

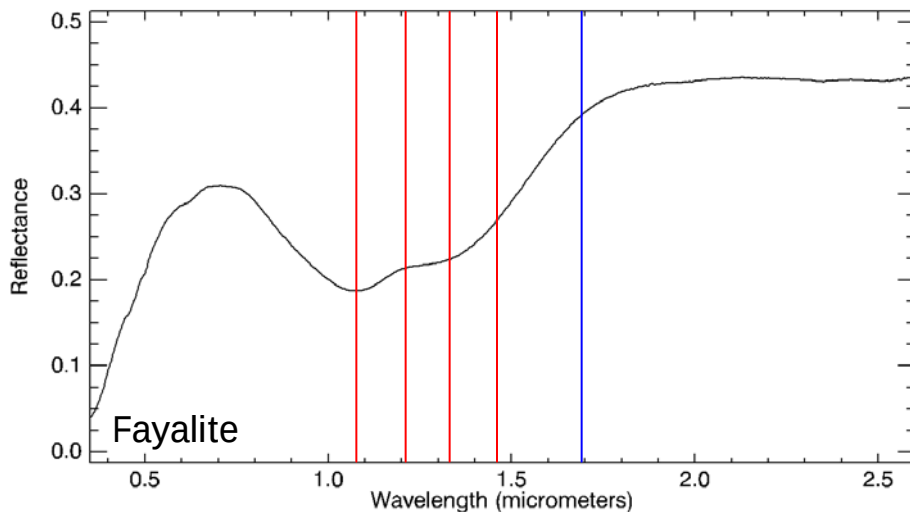
CRISM Special Products for MSL Landing Site Selection

2nd MSL Landing Site Selection Workshop
10/23/2007

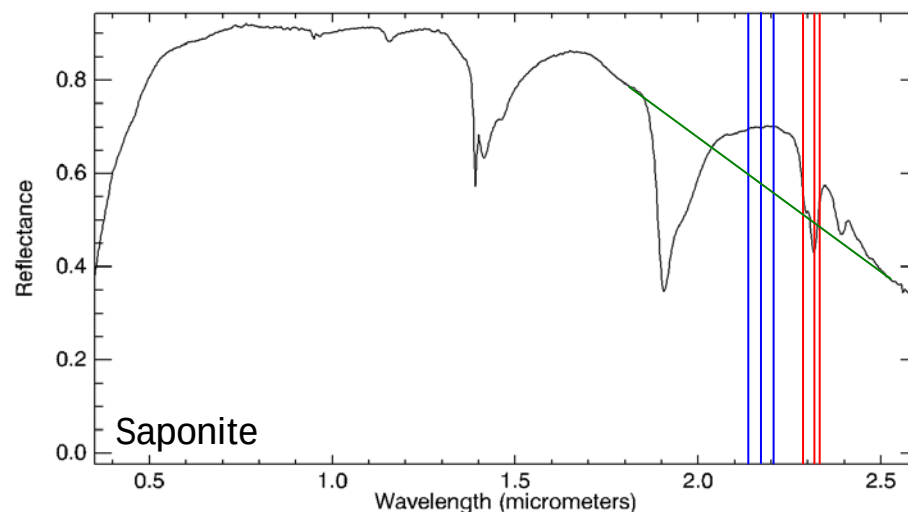
Frank Seelos, Olivier Barnouin-Jha, Kim Seelos,
Alysen Regiec, Scott Murchie

- Spectral Summary Parameters
 - Band math calculations that codify spectral characteristics indicative of certain mineral types or diagnostic absorptions
 - Strong heritage to the OMEGA investigation
 - Refined for CRISM instrument characteristics

Olivine Index (OLINDEX)



2300 nm Drop-Off (D2300)



- Browse Products
 - RGB composites of categorized summary parameters
 - Consistent composite band scaling allows for direct product comparison

VNIR IRON MINERALOGY

Channel	Parameter	Scaling	Significance
Red	530-nm band depth, BD530*	0-0.22 to 0-250	Higher values indicate greater content or larger particle size of oxidized iron minerals
Green	600-nm shoulder, SH600*	1.2-1.4 to 0-250	Higher values correlated with coatings or rinds present on rocks
Blue	1-micron band depth, BDI1000*	0-10. to 0-250	Higher values indicate greater content or larger particle size of iron minerals, especially olivine and pyroxene

MAFIC MINERALOGY

Channel	Parameter	Scaling	Significance
Red	Olivine index OLINDEX*	0-0.13 to 0-250	Higher values indicate greater content or larger particle size of olivine
Green	Low calcium-pyroxene index LCPINDEX*	0-0.1 to 0-250	Higher values indicate greater content or larger particle size of low-calcium pyroxene
Blue	High calcium pyroxene index HCPINDEX*	0-0.2 to 0-250	Higher values indicate greater content or larger particle size of high-calcium pyroxene

SULFATE and HYDRATED MINERALOGY

Channel	Parameter	Scaling	Significance
Red	Sulfate index, SINDEX*	0-0.03 to 0-250	Higher values indicate greater content or larger particle size of minerals or glasses with bound or dissolved molecular water
Green	2100 nm band depth, BD2100*	0.01-0.04 to 0-250	Higher values indicate greater content or larger particle size of monohydrated sulfates
Blue	1900 nm band depth, BD1900*	0.01-0.04 to 0-250	Higher values indicate greater content or larger particle size of hydrated minerals such as sulfates

PHYLLOSILICATE MINERALOGY

Channel	Parameter	Scaling	Significance
Red	2300 nm dropoff, D2300*	0.005-0.02 to 0-250	Higher values indicate greater content or larger particle size of iron/magnesium phyllosilicates
Green	2210 nm band depth, BD2210*	0.005-0.02 to 0-250	Higher values indicate greater content or larger particle size of aluminum phyllosilicates or hydrated silica
Blue	1900 nm band depth, BD1900*	0.01-0.04 to 0-250	Higher values indicate greater content or larger particle size of hydrated minerals

- 3x3 degree study area delineated for each MSL candidate landing site
- Batch processing of Full Resolution Targeted (FRT) hyperspectral observations within each site study area
 - ~125 FRT observations identified
 - Photometric correction ($\cos[\text{incidence}]$)
 - Atmospheric correction (empirical gas-band)
 - Summary parameter calculation
 - Browse product rendering
 - Map projection
- MSL candidate landing site CRISM FRT browse product collection available online
 - http://crism.jhuapl.edu/msl_landing_sites/

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MRO CRISM - MSL Landing Site Selection

MRO CRISM - MSL Landing Site Selection

This web site contains links to CRISM browse products, pre-PDS release data products, reference information, and resources related to CRISM data acquisition and analysis in support of MSL landing site selection.

Contents:

- (1) [MRO Support of MSL Landing Site Selection](#)
- (2) [An Overview of CRISM Observations of the Candidate MSL Landing Sites](#)
- (3) [An Overview of CRISM Browse Images of Candidate MSL Landing Sites](#)
- (4) [Links to CRISM Browse Images of Candidate MSL Landing Sites](#)
- (5) [Archive of pre-PDS Release CRISM Standard Data Products for Candidate MSL Landing Sites](#)
- (6) [Additional Resources](#)

(1) MRO Support of MSL Landing Site Selection:

The MRO project and the CRISM, HiRISE, and CTX science and operations teams support the MSL landing site selection process through the acquisition of high resolution panchromatic, multispectral, and hyperspectral orbital remote sensing data. The first MSL landing site selection workshop was held in May, 2006. At that workshop 30+ candidate landing sites were proposed by the Mars science community. Since then, more sites have been proposed based on new findings from CRISM, OMEGA, and TES, bringing the grand total of proposed landing sites to 46. Between the start of the MRO Primary Science Phase (November, 2006) and the second MSL landing site selection workshop (October, 2007), MRO has surveyed each of the initial candidate sites (and most of the ones suggested later) with nested high spatial resolution CRISM, HiRISE, and CTX observations centered at sites' coordinates.

