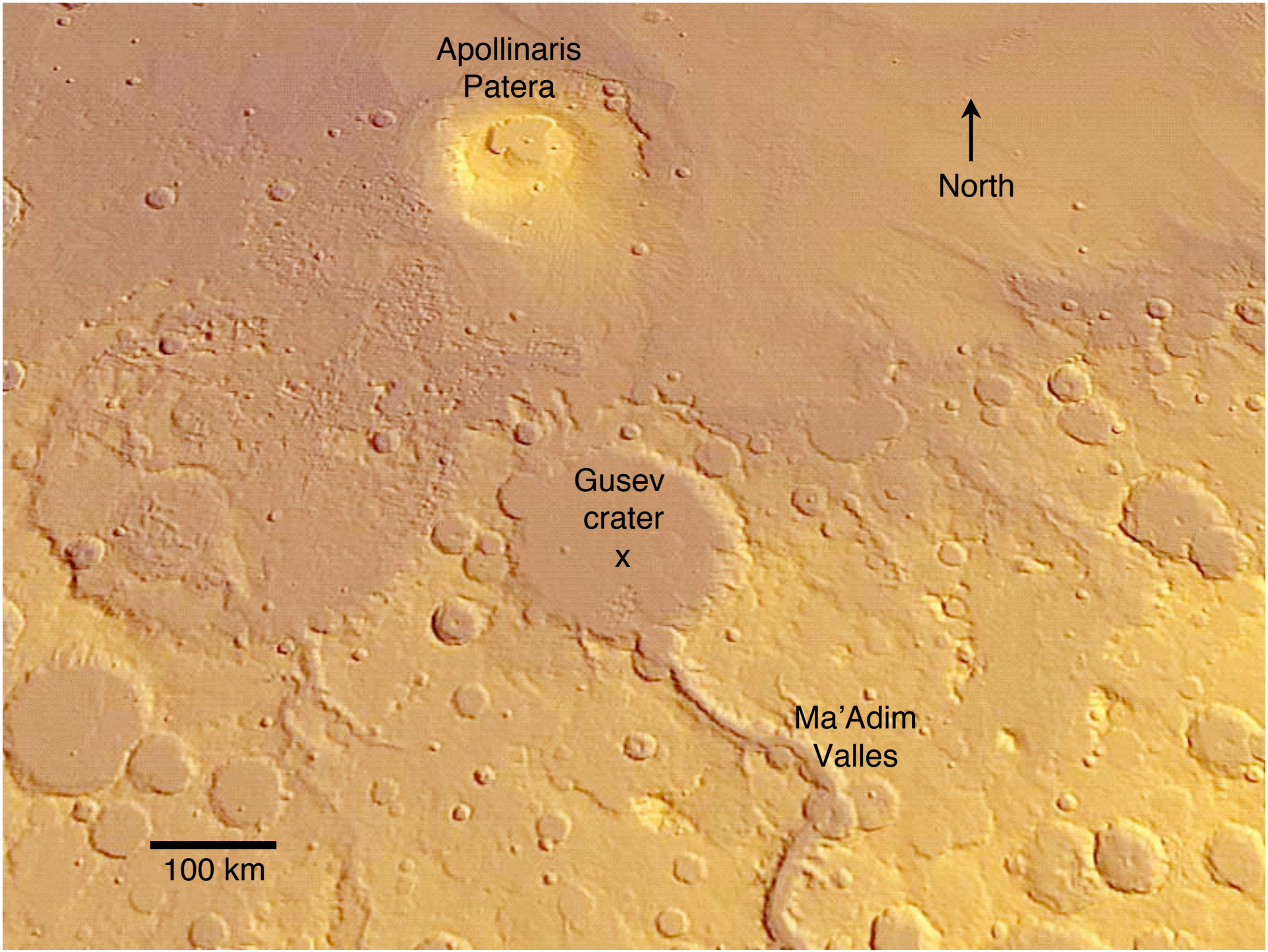


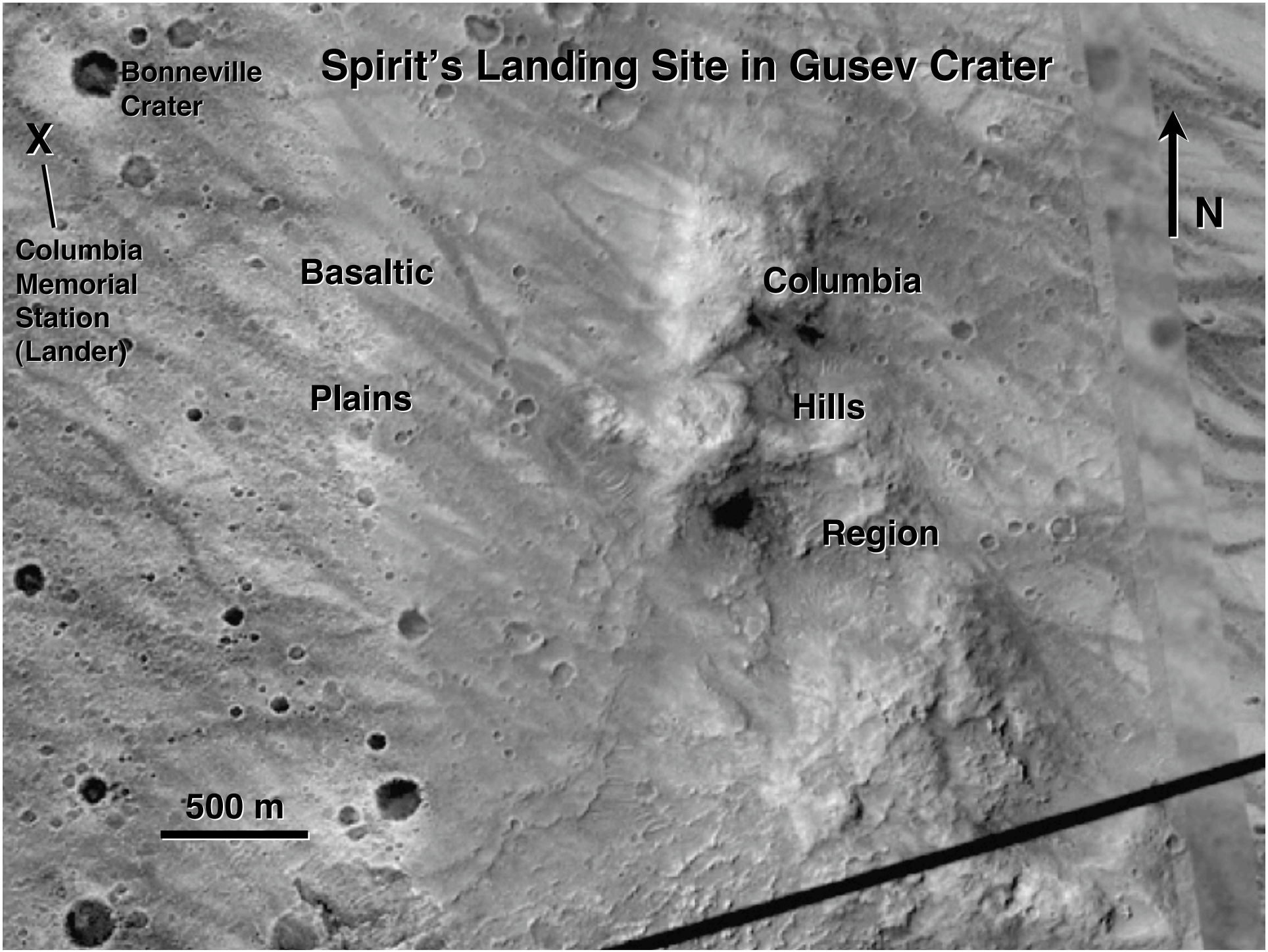
Endurance crater

Victoria crater

MOLA-based Elevation Map of Mars (Low to High)




Apollinaris
Patera
North
Gusev
crater
