

Volcanically Driven Hydrothermal Systems on Post-Noachian Mars: Hotspots of Habitability on a Changing Planet

J.R. Skok and J.F. Mustard

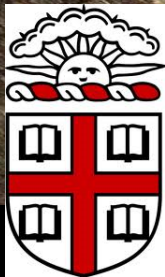
Brown University

with B. Ehlmann, R. Milliken, S. Murchie

Exploring Mars Habitability

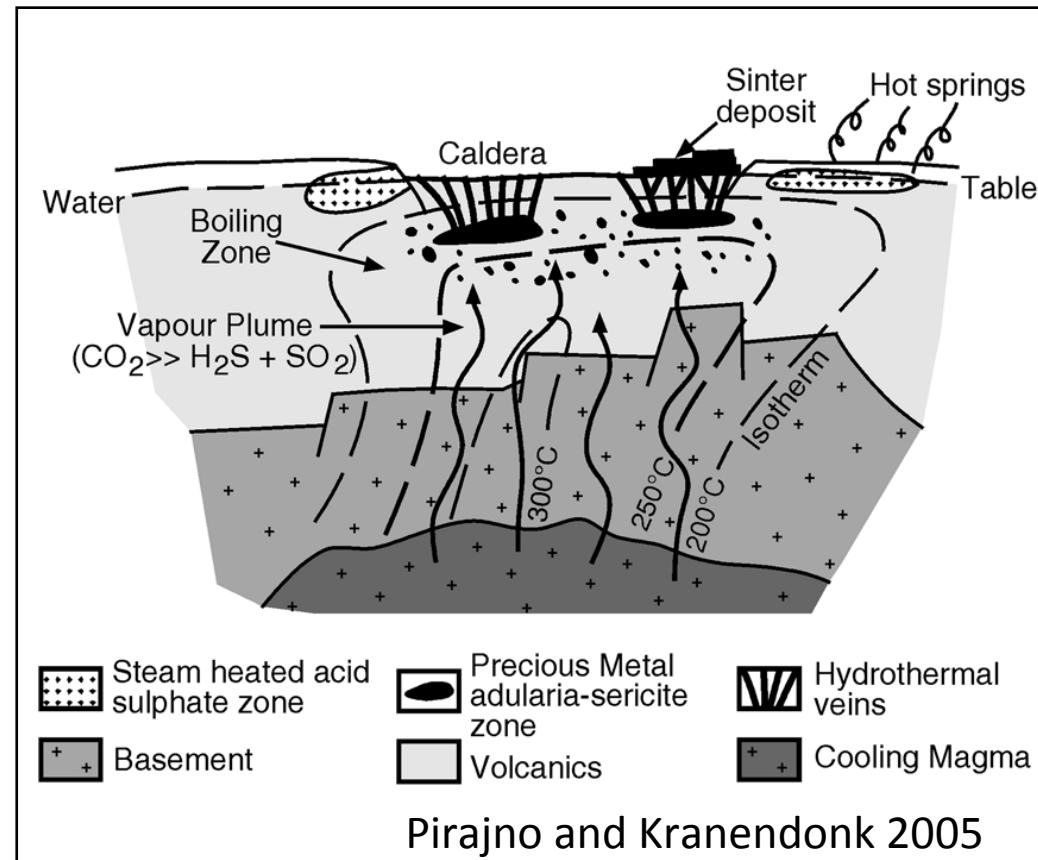
Lisbon, Portugal

June 13, 2011

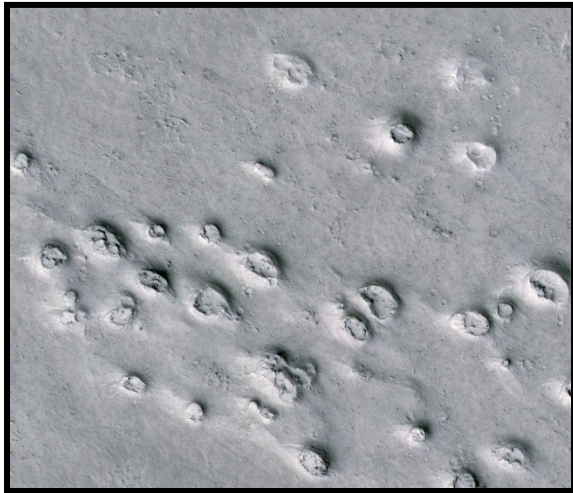


Detailed View of Terrestrial Volcanic Hydrothermal System

- System driven by heat from magmatic chamber.
- Increased thermal gradient heats ground water and may contain magmatic sourced waters.
- Dissolution of mafic minerals would create silica saturated fluids.
- Deposition of silica, sulfates, travertines and oxides occur nears vents and hot springs.

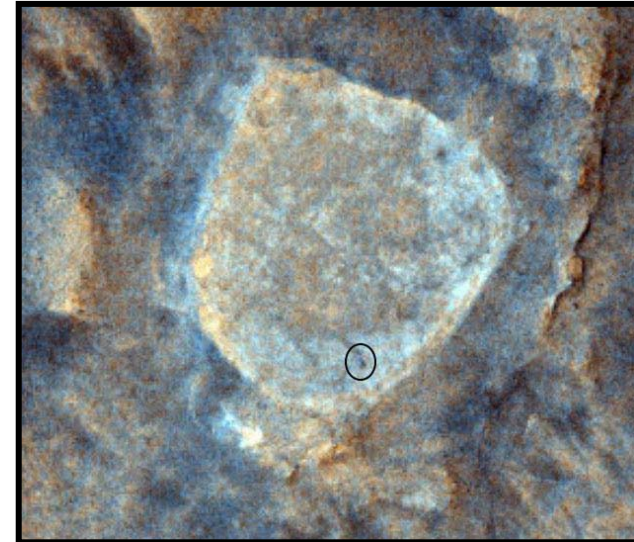


Proposed Sites of Hydrothermal Systems on Mars



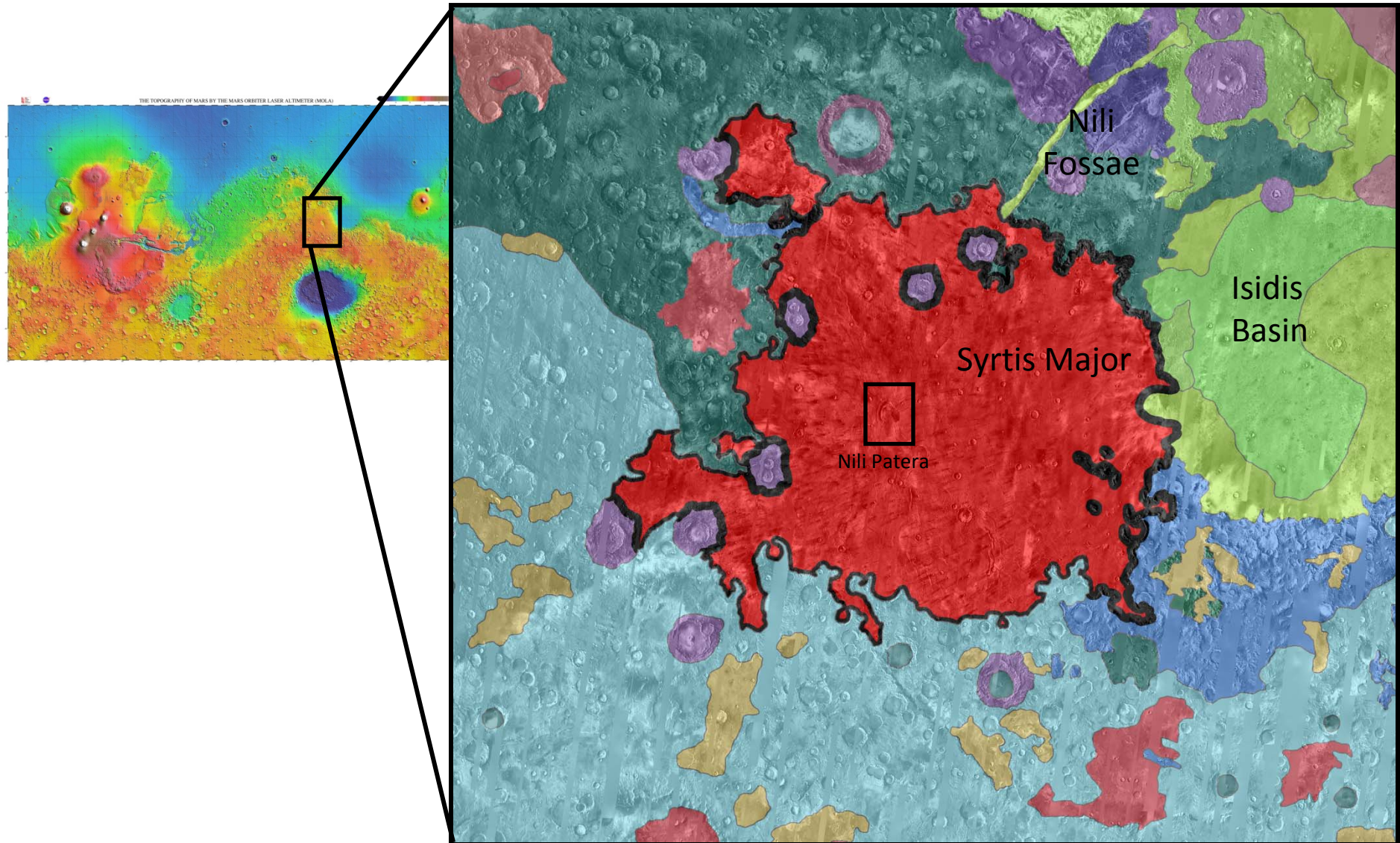
Lava-Rock
interaction to
create rootless
cones. South of Elysium
HiRISE PSP_002622_1820

