NAI Mars Focus Group Videocon

Science and Landing Site Priorities for the Mars 2003 Mission

Presentations by:

- Ronald Greeley (ASU) & Ruslan Kuzmin (Vernadsky Inst.)
- Nathalie Cabrol (NASA Ames)
- Vicky Hamilton & Phil Christensen (ASU)

Discussion moderator: Jack Farmer (ASU)

Technical support: Maria Farmer, David Nelson & Leslee Unser (ASU) & Mike Fitzgerrall (NASA Ames)

Science Objectives for Mission

- Detailed description of the mission science objectives and requirements available at http://athena.cornell.edu
- Determine the aqueous, climatic, and geologic history of sites on Mars where conditions may have been favorable for the preservation of evidence of possible pre-biotic or biotic processes.
- Emphasis on locations possessing clear evidence for surface processes involving water.
- Wide range of possible settings, including former fluvial-lacustrine & hydrothermal environments.

Recommendations of the Life Subgroup of MEPAG
(Mars Exploration Payload Assessment Group)

Life Subgroup GOAL:

DETERMINE IF LIFE EVER AROSE ON MARS

Objective 1: Determine if life exists *today*

Objective 2: Determine if life existed on Mars in the *past*

Objective 3: Assess the extent of prebiotic organic chemical evolution on Mars

Prioritized MEPAG Investigations

- 1A. Map the present 3-dimensional distribution of water in all its forms.
- 1B. Determine the locations of sedimentary deposits formed by past surface and subsurface hydrological processes.
- 2. Carry out *in situ* exploration for possible liquid water in the subsurface.
- 3. Explore high priority candidate sites (i.e., those that provide access to near-surface liquid water) for evidence of extant (active or dormant) life.
- 4. Locate and sample aqueous rock samples for MSR to search for fossil biosignatures.
- 5A. Determine the array of potential energy sources to sustain biological processes (determine the distribution of potential energy sources for life (e.g. near-surface hydrothermal systems), redox state, distribution and abundance of biologically important elements (e.g. P and N).
- 5B. Determine the nature and inventory of organic carbon in representative soils and ices of the Martian crust.
- 5C. Search for complex organic molecules in rocks and soils.
- 6. Determine the distribution of oxidants and their correlation with organics.
- 7A. Determine the timing and duration of hydrologic activity during Martian history.
- 7B. Determine the changes in crustal and atmospheric inventories of organic carbon over time.

Mars Exploration Rover (MER)

- See http://athena.cornell.edu
- Twin rovers (MERs)
- Airbag landing system
- Surface operations
  - MERs are expected to operate on the surface of Mars for a minimum of 90 sols, with the second rover arriving 35 sols after the first
- Rover design and payload

'03 Rover & Payload

Pan Cam

Mini TES

APXS

Micro Imager

Mössbauer

Engineering Constraints

- For complete description of mission engineering constraints see:
  - http://marsoweb.nas.nasa.gov/landingsites/mer2003
  - http://webgis.wr.usgs.gov/mer
- Operation of rovers requires that MER-A be separated by ~37° from MER-B
- Both MERs must land below the –1.3 km MOLA defined elevation
- Power usage and thermal cycling restricts landing sites for MER-A to between 15°S and 5°N and MER-B to between 10°S and 10°N

Engineering Constraints (cont.)

- Landing error ellipses ~56 by 30 km for MER-A at 15°S and ~224 by 30 km for MER-B at 10°N
- Orientation of the ellipse rotates from 66° at 15°S to 87° at 5°N for MER-A and from 98° at 10°N to 81° at 10°S for MER-B
- Landing sites must appear hazard free at MOC scale and possess slopes <15°
- Total rock coverage should be less than 20% (based on thermal inertia) with <1% rocks being >0.5m high

Engineering Constraints (cont.)

- Radar reflectivity >0.05; extremely high albedo and low thermal inertia regions to be avoided
- Fine component thermal inertia values >3-4 x 10-3 cal cm-2 s-0.5 K-1 or cgs units (equivalent to 125-165 J m-2 s-0.5 K-1 or SI units)
- Low-altitude winds <20 m/s

