MER Landing Site Ellipse Changes & Status

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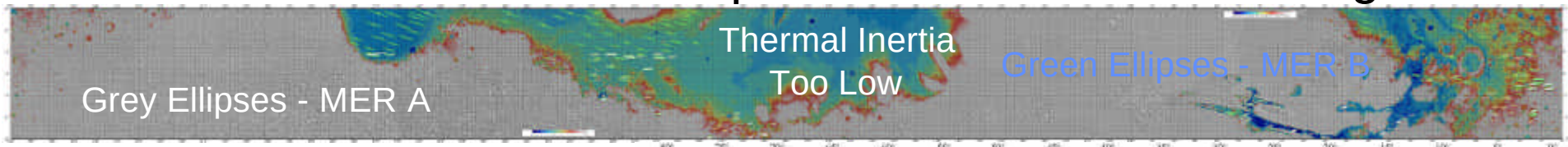
Embassy Suites, Arcadia

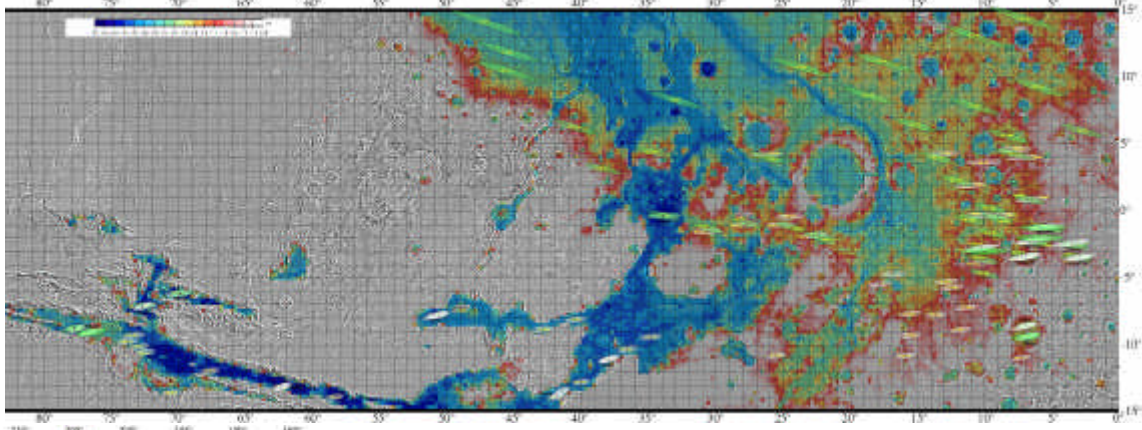
MER Landing Sites

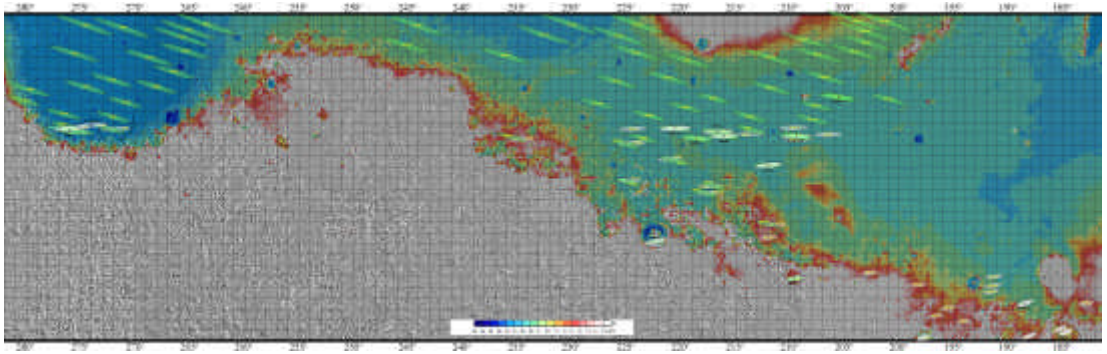
Mars Exploration Rover

±15° Latitude Band, <-1.3 km Elevation; ~5% of Surface
Smooth, Flat Over Ellipse, ~185 Possible Landing Sites



White Ellipses
Selected by Science
Community, ~25
Western Hemisphere
Hematite, Melas, Eos





Eastern Hemisphere
Gusev, Gale
Athabasca, Isidis
Low Wind Elysium

3rd Workshop MER Landing Site Evaluations

Mars Exploration Rover

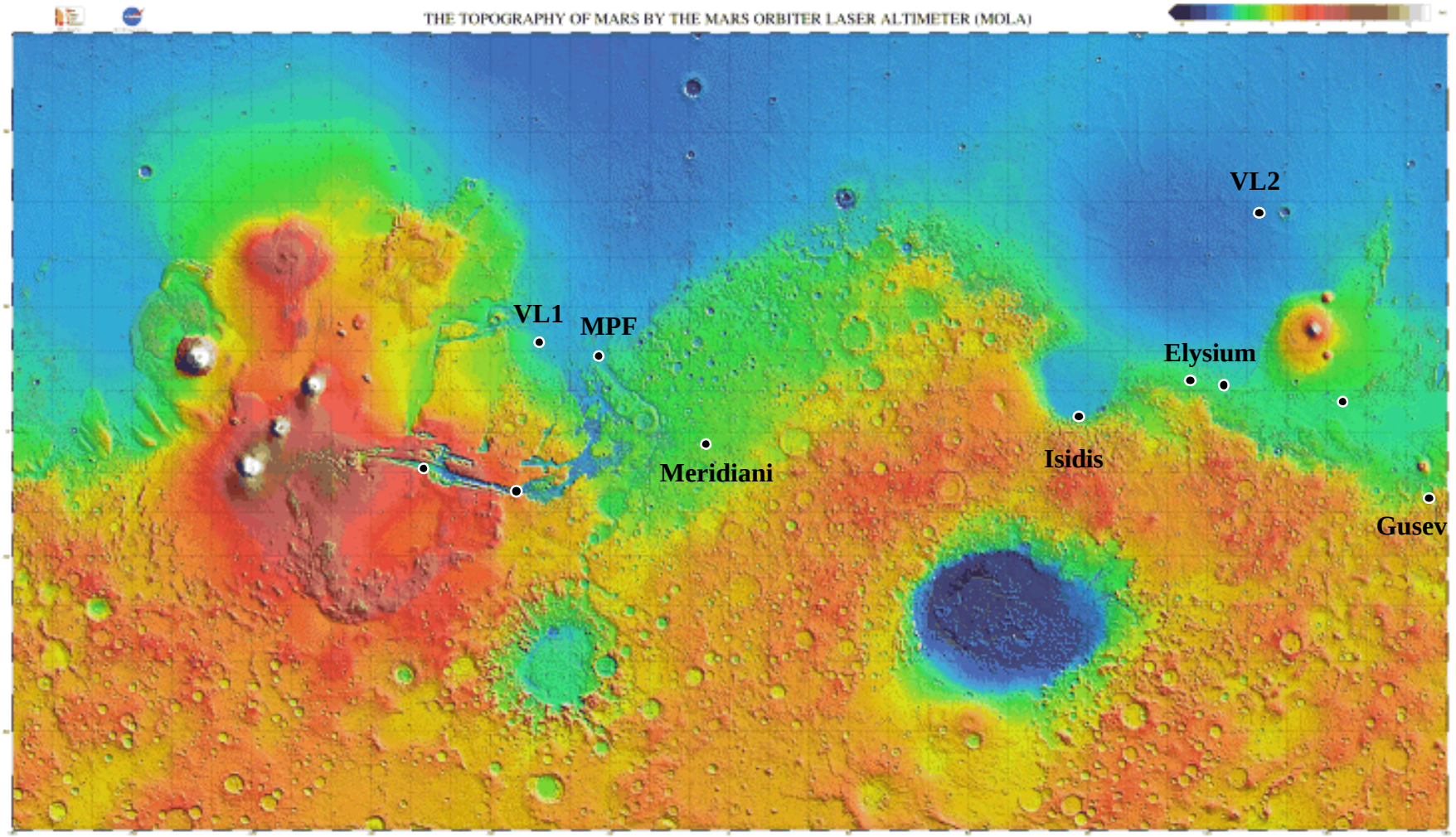
Science Criteria	***Hematite***	***Gusev***	***Isidis***	***Melas***	***Eos***	***Athabasca***
Evidence for Water Activity	🟢	🟢	🟢	🟢	🟢	🟢
Address Climate/Geologic History	🟢	🟢	🟢	🟢	🟢	🟡
Preserve Biotic/Prebiotic Materials	🟢	🟢	🟡	🟡	🟡	🟡
Definitive Testing of Hypothesis(es)	🟢	🟢	🟢	🟡	🟡	🟢
Accessible Diversity Within the Site	🟢	🟡	🟢	🟡	🟡	🟢
Site Diversity (for MER's)	🟢	🟢	🟢	🟢	🟢	🟢
Site Diversity (from VL and MPF)	🟢	🟢	🟢	🟢	🟢	🟢
Materials for Athena Analyses	🟢	🟢	🟢	🟢	🟢	🟢
Rock Abundance (pro and con)	🟡	🟡	🟢	🟡	🟢	🟢
Trafficability	🟢	🟢	🟡	🟡	🟡	🔴
Amount of Dust Obscuration	🟢	🟡	🟡	🟢	🟢	🟡
Mission Lifetime	🟡	🟡	🟢	🟢	🟢	🟡
Relief at Scale of Rover Traverse	🟡	🟡	🟡	🟢	🟡	🟢
Potential Useful Earth Analogs	🟢	🟢	🟢	🟢	🟢	🟢
Safety Criteria						
1 km Slope	🟢	🟢	🟢	🔴	🔴	🟢
100 m Slope	🟢	🟢	🟢	🔴	🟡	🟢
10 m Slope	🟢	🟡	🟡	🔴	🟡	🟢
Relief (Craters, Hills)	🟢	🟡	🟡	🔴	🟡	🟡
Rock Abundance/Trafficability	🟢	🟢	🟡	🟡	🔴	🔴
Potentially Hazardous Rocks	🟢	🟢	🟡	🟡	🔴	🟡
Horizontal Winds (Shear/Turbulence)	🟢	🟡	🟡	🟡	🟡	🟡
Horizontal Winds (Sustained Mean)	🟢	🟡	🟡	🔴	🔴	🟡
Vertical Winds	🟡	🟢	🟡	🟡	🟡	🟡
Temperature at Site	🟡	🟡	🟢	🟡	🟢	🟡
Dust	🟢	🟡	🟡	🟢	🟢	🟡
Load Bearing Surface	🟢	🟢	🟢	🟢	🟢	🟢
Elevation	🟢	🟢	🟢	🟢	🟢	🟢
Radar Reflectivity	🟢	🟢	🟢	🟢	🟢	🟢
Public Engagement						
Aesthetics (Views/Relief)	🟡	🟡	🟢	🟢	🟢	🟢
Differs from VL or MPF Sites	🟢	🟢	🟡	🟢	🟢	🟢
Habitability for Life (Past or Present)	🟢	🟢	🟡	🟡	🟡	🟡
Explainable to Public (Good Story)	🟢	🟢	🟢	🟢	🟢	🟢