(2) An Overview of CRISM Observations of the Candidate MSL Landing Sites:

The characteristics of the standard CRISM data acquisition modes and resulting data products are listed in the table below. The MSL candidate landing site survey campaign has resulted in the acquisition of at least one high quality Full Resolution Targeted (FRT) observation for each of the initial candidate sites. Many of the candidate sites are of great scientific interest irrespective of the MSL landing site selection process. As a result additional CRISM hyperspectral coverage is clustered around those sites with previously known mineralogical diversity.

CRISM also acquires multispectral survey (MSP) data of the candidate landing sites as a natural consequence of the ongoing global mapping (multispectral survey) campaign.

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(4) Links to CRISM Browse Images of Candidate MSL Landing Sites

Click on the name of a site below to see CRISM images covering it or located nearby:

NAME	LOCATION	ELEVATION	KEY FEATURES	SITE PROPOSER
Nili Fossae Trough	20.93°N, 74.35°E	-0.6 km	Phyllosilicates	J. Mustard
Holden Crater Fan	26.32°S, 325.30°E	-2.3 km	Layered Materials	Irwin, Grant, Malin, Edgett, Rice
Terby Crater	27.7435°S, 74.1137°E	-5 km	Layered Material	S. Wilson, Cohen, Dobrea
Marwth Vallis	24.65°N, 340.1°E	-3.1 km	Phyllosilicates	J-P Bibring, J. Michalski
Eberswalde Crater	23.85°S, 326.75°E	-1.4 km	Delta	J. Schieber, J. Dickson, J. Rice
Gale Crater	4.50°S, 137.35°E	-4.5 km	Interior Layered Deposits	J. Bell, N. Bridges
W Candor Chasma	5.80°S, 284.17°E	1.8 km	Sulfate Deposits	N. Mangold
N Meridiani	2.37°N, 6.69°E	-1.5 km	Sedimentary Layers	Edgett/Malin
Juventae Chasma	4.45°S, 298.09°E	-2.8 km	Layered Sulfates	J. Grotzinger
Nilo Syrtis	29.16°N, 72.97°E	-0.5	Phyllosilicates	J. Mustard
Melas Chasma	9.81°S, 283.62°E	-1.9 km	Paleolake	C. Quantin
E. Meridiani	0.01°N, 3.66°E	-1.3 km	Sedimentary Layers	B. Hynek
Iani Chaos	2.06°S, 342.41°E	Below -2 km	Hematite, Sulfate	T. Glotch
Nili Fossae Crater	18.44°N, 77.58°E	-2.6 km	Valley Networks, Delta sediments	R. Harvey, J. Rice
Eos Chasma	10.7°S, 322.05°E	-4 km	Chert	V. Hamilton
Meridiani Crater Lake	5.72°N, 358.03°E	-1.5 km	Crater lake sediments	L. Posiolova
NE Syrtis Major	~16.21°N, ~76.63°E	1 km	Volcanics	R. Harvey
Hellas/Dao Vallis	39.5°S, 82.7°E	-6 km	Valley Terminus, Layered Deposits	L. Crumpler
Xanthe Hypanis Vallis	11.4°N, 314.65°E	-2.6 km	Layered Deposits	L. Crumpler
SW Arabia Terra	6.01°N, 355.60°E	-1 km	Sed. Rocks, Methane	C. Allen
W. Arabia Crater	8.45°N, 359.09°E	-1.2 km	Sedimentary Rocks	E. Heydari
W. Meridiani	1.7°S, 352.39°E	-1.0 to -1.5 km	Sediments, Hematite	H. Newsom
Elysium/Avernus Colles	3.05°S, 170.60°E	-2.5 km	High iron abundance	L. Crumpler
Isidis Basin Facament	18.00°N, 79.60°E	-3.5 km	Volatiles sink	L. Crumpler

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http://crism.jhuapl.edu/msl_landing_sites/

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MSL Landing Site Selection - Nili Fossae Crater

View PDS Archive

	FRT000047A3	FRT00005850	FRT00005C5E	FRT000066A4	FRT0000722C
vnir_rgb					
Enhanced visible color					
red = 592nm	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
green = 533 nm	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
blue = 492nm	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon
vnir_fem					
Oxidized iron minerals					
red = BD530 (ferric minerals)	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
green = SH600 nm (coatings)	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
blue = BD1000nm (variety of iron minerals)	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon
ir_ira					
IR surface brightness					
gray level = brightness at 1330nm.	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon

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ir_maf

Mafic mineralogy

red = OLINDEX (olivine)

green = LCPINDEX (low-Ca pyroxene)

blue = HCPINDEX (high-Ca pyroxene)

Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon

ir_ply

Hydroxylated silicates

red = BD2300 (Fe/Mg phyllosilicate)

green = BD2210 (Al phyllosilicate or hydrated glass)

blue = BD1900 (hydrated sulfates, clays, or glass)

Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon

ir_hyd

Bond water

red = SINDEX (water-containing minerals)

green = BD2100 nm (monohydrated sulfates)

blue = BD1900nm (hydrated sulfates, clays, or glass)

Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon

ir_ice

Water and CO2 ice

red = BD1900 0.0-0.40 (water ice or hydrated sulfates, clays, or glass)

green = BD1600 0.0-0.65 (water ice)

blue = BD1435 0.0-0.35 (CO2 ice)

