VERNAL CRATER, SW ARABIA TERRA

Subsurface Water, Lake, Springs

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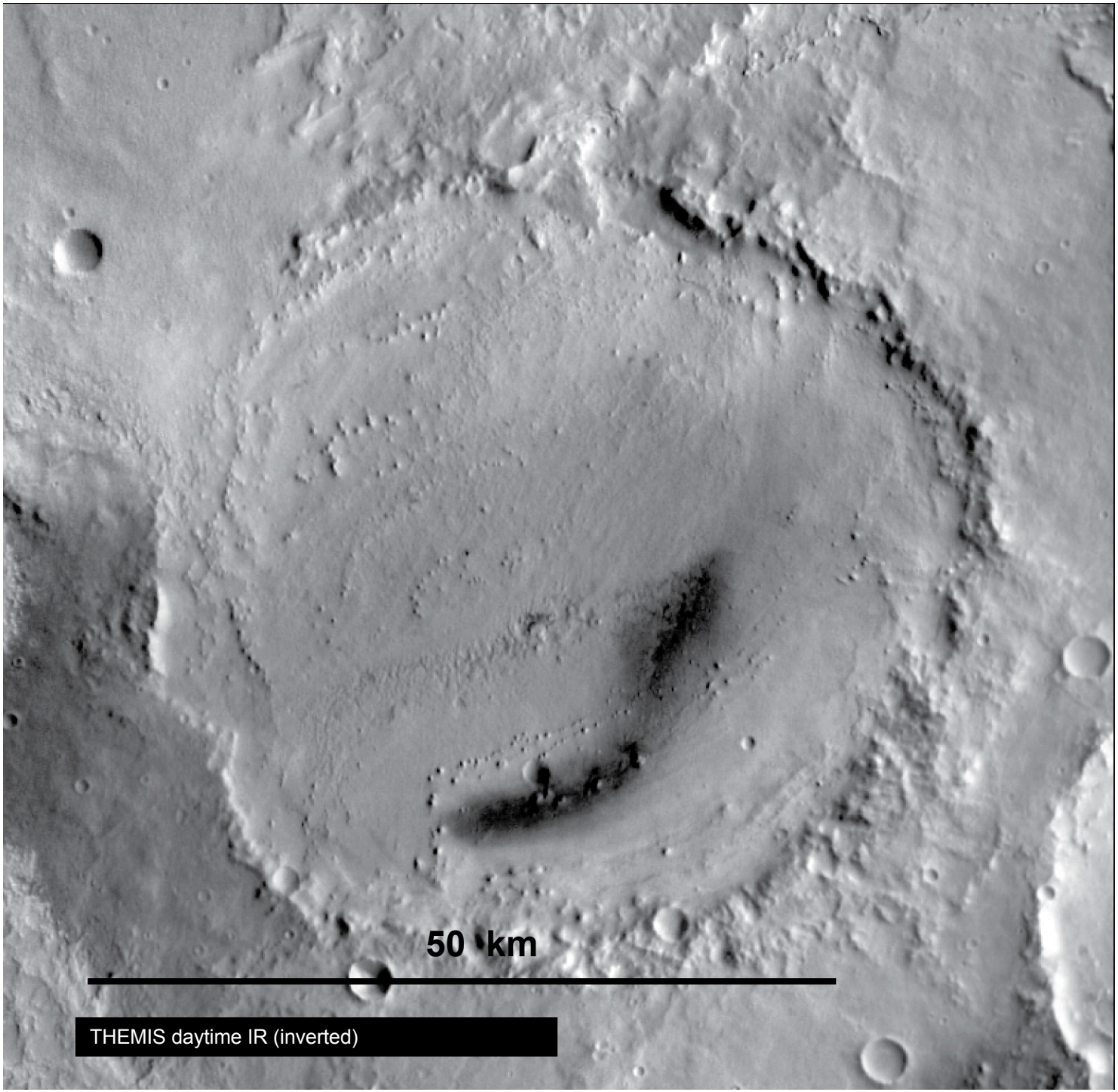