x
Ma'Adim
Valles
100 km

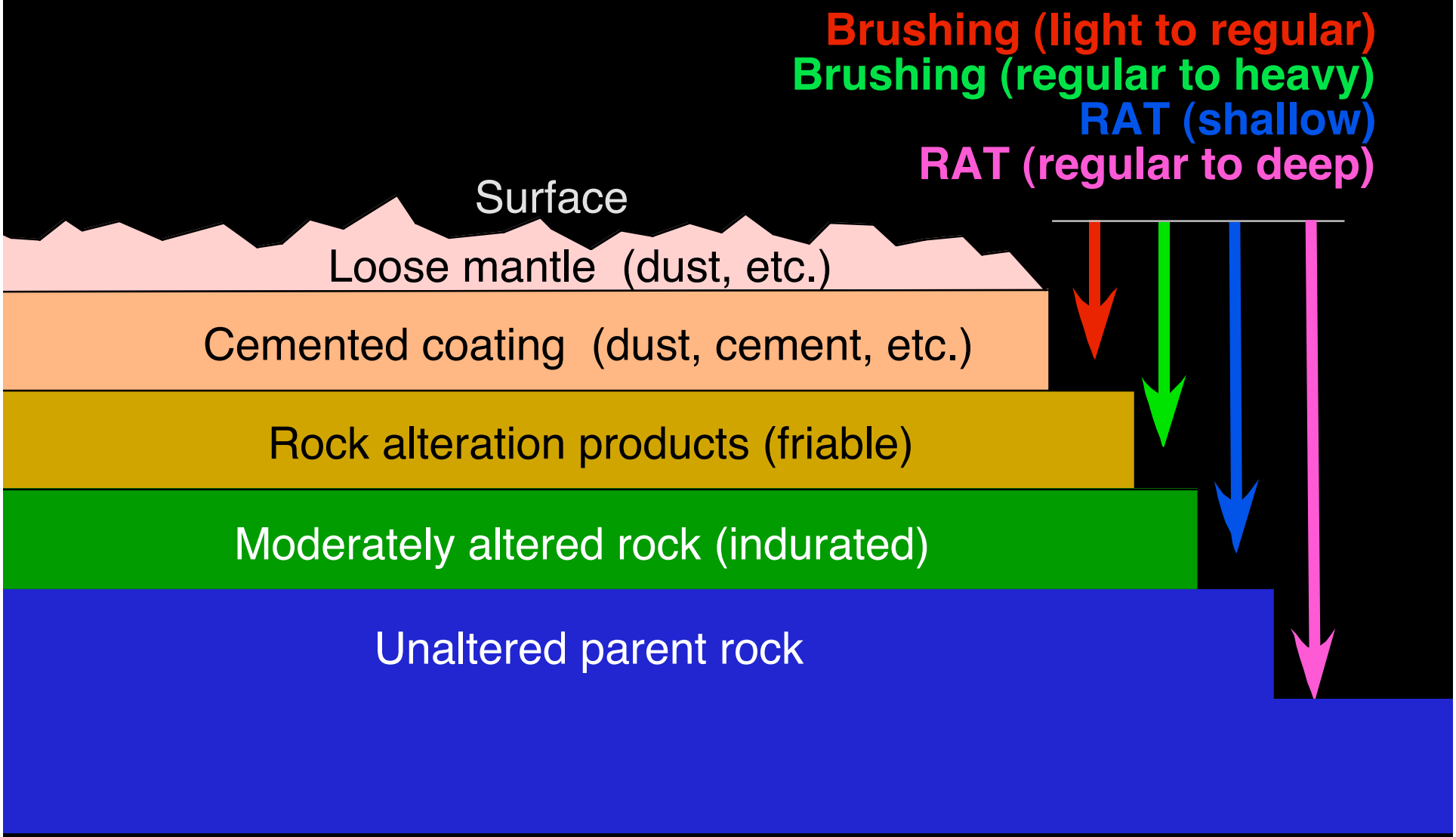

Spirit's Landing Site in Gusev Crater
Bonneville Crater
X
Columbia Memorial Station (Lander)
Basaltic
Plains
Columbia
Hills
Region
N
500 m