Ellipse Changes Since 3rd Workshop

- 6 Ellipses Evaluated at 3rd Workshop, 3/02
- Melas & Eos Removed - Concerns Over Winds
- Athabasca Demoted - High Radar Backscatter
  - Athabasca Ellipse Shifted Slightly East
- Isidis Promoted to Prime
- 2 Low Wind Sites Identified in Elysium
  - Evaluated Sites in Meridiani, SE Isidis & Elysium
  - Acceptable Sites in SE Isidis Low Science; Meridiani Too Cold & Close to Hematite
  - Elysium Sites Preferred on Basis of Safety & Science
- Athabasca Removed 6/02 - Cannot Disprove Rough Surface
- First Order Safety Evaluation of 2 Elysium Sites Completed
- Significant New THEMIS/MOC Images Obtained
- 1 Elysium Ellipse Selected on Safety & Science 8/02
- 4 Sites Currently Under Study

Landing Sites on Mars

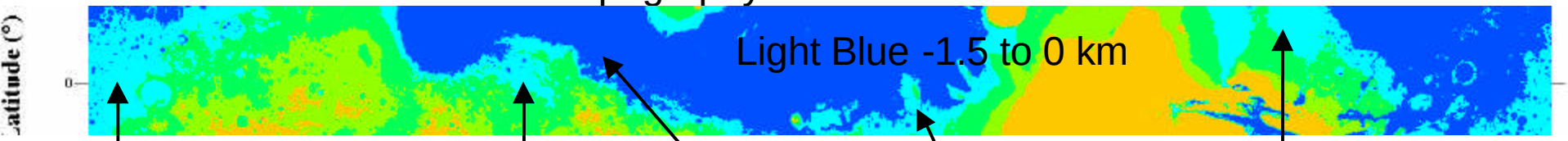
Mars Exploration Rover

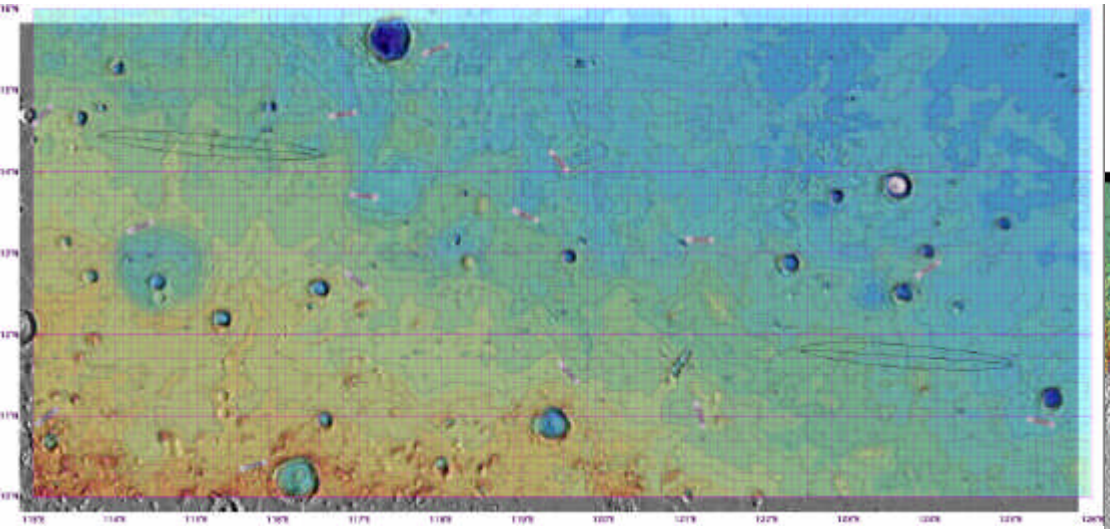


Safe, Low Wind Landing Sites

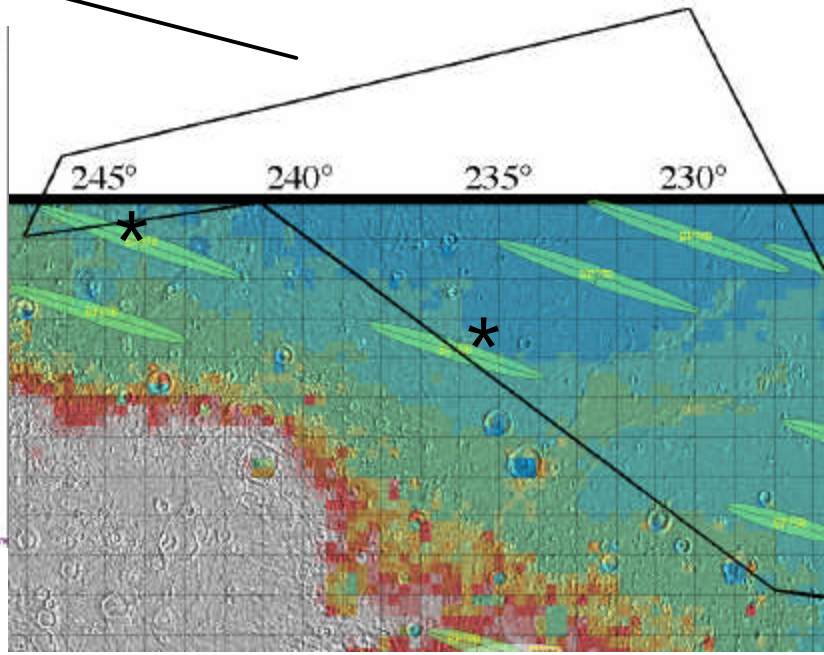
Mars Exploration Rover

Topography 20°N to 20°S





Elysium Low Wind Ellipses



W Elysium Low Wind Polygon

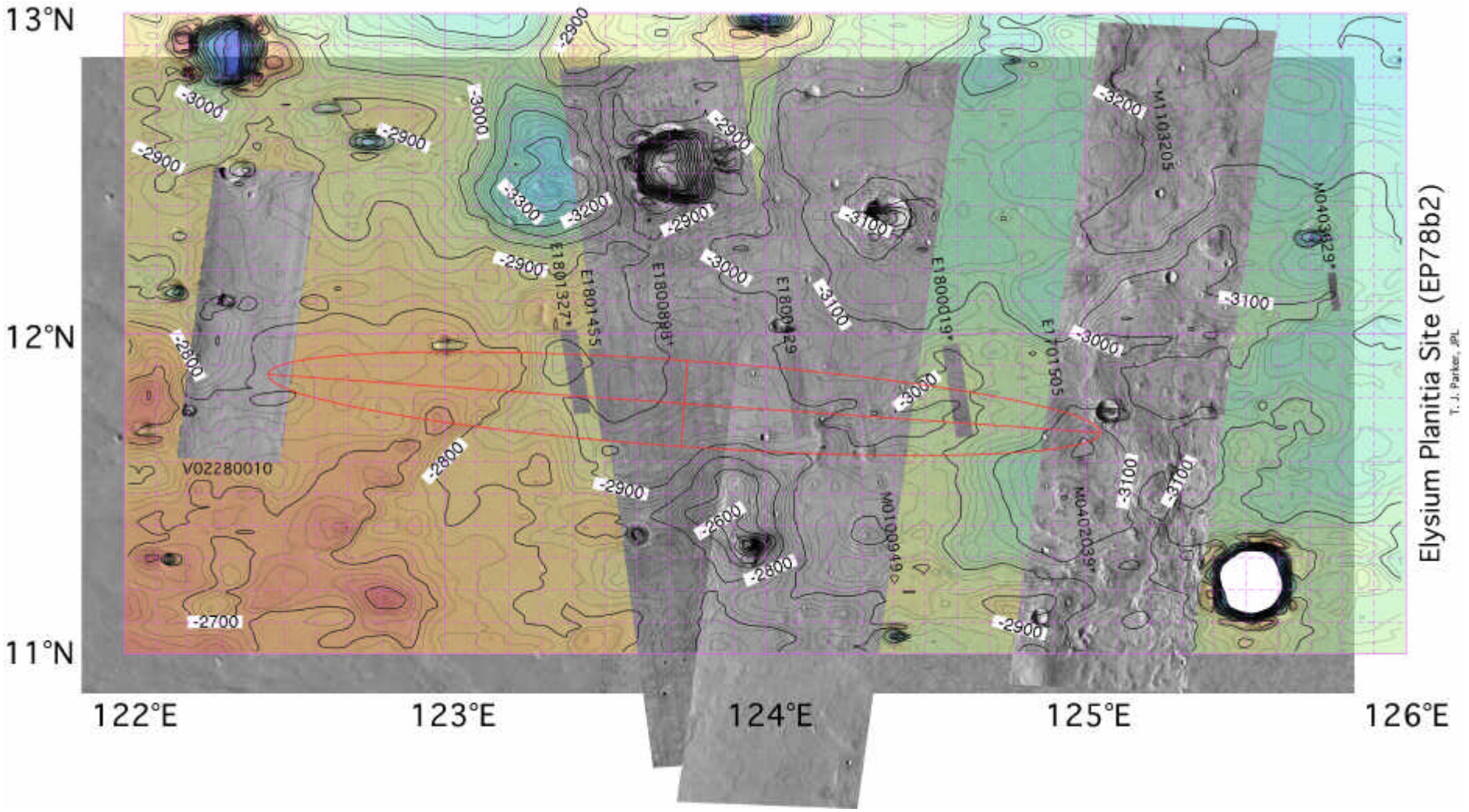