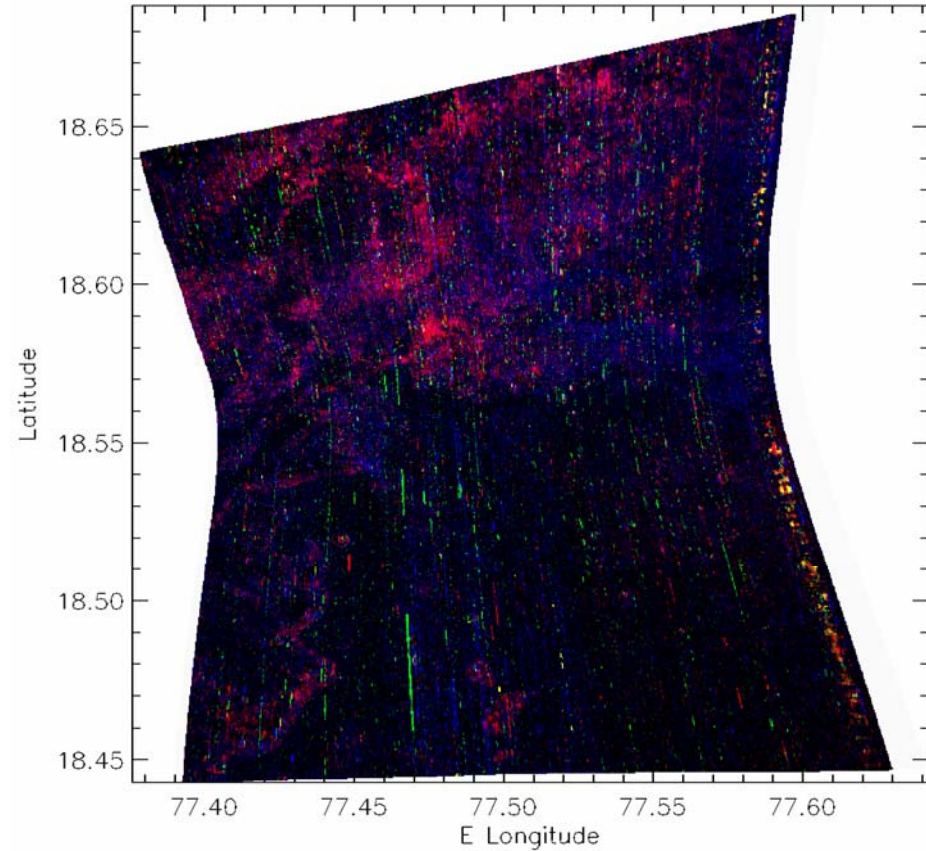
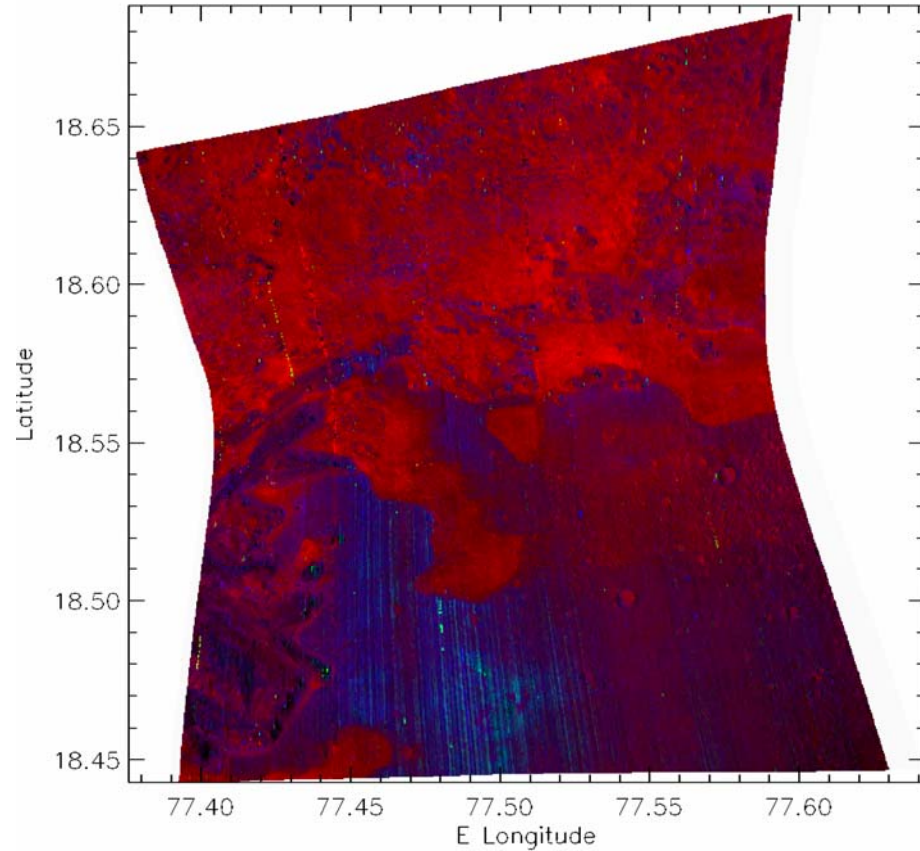
Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG	Downloads: PNG
PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid	PNG w/ geo. grid
Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon	Lat/Lon

Editor: JHU/APL Webmaster
JHU/APL Official: Kerri Beisser
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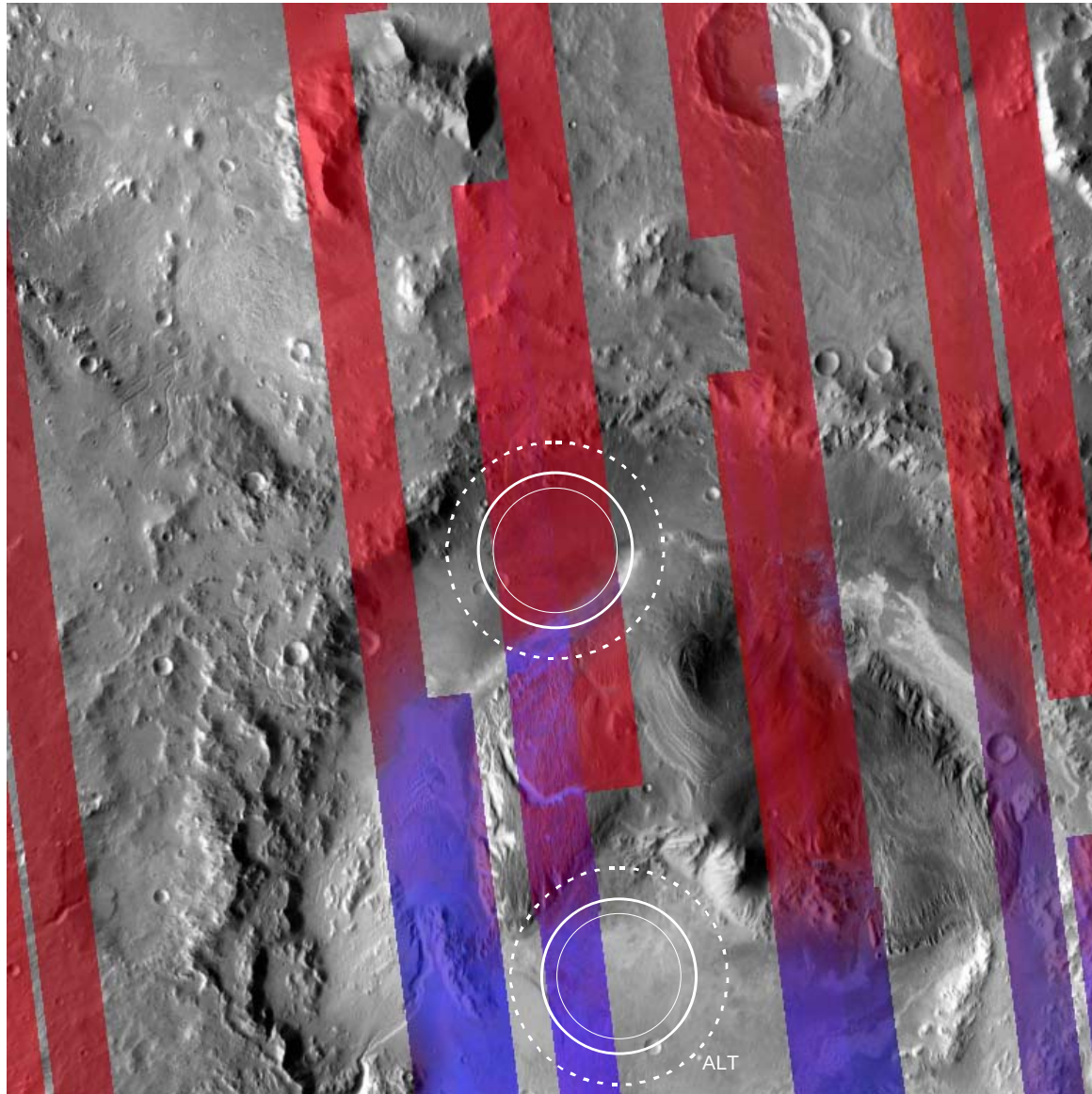
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- Batch processing of CRISM multispectral data that intersect each candidate landing site study area
 - Photometric correction ($\cos[\text{incidence}]$)
 - Atmospheric correction (empirical gas-band)
 - Summary parameter calculation
 - Map projection and layer stacking (MRO standard; entropy ordering)
 - Browse product rendering (THEMIS day IR overlay @ 256 ppd)
- Four CRISM multispectral browse product mosaics have been generated for each site
 - FEM (iron mineralogy)
 - MAF (mafic mineralogy)
 - HYD (sulfate and hydrated mineralogy)
 - PHY (phyllosilicate mineralogy)
- The complete product set is on display on the back wall