Apollinaris Mons

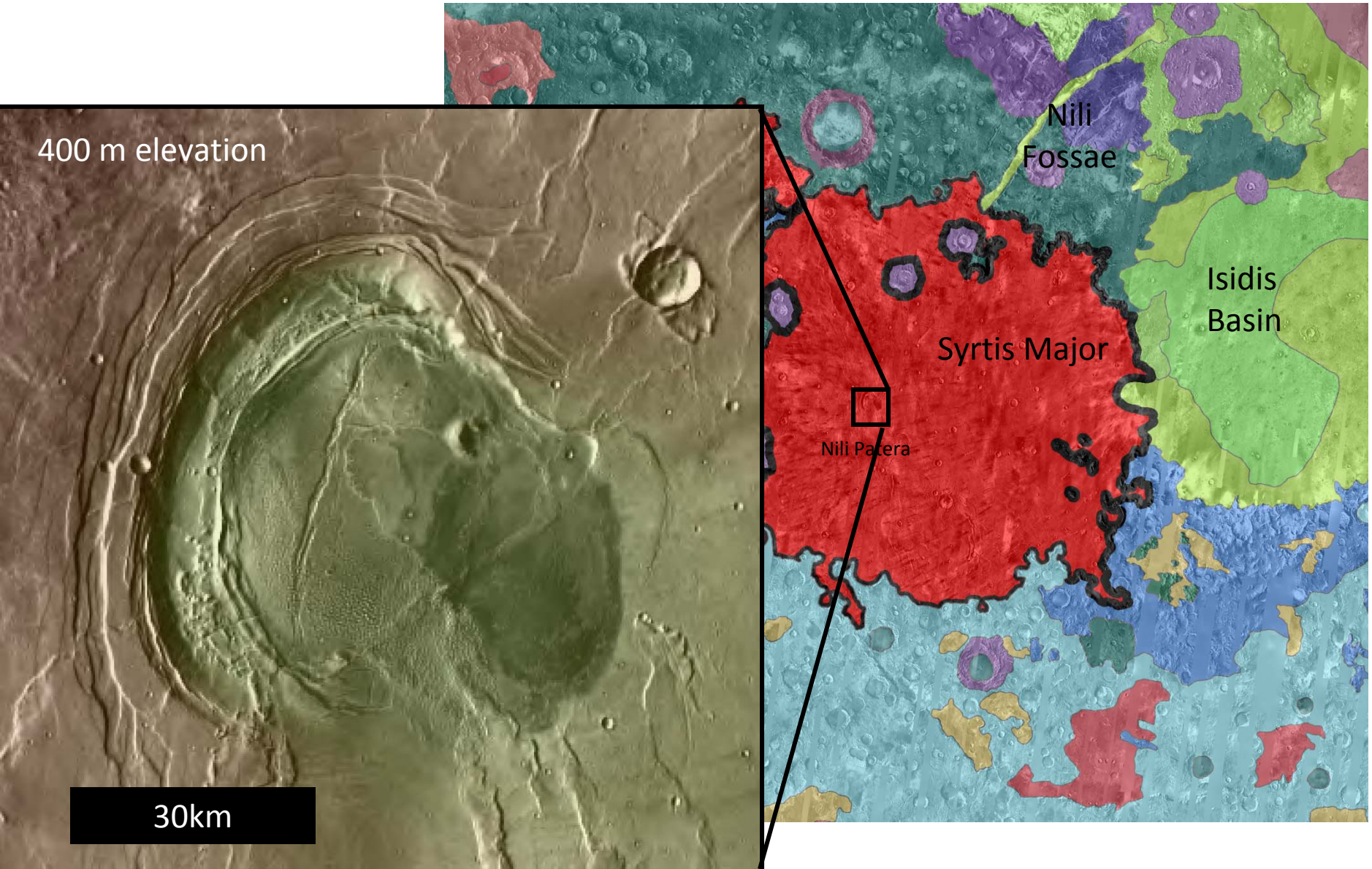


Home Plate, Gusev
Crater. Squyres et al 2007

Syrtis Major Volcanic Complex

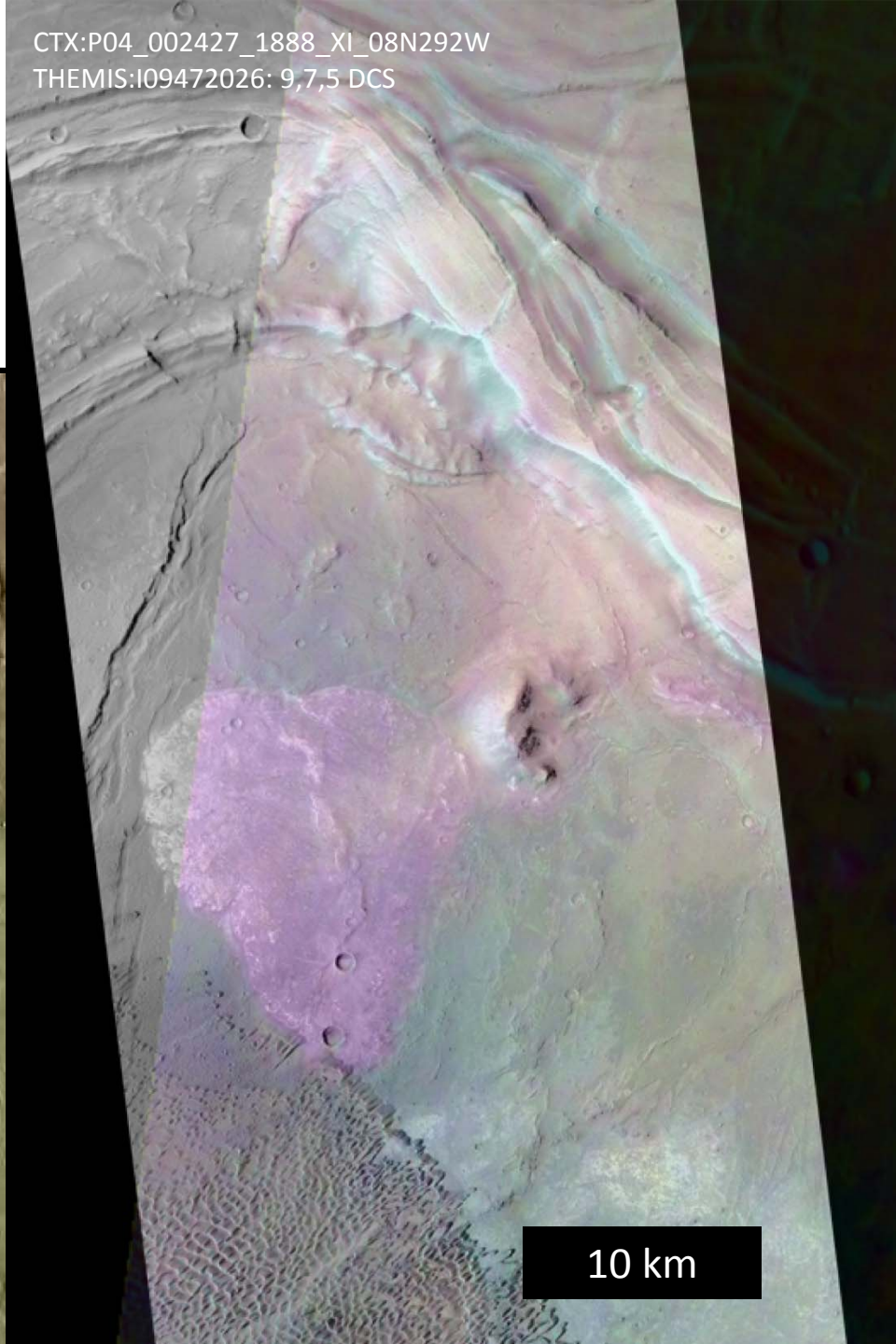
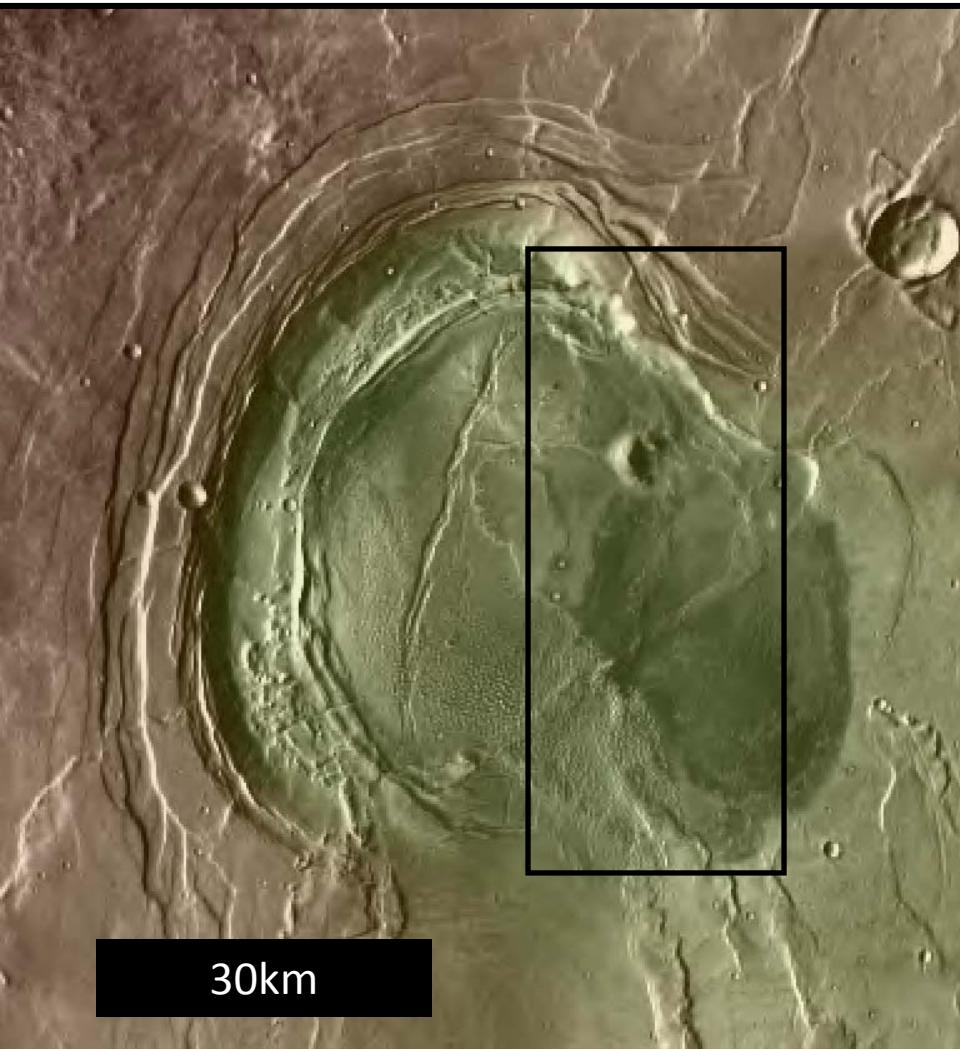