VERNAL CRATER

6° N 354° E

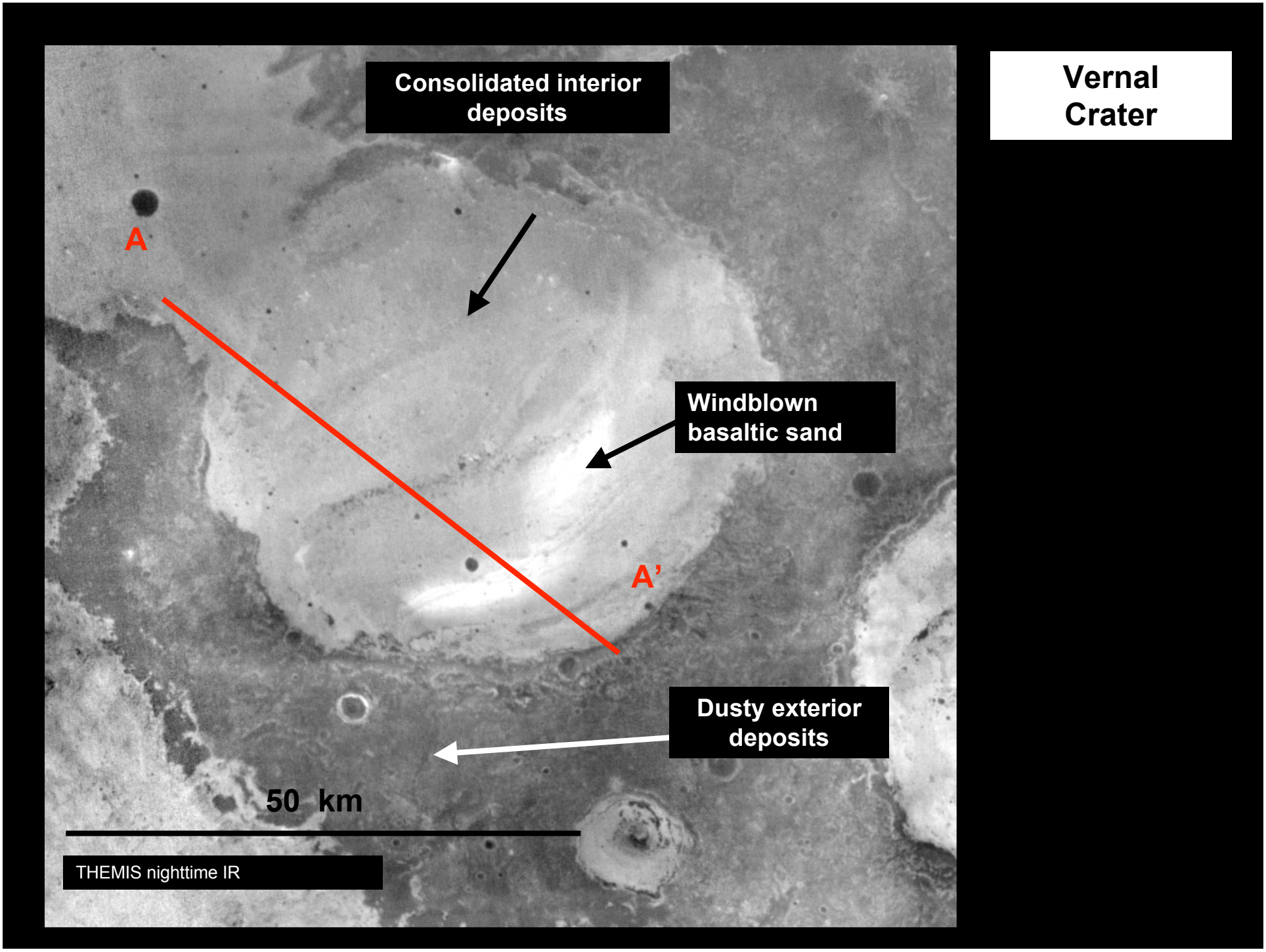
SW Arabia Terra

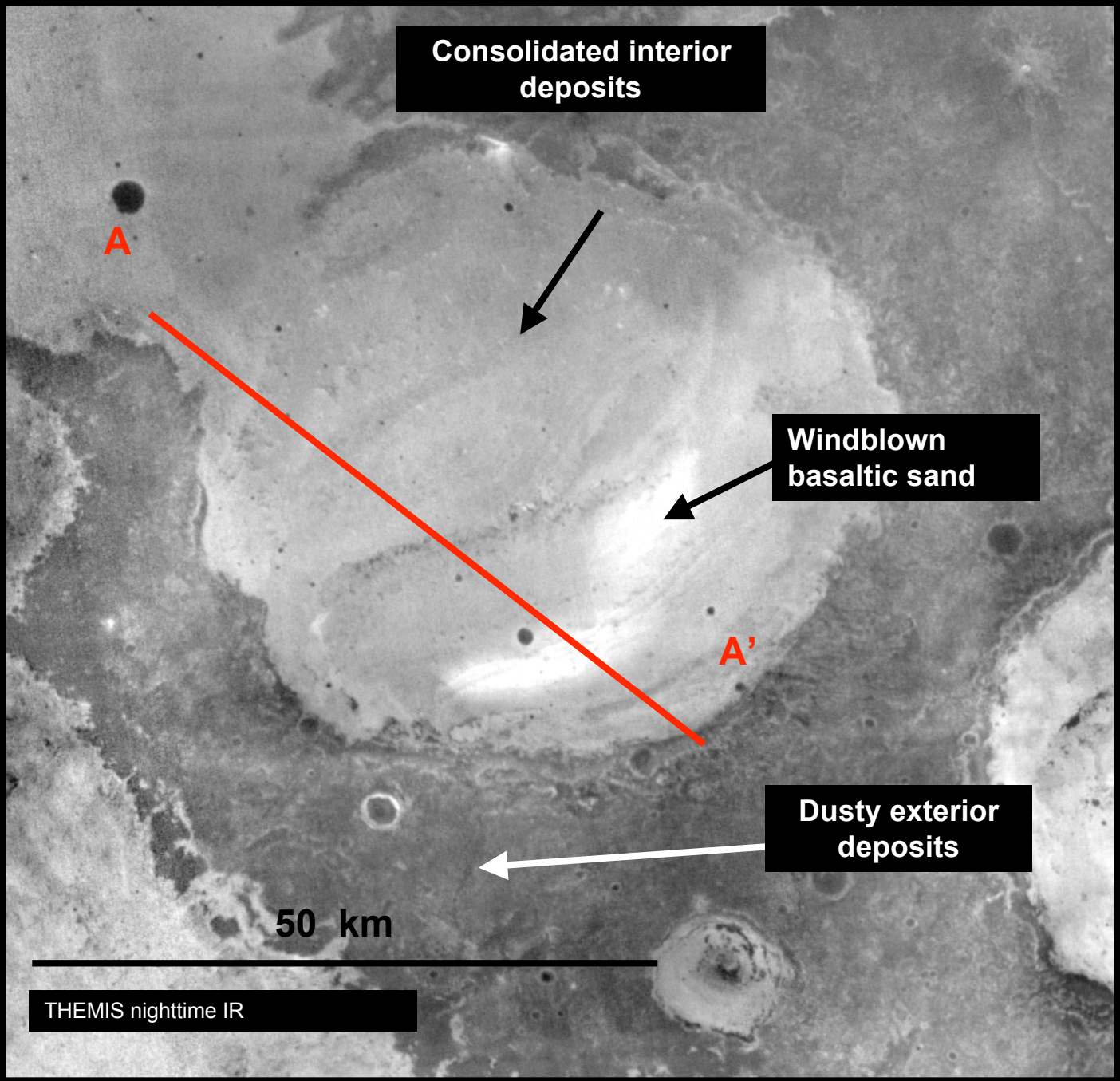
N Meridiani Planum

Noachian

55 km dia

750 m deep

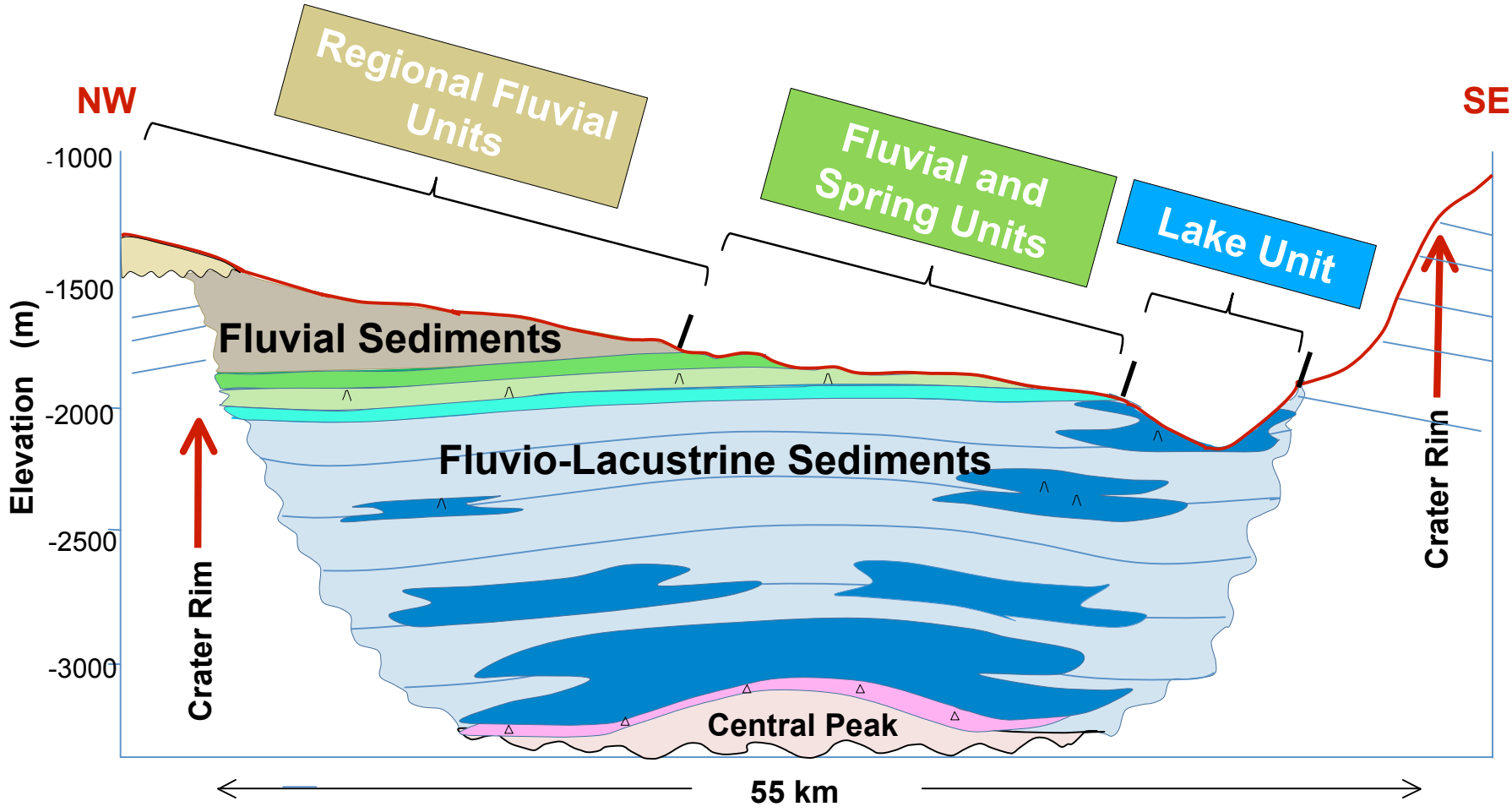

Vernal Crater
Consolidated interior deposits
A
Windblown basaltic sand
A'
Dusty exterior deposits
50 km
THEMIS nighttime IR

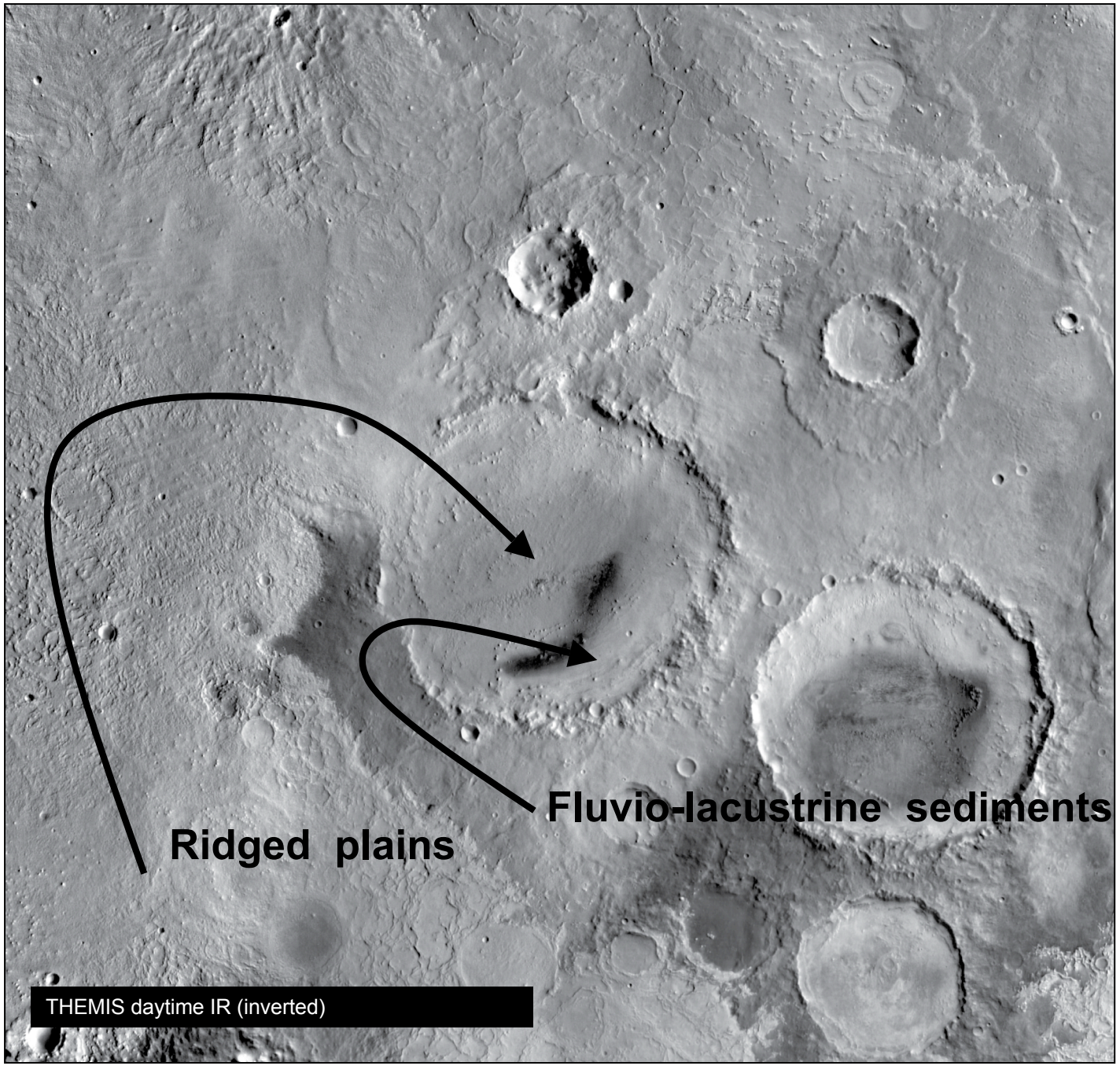


Vernal Crater

Thin layers of dust and sand degrade CRISM spectra

Vernal Crater
Schematic Cross Section A-A'
(vertical exaggeration ~ 11.6 x)

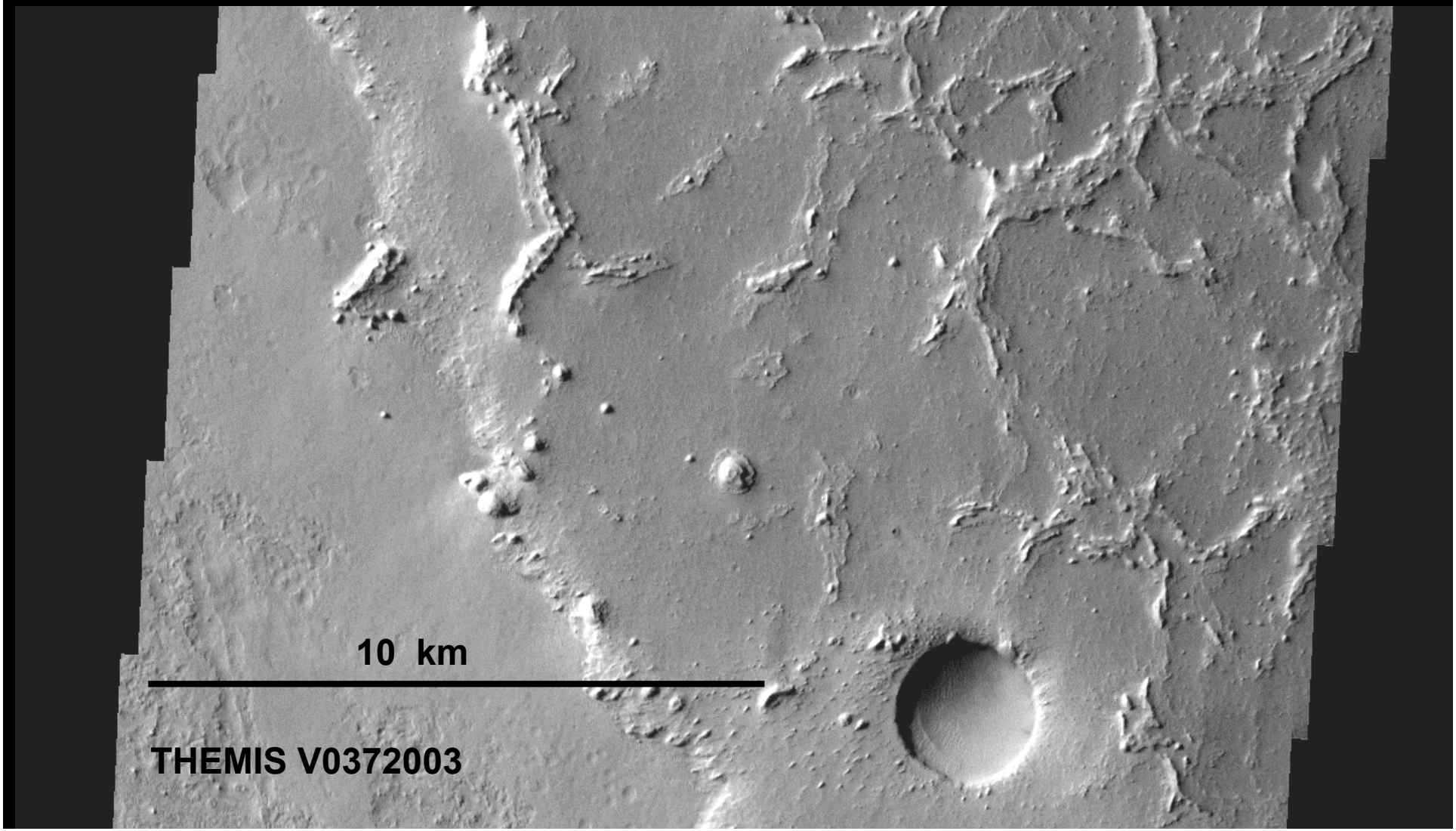




> 1500 m of fill by two regional units, both formed by water

Ridged Plains Unit

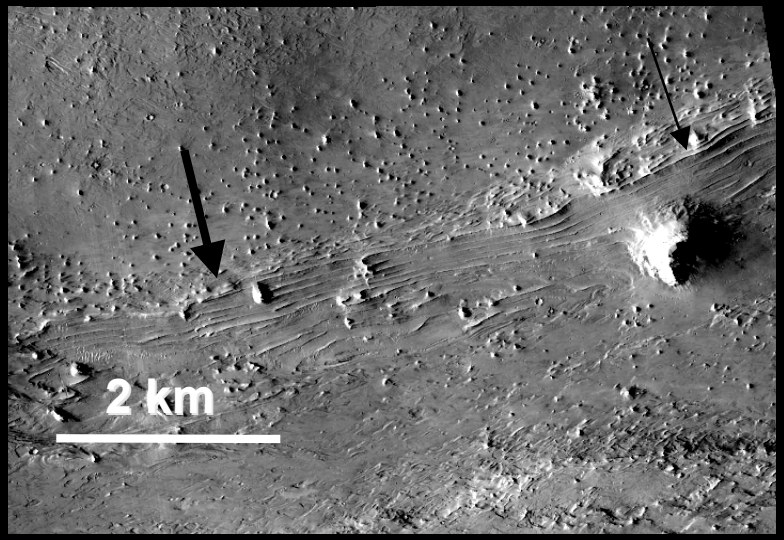
- Rampart craters
- Inverted anastamozing channels
- Associated with Noachian highlands drainages