* Are Low Wind Ellipse Centers

Identifying New Safe Ellipses

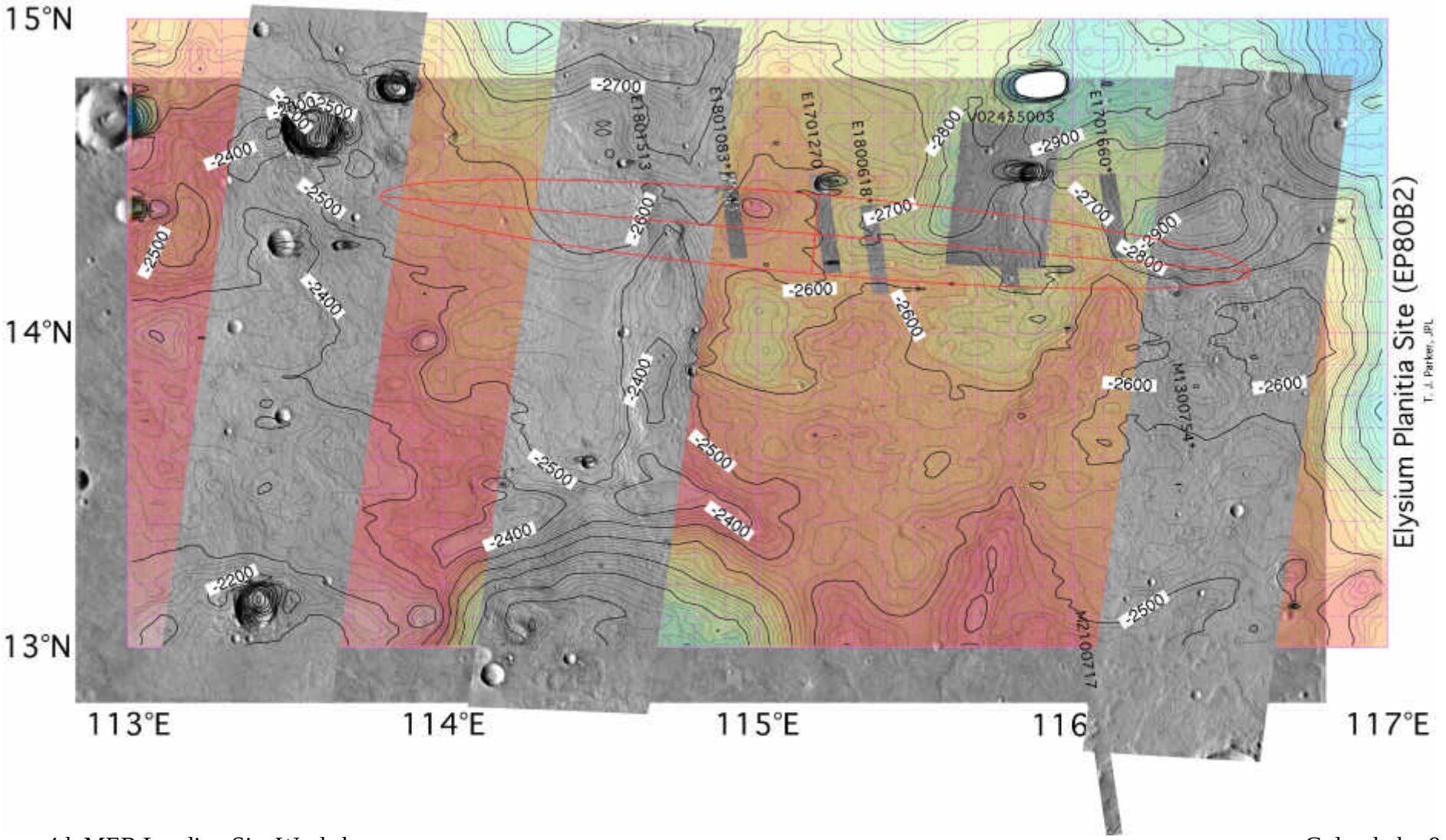
- **Low Wind Highest Priority**
  - Evaluate GCM for Quiet Regions for Season/Time Arrival
  - Regional Mesoscale Wind Models Confirmed Low Wind Regions
- **Relax Elevation (0 km) and Latitude in Search**
- **Evaluated Science Preference Among Low Wind Areas**
- **Selected 2 Highest Science Among Low Wind Areas**
  - 2 Elysium Ellipses
  - Selected Using THEMIS Images, Thermophysics and Slopes
- **High Resolution Mesoscale Wind Models of 2 Ellipses**
  - Confirmed They Are Low Wind
- **Evaluated Existing Remote Sensing Data**
- **Targeted Ellipses for THEMIS and MOC Imaging**
- **First Order Evaluation of Safety**
- **Selected One of Two as Finalist**

EP78B2

Mars Exploration Rover



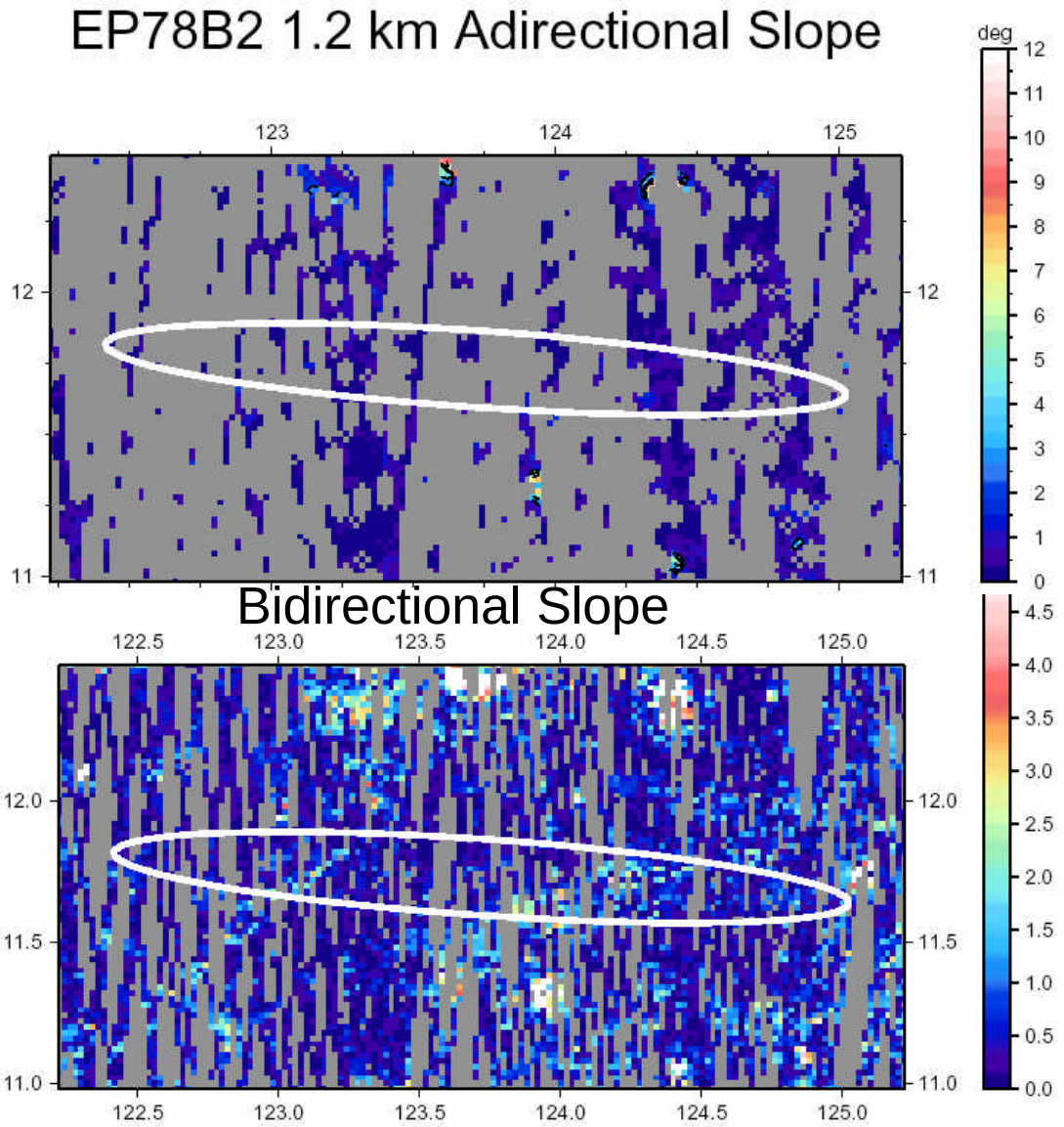
EP80B2

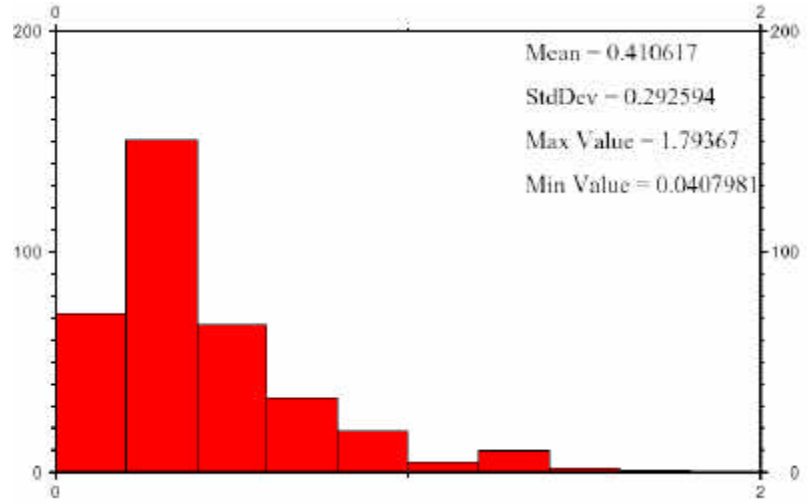

15°N
14°N
13°N
113°E
114°E
115°E
116
117°E
-2700
-2500
-2400
-2600
-2800
-2900
-2200
E1801513
E1801083
E1701270
E1800618
V02455003
E1701660
M1300754
M2100717
Elysium Planitia Site (EP80B2)
T. J. Parker, JPL