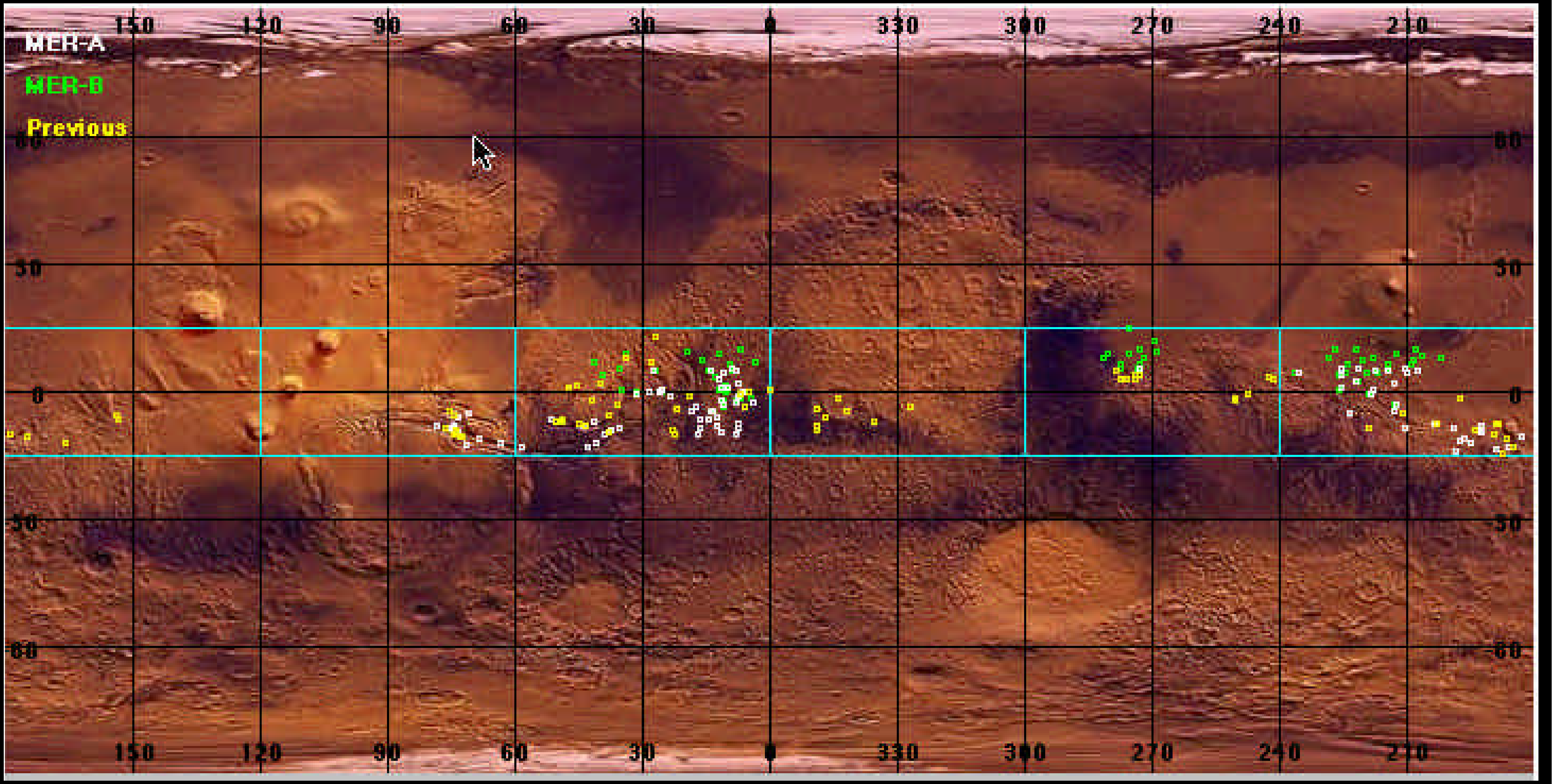
Potential Landing Sites

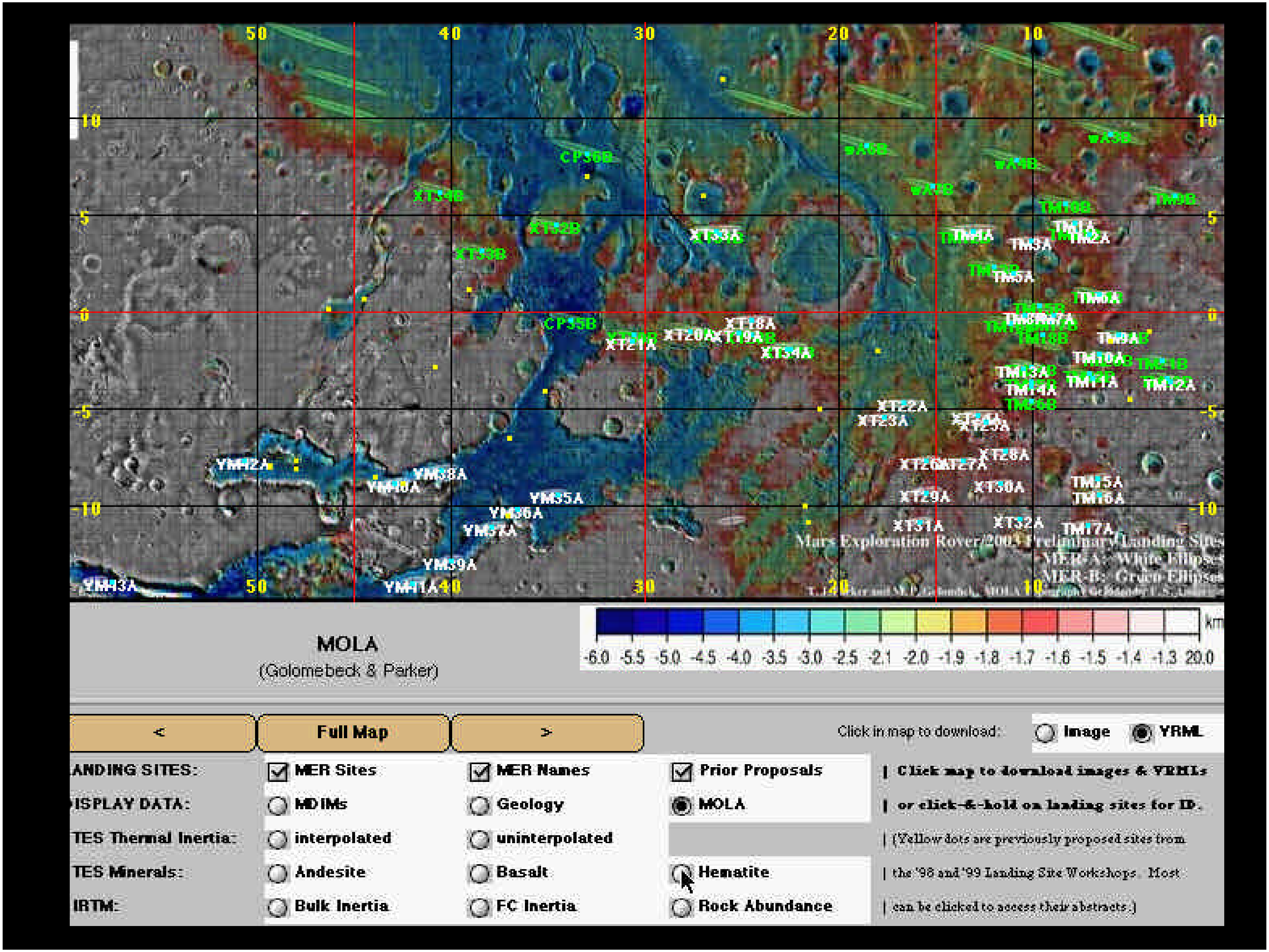
- Preliminary evaluation of potential landing sites was made for each 2.5° in latitude by placing ellipses of the proper size in all locations:
  - Below –1.3 km in elevation
  - With acceptable fine component thermal inertia values
  - Free of obvious hazards in the Mars Digital Image Mosaics (smooth and flat in the MDIM without scarps, large hills, depressions or large fresh craters)