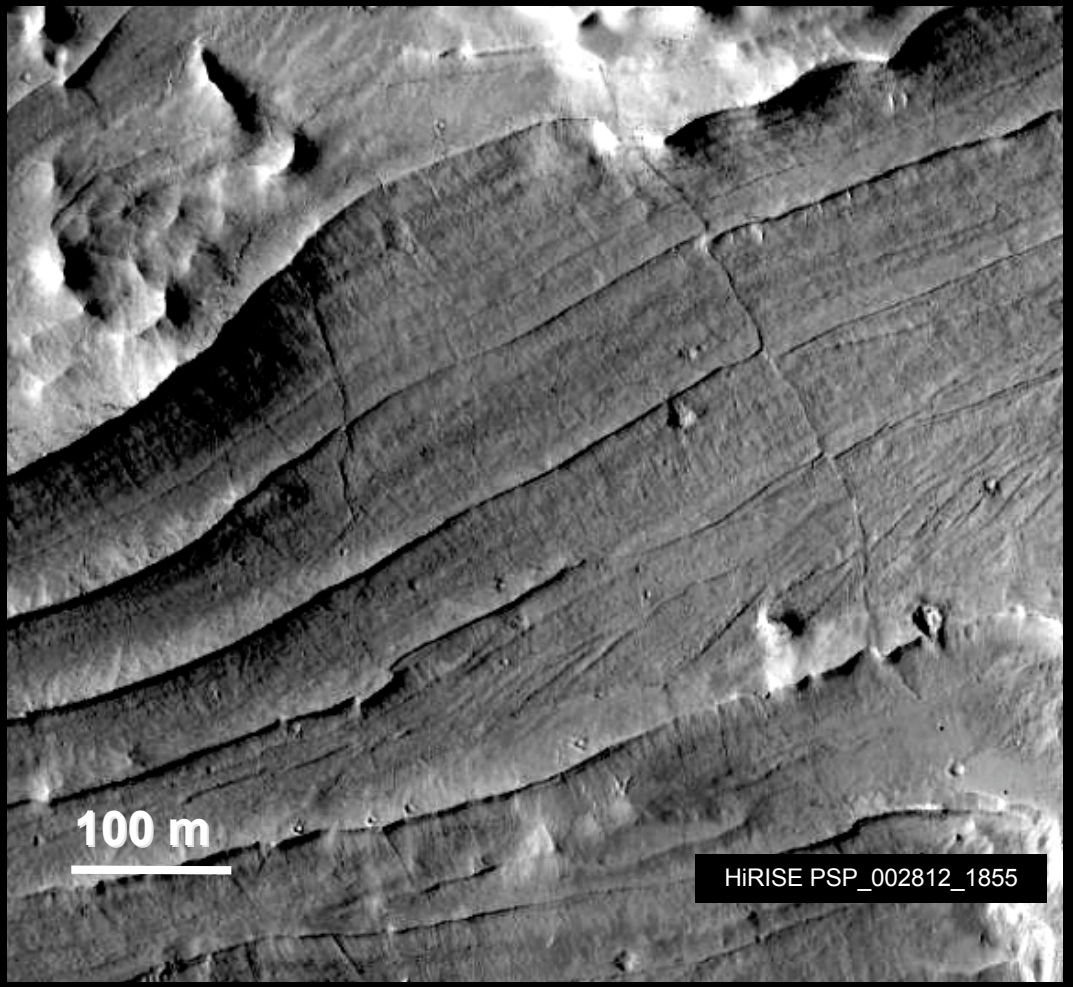


Fluvio-Lacustrine Unit -- Lakebed Sediments

- Fine, evenly layered
- Repetitive and uniform cycles
- Parallel bedding
- 10+ km extent

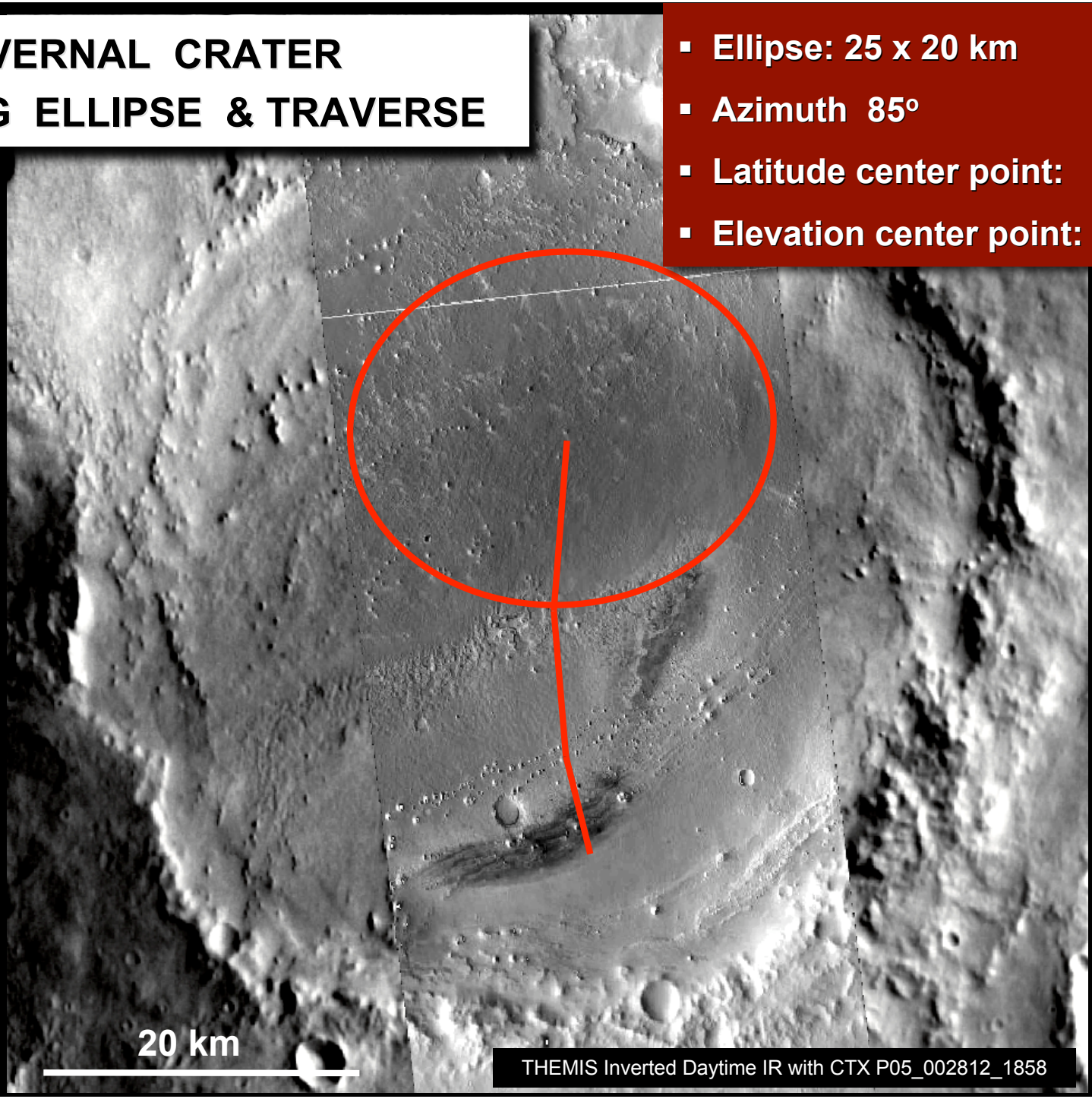
HiRISE PSP_002812_1855





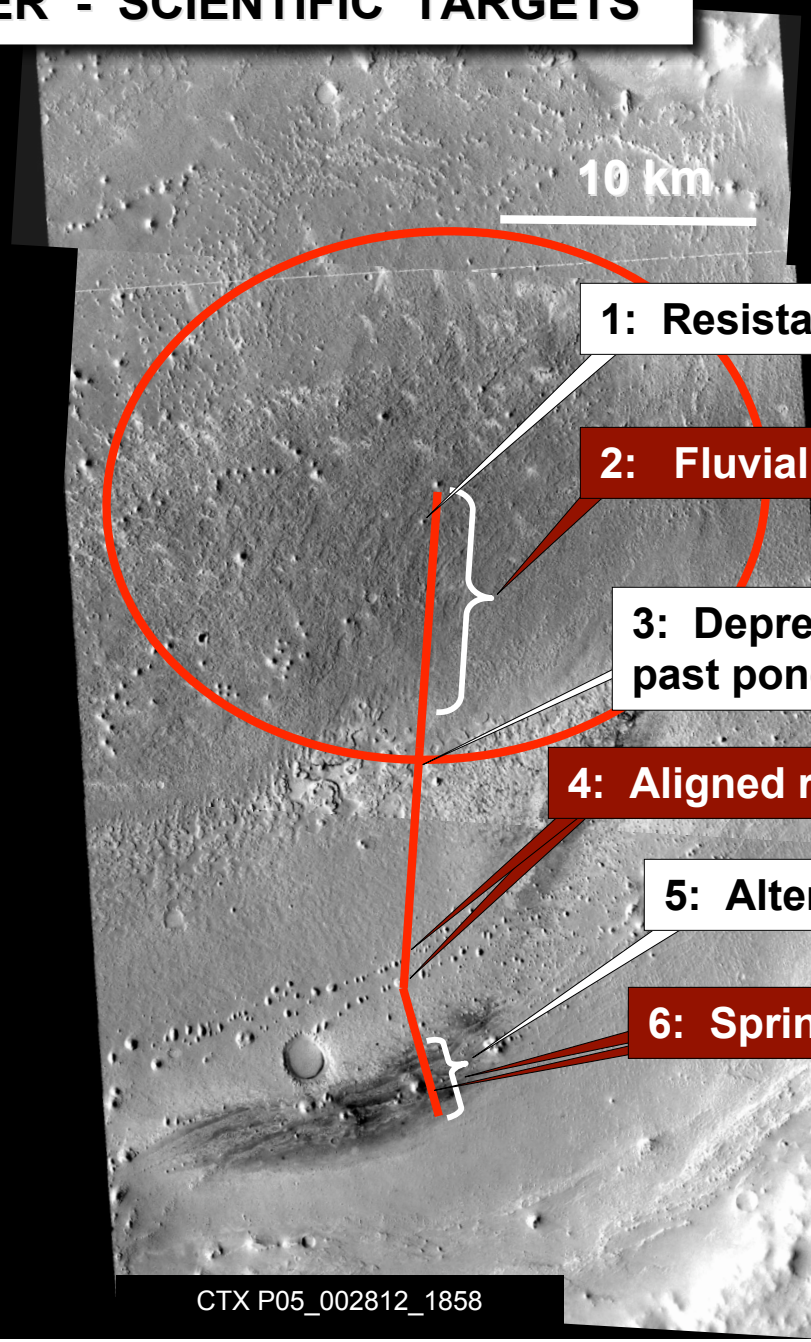
VERNAL CRATER
LANDING ELLIPSE & TRAVERSE

- Ellipse: 25 x 20 km
- Azimuth 85°
- Latitude center point: 6.02° N
- Elevation center point: -1700 m



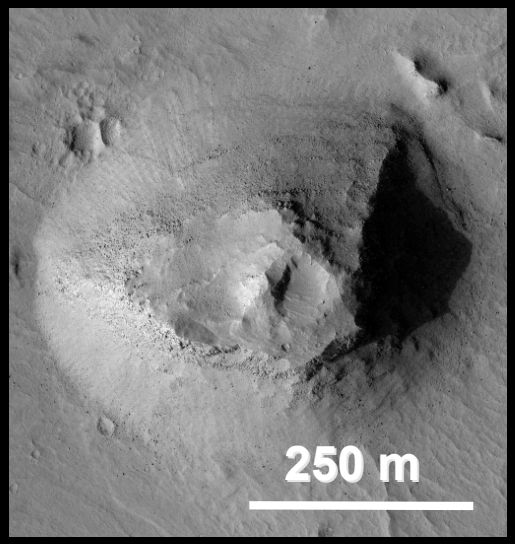
THEMIS Inverted Daytime IR with CTX P05_002812_1858