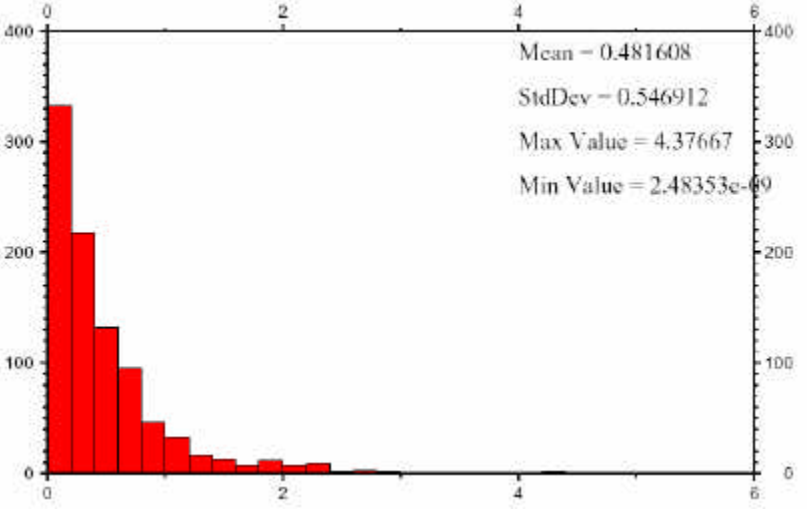
Elysium Ellipses - EP78B2 and EP80B2

- Rock Abundance as Low as Possible in Region
  - Slightly lower at EP78B2
  - Average ~5% (7 pixels are 1, 6, 6, 6, 8, 6% plus a small bit of 11%);
  - EP80B2, Average 9% (3 pixels from east to west are 3, 11, 12%)
- Mesoscale Wind Models - Comparable Results
  - Horizontal winds for both sites are comparable
  - Slightly lower at EP78B2 (4±2 m/s, similar to Hematite)
  - EP80B2 (6±2 m/s, similar to Gusev).
  - Turbulence at both sites is comparable to Gusev
  - Longer wavelength shear at both sites is quite low - comparable to Hematite
- EP78B2 Appears Smoother at All Scales Than EP80B2
  - 1.2 km a- and bi-directional Slopes
  - 100 m MOLA Pulse Spread & Allen Variation Extrapolated From Longer MOLA
  - THEMIS (1 visible per ellipse) and MOC Images (6 per ellipse)