Bonneville crater, Gusev Crater

Reveals deep impact gardening of the regollith

200 m diameter, 15+ m deep

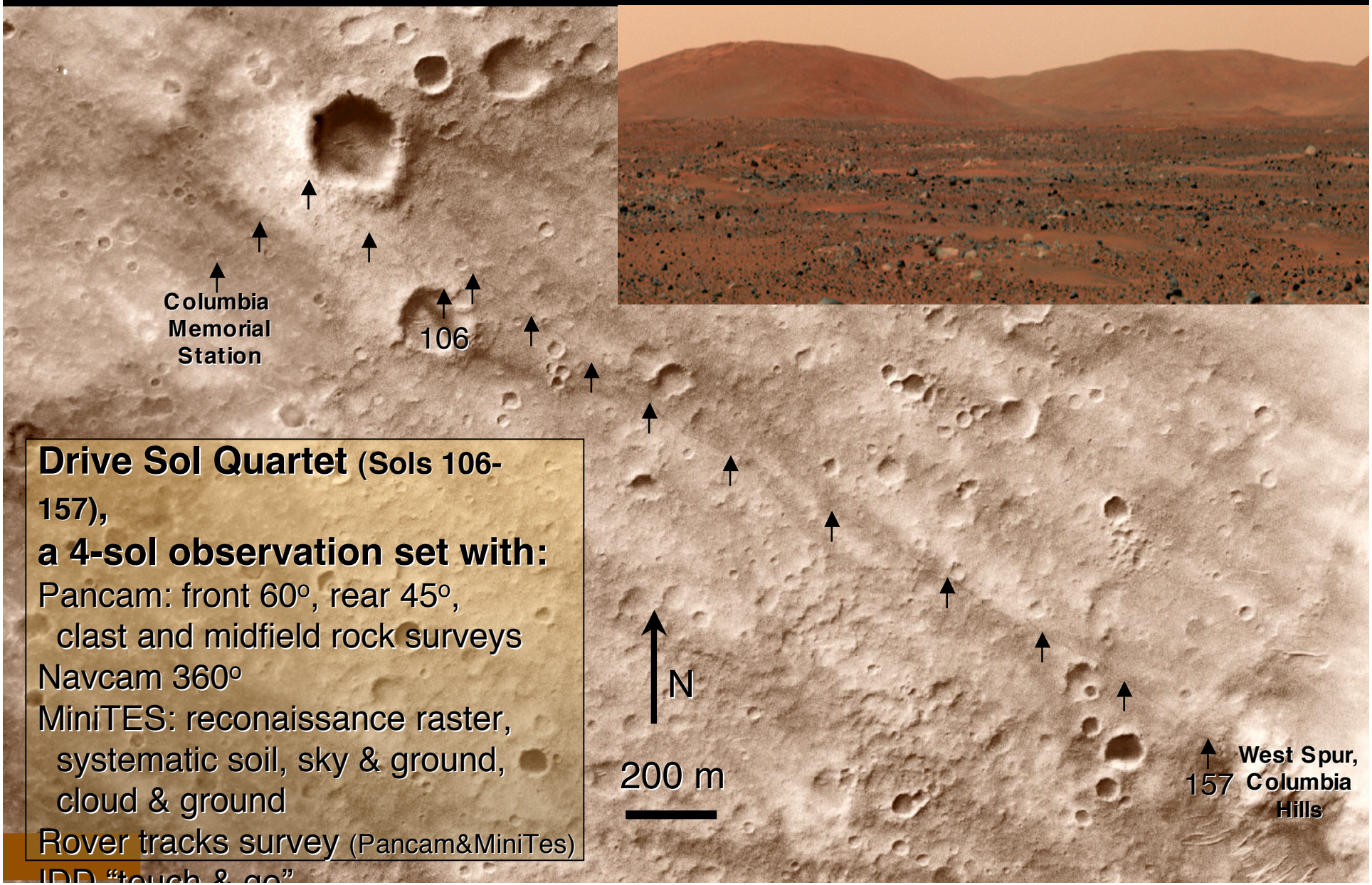
Detailed Rock Study using the Athena Instrument Suite



Des Marais

Mazatzal basalt, Gusev crater

Spirit's Traverse from Columbia Memorial Station to the Columbia Hills, January-June 2004



Drive Sol Quartet (Sols 106-157),

a 4-sol observation set with:

Pancam: front 60°, rear 45°, clast and midfield rock surveys

Navcam 360°

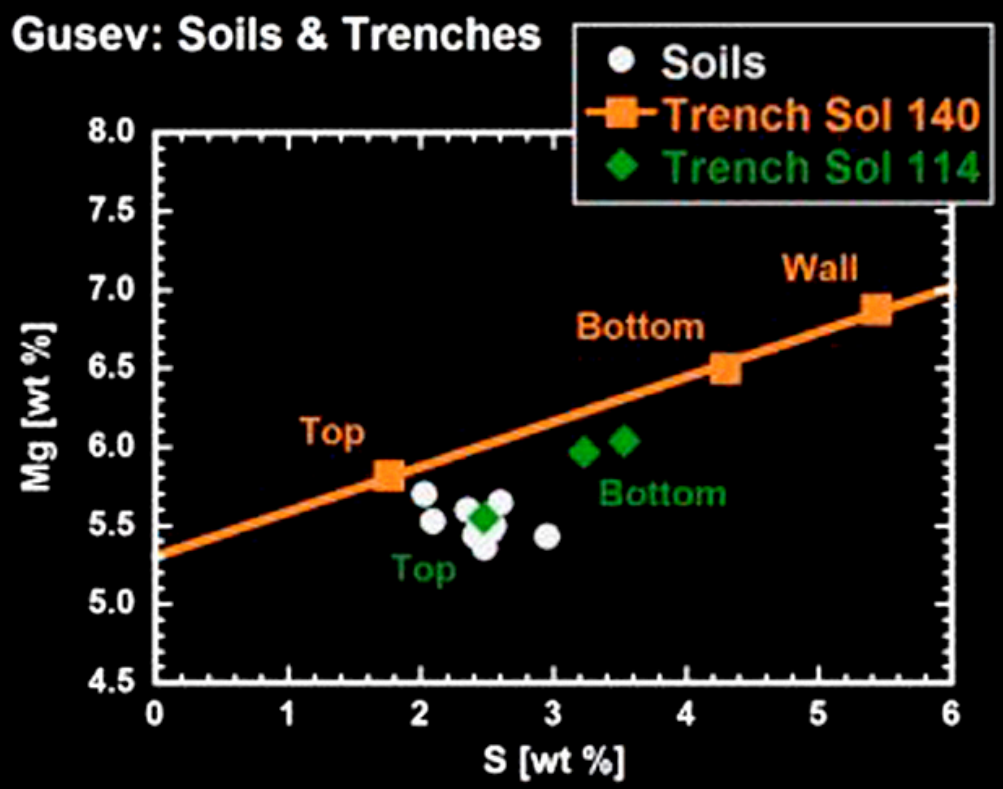
MiniTES: reconaissance raster, systematic soil, sky & ground, cloud & ground