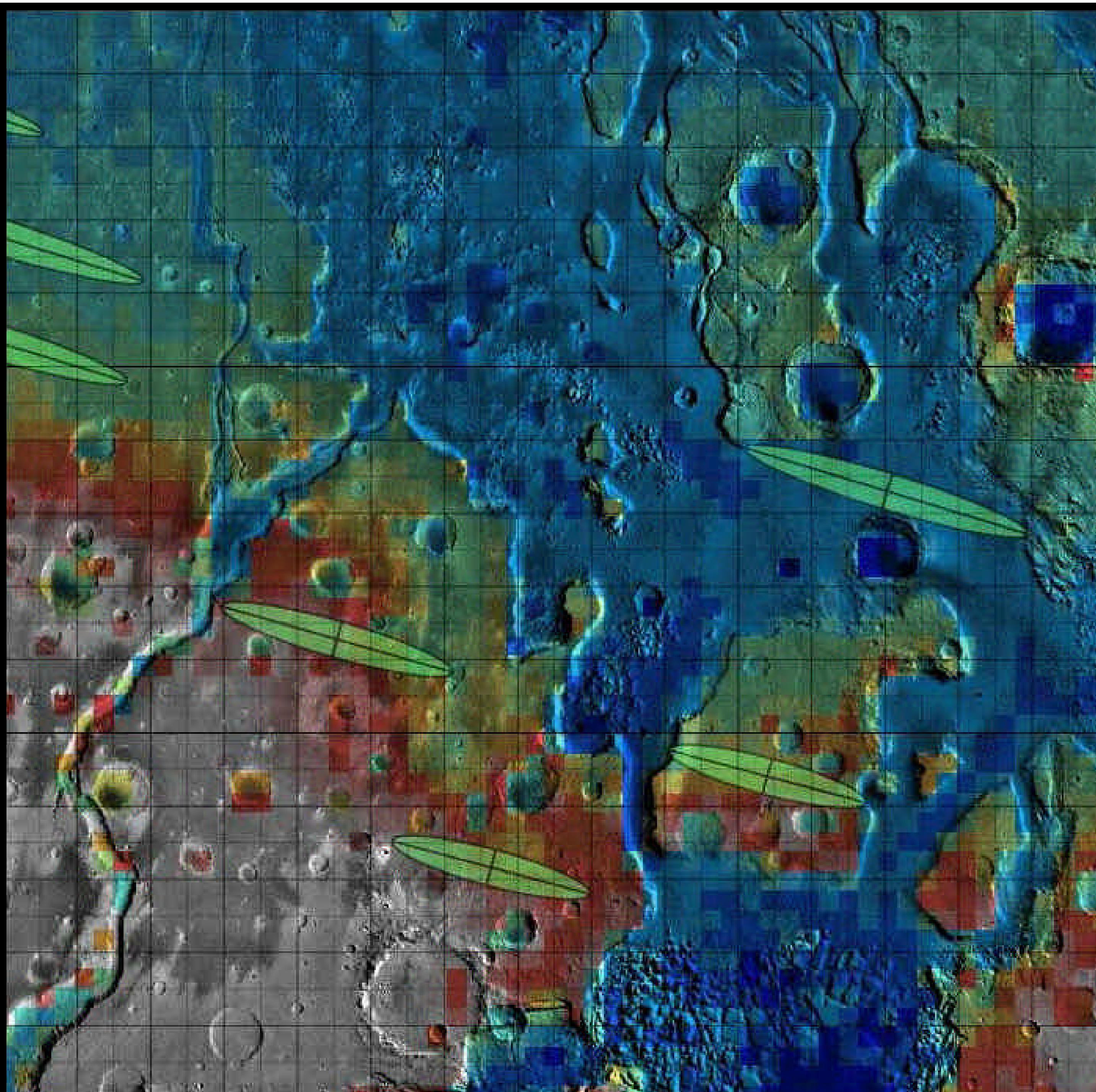
Preliminary Evaluations

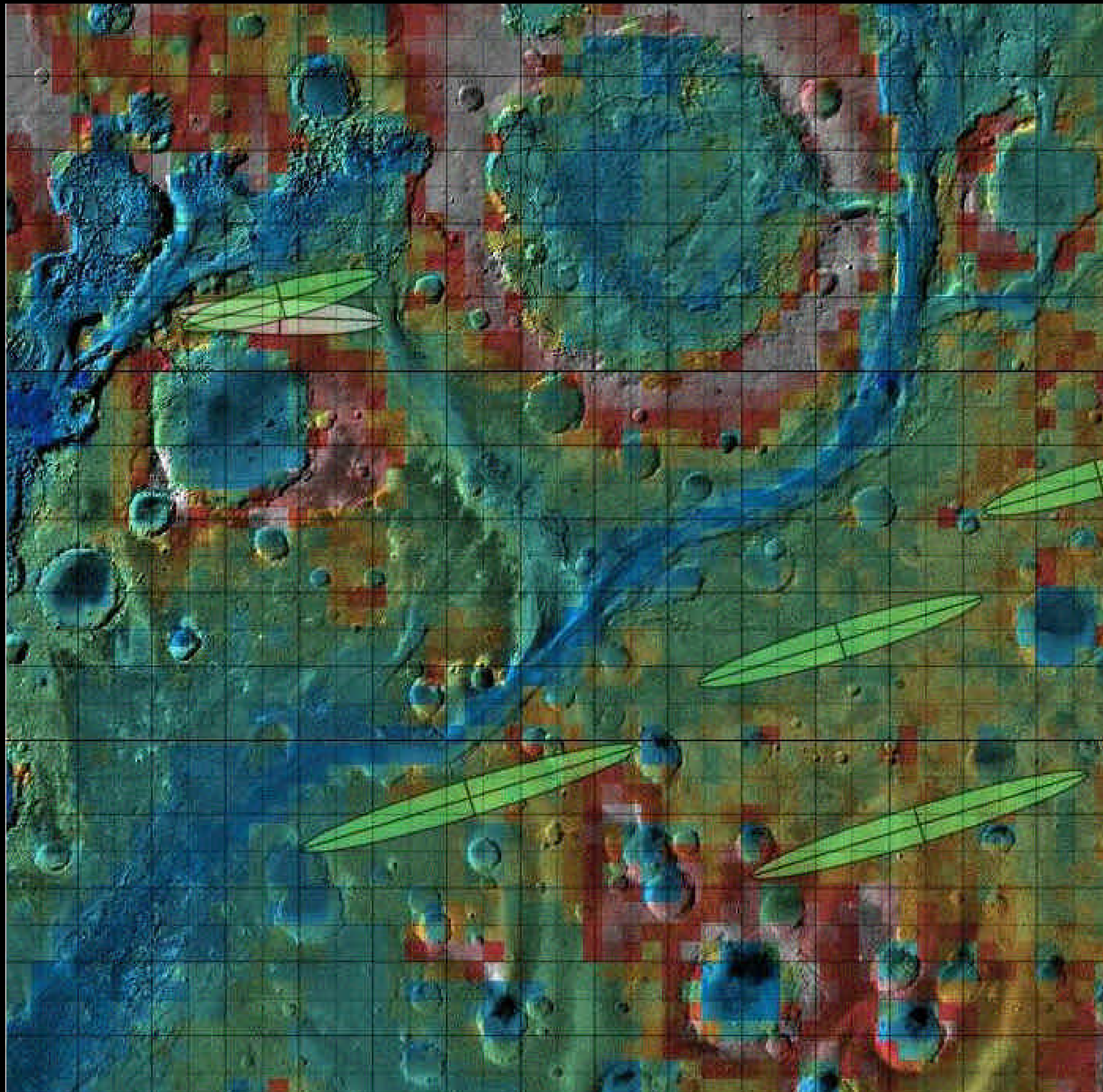
- ~185 potential landing sites shown to meet criteria (100 sites for MER-A & 85 for MER-B).
  - A complete listing of all of these sites can be viewed at:
    - http://marsoweb.nas.nasa.gov/landingsites/mer2003
    - http://webgis.wr.usgs.gov/mer