EP78B2 1.2 km Slope



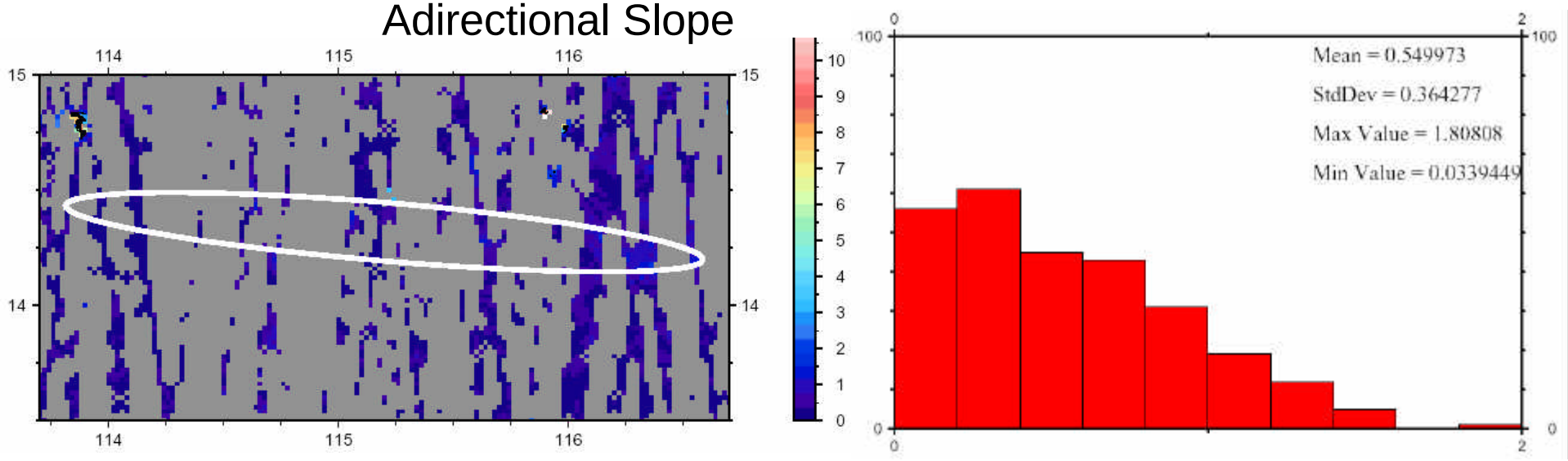




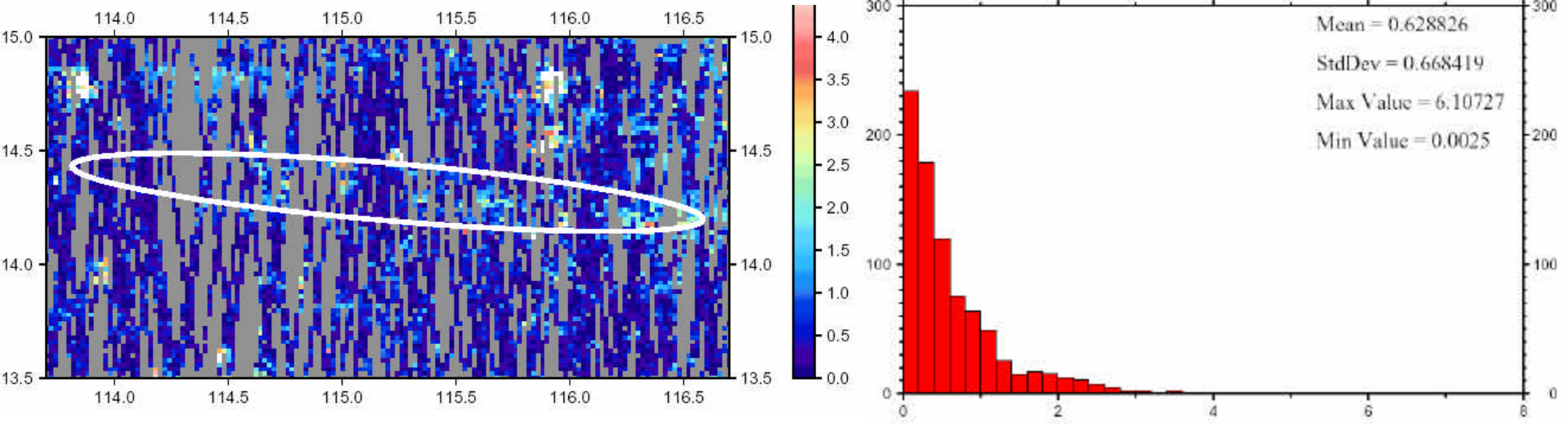
EP80B2 1.2 km Slope

Mars Exploration Rover

Adirectional Slope

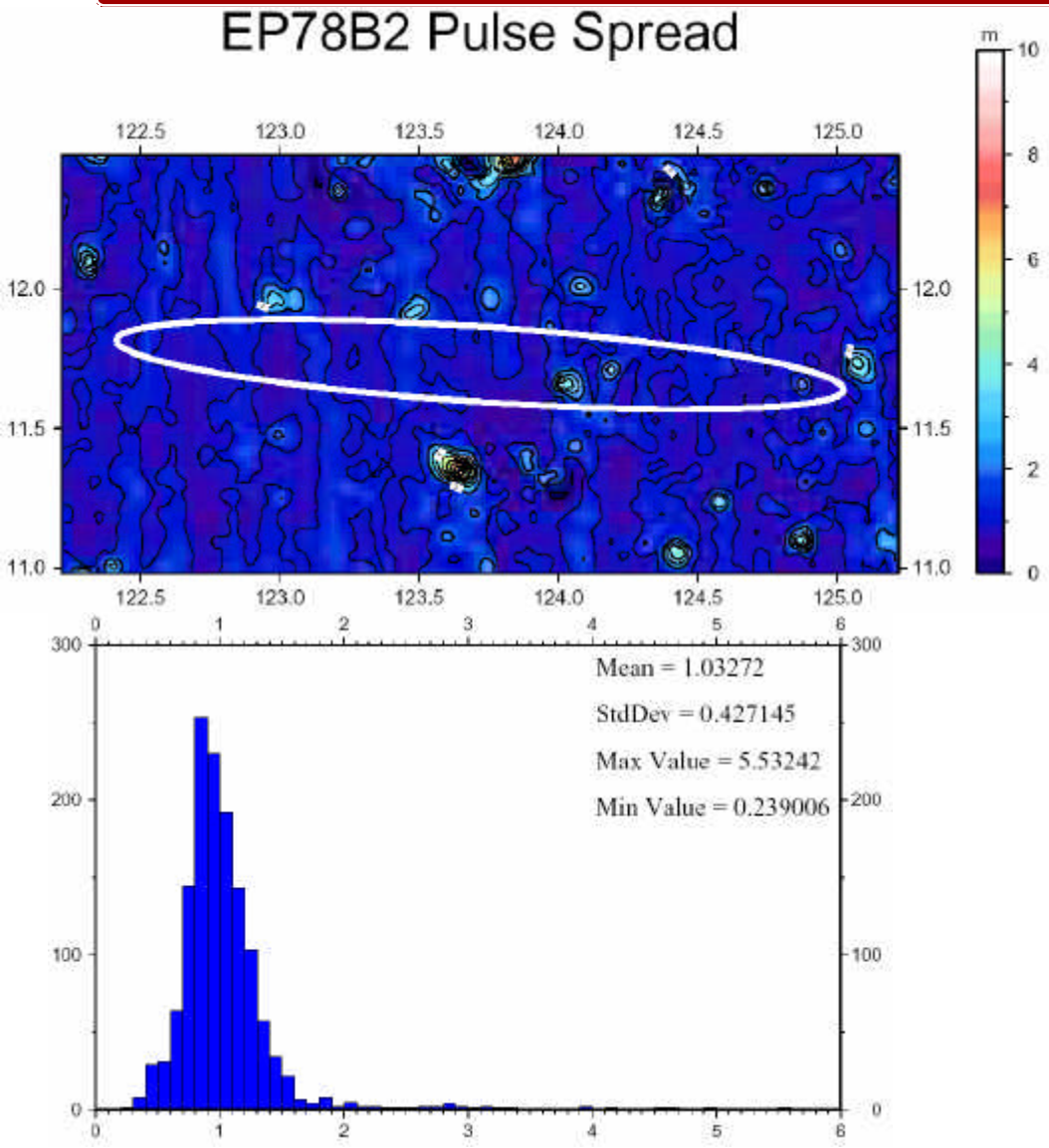


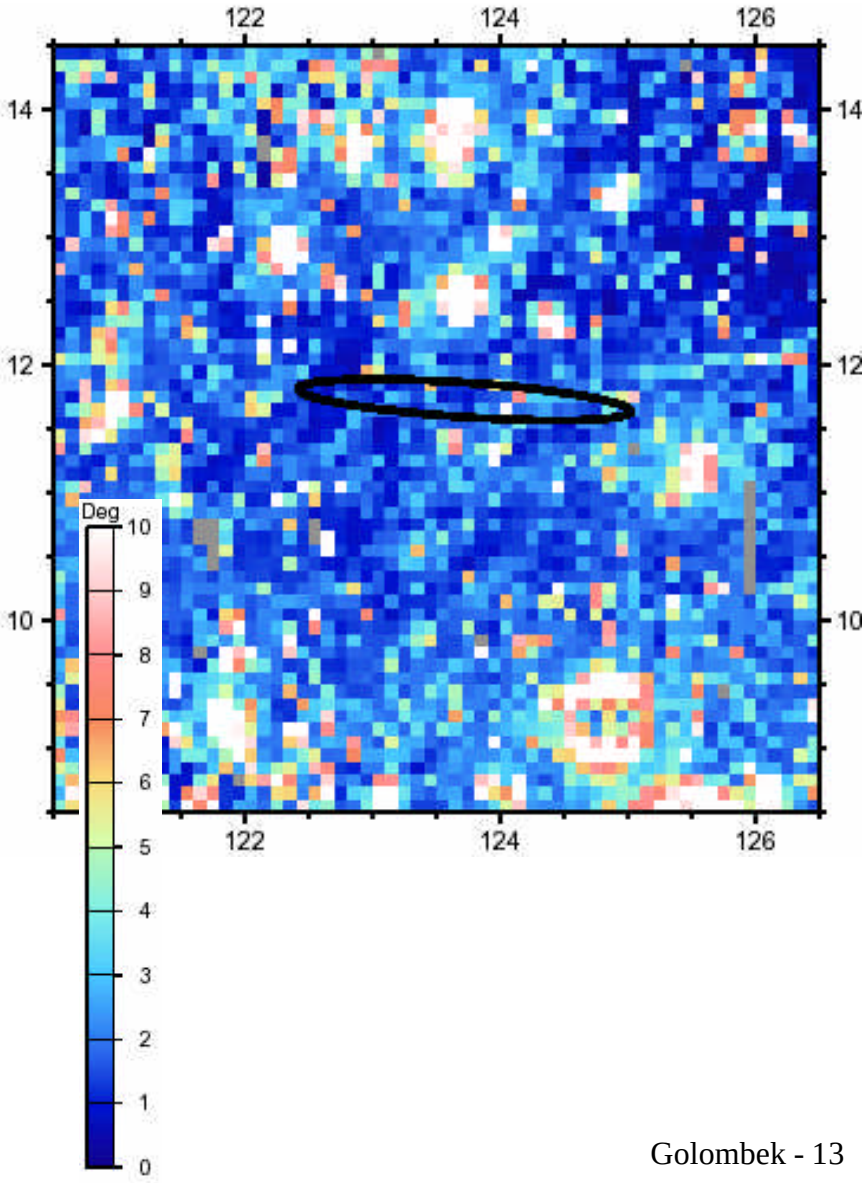
Bidirectional Slope



EP78B2 100 m Slope

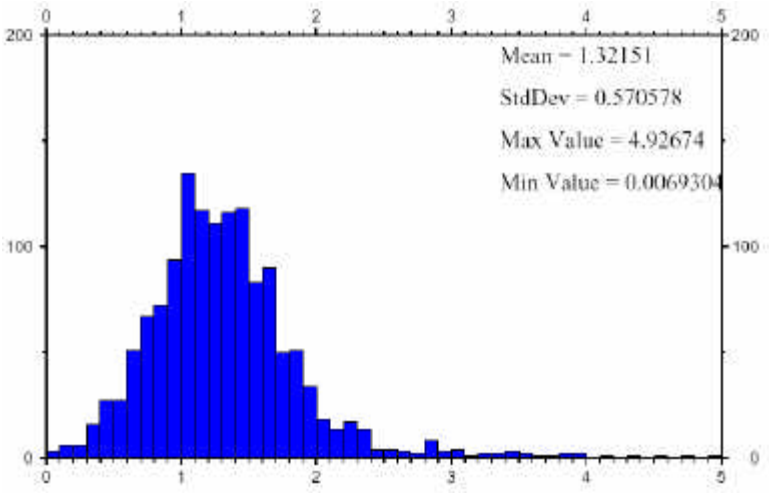
Mars Exploration Rover



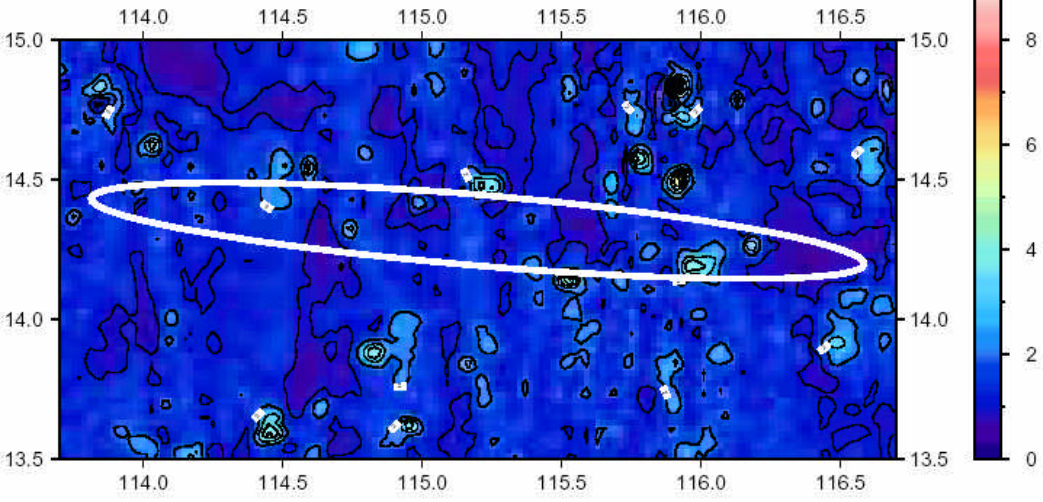


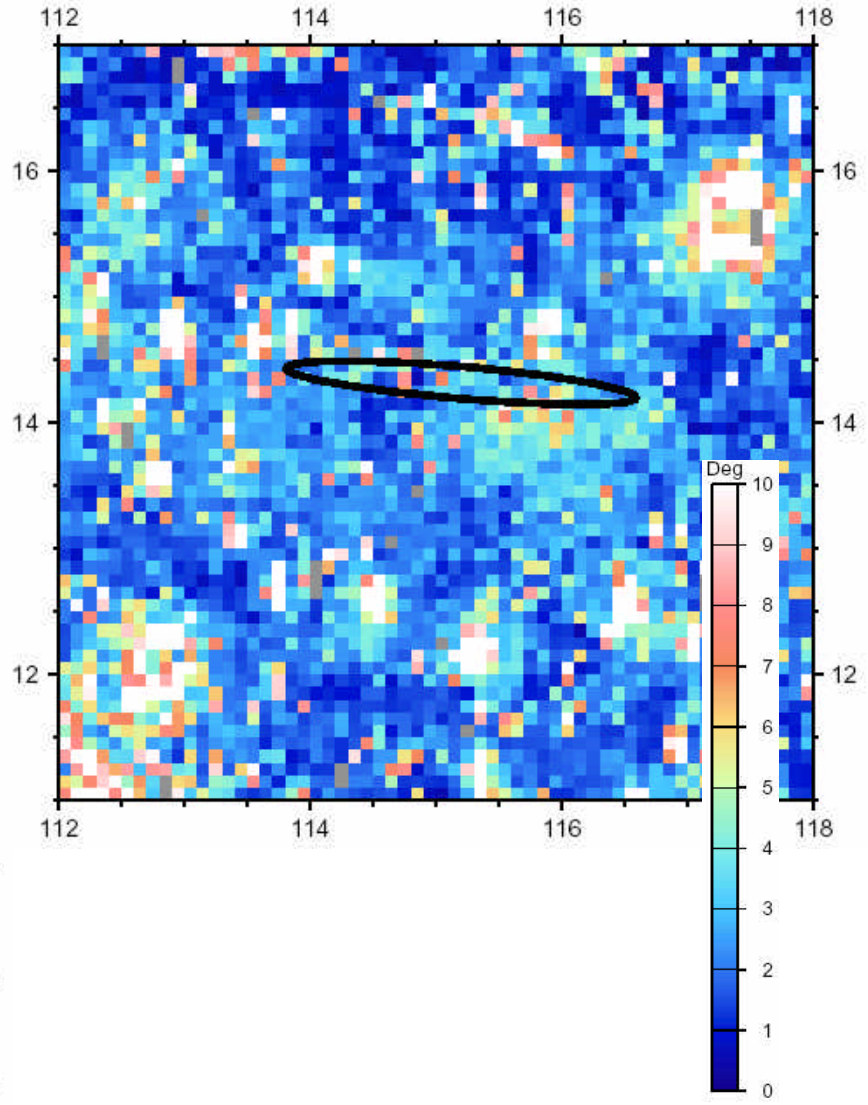
EP80B2 100 m Slope

Mars Exploration Rover



EP80B2 Pulse Spread





EP78B2 Smoother than EP80B2

- Bidirectional 1.2 km Slope 0.48 vs 0.63
- Adirectional 1.2 km Slope 0.41 vs 0.55
- Pulse Spread 1.0 m vs 1.3 m
  - Like Isidis versus Like Gusev
- Extrapolated 100 m Slopes
  - 3 pixels >5° vs 5 pixels >5°
  - Hurst Exponent <1 EP80B2 Rougher at 10 m than 100 m
  - Hurst Exponent ~1 EP78B2 As Smooth at 10 m as 100 m
- THEMIS Images Appear Smoother
  - 100 m/pixel Thermal Images (Many in Each Ellipse)
  - 20 m/pixel Visible Images (1 per Ellipse)
- 3 m/pixel MOC Images Appear Smoother (6 per el)
  - More Dunes in Lows in EP80B2