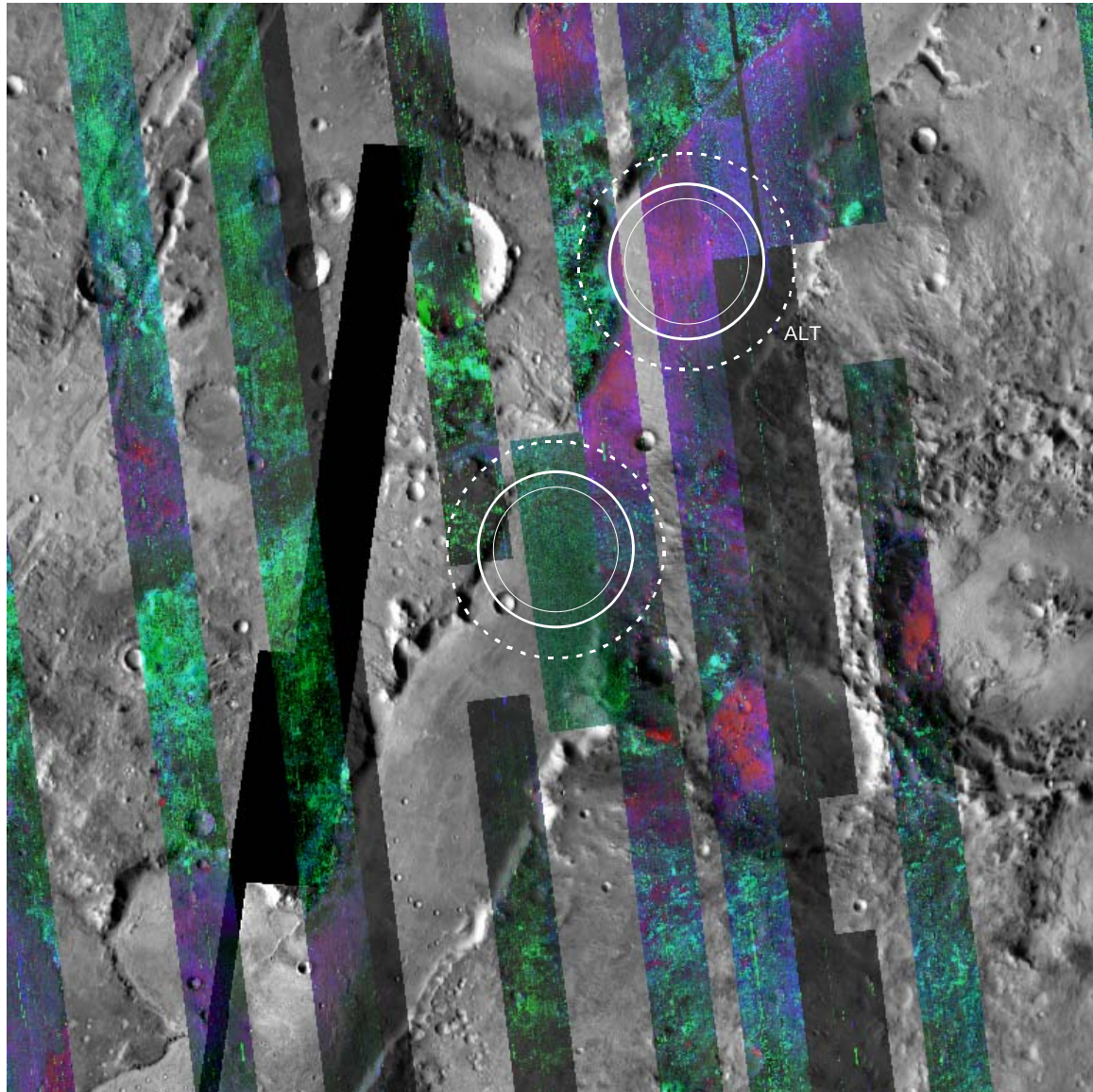
FEM (Iron Mineralogy) Example Gale Crater