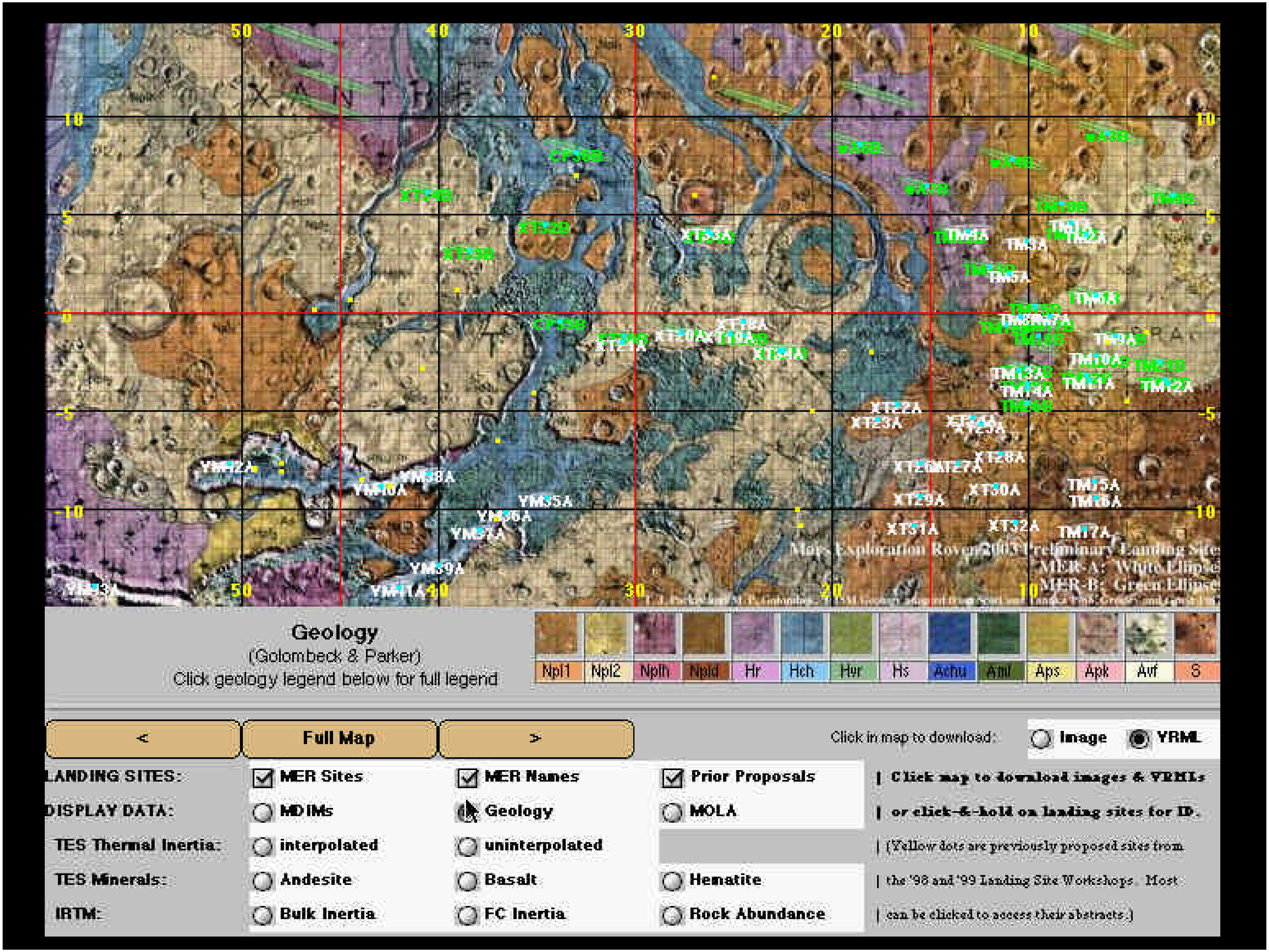
Potential Landing Sites



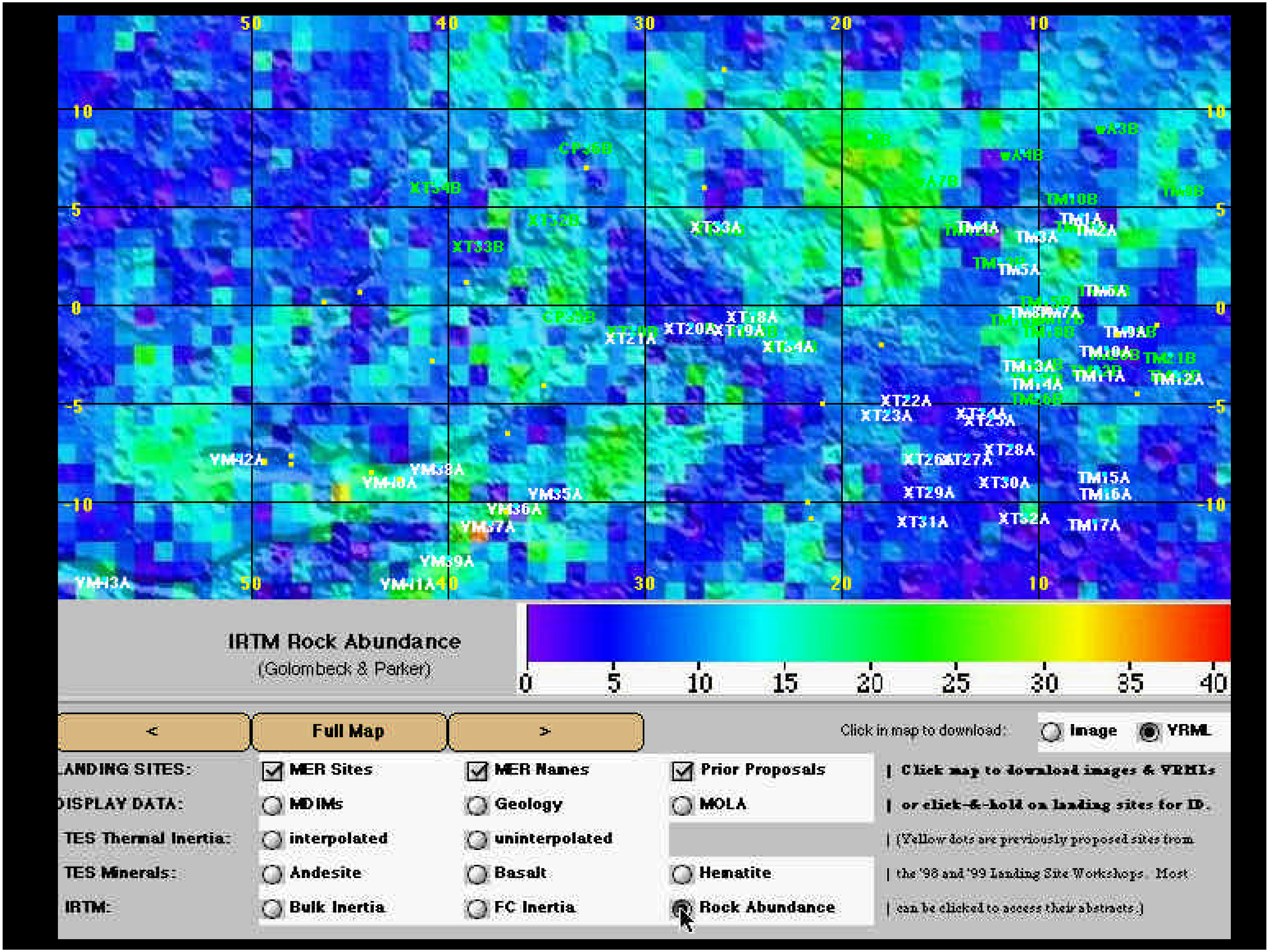

Mars Exploration Rover/2003 Preliminary Landing Sites
MER-A: White Ellipses
MER-B: Green Ellipses
CP36B
CP35B
XT34B
XT32B
XT33B
XT33A
XT18A
XT19A
XT20A
XT21A
XT24A
XT22A
XT23A
XT28A
XT30A
XT29A
XT31A
XT32A
TM1A
TM2A
TM3A
TM4A
TM5A
TM6A
TM9A
TM10A
TM11A
TM12A
TM13A
TM14A
TM15A
TM16A
TM17A
TM9B
TM10B
TM16B
TM18B
YM42A
YM40A
YM38A
YM35A
YM36A
YM37A
YM39A
YM41A
YM43A
MOLA
(Golombeck & Parker)
-6.0 -5.5 -5.0 -4.5 -4.0 -3.5 -3.0 -2.5 -2.1 -2.0 -1.9 -1.8 -1.7 -1.6 -1.5 -1.4 -1.3 20.0
km
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
Click map to download images & VRMLs
or click-&-hold on landing sites for ID.
(Yellow dots are previously proposed sites from
the '98 and '99 Landing Site Workshops. Most
can be clicked to access their abstracts.)