EP80B2 Rougher Than EP78B2

SLOPE AND PULSE STATISTICS

Mars Exploration Rover

Site	B1.2	A1.2	B sd	1.2 A sd	Av PW	sd PW
TM10A2	0.15	0.21	0.18	0.45	0.75	0.24
TM20B2	0.16	0.22	0.20	0.47	0.75	0.24
IP84A2	0.19	0.14	0.24	0.10	1.10	0.35
IP96B2	0.18	0.14	0.24	0.10	1.08	0.33
EP55A2	0.20	0.16	0.44	0.20	1.42	0.44
EP78B2	0.48	0.41	0.55	0.29	1.03	0.43
EP80B2	0.63	0.55	0.67	0.36	1.32	0.57
VL1	0.27	0.32	1.02	1.01		
VL2	0.28	0.27	0.28	0.19		
MPF	0.30	0.25	1.07	0.68		

B1.2, A1.2-Mean Bidirectional, Adirectional Slope; sd-Standard Deviation; Av PW-Mean Pulse Width

MER Landing Site Ellipse Data

Mars Exploration Rover

Landing Site, Ellipse #	MDIM2 Lat. Long. W	MOLA(1) Lat. Long. E	Ellipse Length km	Ellipse Width km	Ellipse Azimuth deg
Hematite, TM20B2 TM10A2	2.07S 6.08	2.06S 353.77	117 119	18 17	86 84
Gusev, EP55A2	14.82S 184.85	14.64S 175.06	96	19	76
Isidis, IP84A2 IP96B2	4.31N 271.97	4.22N 87.91	132 135	16 16	88 91
Elysium, EP78B2	11.91S 236.10	11.73S 123.72	155	16	94
Elysium, EP80B2	14.50N 244.63	14.32N 115.20	165	15	95

*Ellipse Azimuth Measured Clockwise from North for Beginning of Launch Period

Average Thermophysical Properties

Landing Site	TES I	TES Alb	IRTM FC I	IRTM Rock
Hematite	232	0.170	307	5
Gusev	274	0.222	248	7
Isidis	454	0.228	384	14
Elysium, 78B	264	0.229	303	5
Elysium, 80B	274	0.228	315	9
VL1	320	0.255	250	16
VL2	240	0.235	175	17
MPF	425	0.218	344	18

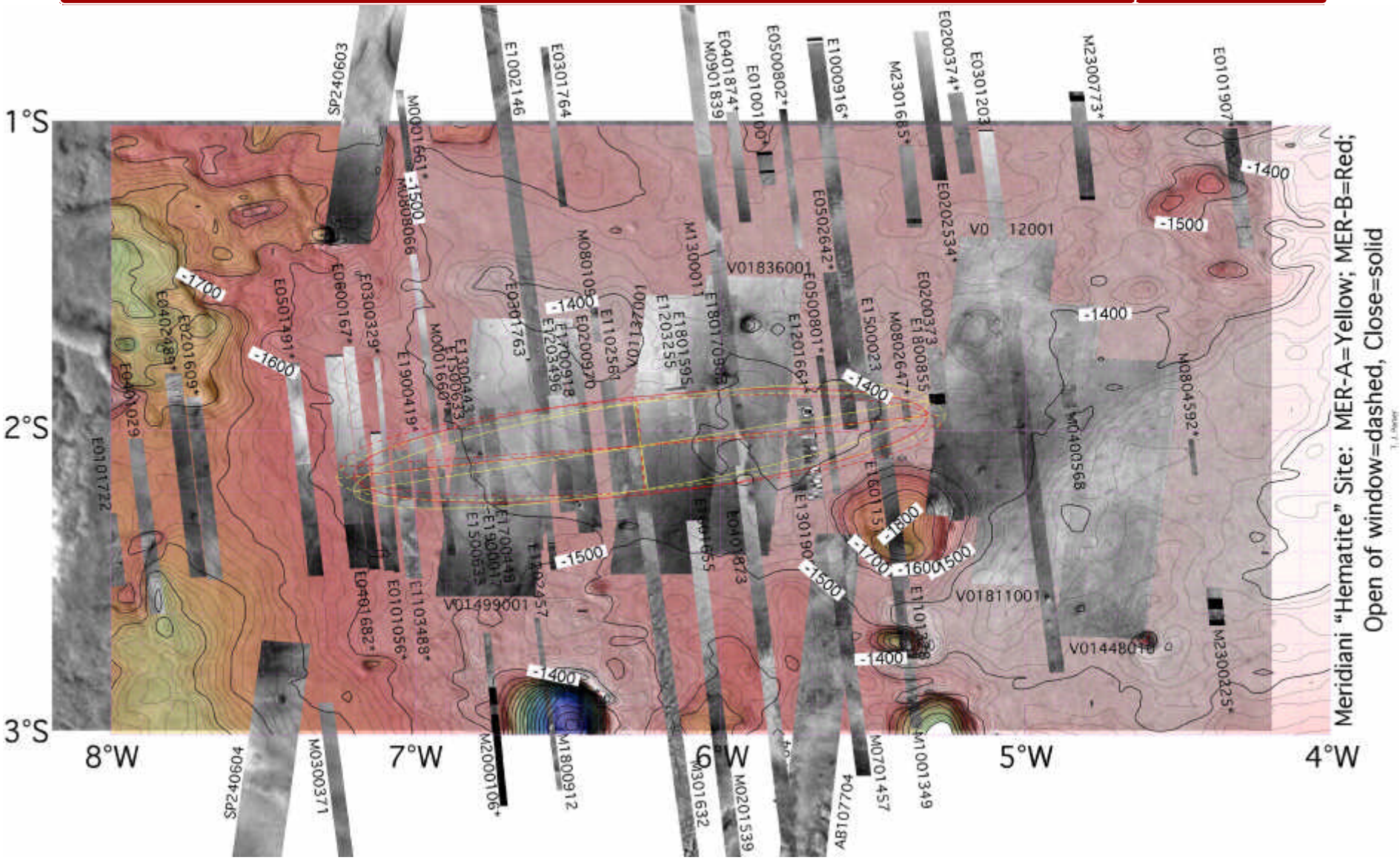
Thermal inertia (I) and fine component (FC) thermal inertia in SI units, J m^{-2} $s^{-0.5}$ K^{-1}. Rock abundance (Rock) - percent of surface covered.

SAFETY & SCIENCE

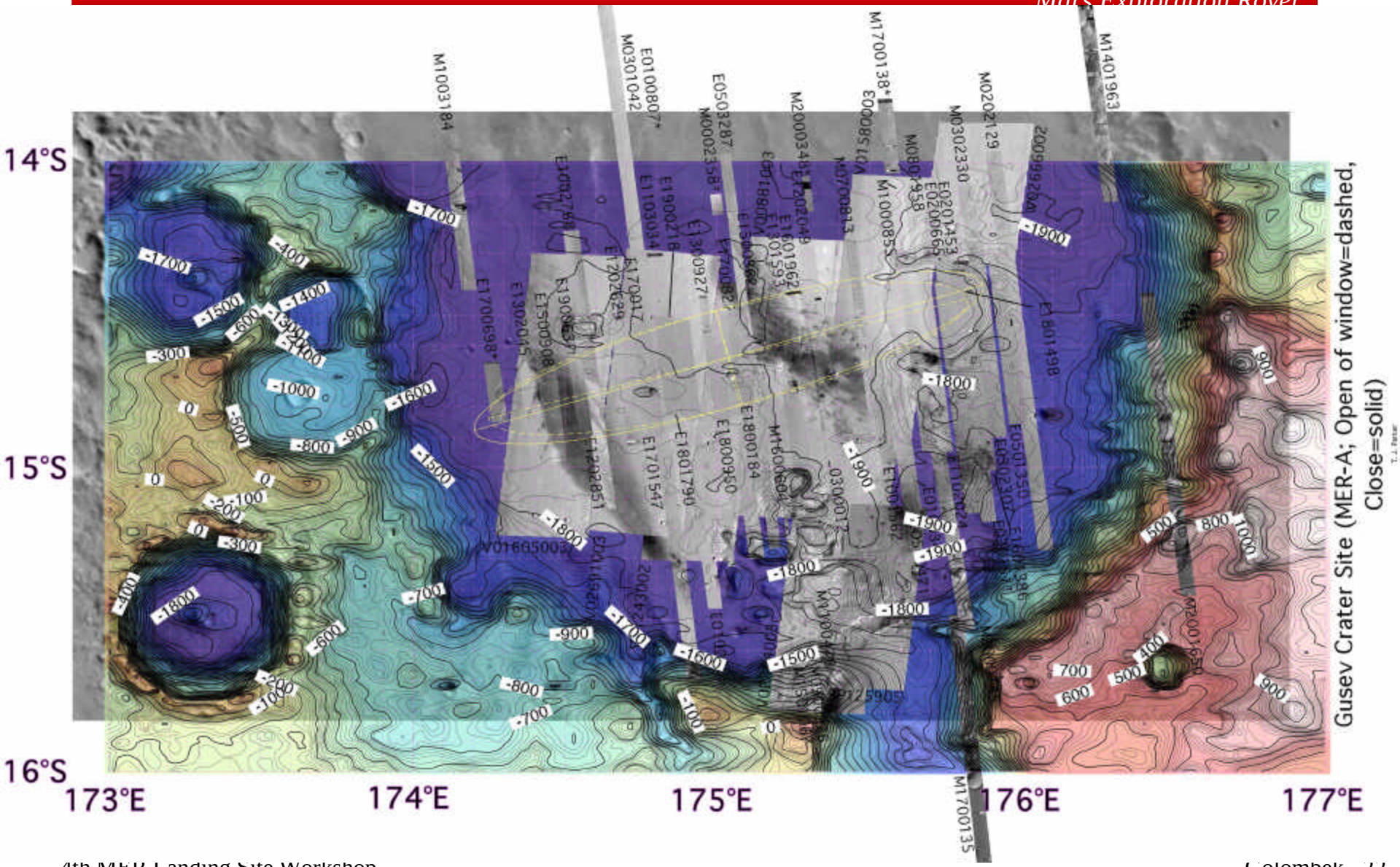
- EP78B2 Preferred on Safety Grounds
  - Lower Rock Abundance
  - Lower Slopes at All Scales
  - Slightly Lower Horizontal Winds
  - Also Further South [11.9N versus 14.5N]
- Science - Both Highland/Lowland Bdry
  - More Thermophysical Variation in EP78B2
  - More Dust Mantling at EP80B2, More Dunes
  - More Relief at EP80B2
  - Little Science Difference Between 2
- EP78B2 Selected; EP80B2 Eliminated