VERNAL CRATER - SCIENTIFIC TARGETS



Stops 1 - 3

1. **Resistant knobs -- cemented by subsurface water**



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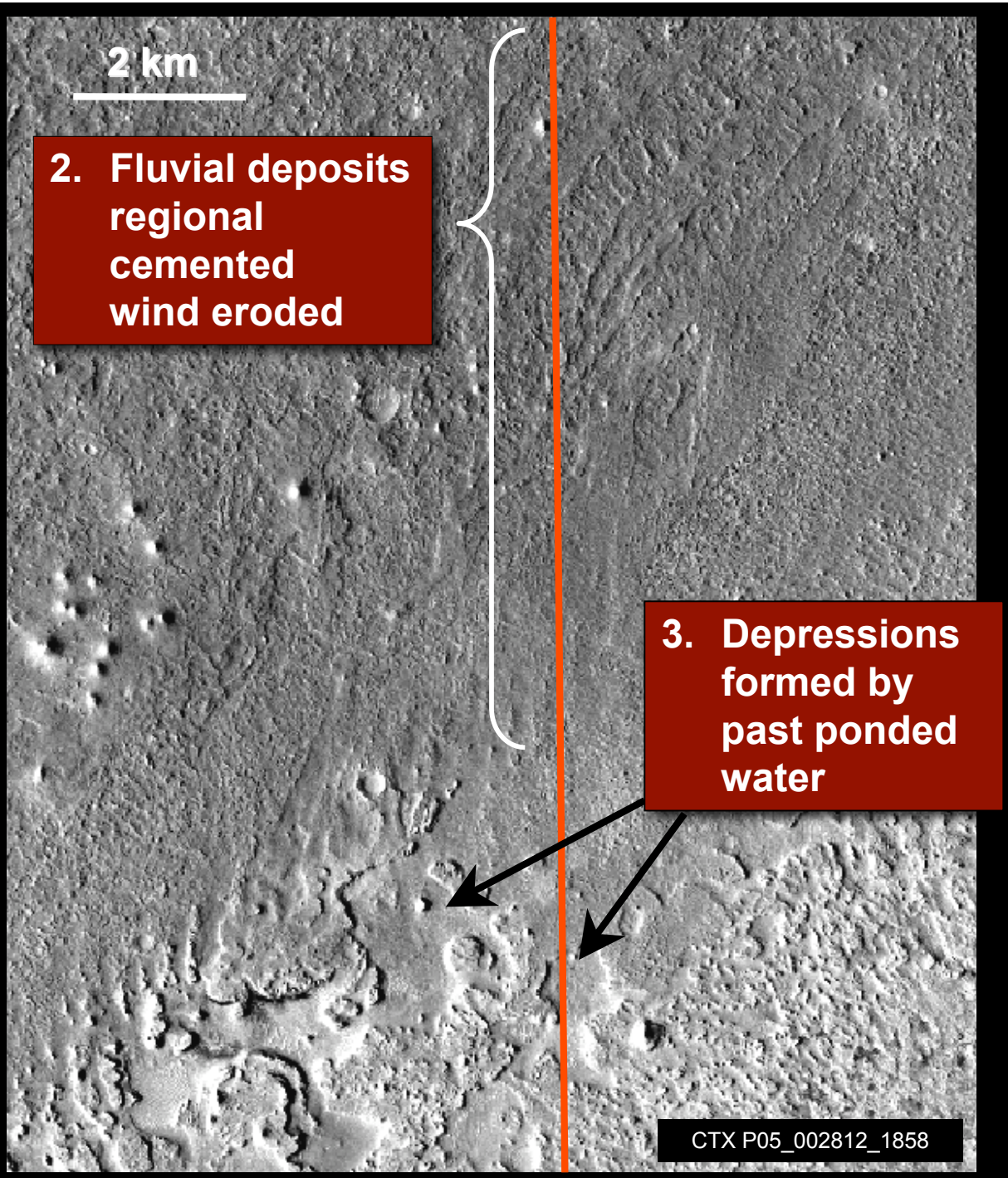