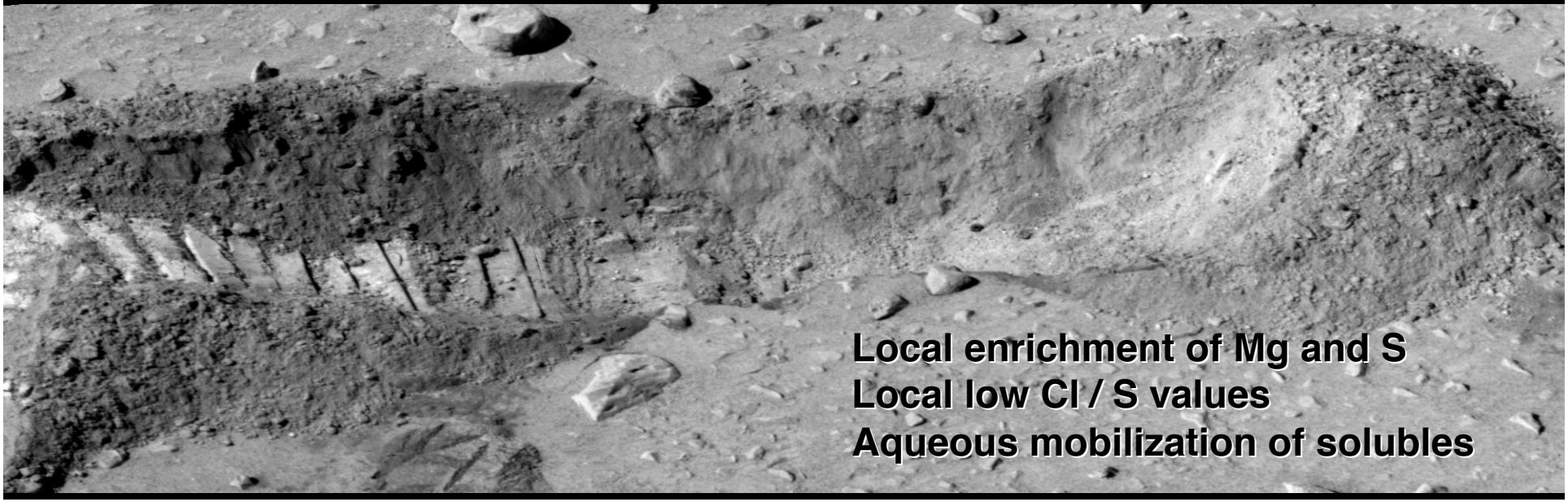
Rover tracks survey (Pancam&MiniTes)

IDD "touch & go"

The Boroughs Trench

Sol 140



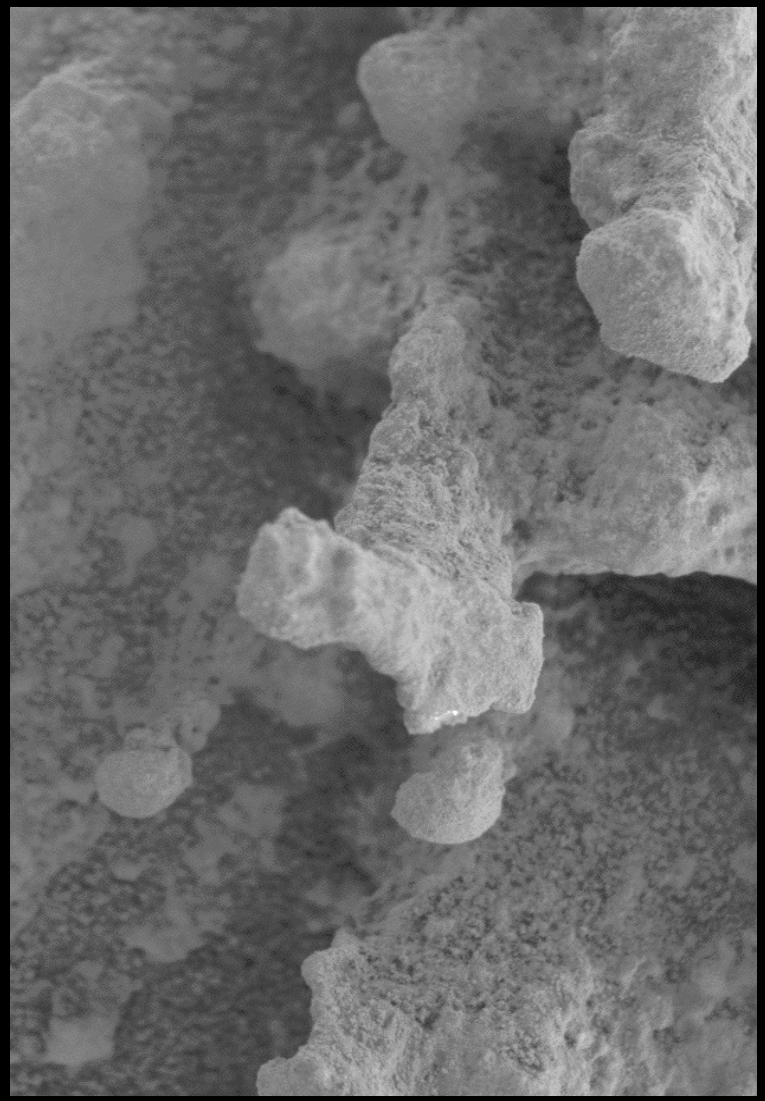


Local enrichment of Mg and S
Local low Cl / S values
Aqueous mobilization of solubles

Columbia Hills, Hank's Hollow: Pot of Gold and Breadbasket

Cavernous Weathering

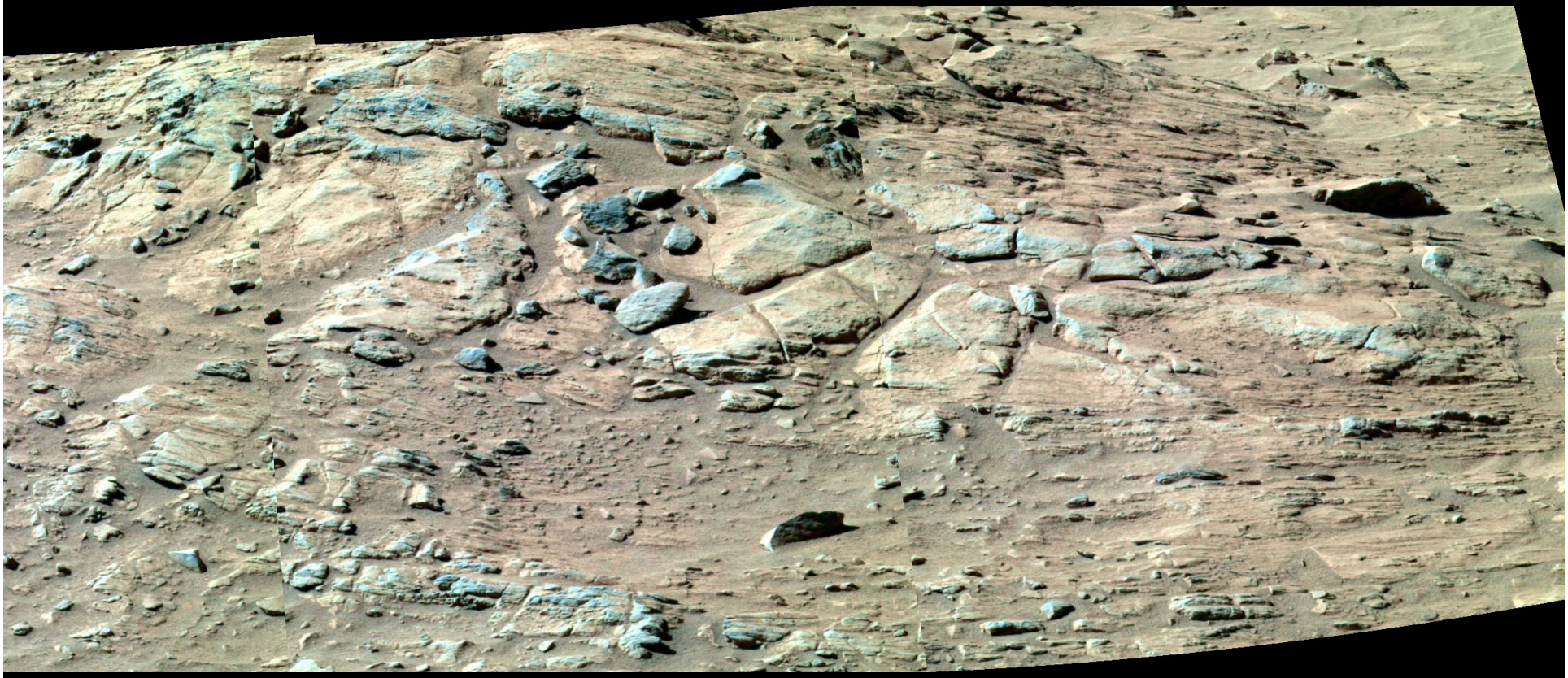
Terrestrial Analog for Pot of Gold? (J. Rice)