Nili Patera Caldera



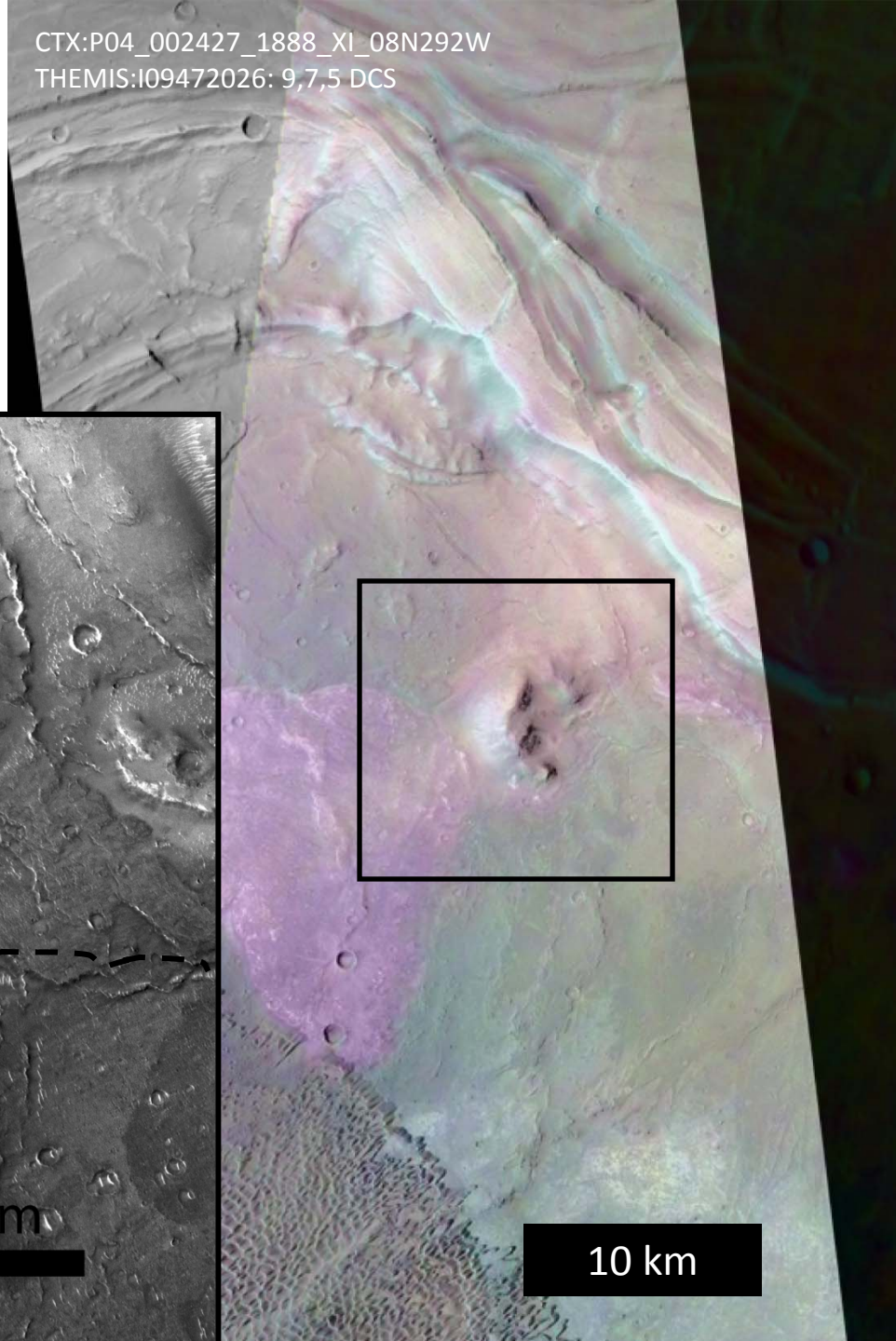
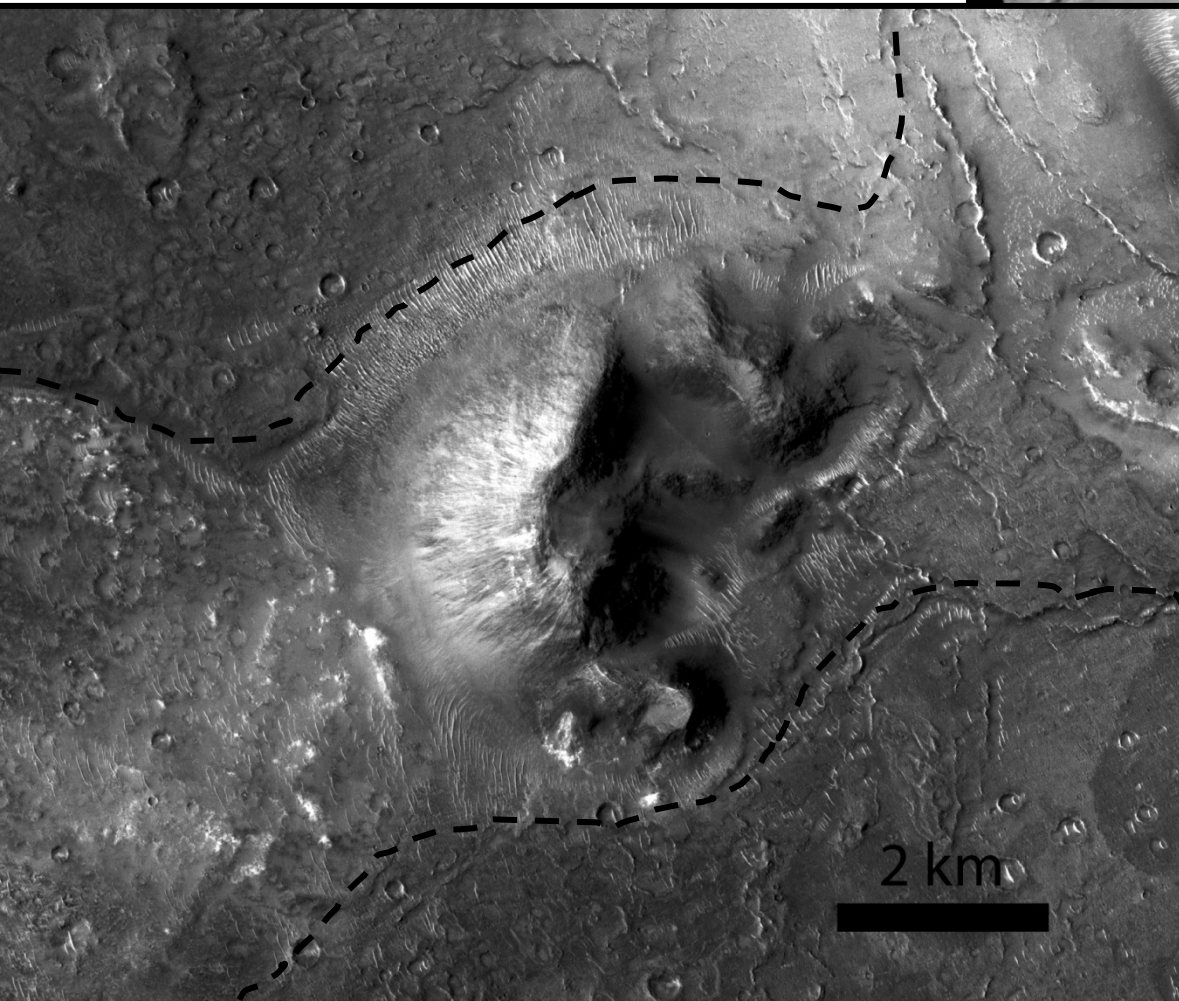
High Silica Detection