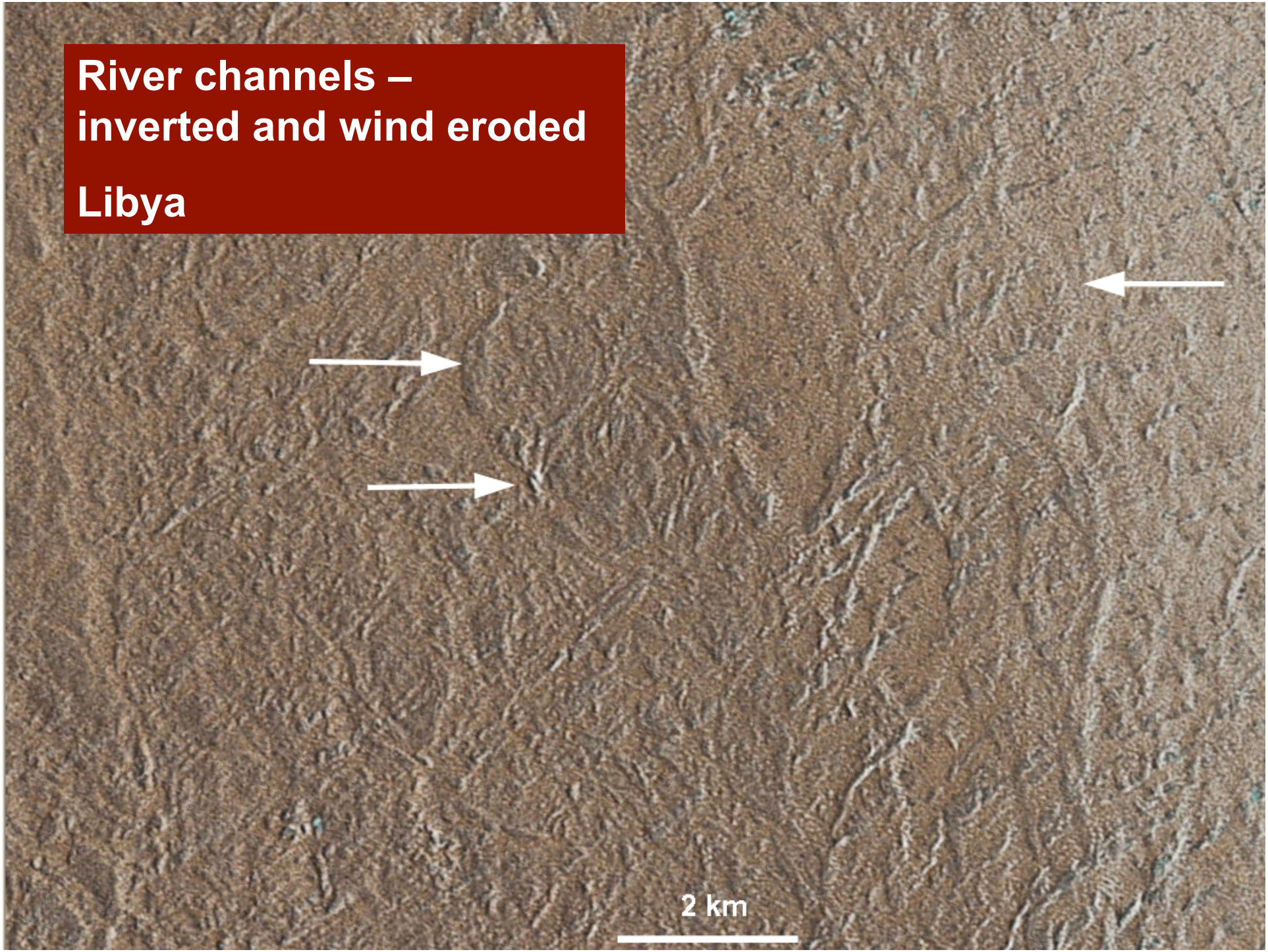
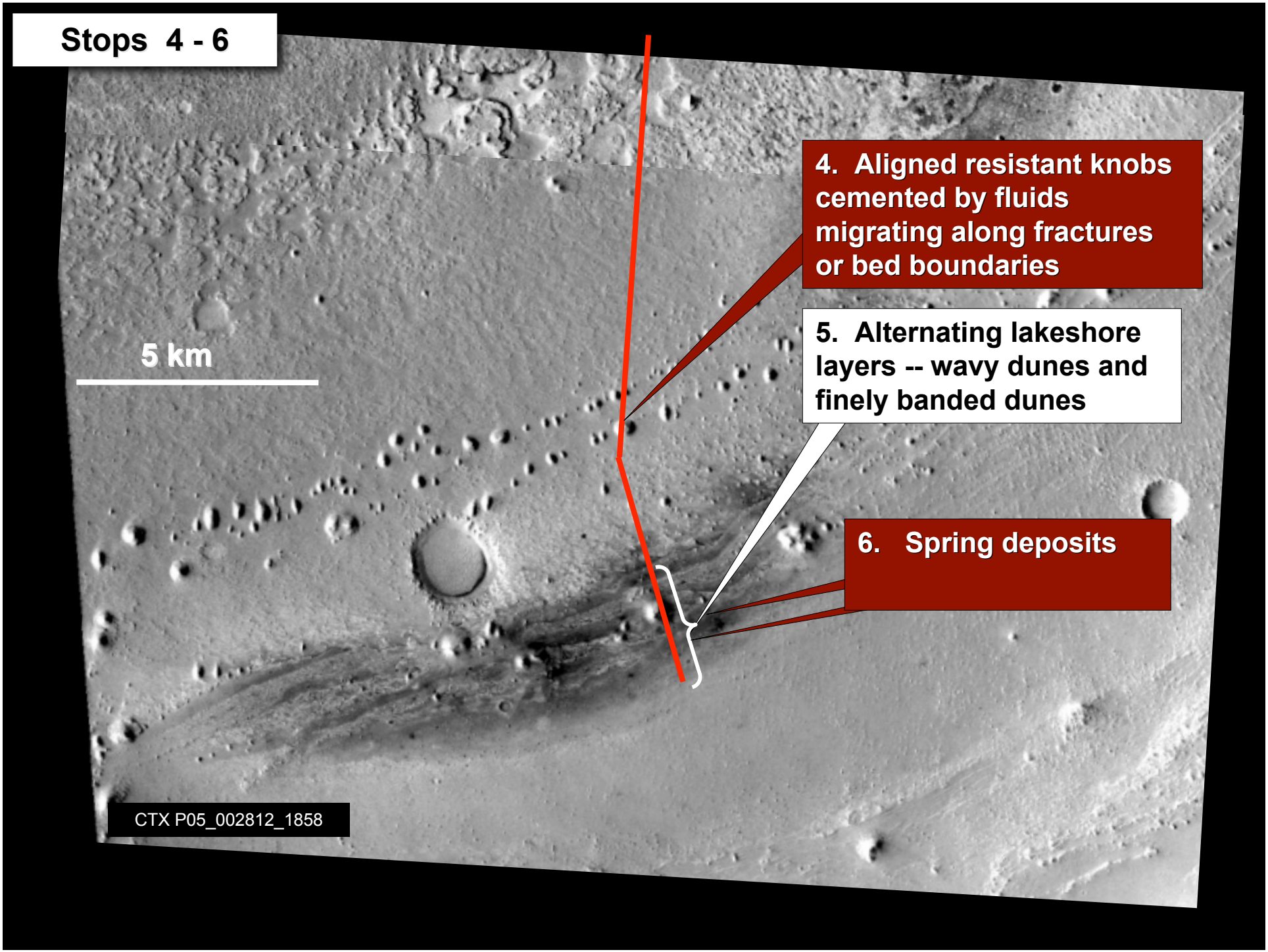
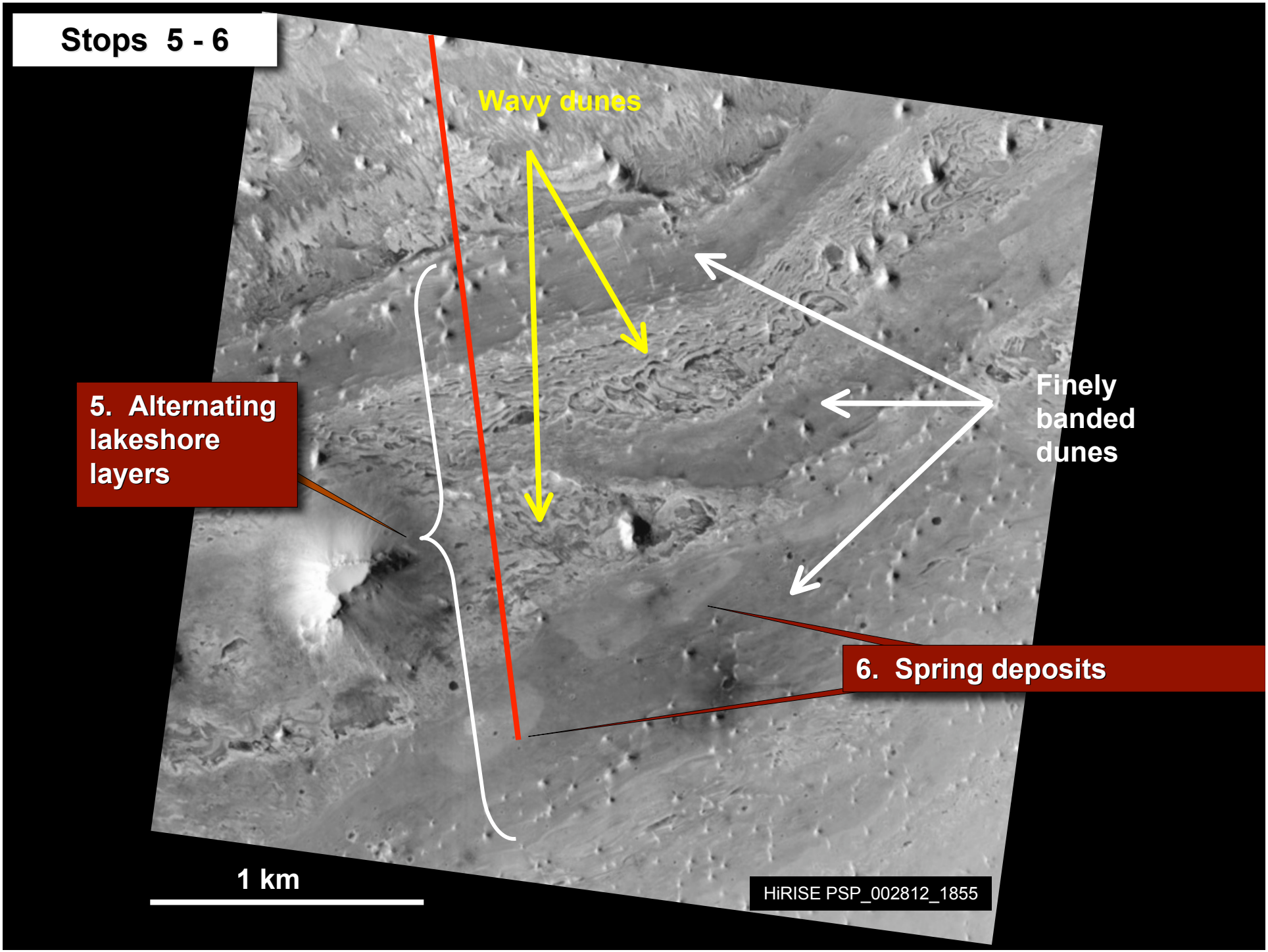
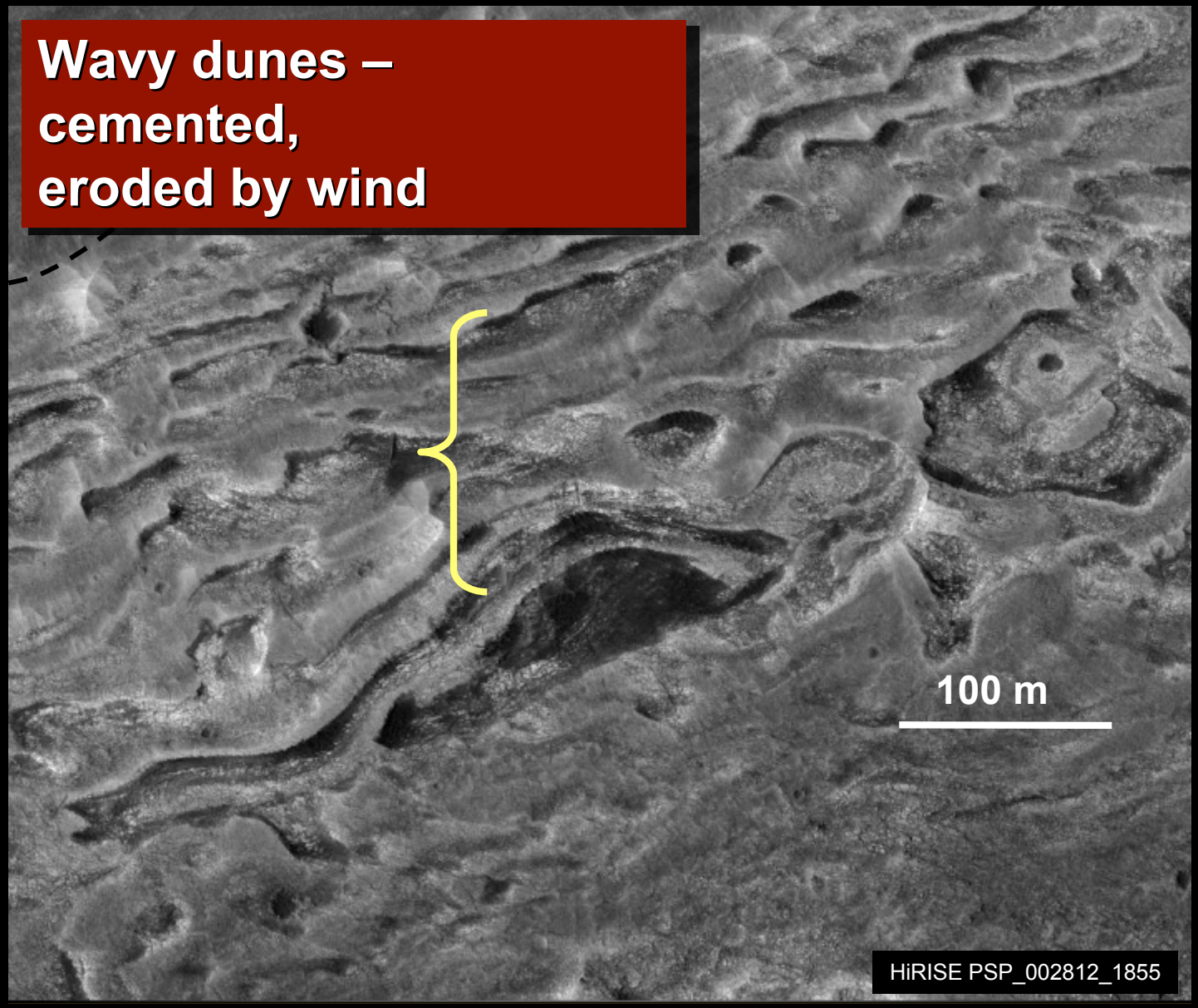
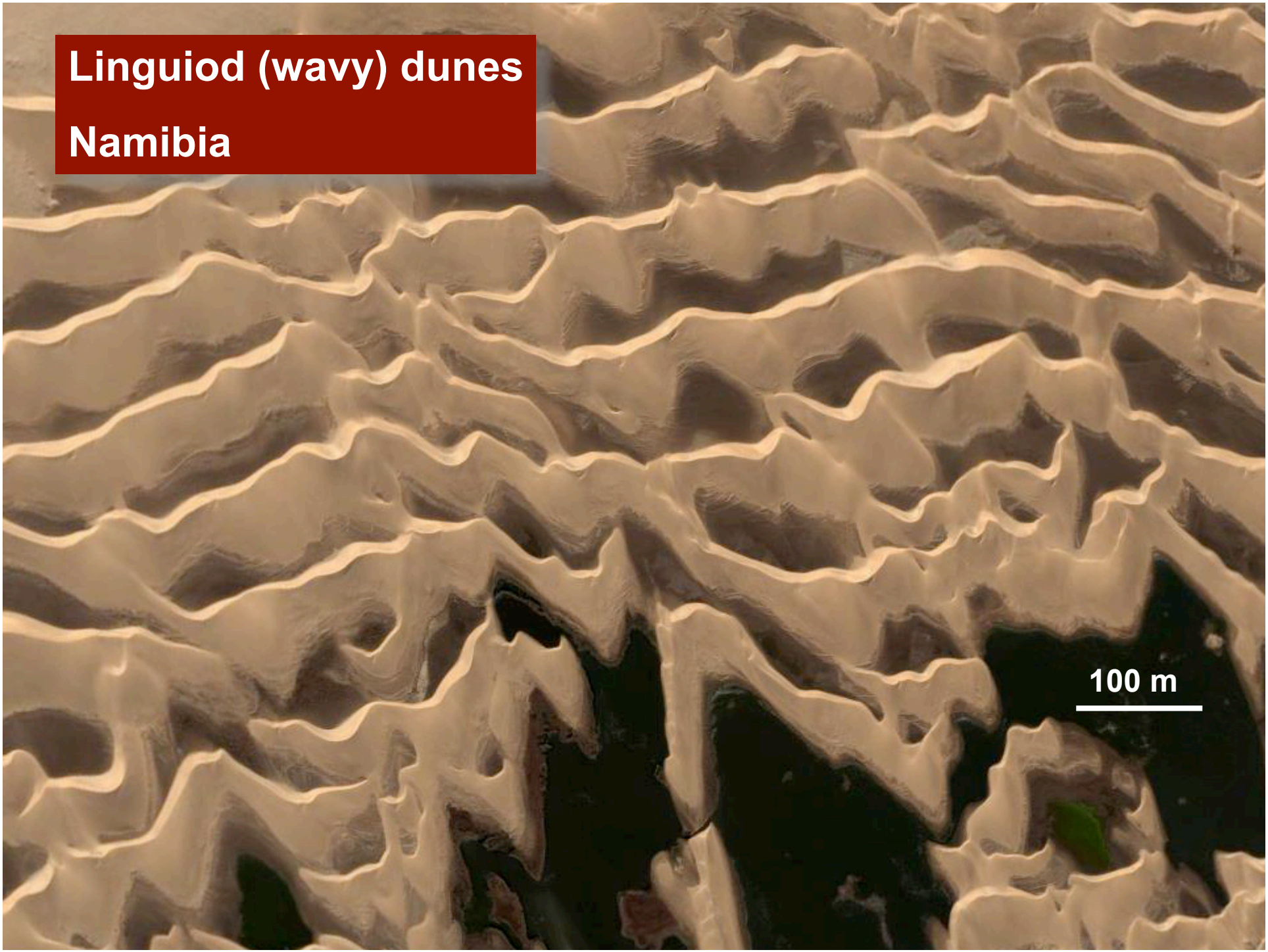