MERIDIANI

Mars Exploration Rover

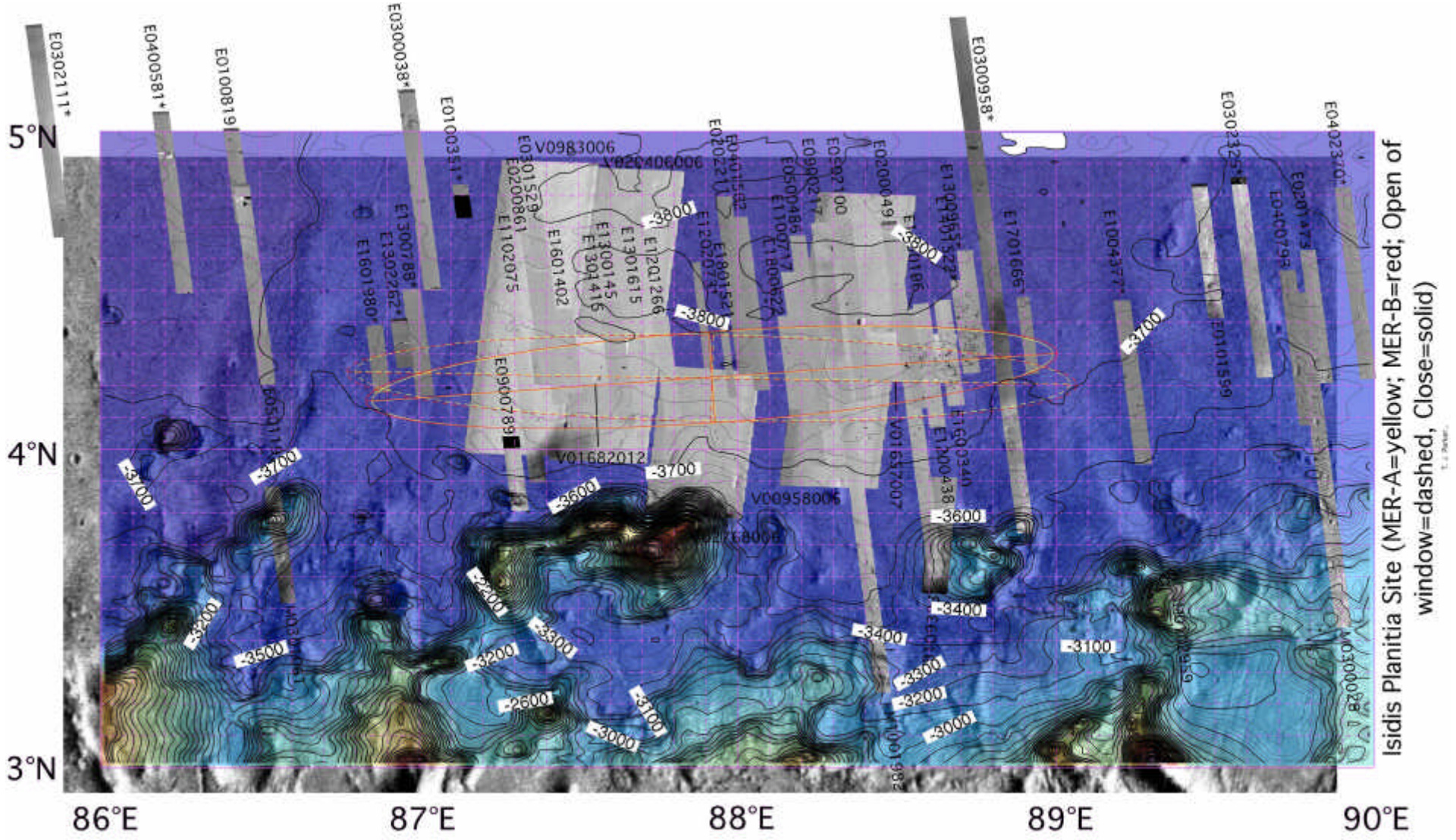


GUSEV


14°S
15°S
16°S
173°E
174°E
175°E
176°E
177°E
Gusev Crater Site (MER-A; Open of window=dashed, Close=solid)