R: BD530
G: SH600
B: BDI1000



MAF (Mafic Mineralogy) Example Nili Fossae Trough

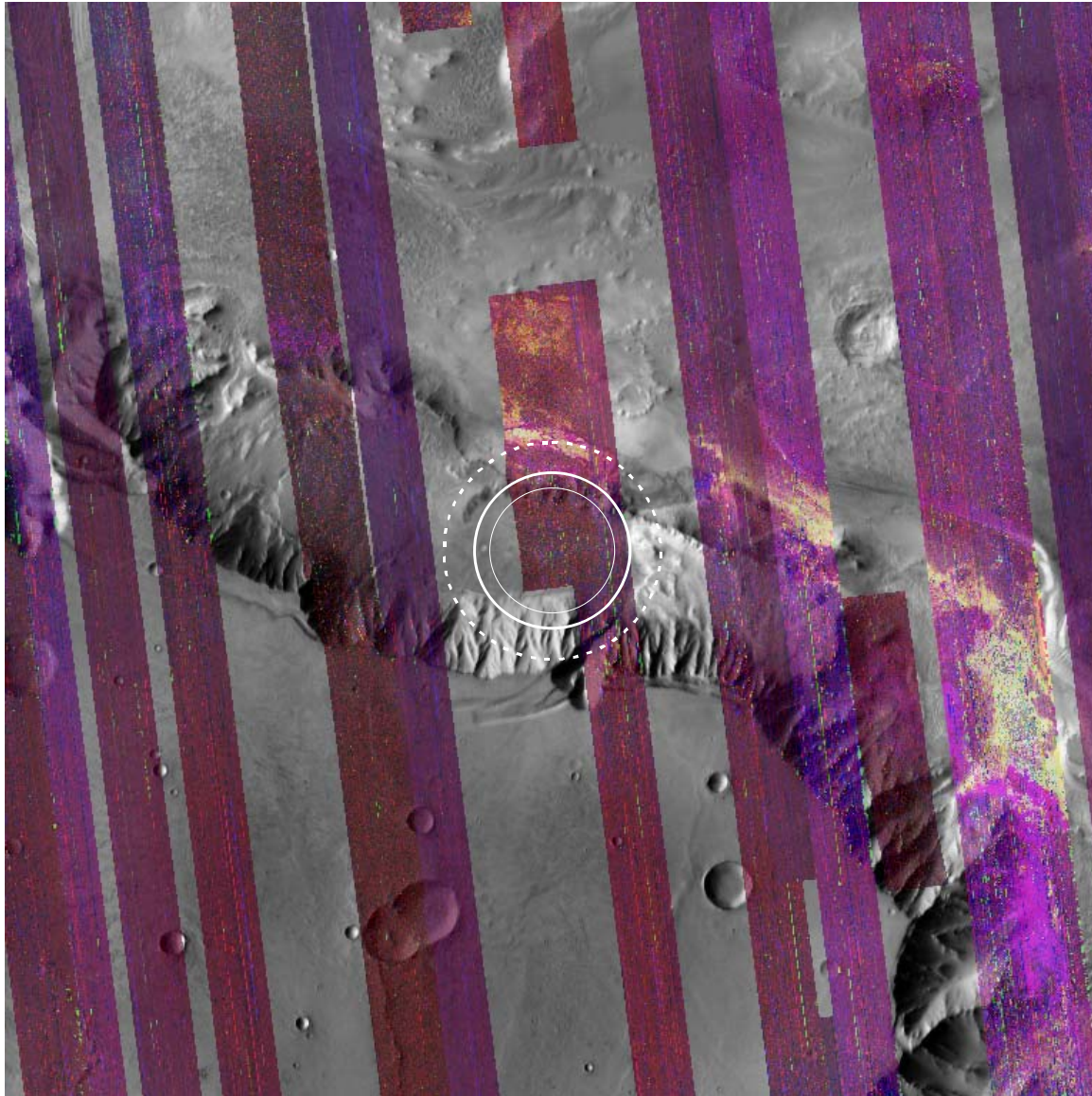
R: OLINDEX
G: LCPINDEX
B: HCPINDEX



R: SINDEX

G: BD2100

B: BD1900

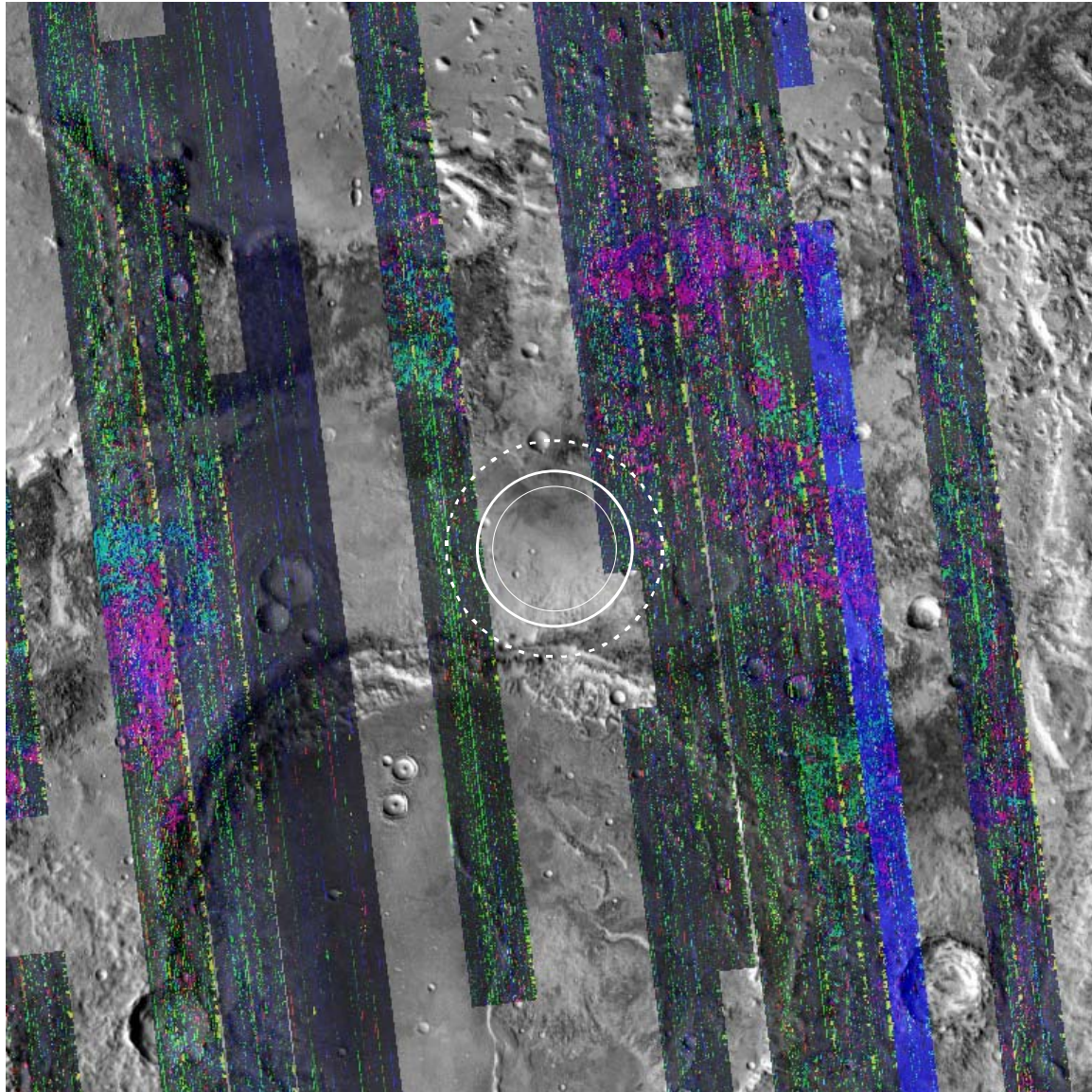