CTX:P04_002427_1888_XI_08N292W
THEMIS:I09472026: 9,7,5 DCS



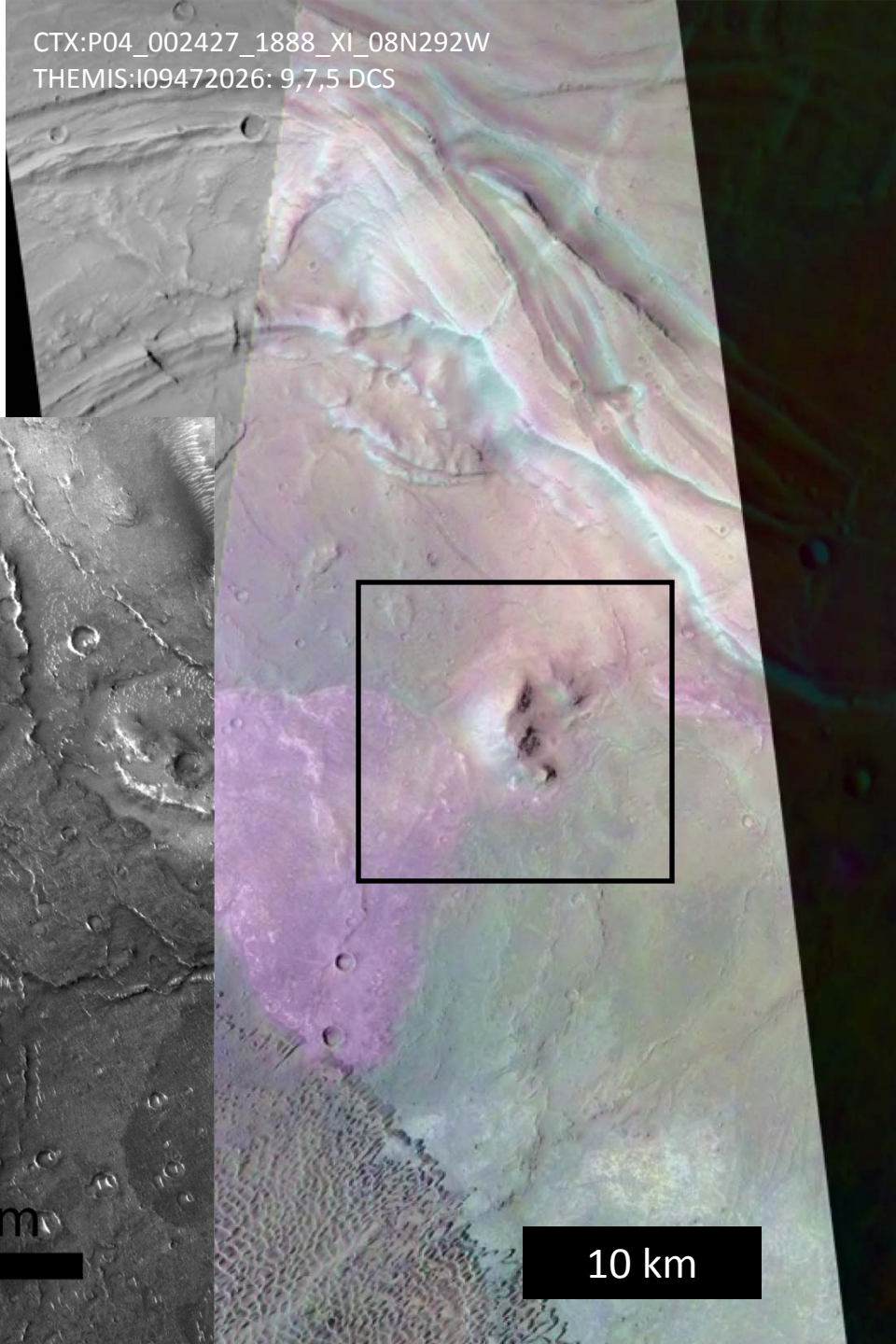
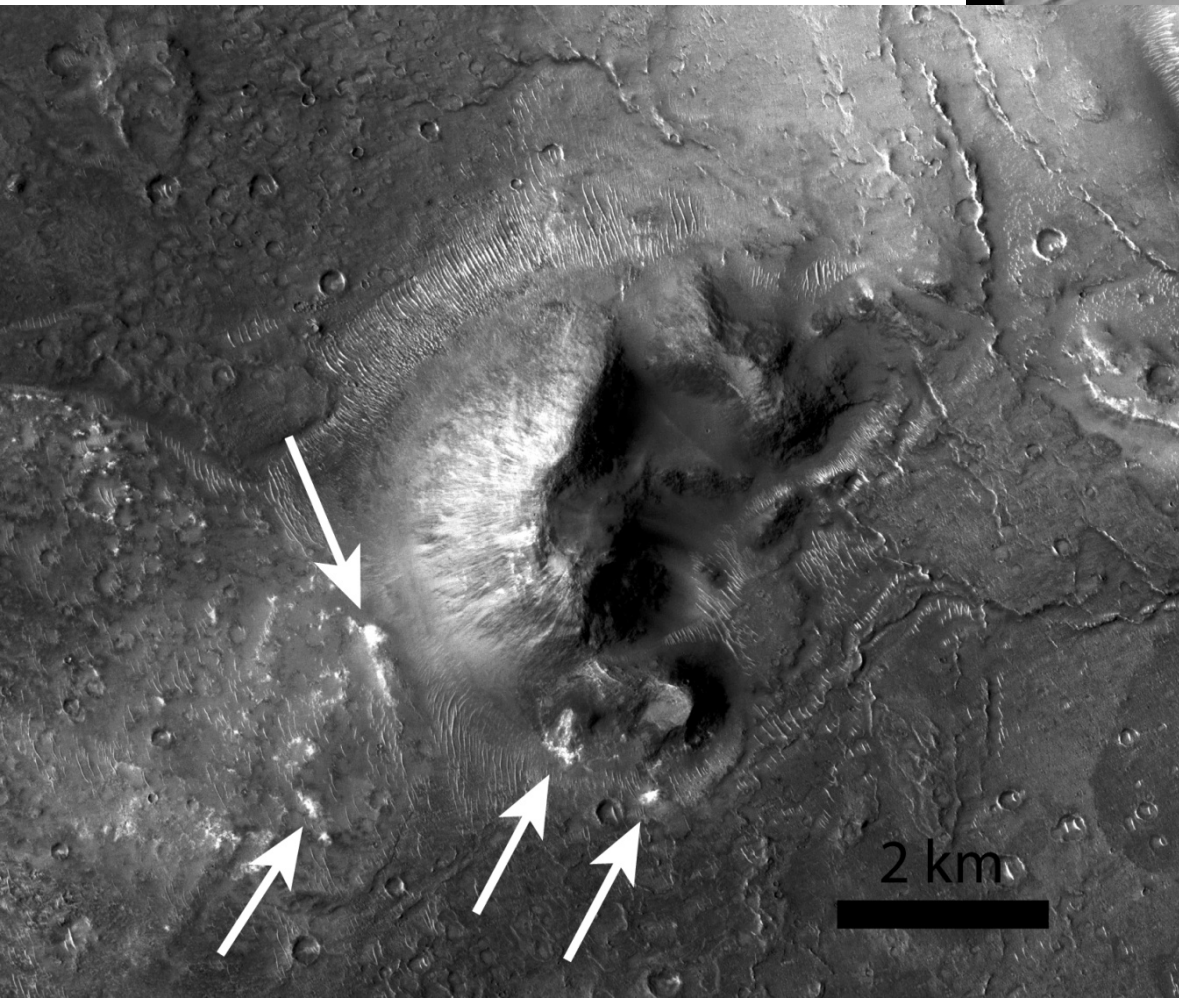
CTX:P04_002427_1888_XI_08N292W
THEMIS:I09472026: 9,7,5 DCS

Nili Patera Cone

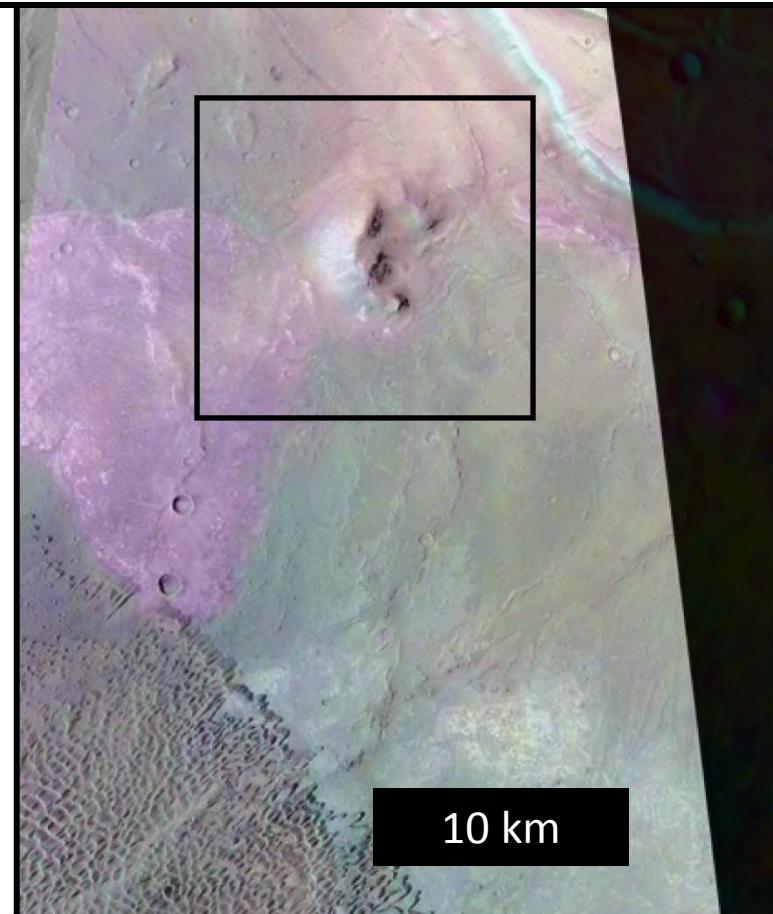
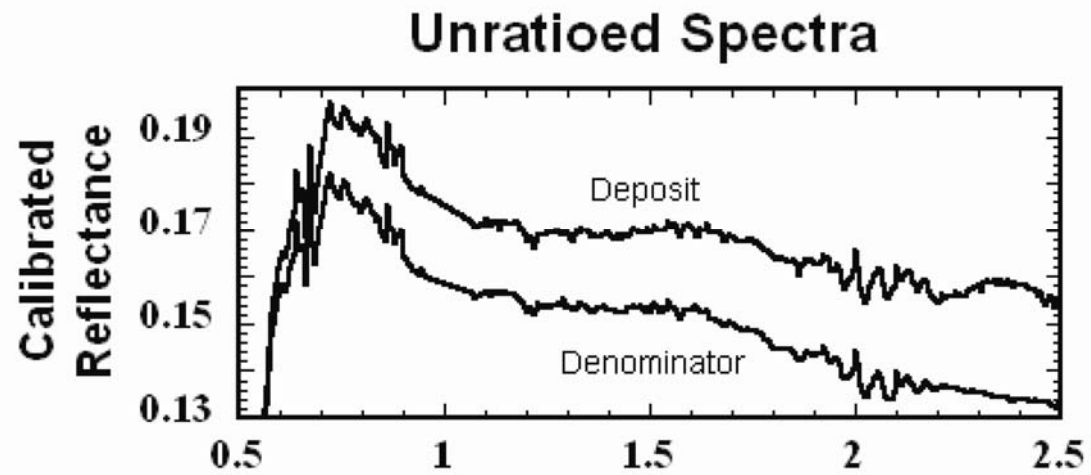