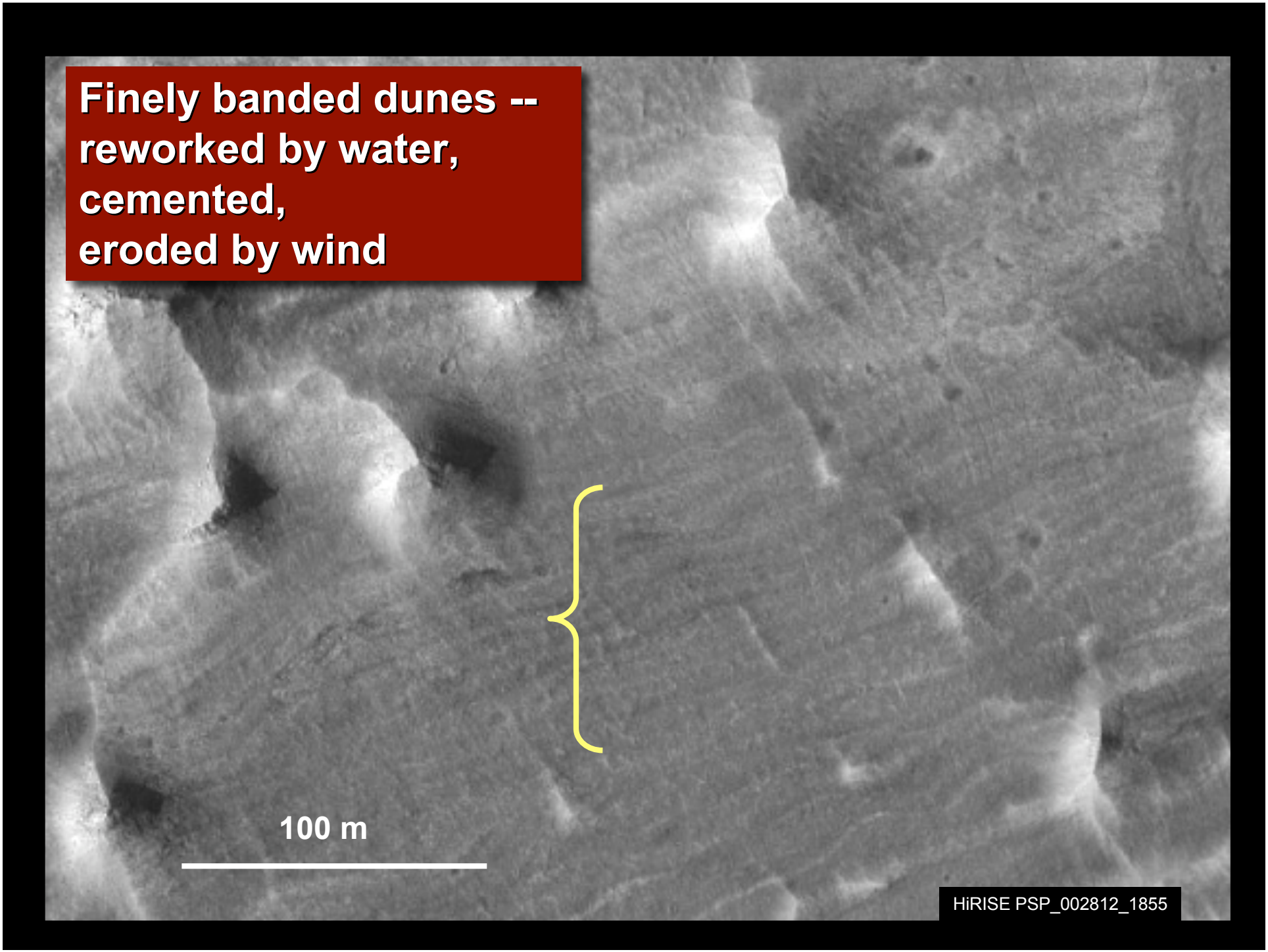

River channels –
inverted and wind eroded
Libya
2 km


Stops 4 - 6
4. Aligned resistant knobs cemented by fluids migrating along fractures or bed boundaries
5. Alternating lakeshore layers -- wavy dunes and finely banded dunes
6. Spring deposits
5 km
CTX P05_002812_1858

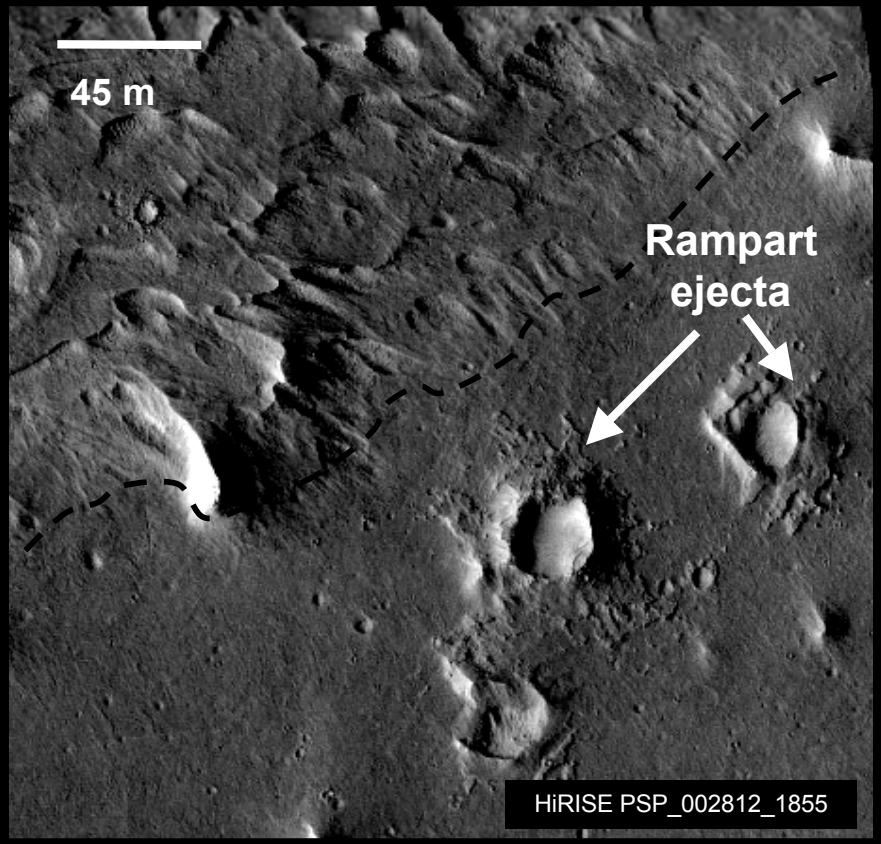

Stops 5 - 6
Wavy dunes
5. Alternating lakeshore layers
Finely banded dunes
6. Spring deposits
1 km
HiRISE PSP_002812_1855

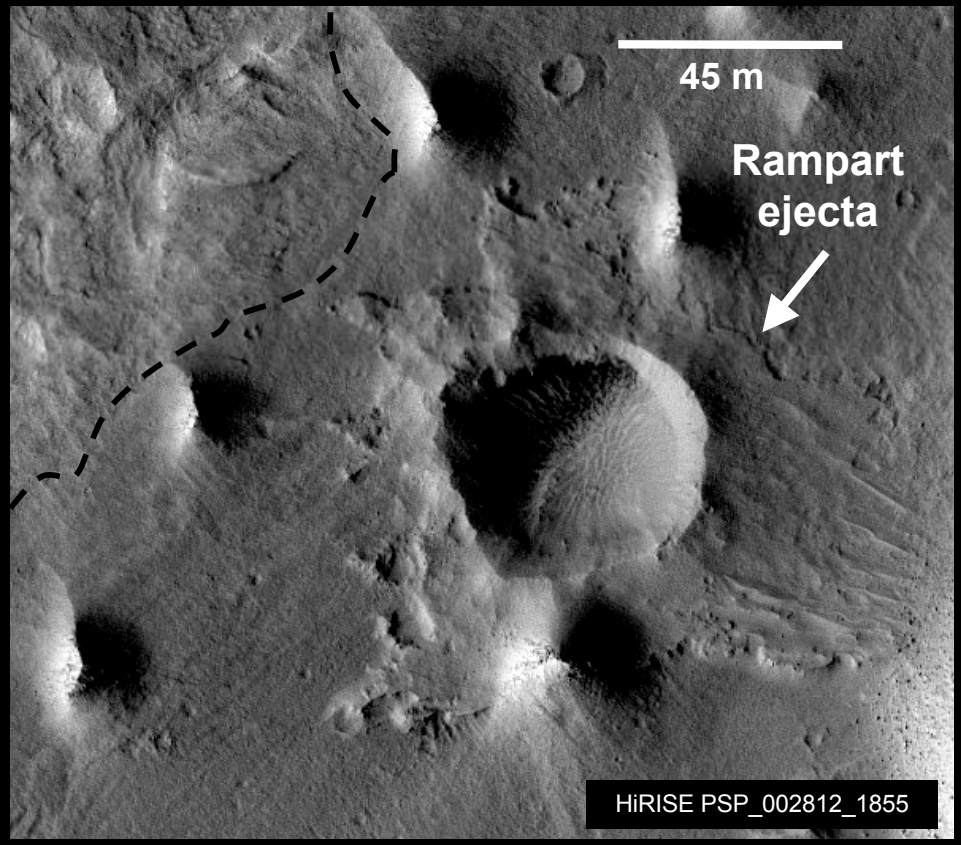

Wavy dunes –
cemented,
eroded by wind
100 m
HiRISE PSP_002812_1855


Linguiod (wavy) dunes
Namibia
100 m


Finely banded dunes --
reworked by water,
cemented,
eroded by wind
100 m
HiRISE PSP_002812_1855

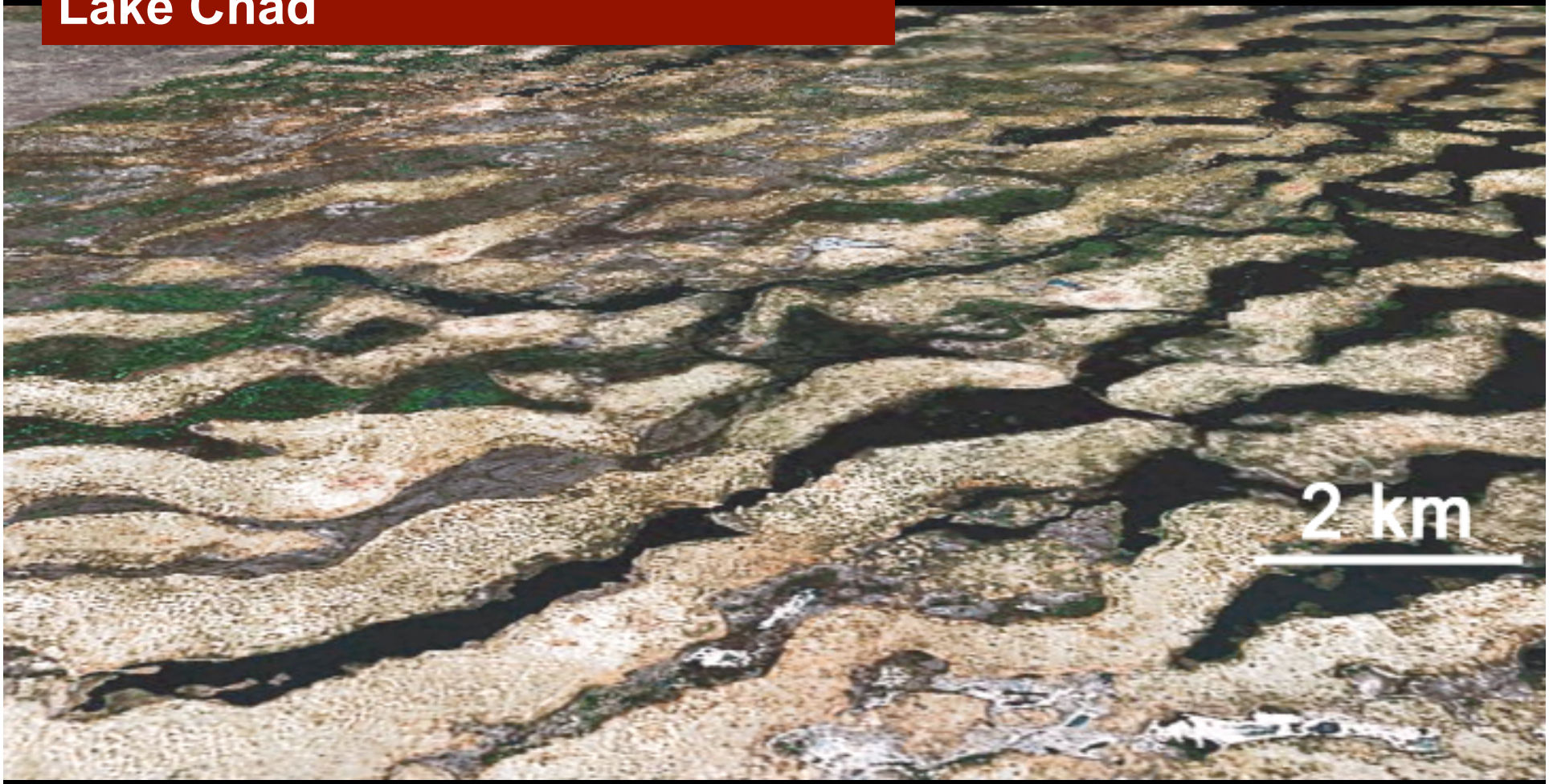
Rampart ejecta in finely banded unit -- indicates past occurrence of water or ice in the near-surface