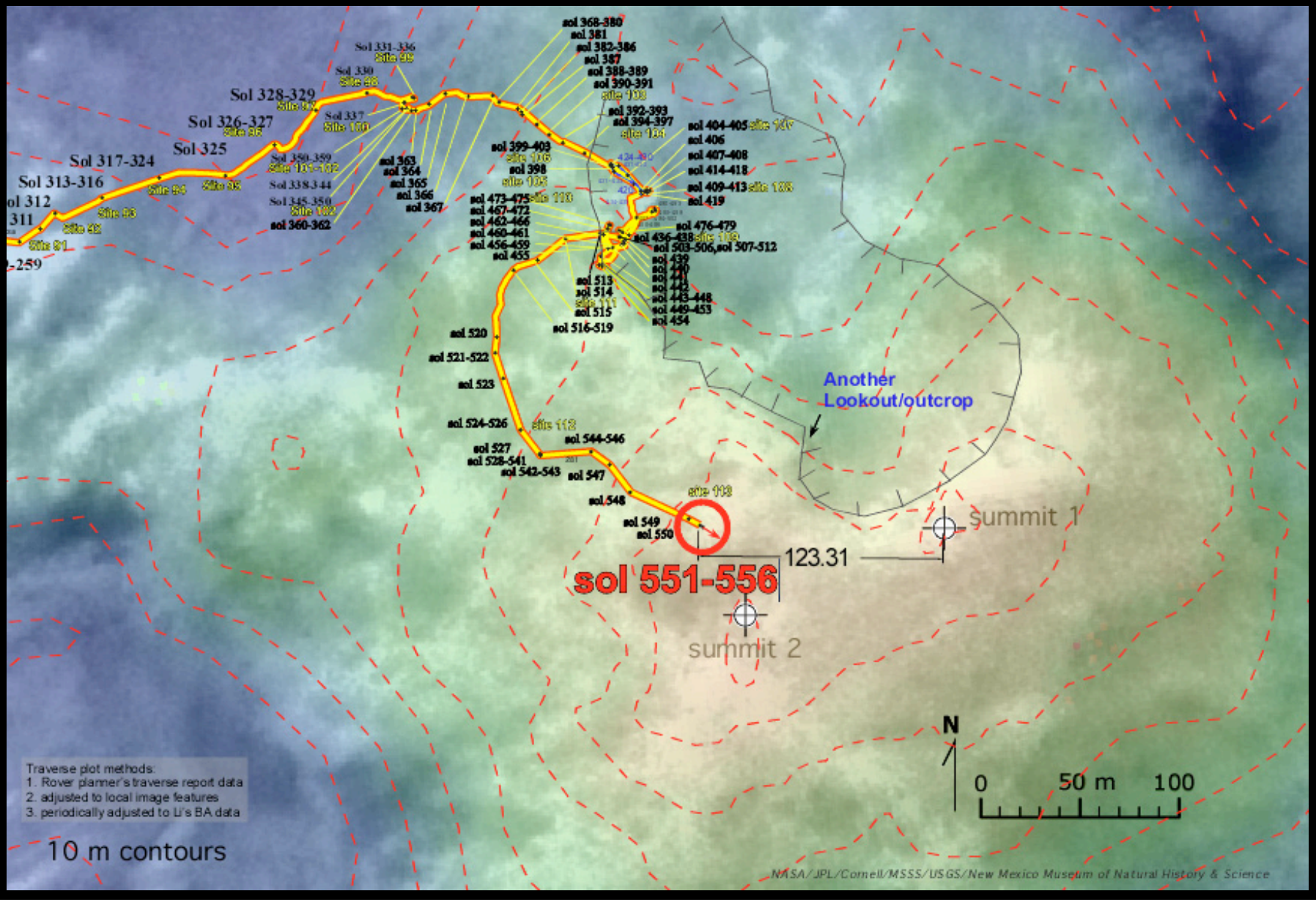
Columbia Hills, Gusev

Mars Hill, Death Valley

Spirit Sol 313, Bedrock at West Spur



Sol 556 Traverse Map (L. Crumpler)