Light-toned Deposits

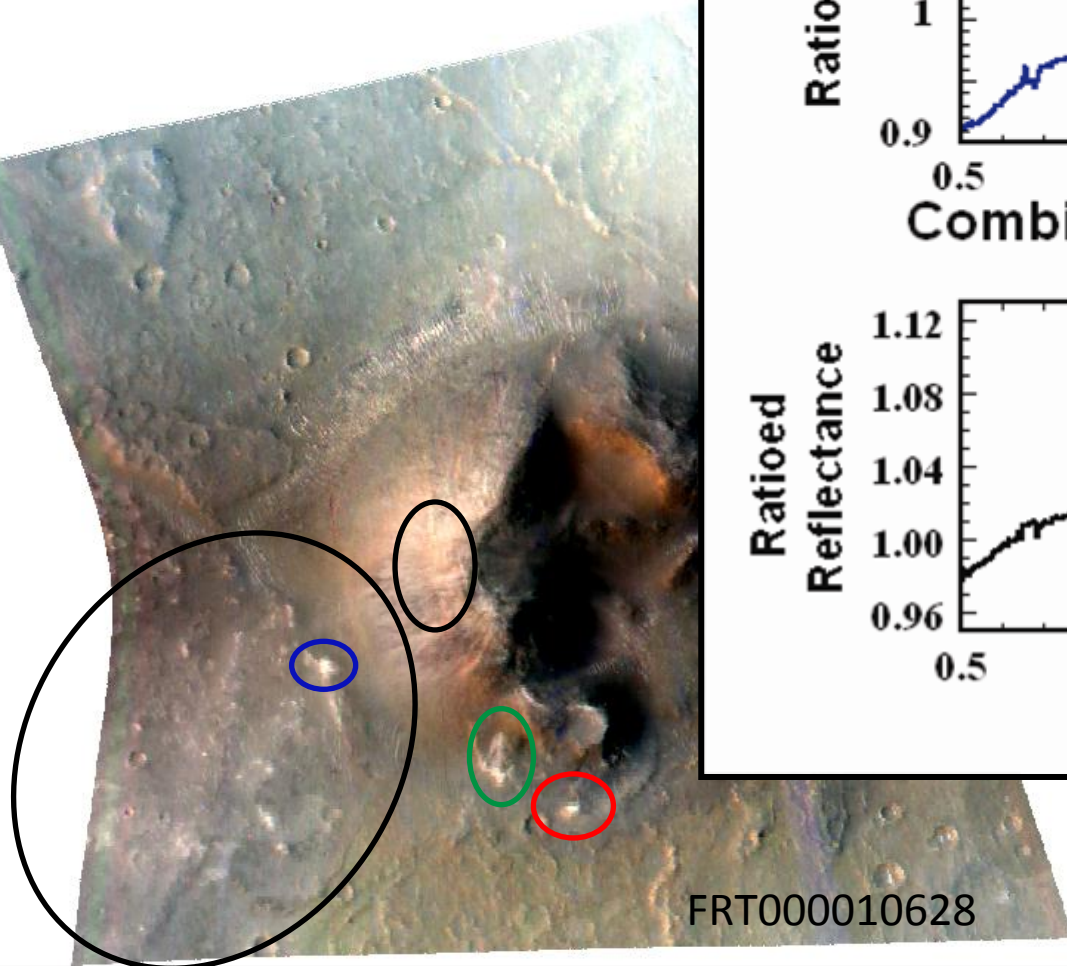
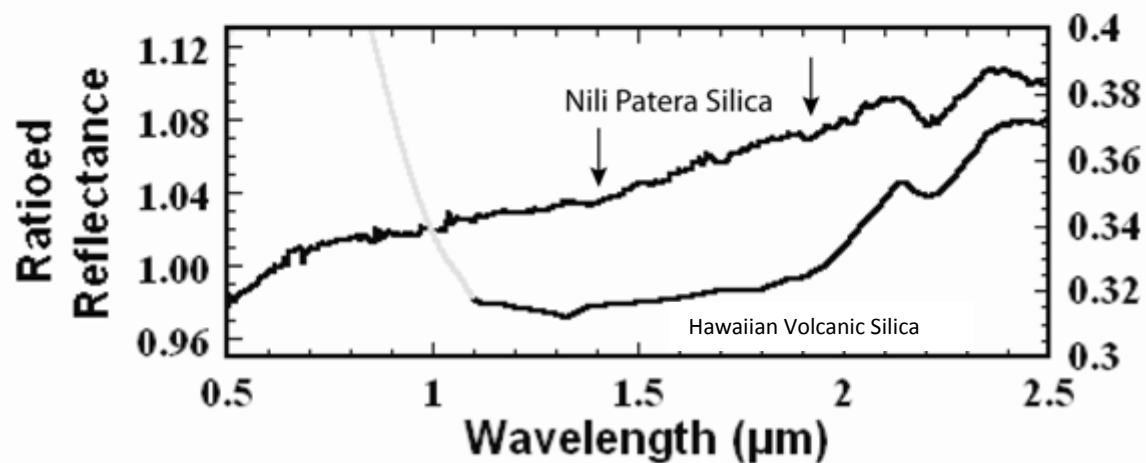
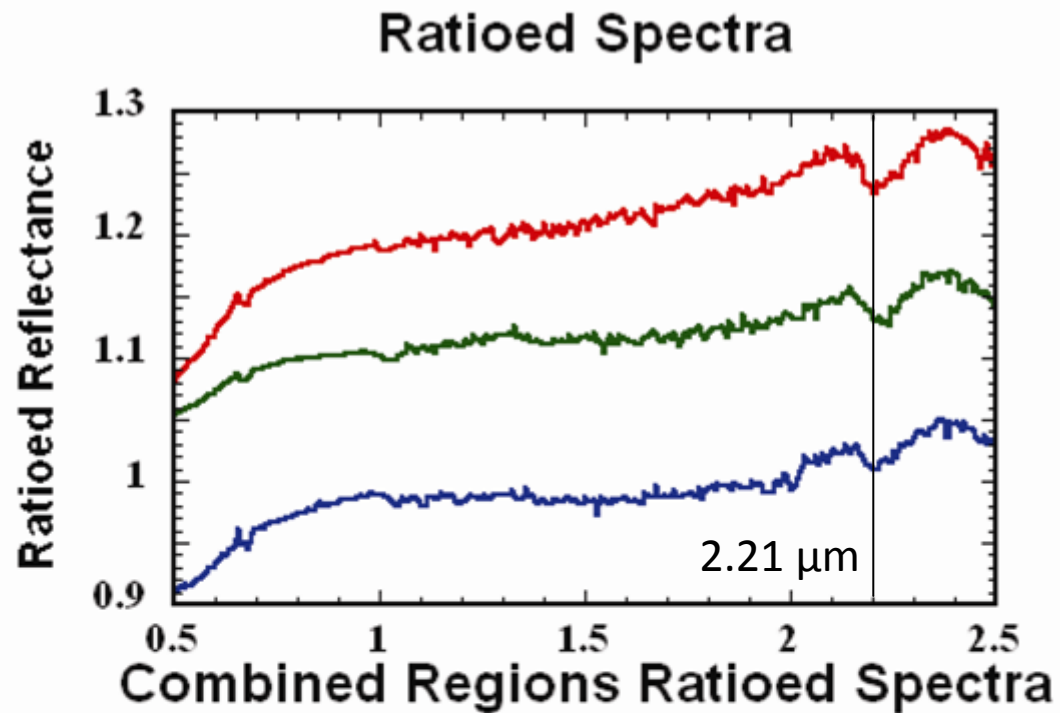
CTX:P04_002427_1888_XI_08N292W
THEMIS:I09472026: 9,7,5 DCS