PHY (Phyllosilicate Mineralogy) Example Mawrth Vallis

R: D2300

G: BD2210

B: BD1900

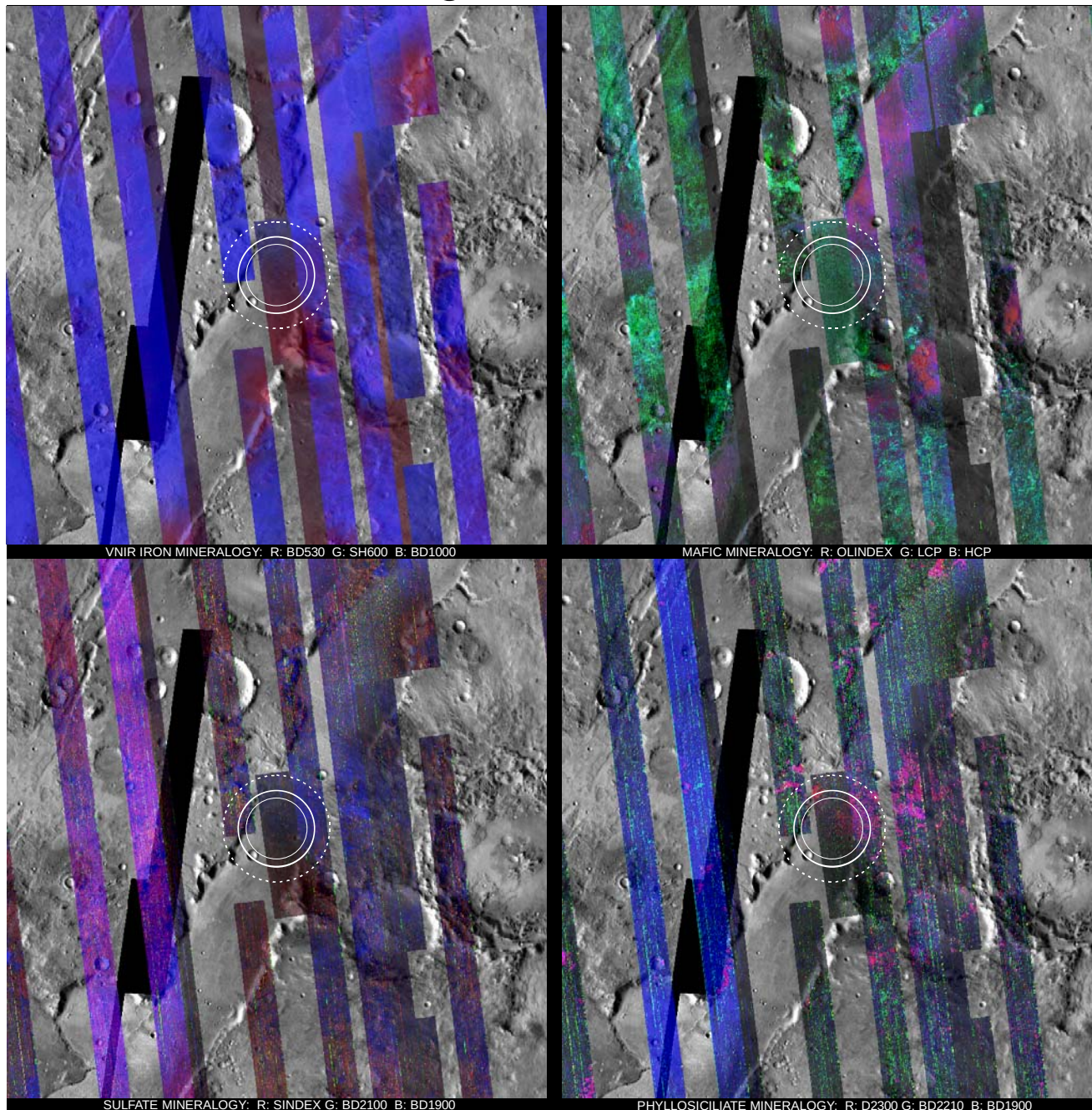




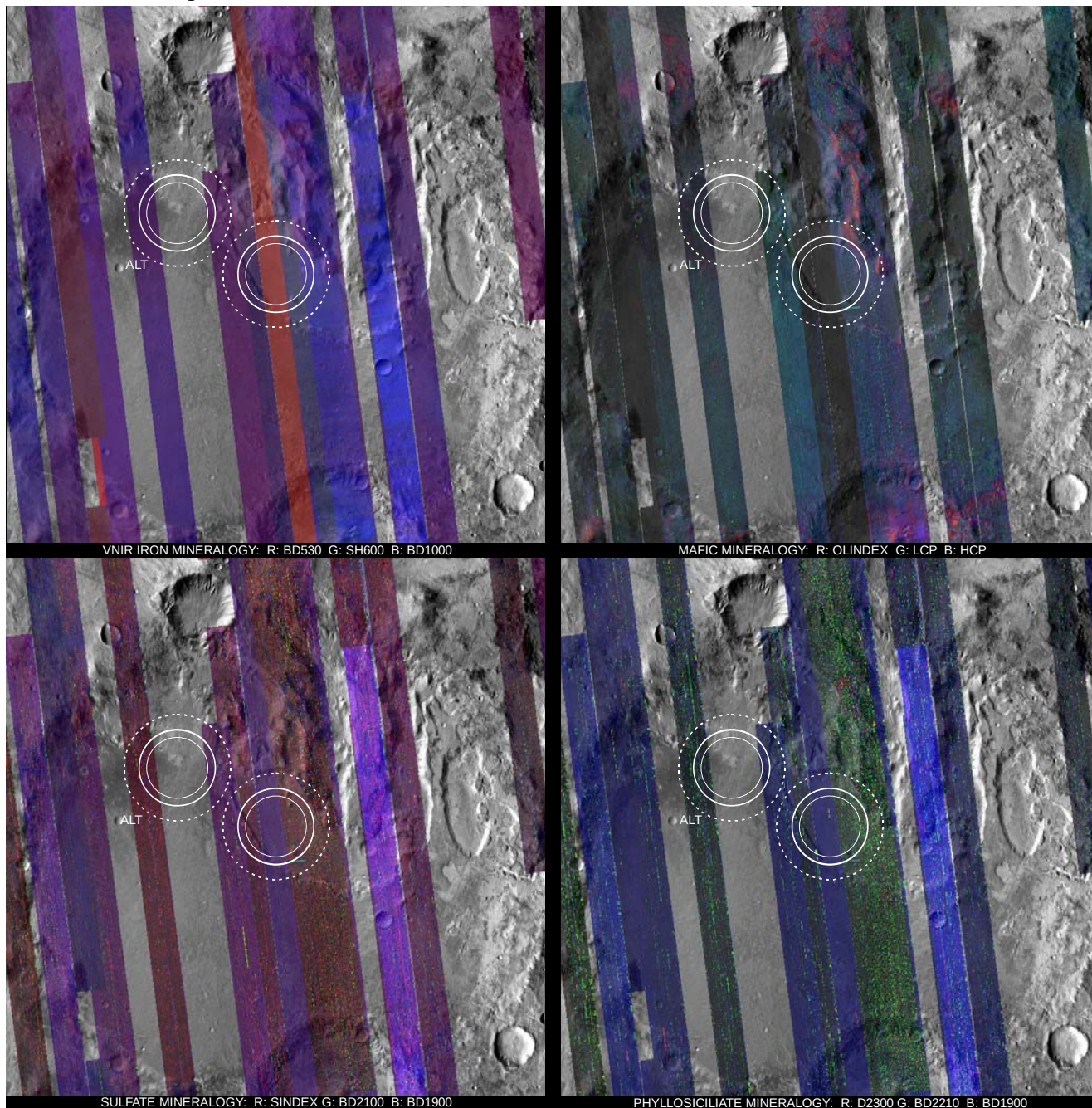
CRISM Multispectral Browse Product Highlights