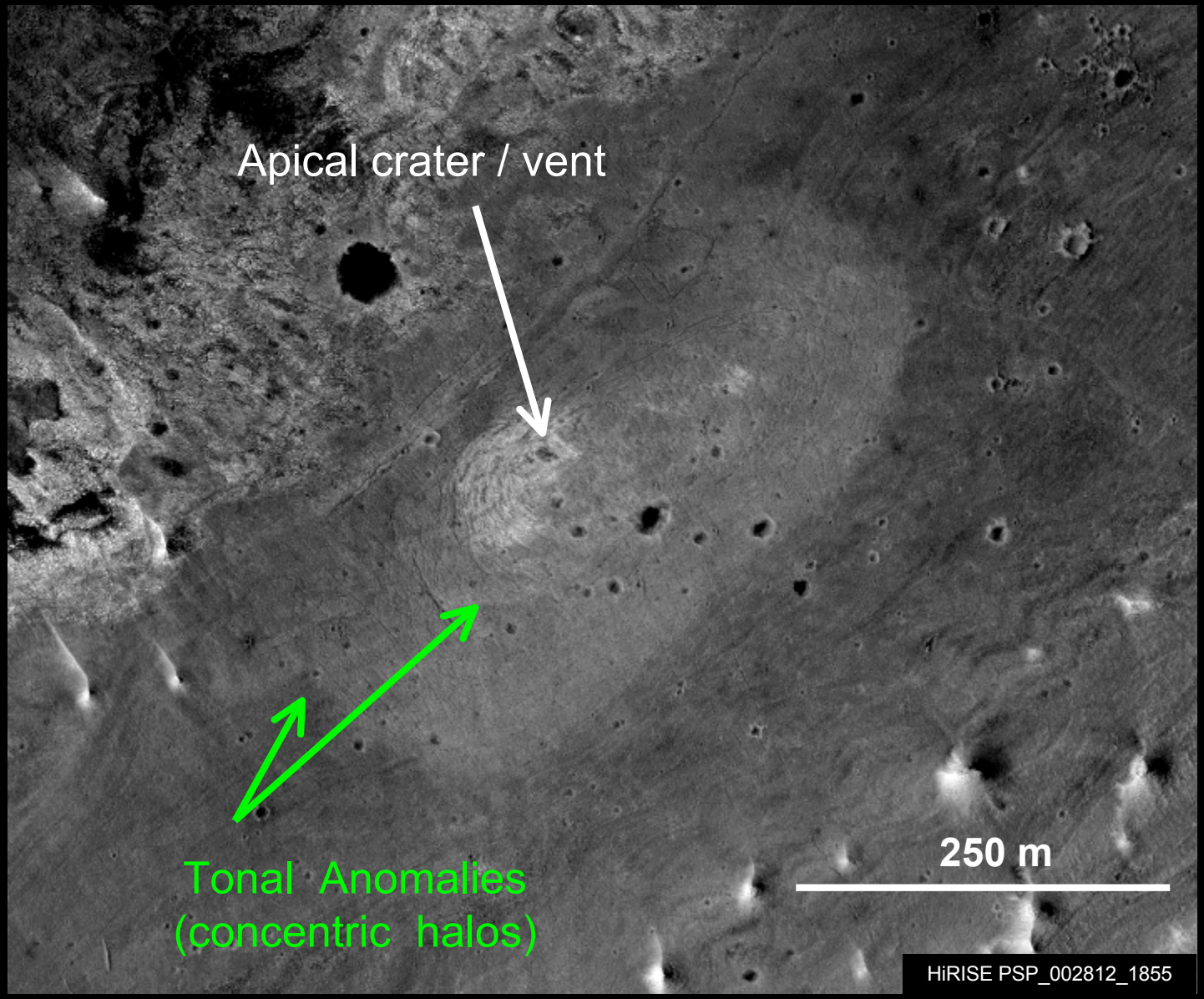
Lacustrine overprinted dunes – smoothing by aqueous reworking