Calibrated CRISM Spectra

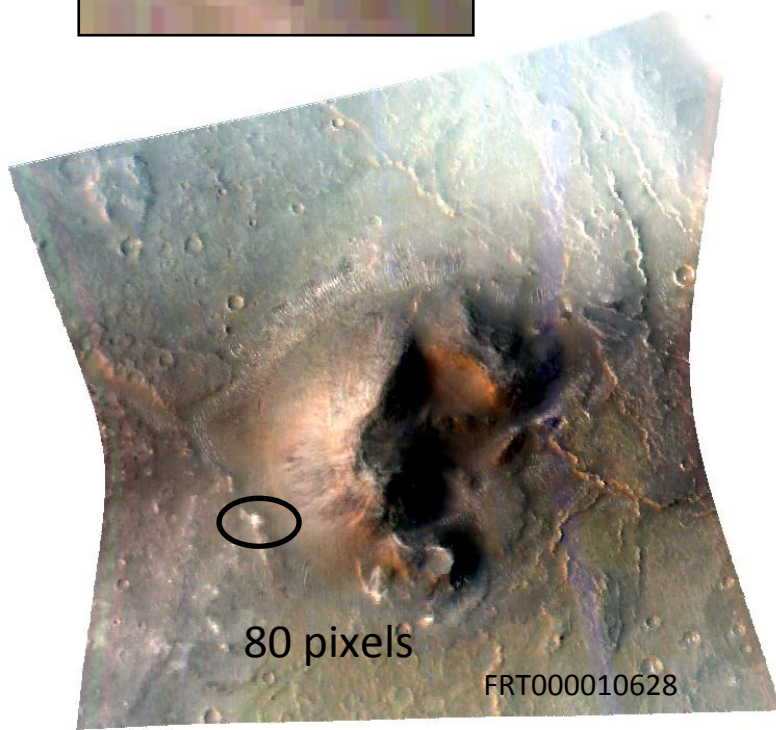
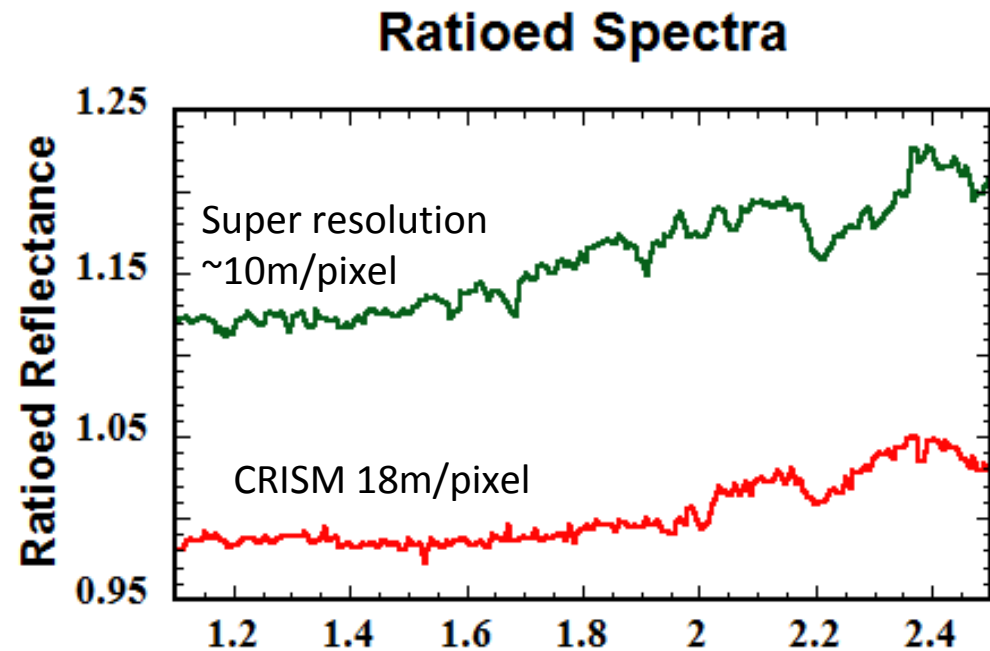
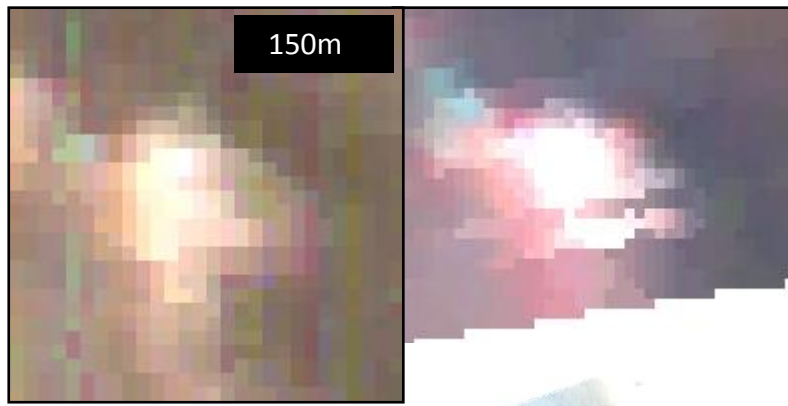


Ratioed Spectra

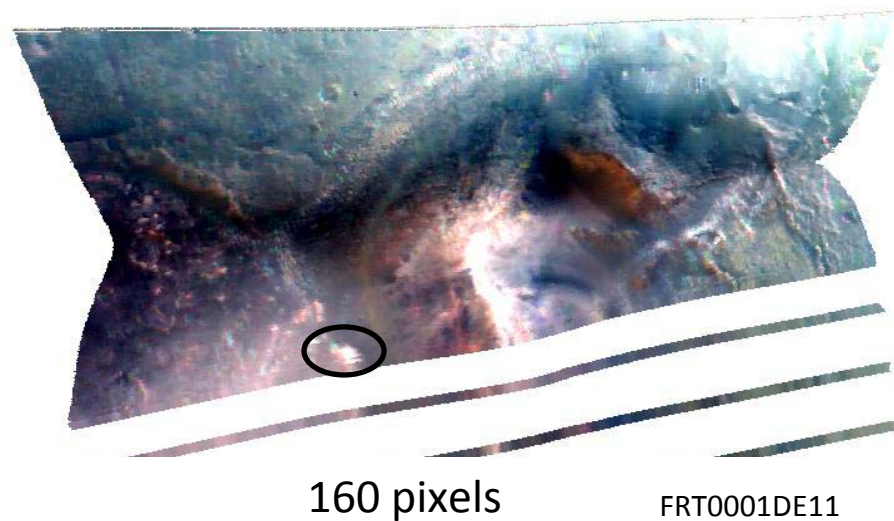


Position and shape of 2.21 μm are consistent with Si-OH.

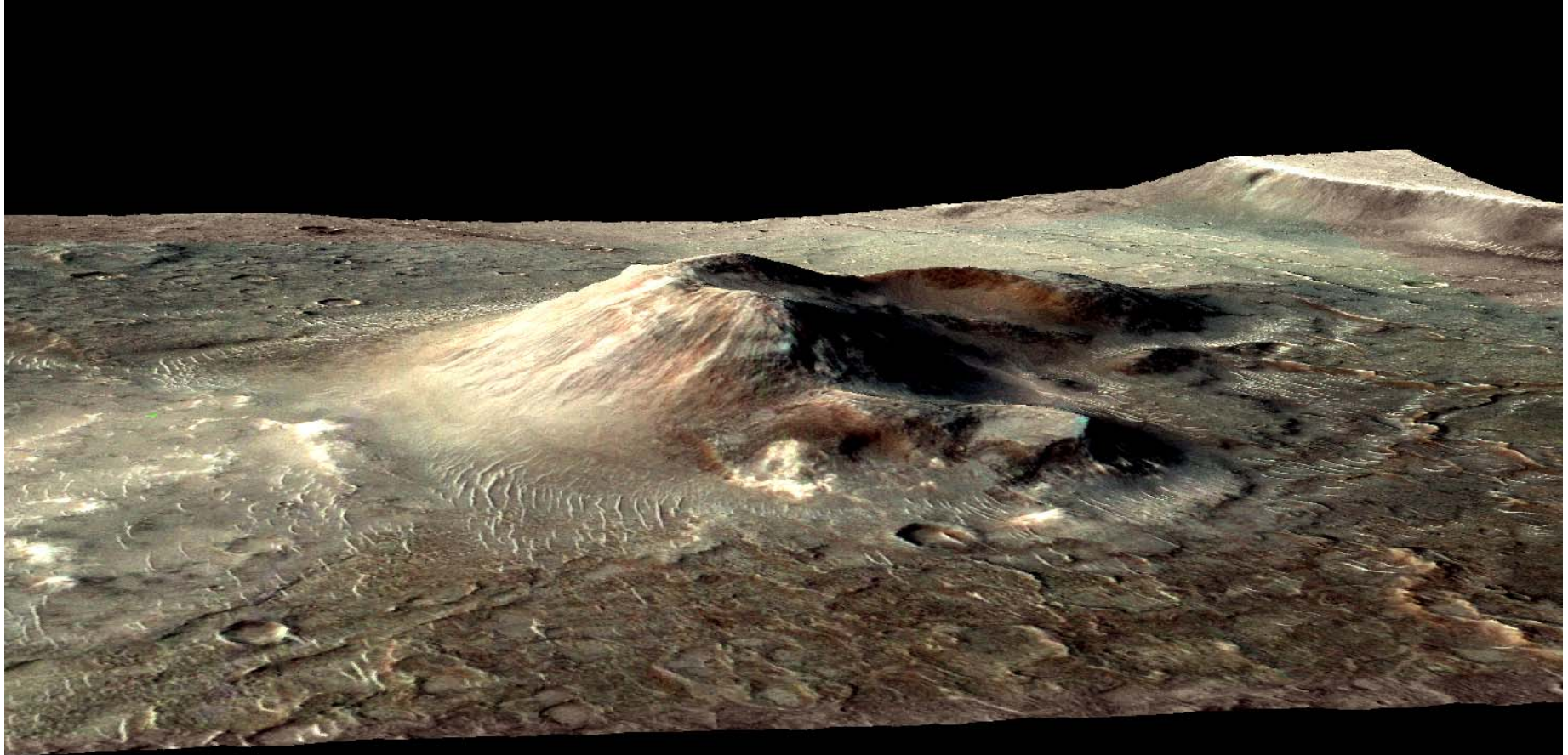
Spectral Reproduction with Super resolution CRISM