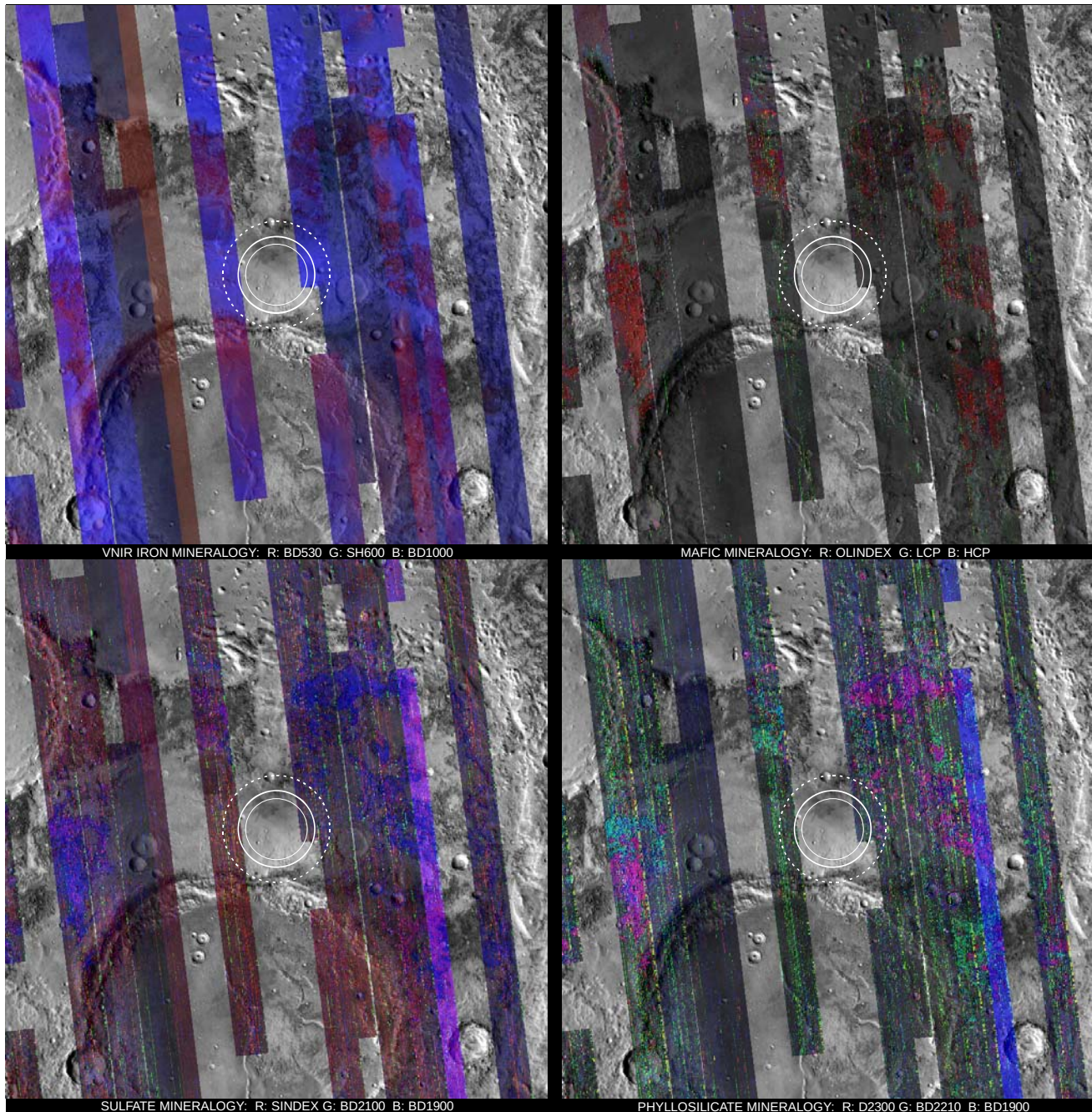
1. Nili Fossae Trough



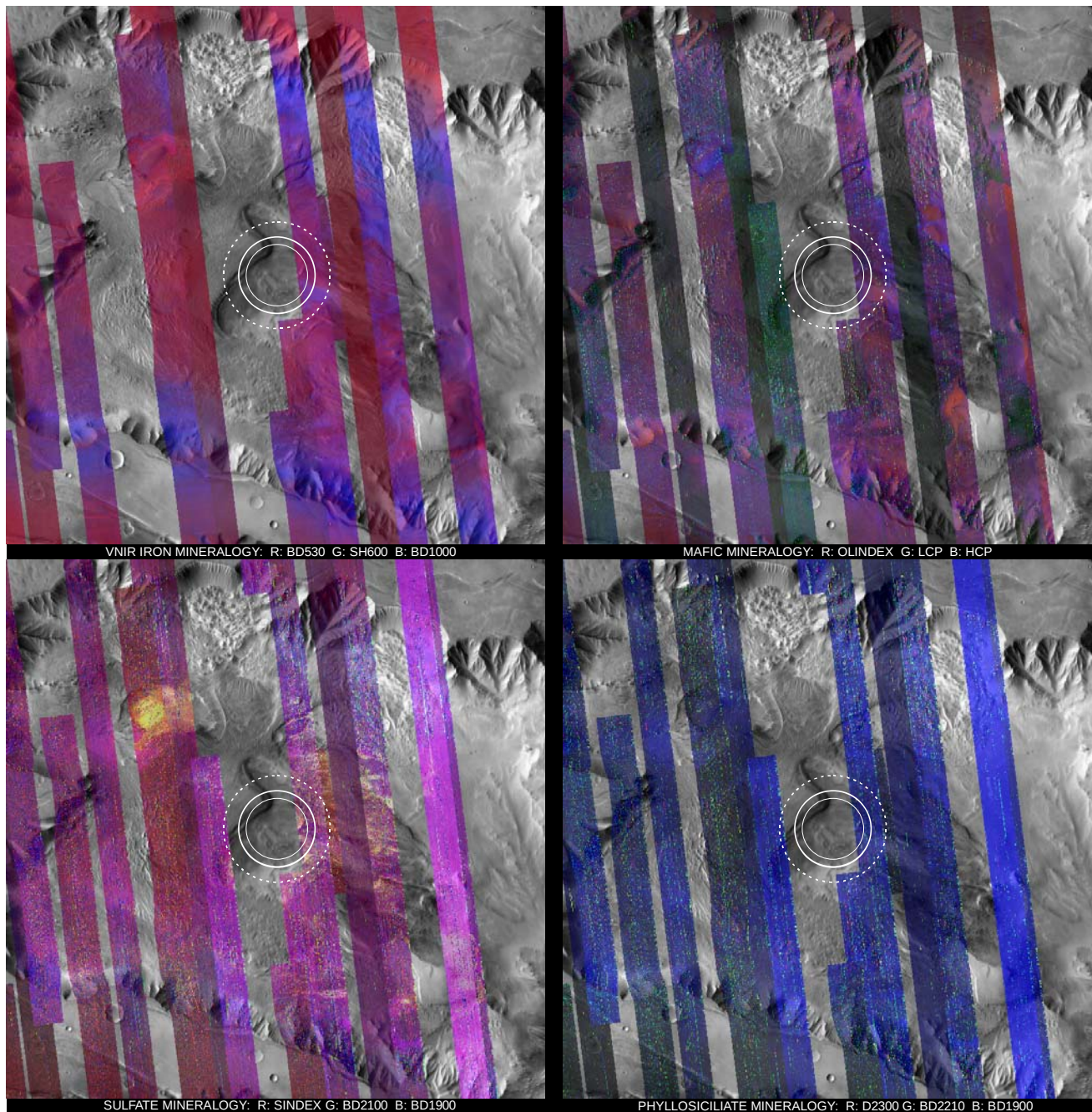
3. Terby Crater & Alternate



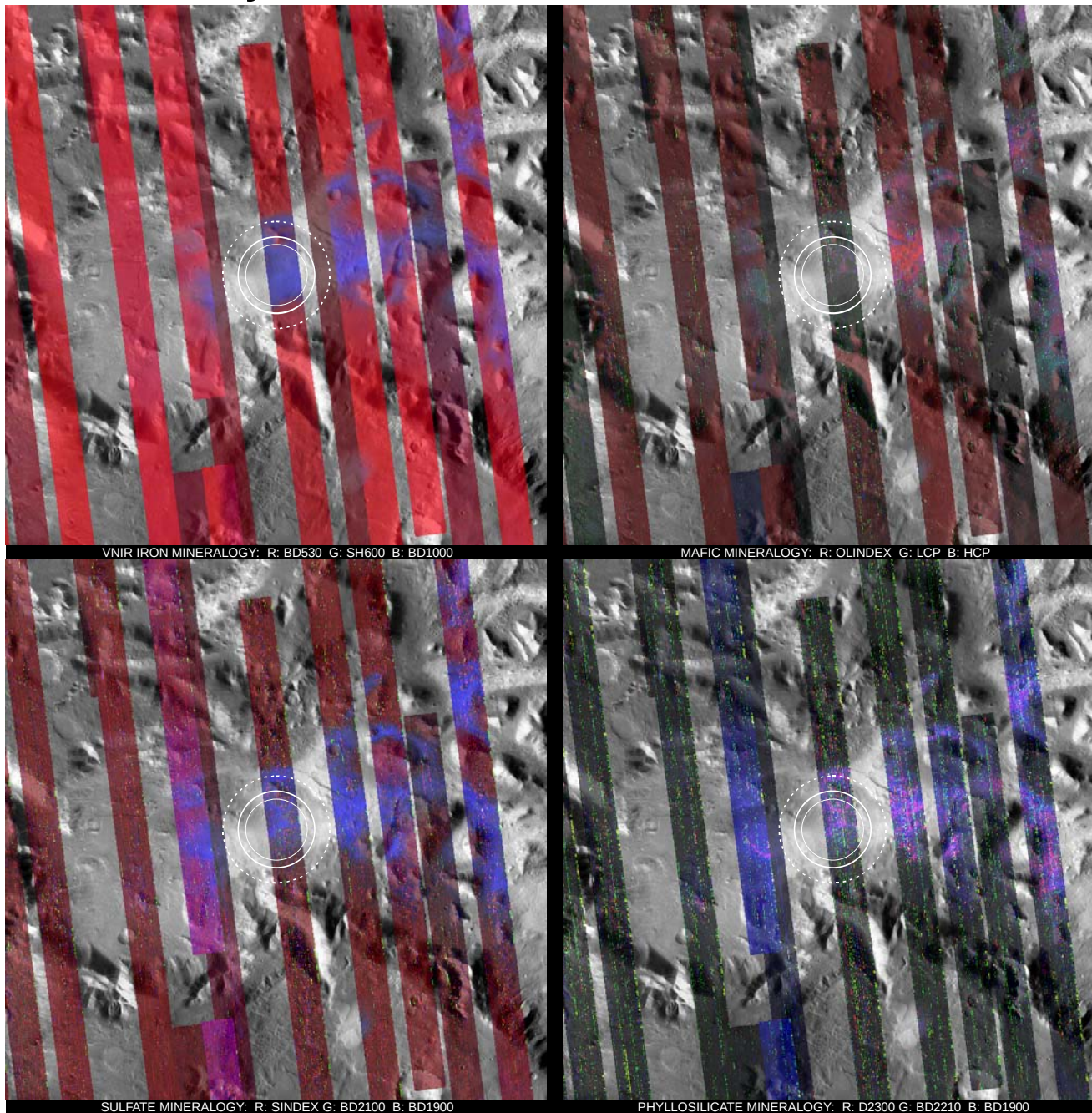
4. Mawrth Vallis