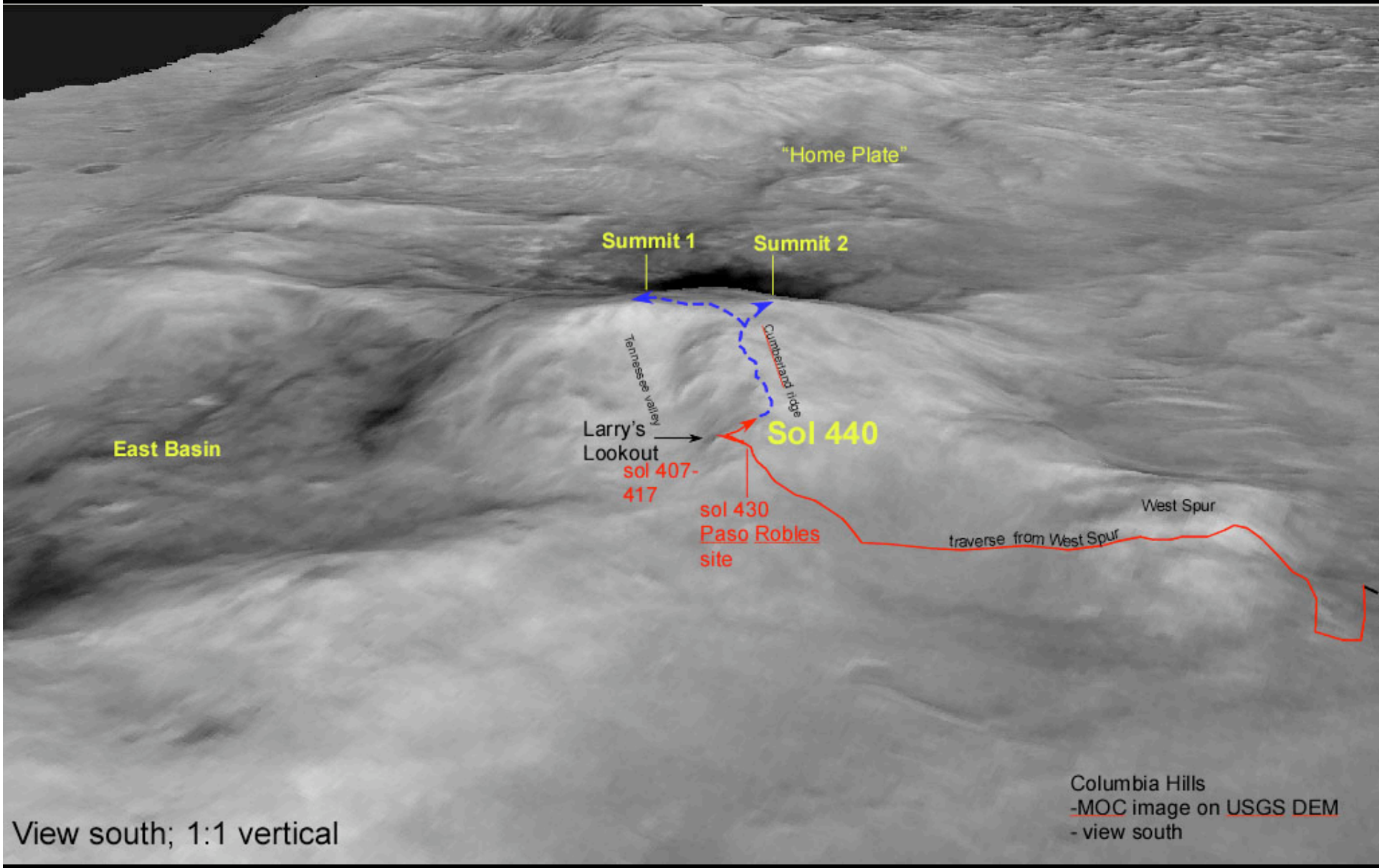


Methuselah, Sol 454

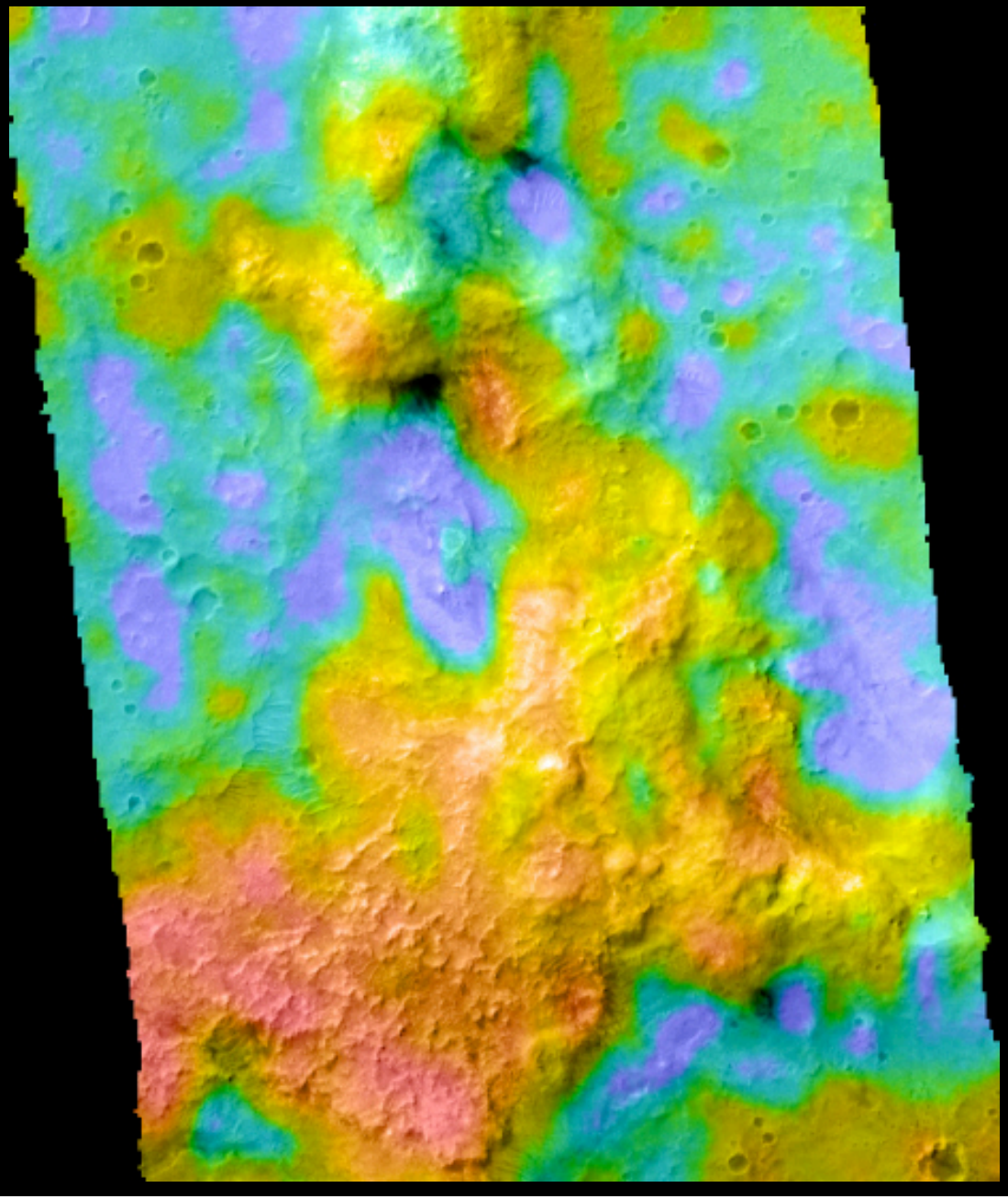
Larry's Lookout Area

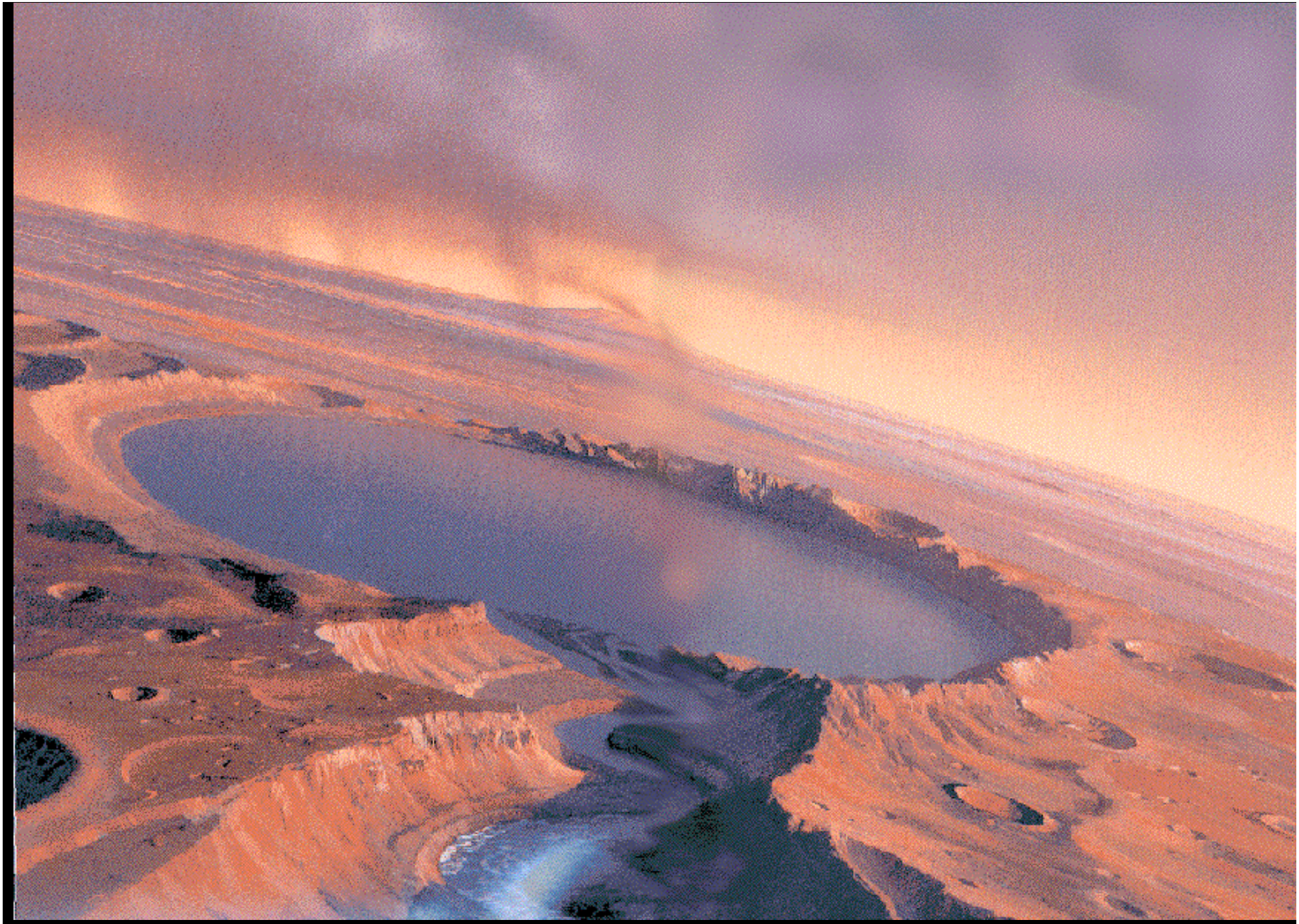
Sol 489

Sol 452 Perspective View of Husband Hill, Looking SE