Super Resolution

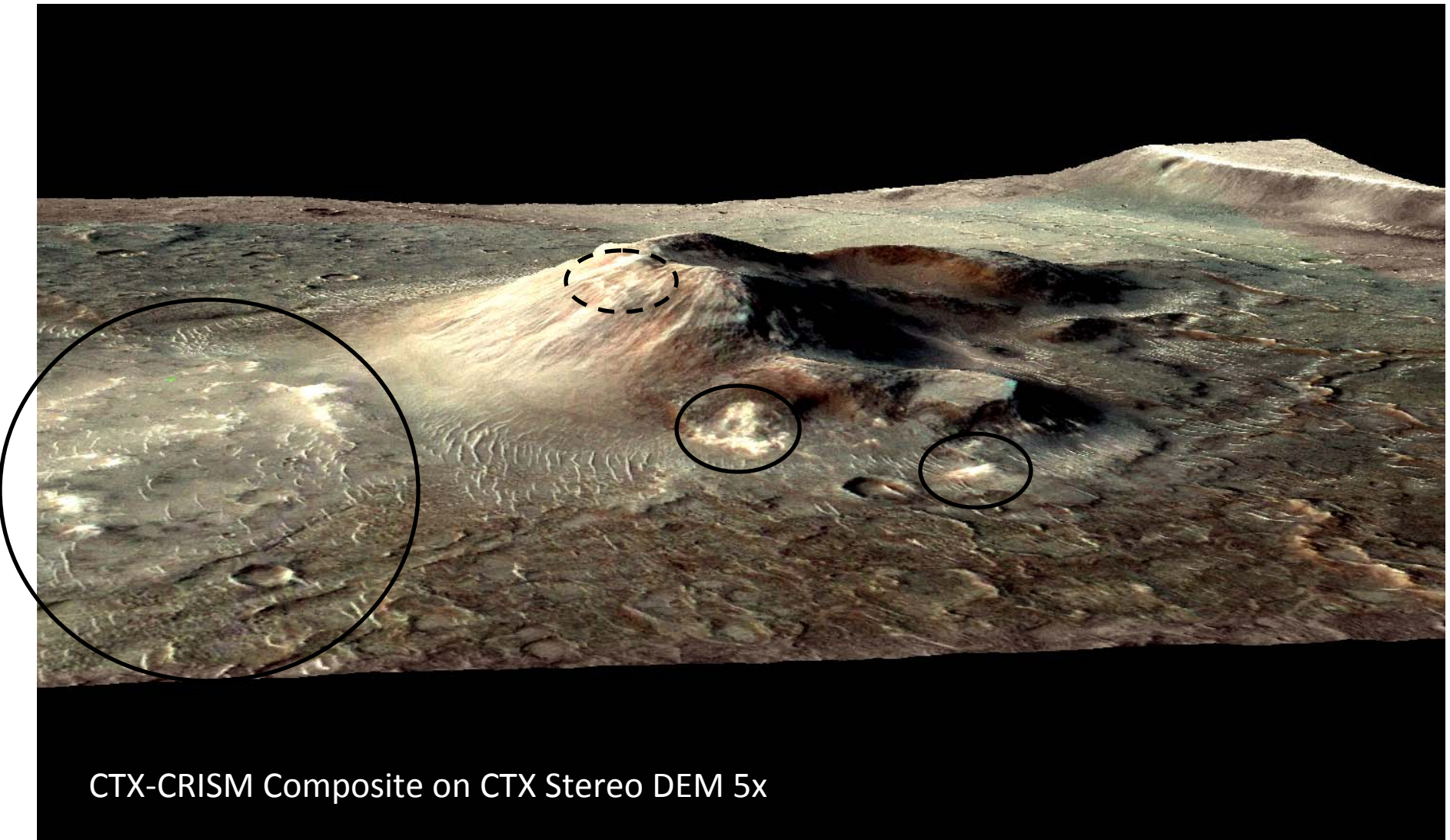


Nili Patera Volcanic Cone



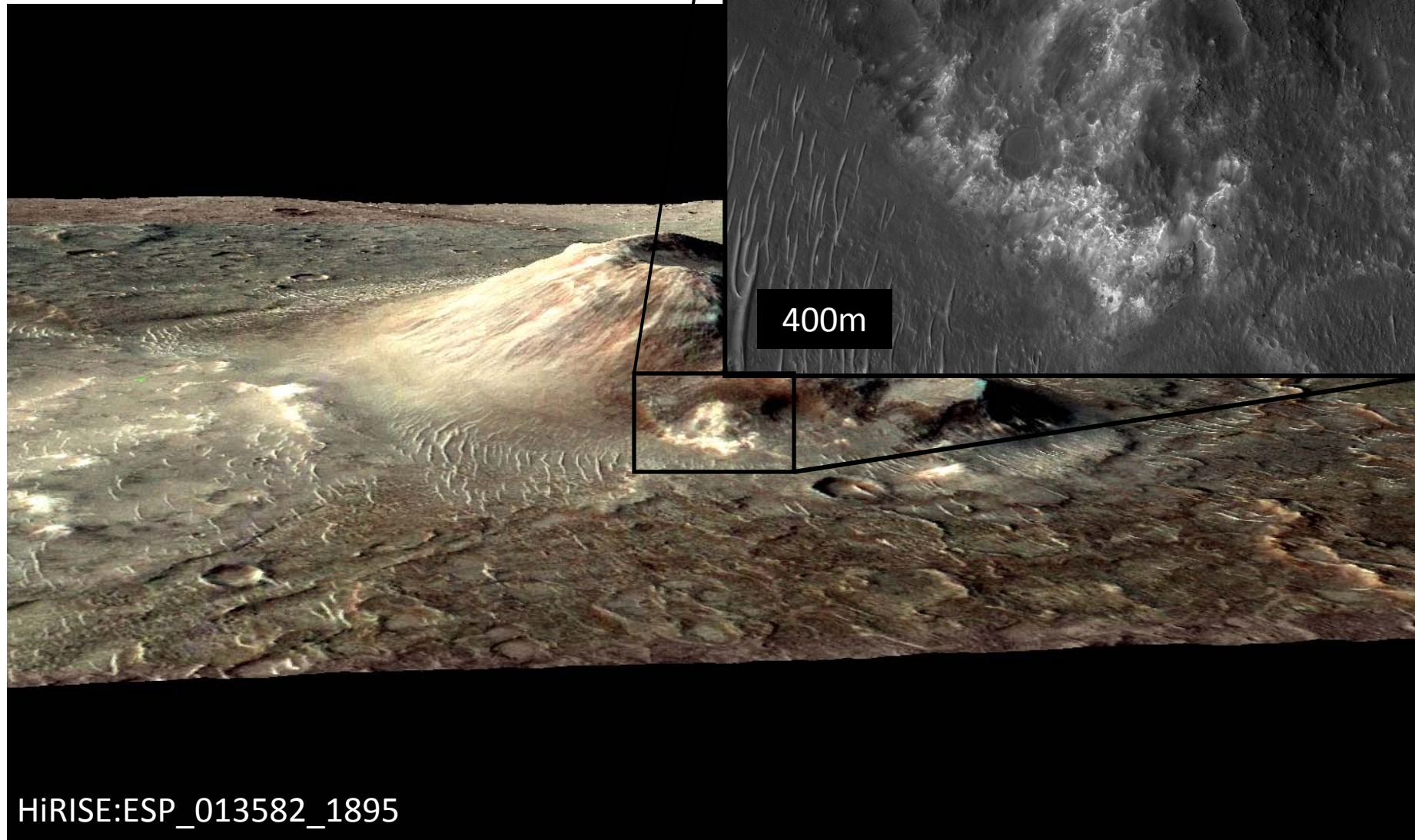
CTX-CRISM Composite on CTX Stereo DEM 5x