7. West Candor Chasma



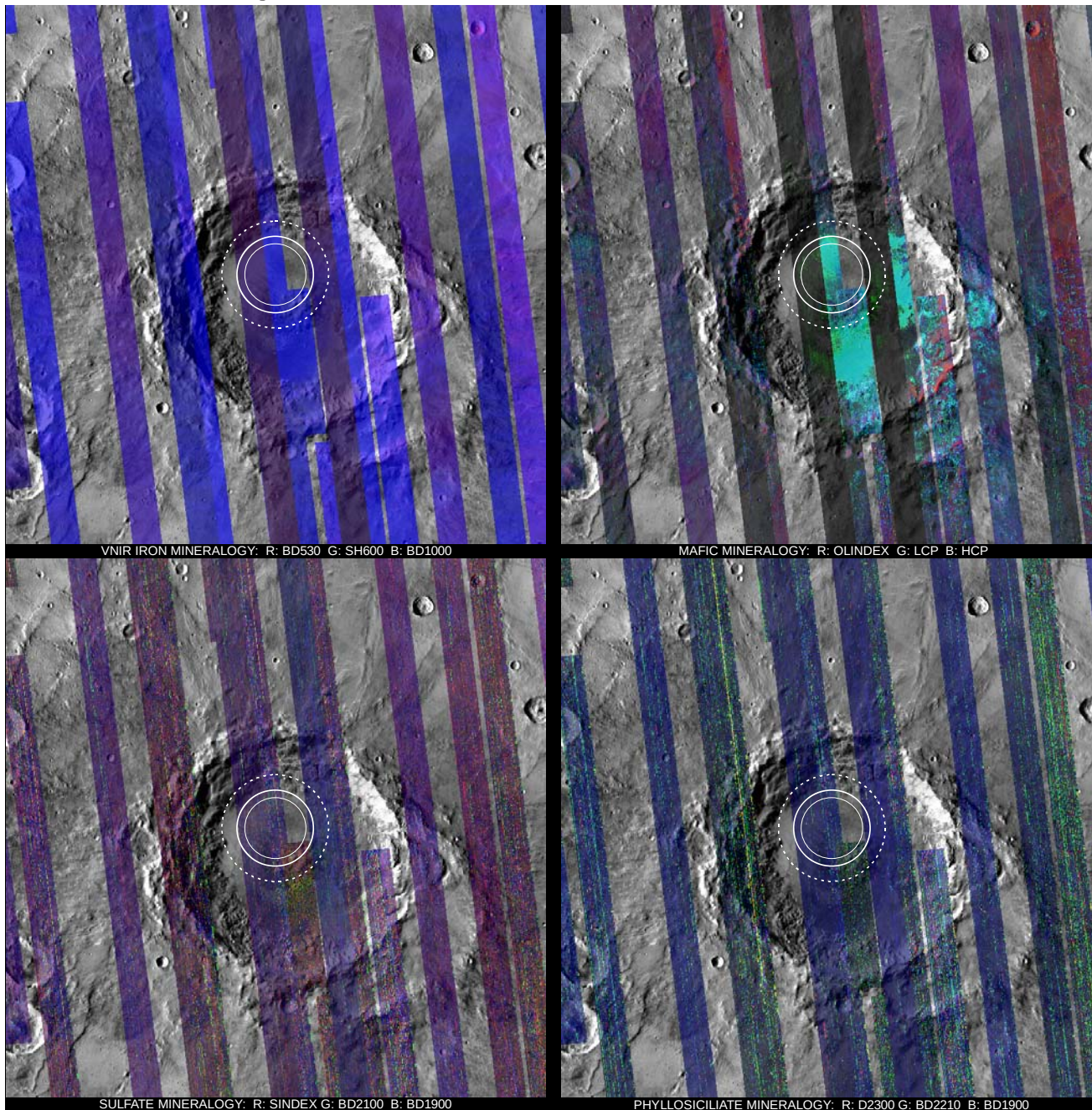
10. Nilo Syrtis



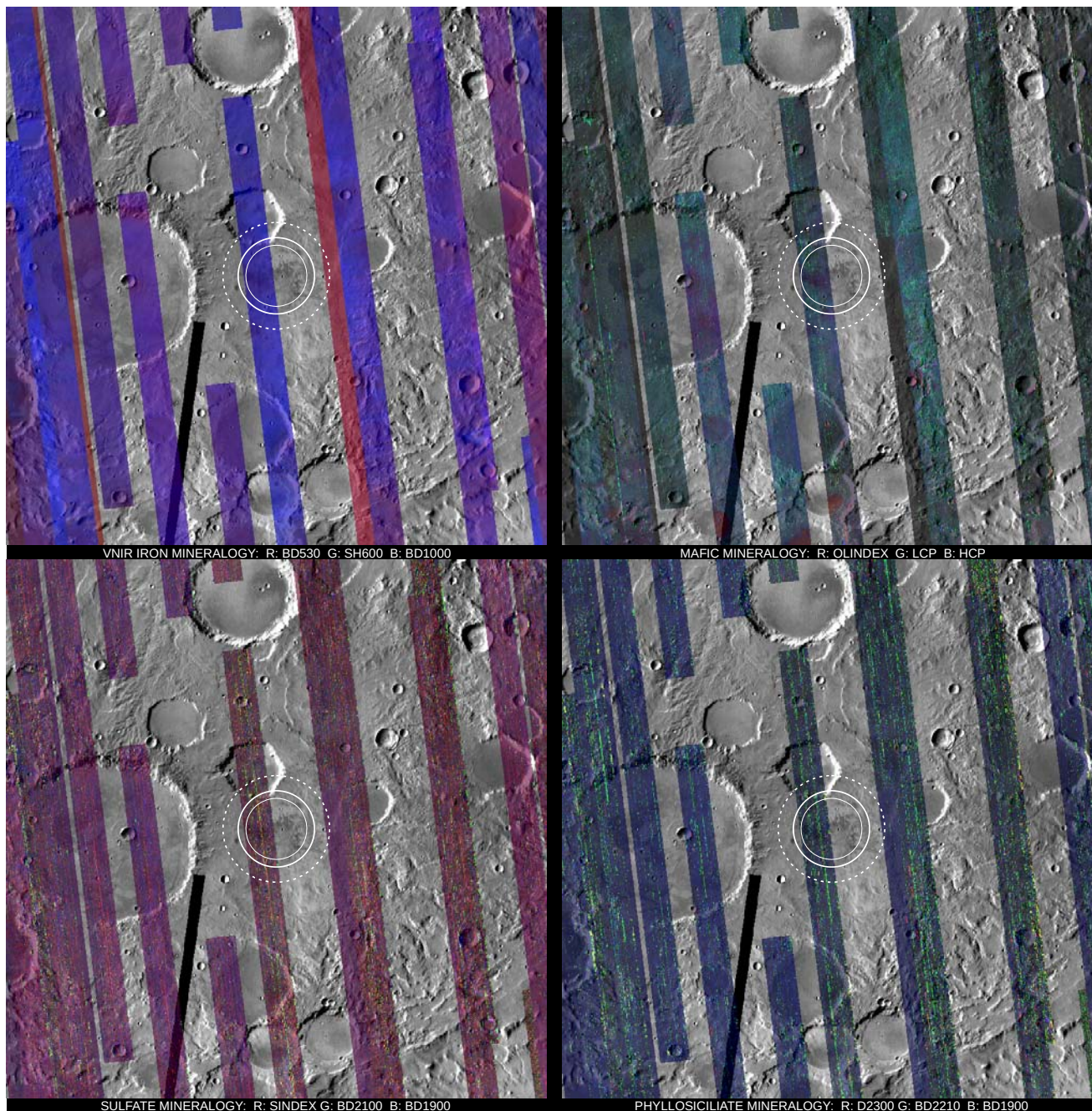
11. Melas Chasma



29. Ritchey Crater



42. Chloride Site 5



23. Elysium/Avernus Colles