Columbia Hills, THEMIS

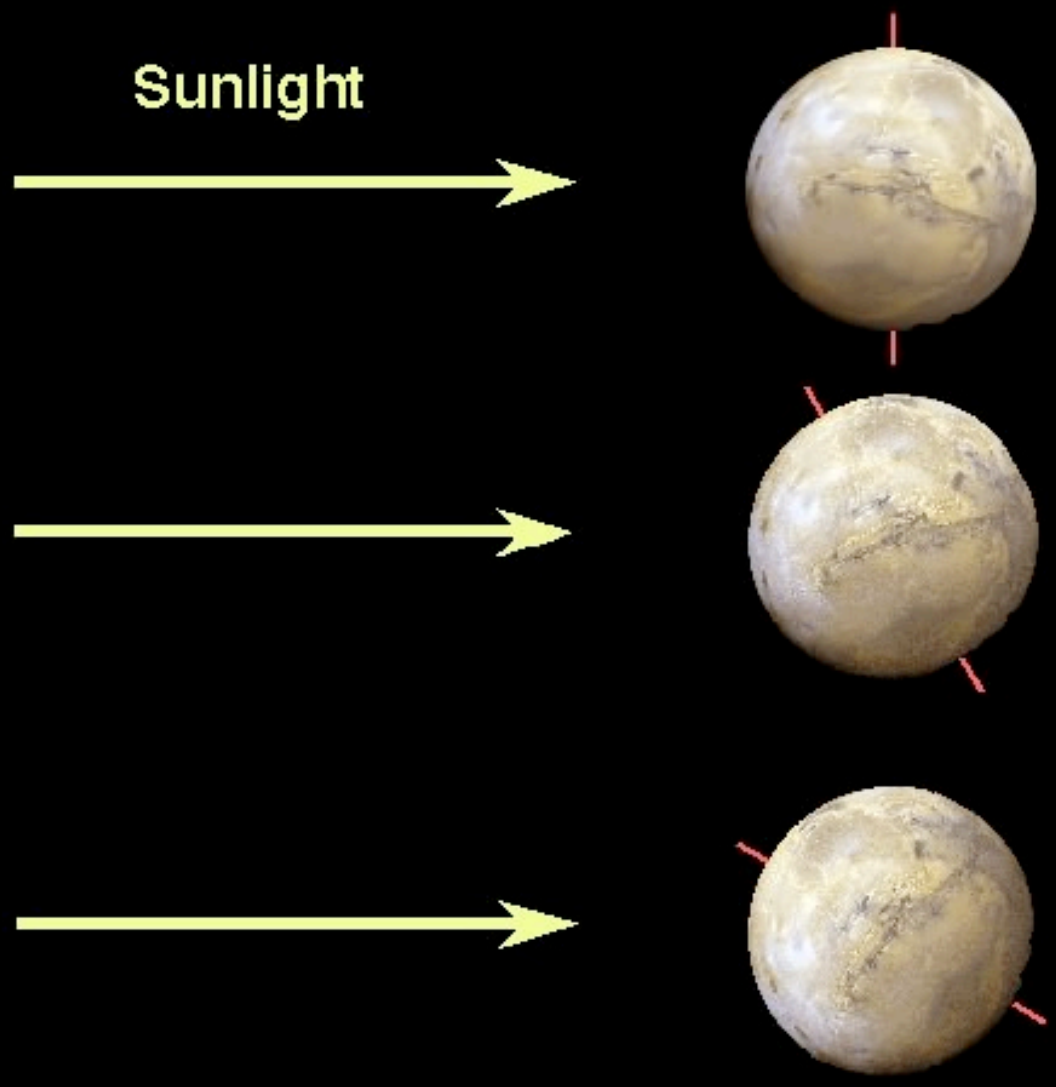




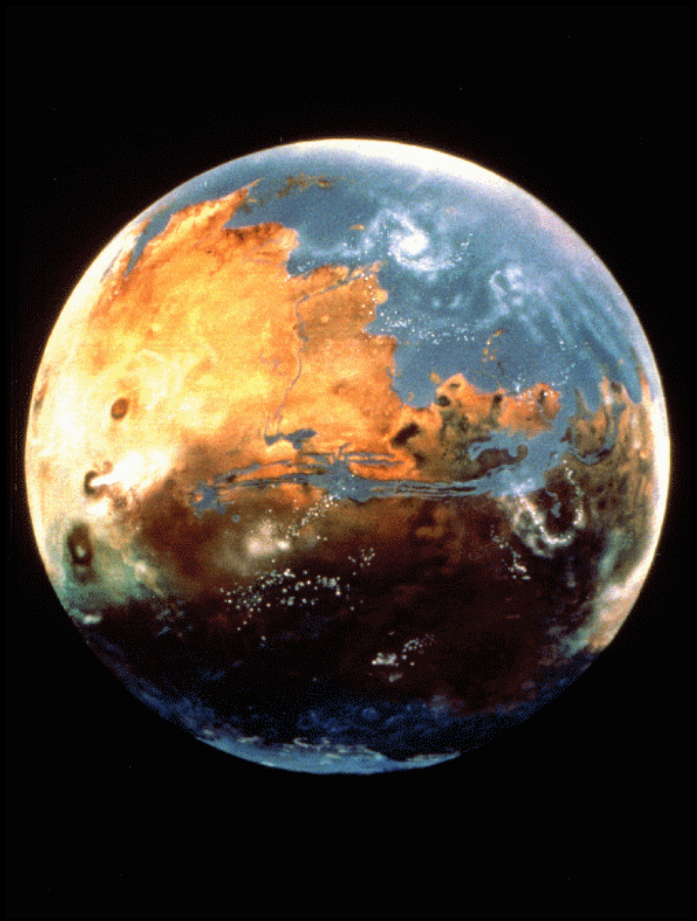
Gusev Crater, long ago?

National Geographic Society

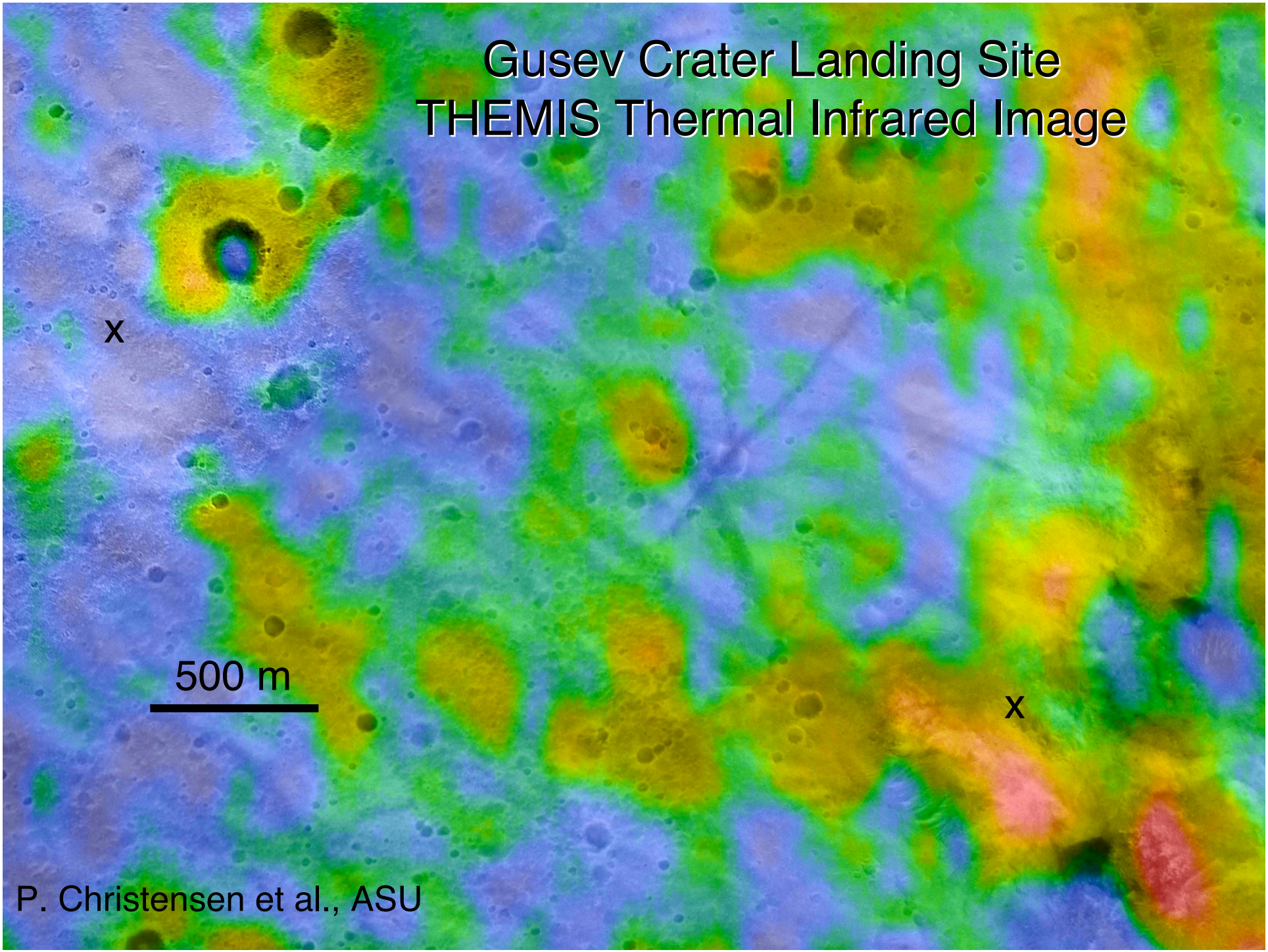
Obliquity changes can exert major effects upon the abundance and global distribution of water in the surface environment



Mechanism for replenishing fresh water to low-latitude aquifers?



End


Gusev Crater Landing Site
THEMIS Thermal Infrared Image
x
500 m
x
P. Christensen et al., ASU