Nili Patera Volcanic Cone

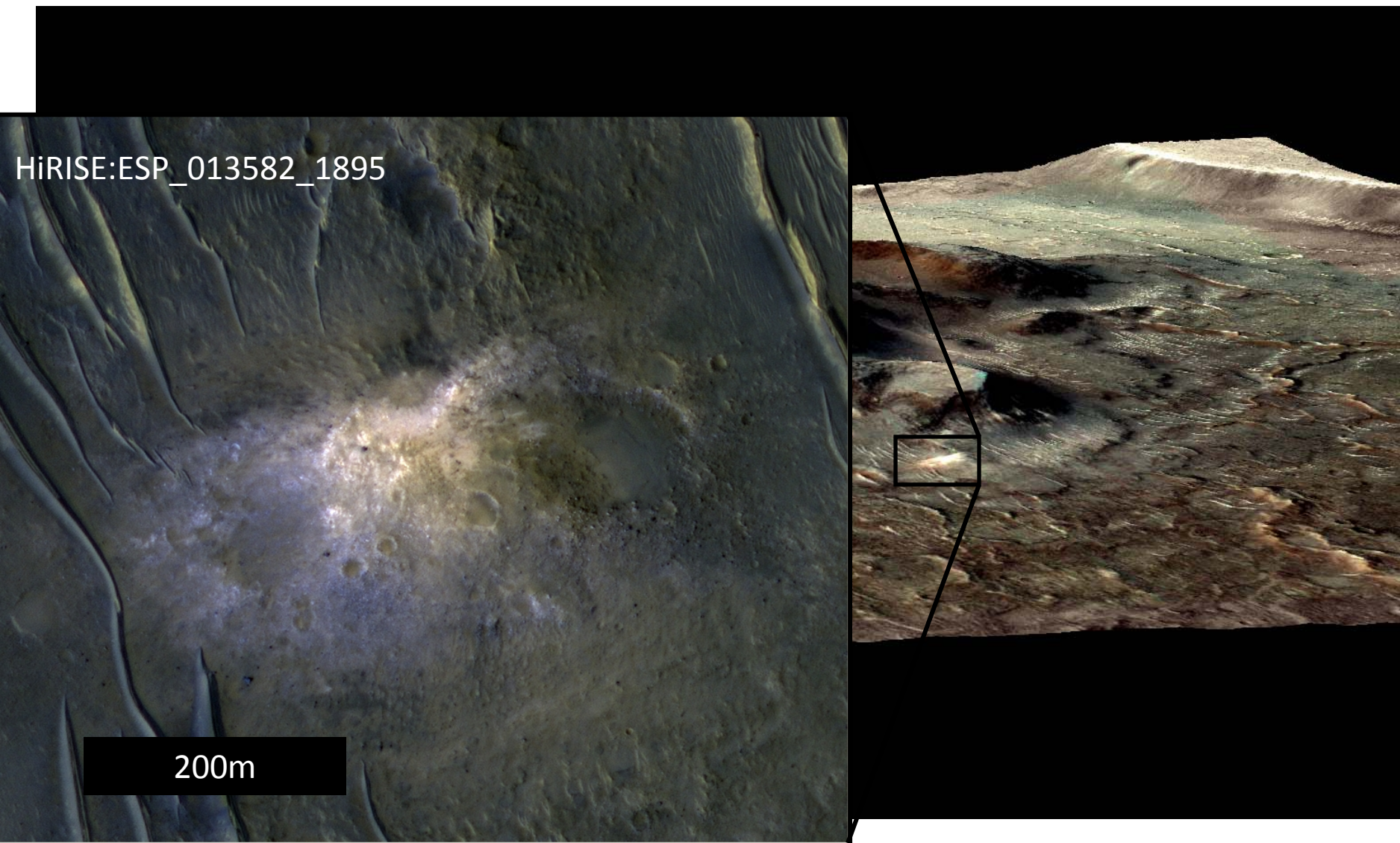


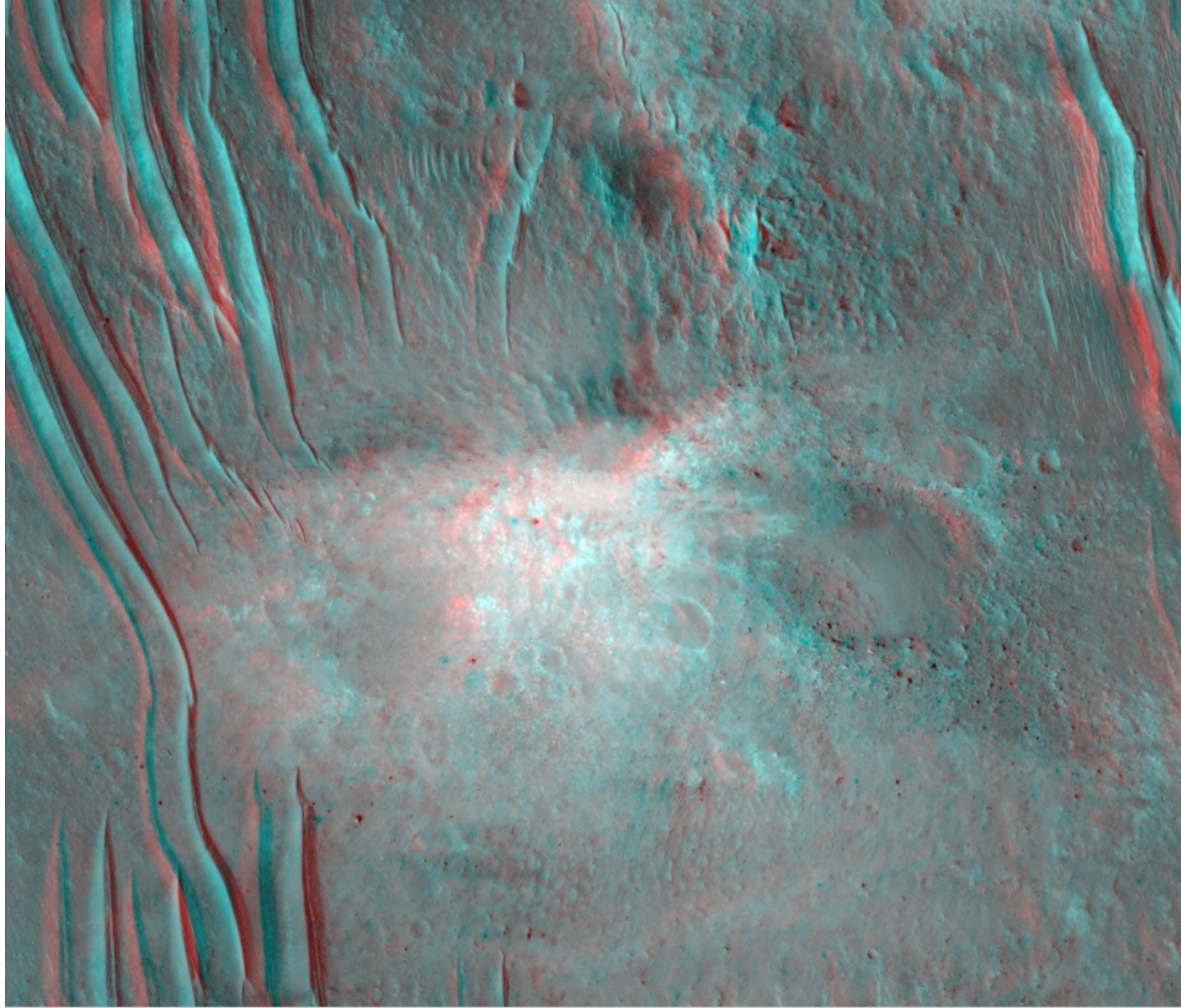
CTX-CRISM Composite on CTX Stereo DEM 5x

Fan Deposit



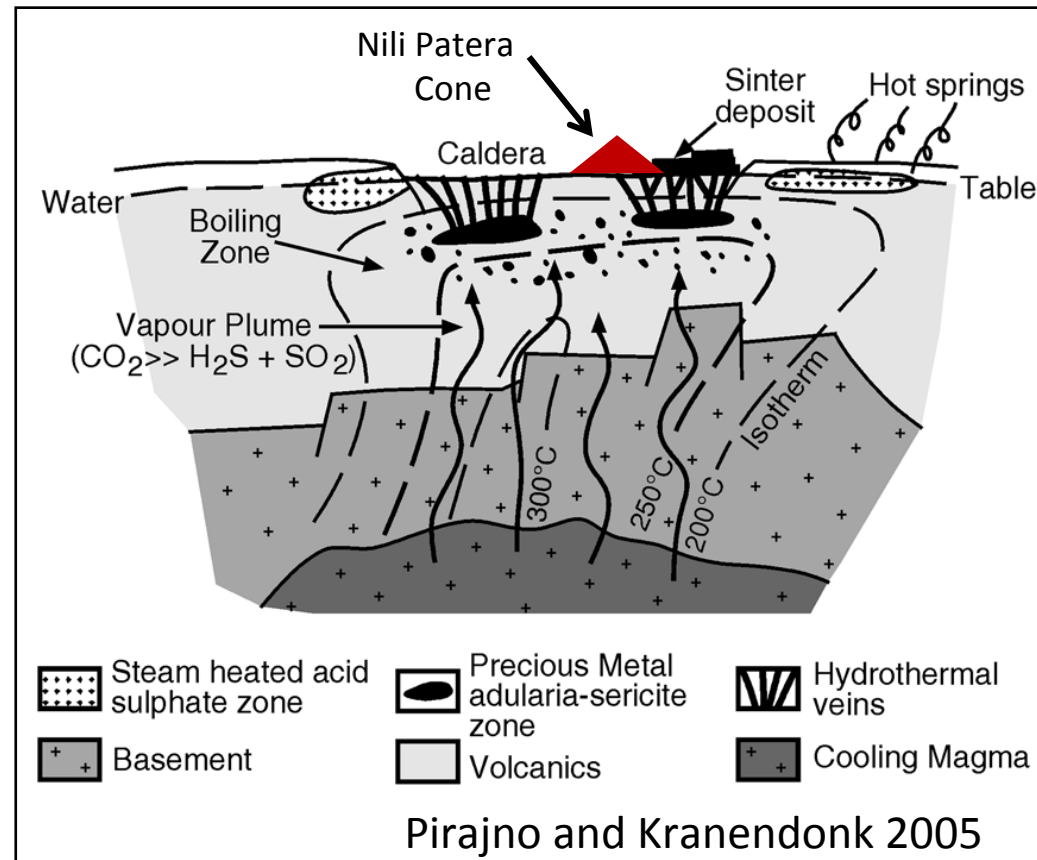
South Deposit





Review of Nili Patera Hydrothermal System Model

- Complex Syrtis Major caldera indicated several eruptive episodes. Hiesinger and Head 2004
- Dacite bearing flow in Nili Patera would require magmatic differentiation and a long lived system. Christensen et al. 2005
- Silica is deposited on the flank of the cone, in nearby mounds and in a field of deposits on the dacitic flows.

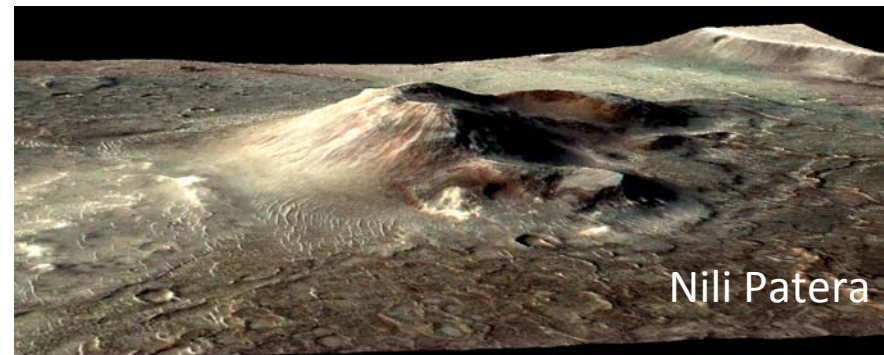


Habitability of Volcanic Hydrothermal Systems on Mars

- Hydrothermal Systems would provide high water, energy and habitability for duration of magmatic body.
- Volcanic hot spring environments may provide habitable pathway between deep hydrosphere / possible deep biosphere and the surface.
- Systems would deposit silica sinter, an ideal substance for preserving biosignatures. Farmer and Des Marais 1999



Yellowstone



Nili Patera