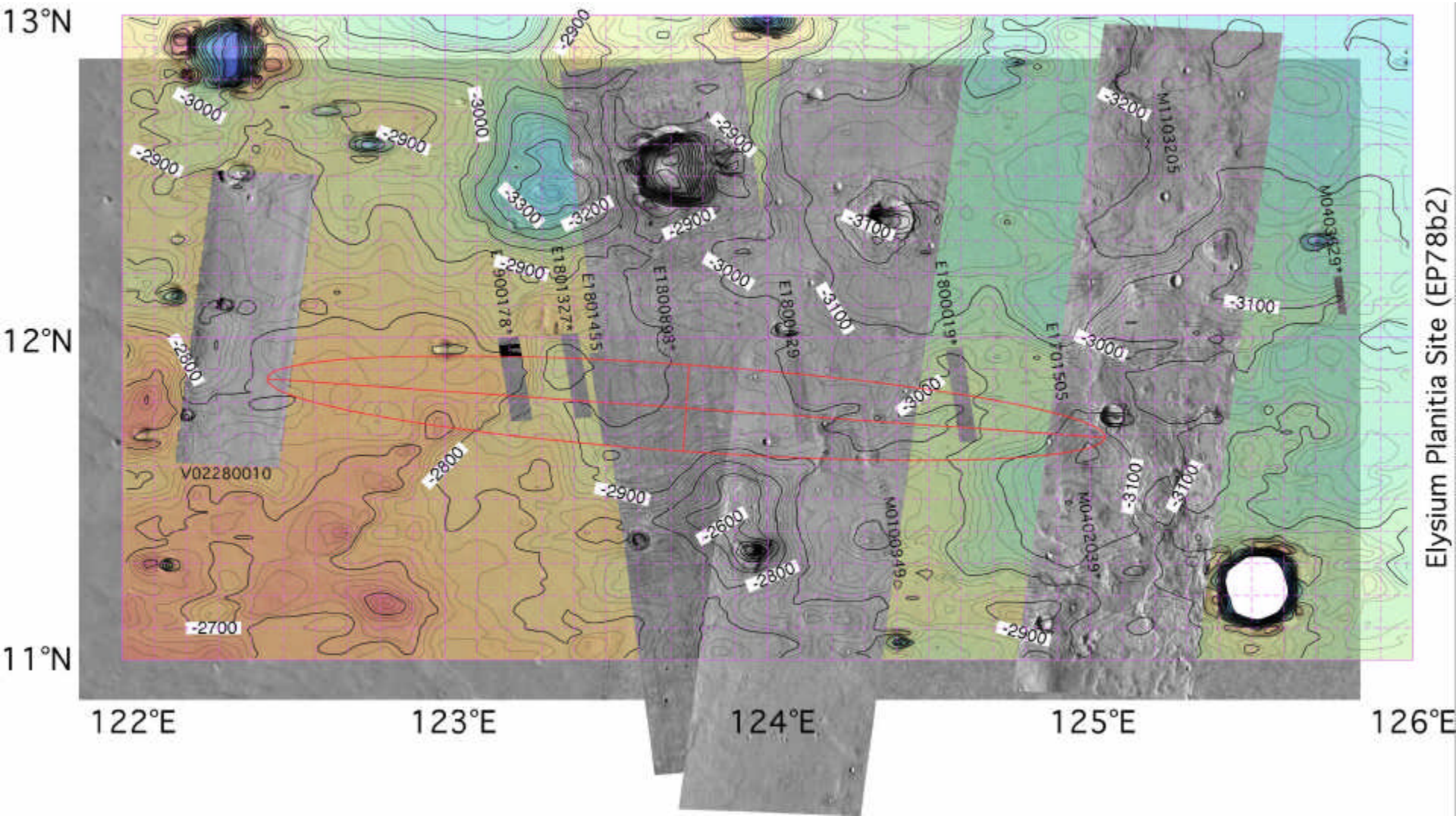
ISIDIS

Mars Exploration Rover



EP78B2

Mars Exploration Rover



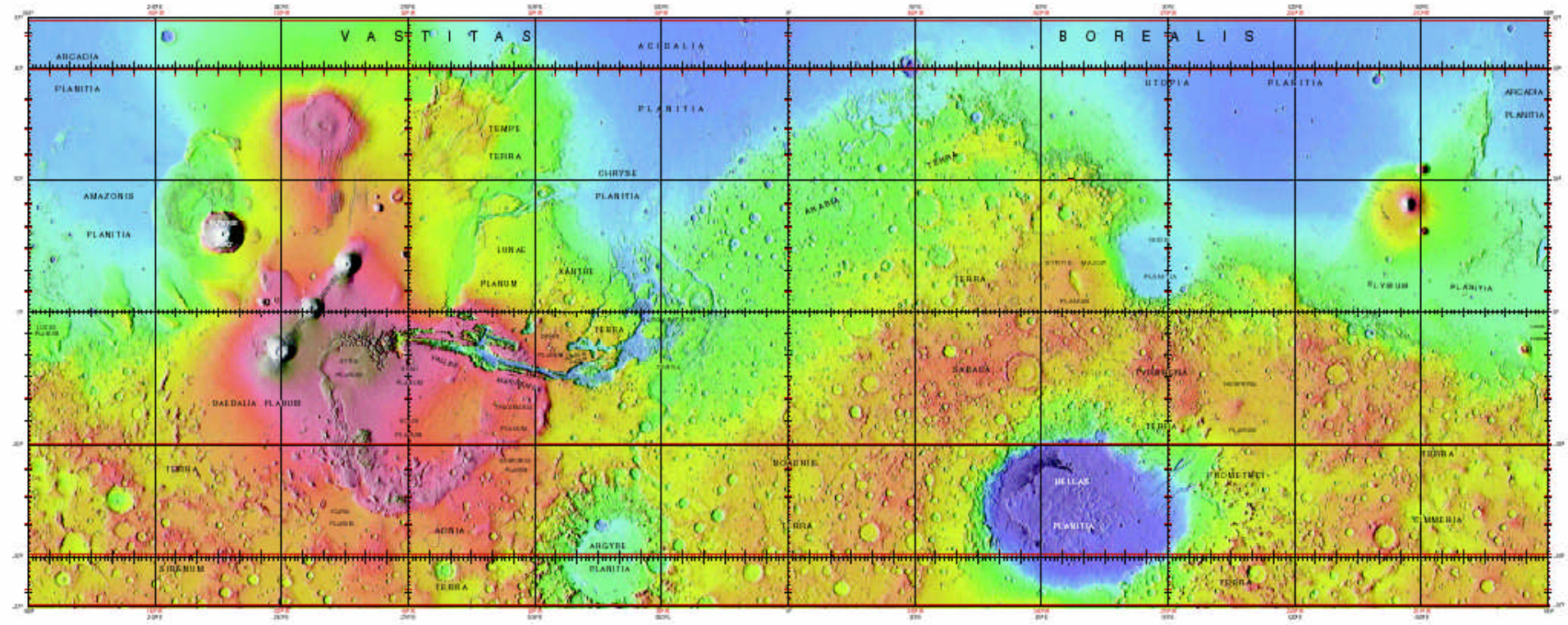
NOMECLATURE

- Hematite Name Changed to Meridiani Planum
  - Hematite is a Mineral, Not Mars Location
  - New Name for Smooth Area of Hematite Ellipse
    - Meridiani Planum - In New USGS Map Based on Physiography
    - Terra Meridiani - Low Albedo Feature
    - Provisionally Accepted by IAU - K. Tanaka, Mars Task Group
- Elysium Name Maintained
  - Actually in Utopia Physiographic Province
    - Just West of Basin Divide of Elysium in Utopia Planitia
  - But Ellipses Squarely in Elysium in Existing Maps
  - Ellipse May Get Eliminated (Based on Low Science Ranking) Before New Maps Come Out

New USGS Mars Map

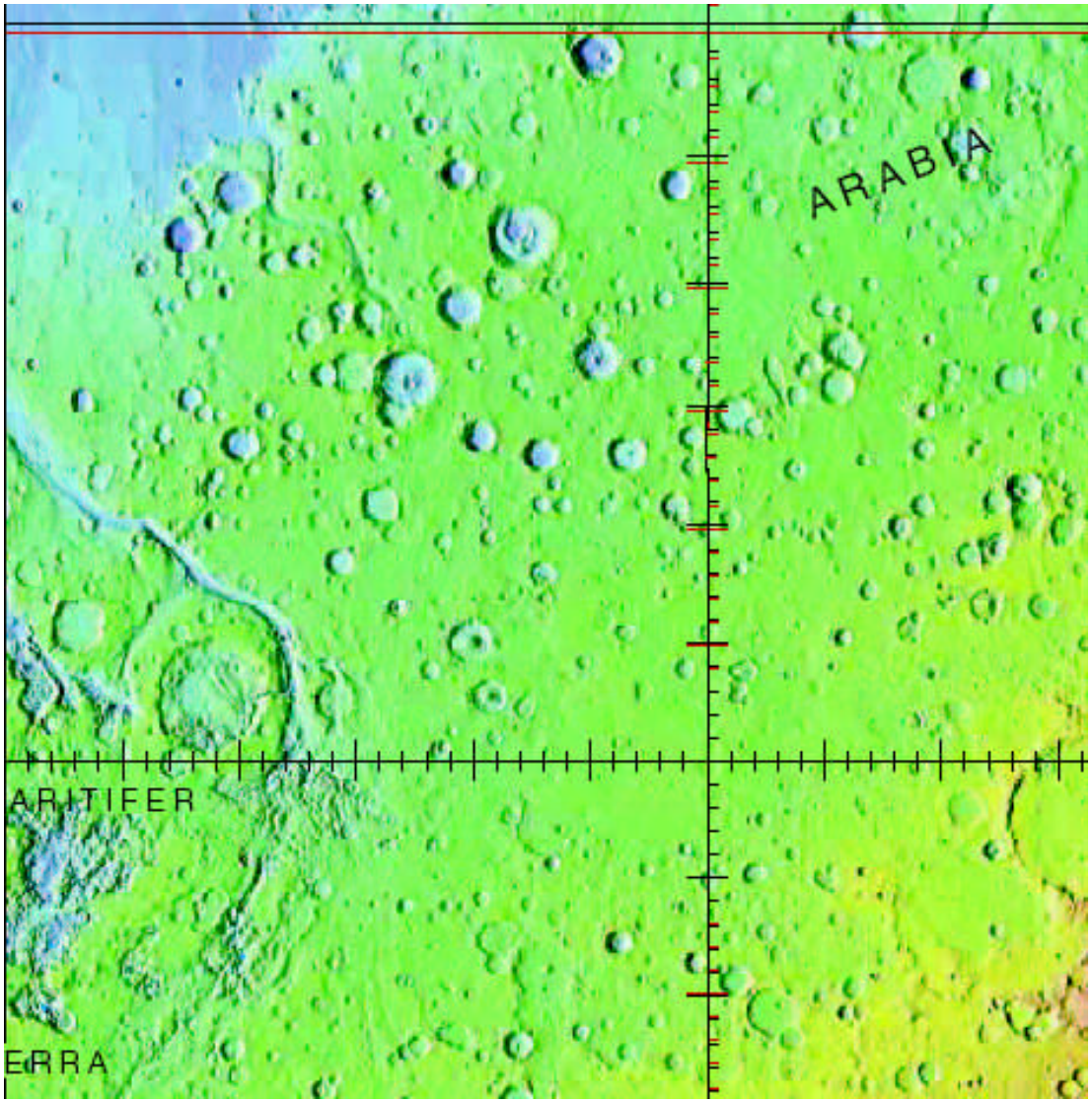
Mars Exploration Rover

Based on MOLA Topography - Soon to be Widely Distributed As Wall Maps



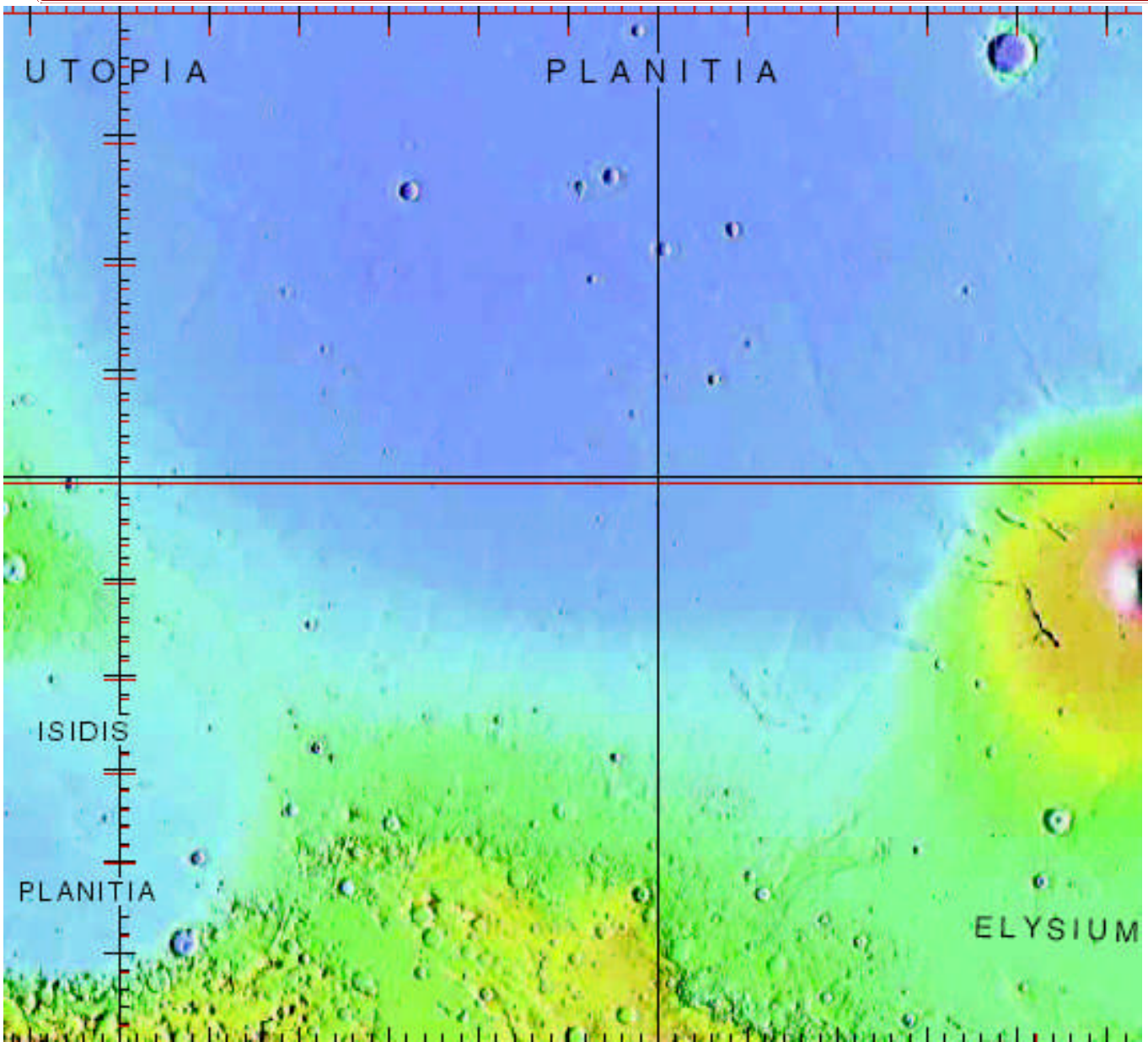
MARS REGIONAL NAMES

Meridiani Planum



Smooth Flat Area Near 0, 0

Elysium



Based on Physiography

Elysium Ellipses Actually in Utopia Plantitia, just to West of Wrinkle Ridge Divide

EP78B2 in “Elysium”