Lake Chad



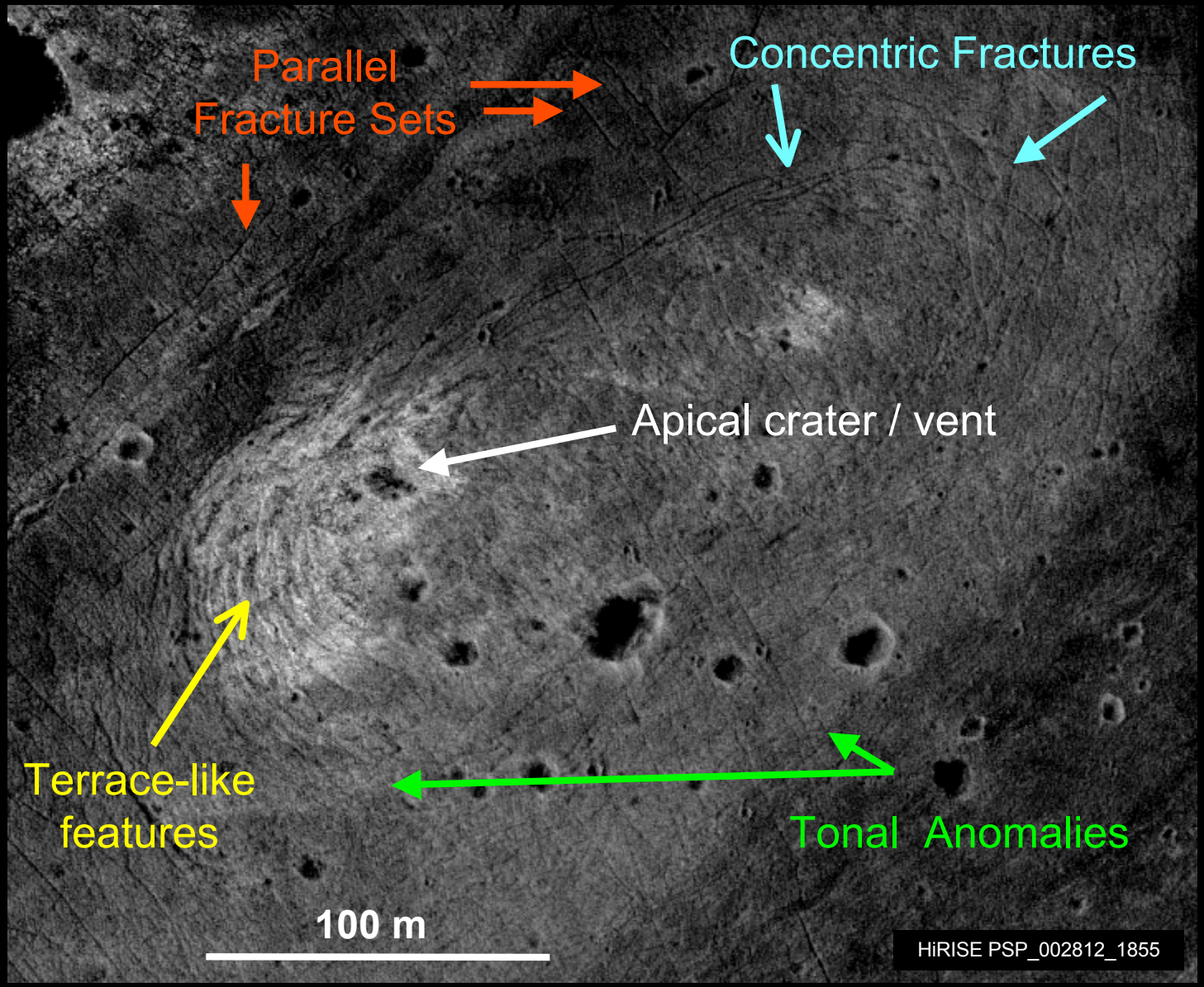
Stop 6

Western Spring Deposit



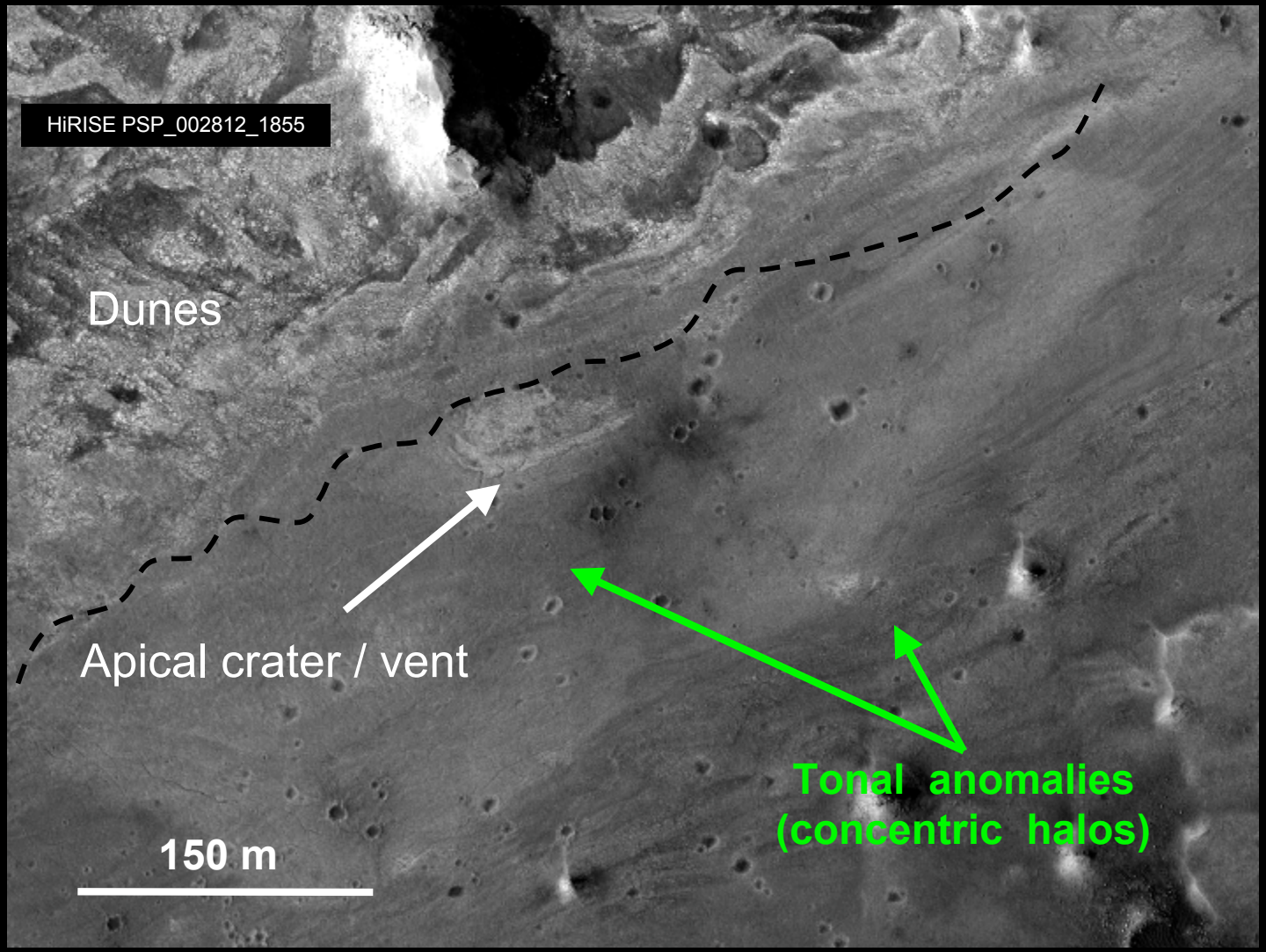
Stop 6

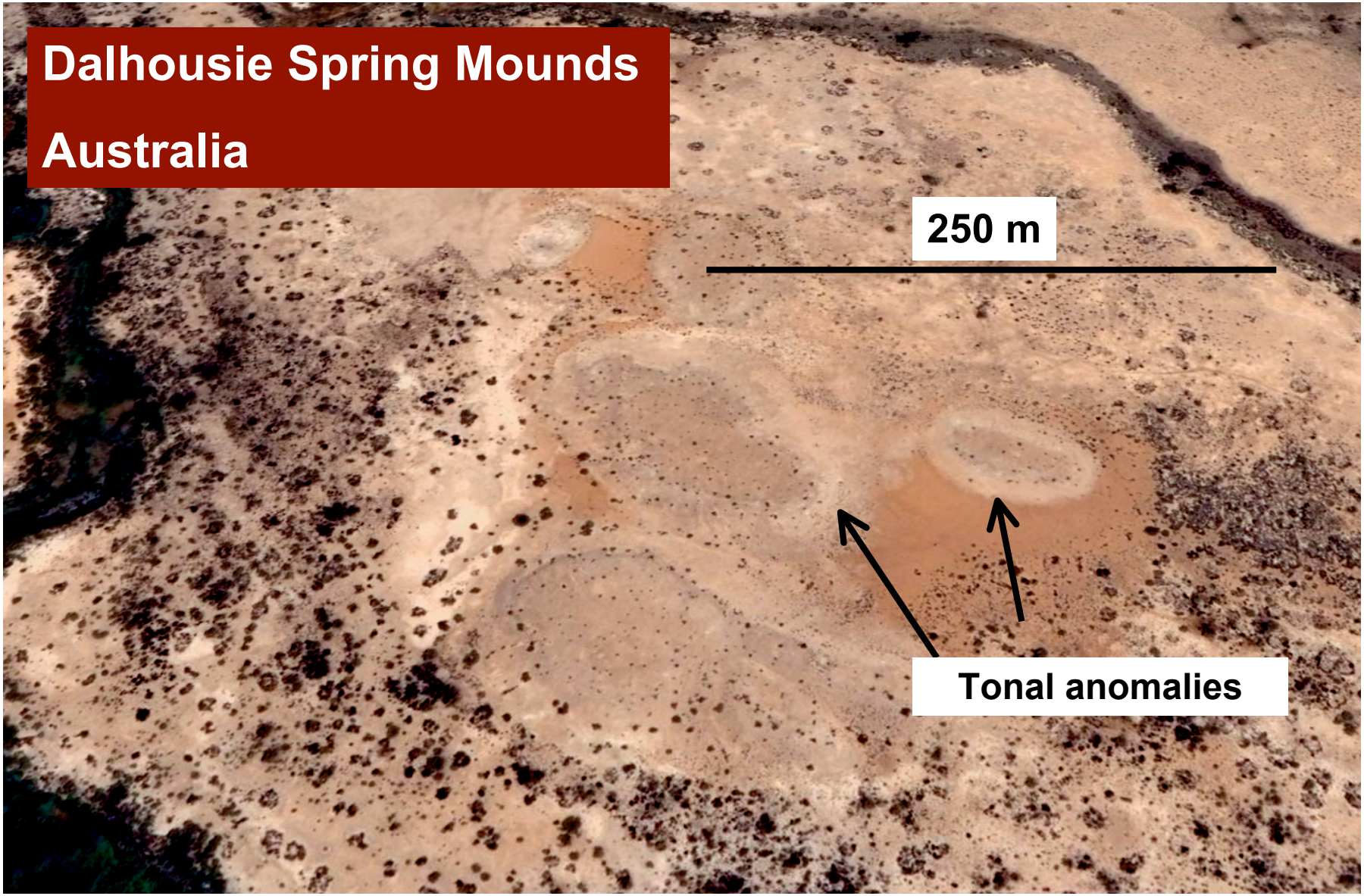
Western Spring Deposit



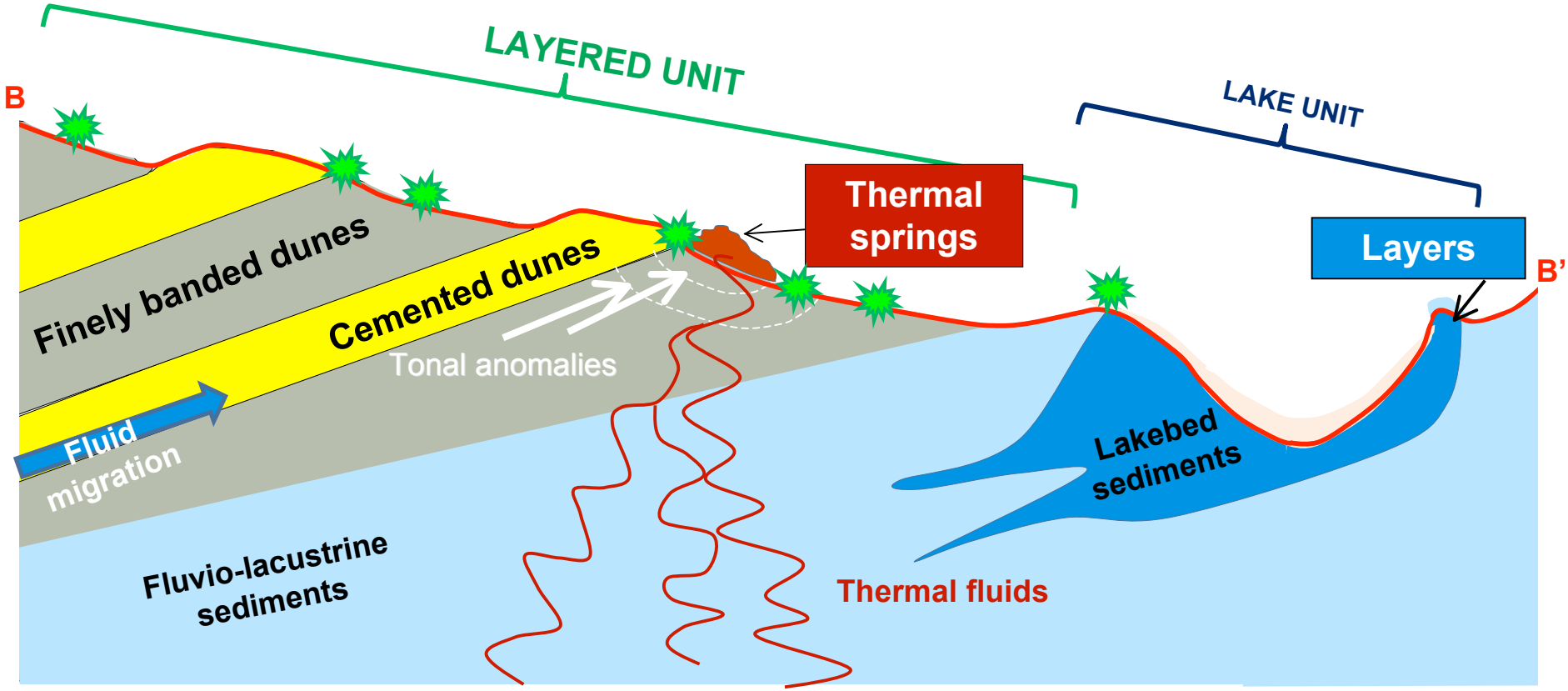
Stop 6

Eastern Spring Deposit




Dalhousie Spring Mounds
Australia
250 m
Tonal anomalies

Vernal Crater - Conceptual Cross Section



Areas of interest for habitability

Vernal Crater Science Criteria

Ability to Assess Biological Potential w/MSL Payload

Evidence for Habitable Environment	**Lacustrine layers** **Cemented dunes** **Spring terraces** **Rampart ejecta**
Aqueous Environment	**Lake** **Springs** **Subsurface water**

Preservation of Bio-Signatures

Organic Material, (Pre) Biotic Material	**Lacustrine layers** **Spring sinters**
Biologic Textures	**Lacustrine layers** **Spring sinters**
Mineralogic Biosignatures	**Tonal anomalies (concentric halos) near springs**

Vernal Crater Science Criteria

Ability to Characterize	
Geology/Geochemistry	**Soft rock geology compatible with MSL**
Context within Geologic Timescale	**Relative timescale from MSL + HiRISE**
Context within Geologic/ Geomorphic/Stratigraphic Setting	**Geologic context from MSL + HiRISE**
Accessibility	
Accessed by Rover/Arm	**Fully accessible**
Go To Distance/trafficability to Materials of Interest	
<1 km	**Resistant knobs; fluvial deposits**
<5 km	**Resistant knobs; fluvial deposits**
>10 km	**Lake sediments, springs, cemented dunes**
Dust Obscuration	**DCI 0.93 – 0.96**
Reduced Performance	
Thermal Constraints	**None (similar to Meridiani)**

Vernal Crater Safety Criteria

Surface Slope/Relief

2-10 km length scale	**Max 3 degrees (MOLA)**
1-2 km length scale	**Max 25 m at 1 km; 50 m at 2 km (MOLA)**
200-1000 m length scale	**~1% of area has knobs 200 m across (CTX, THEMIS)**
2-5 m length scale	**~ 10 % of area has ridges ~ 100 m long (MOC)**
Relief in HiRISE	**Landing ellipse HiRISE not available yet**

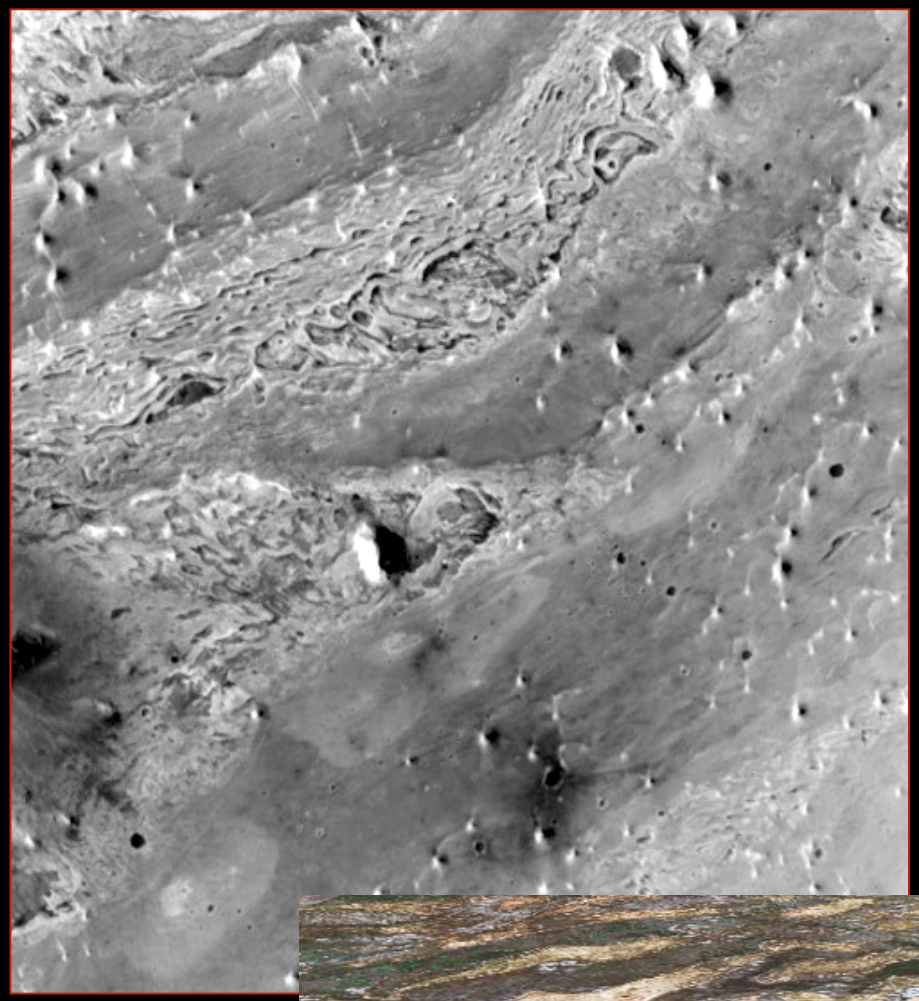
Warning Track Slope

2-10 km length scale	**Max 3 degrees (MOLA)**

Flexibility of Ellipse Placement	**+/- 2 km down-track; +/- 5 km cross-track**
Safe Haven? (non go to)	**32 x 24 km ellipse possible** **altitude between -1 and -2 km** **slope / roughness values unchanged** **3 of 6 prime science sites within safe haven**

Vernal Crater Safety Criteria

Rock Abundance	
IRTM	**12 %**
TES	**10 %**
Rocks Present in HiRISE	**Landing ellipse HiRISE not available yet**
Load Bearing Surface	
Thermal inertia	**100 – 200 (TES)**
Albedo	**0.22 – 0.24 (TES)**
Radar reflectivity	**No anomalously low reflectivity**
Dust	
DCI	**0.93 – 0.96**
Albedo	**0.22 –0. 24 (TES)**
Cold Temperatures	**No (landing site near 6^{o} N)**
Trafficability	**Few steep slopes; few contemporary dunes**
Atmospherically Challenging	**No (entire ellipse below – 1600 m)**



CONCLUSIONS

VERNAL CRATER PROVIDES UNIQUE ACCESS TO HIGH PRIORITY SCIENTIFIC TARGETS

- Springs deposits
- Lakeshore deposits
- Cemented dunes & knobs
- Dunes reworked by water
- Regional fluvial deposits