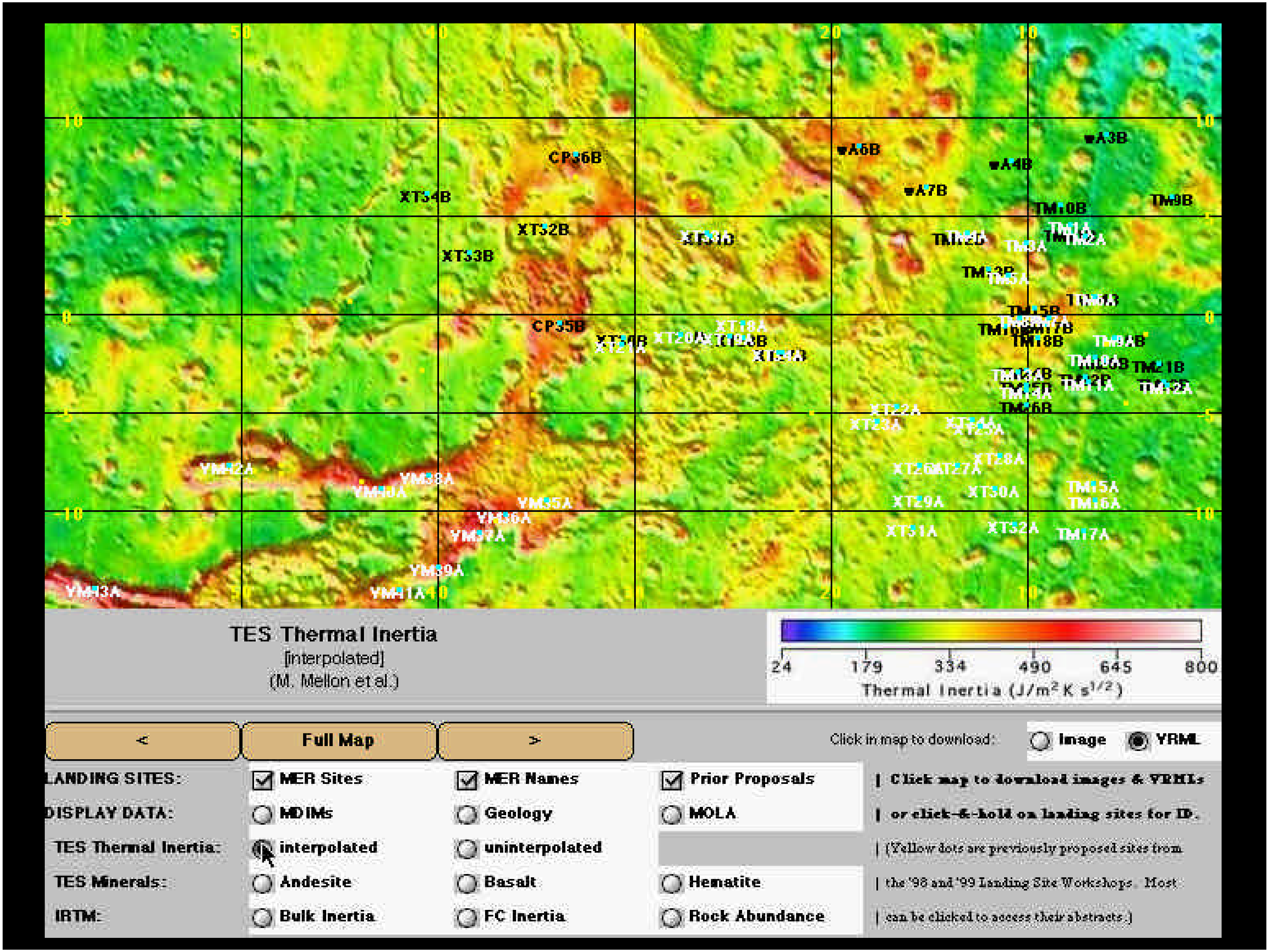




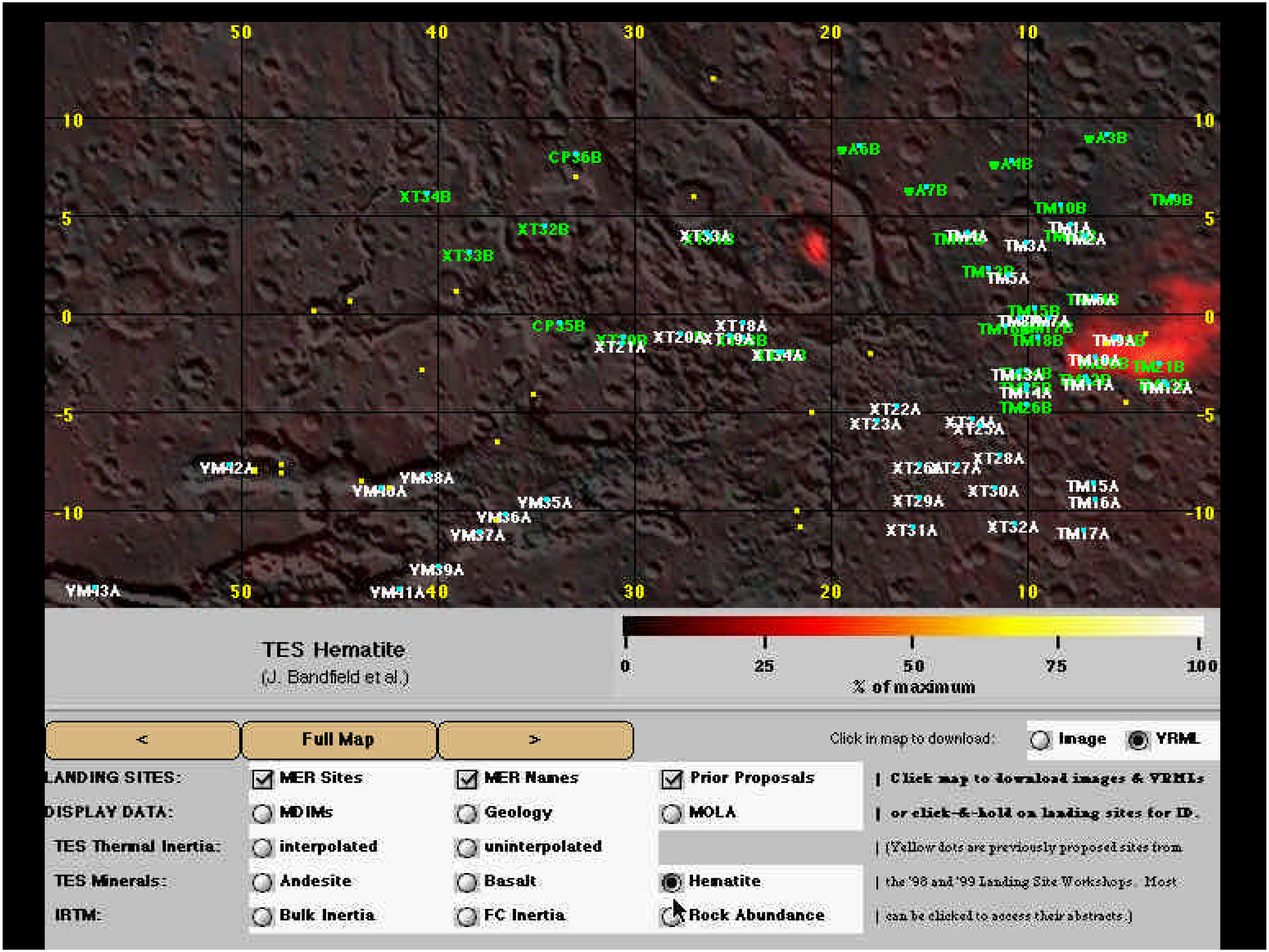


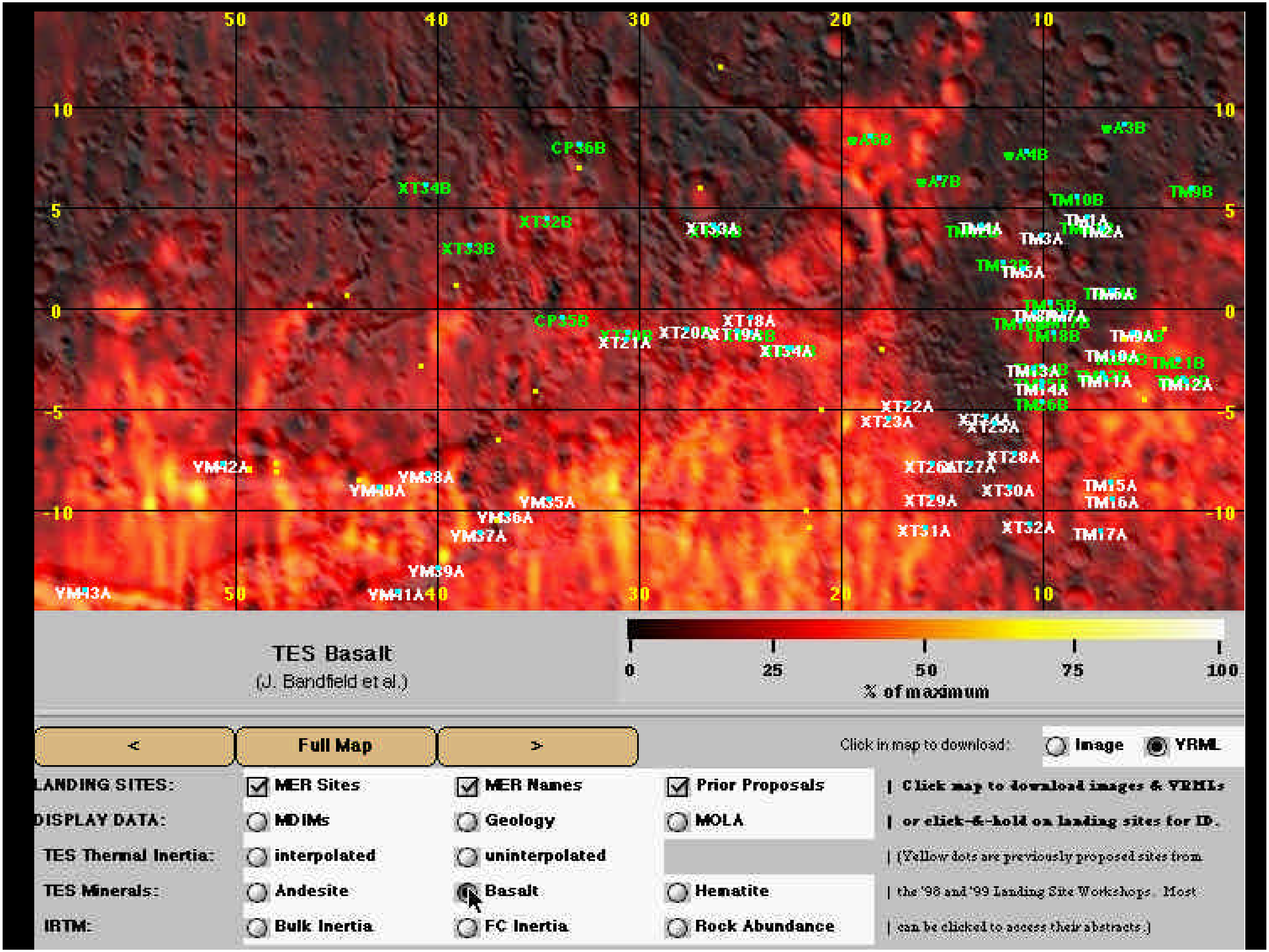
Mars Exploration Rover 2003 Preliminary Landing Sites
MER-A: White Ellipse
MER-B: Green Ellipse
Geology
(Golombeck & Parker)
Click geology legend below for full legend
Npl1
Npl2
Nplh
Npld
Hr
Hch
Hvr
Hs
Achu
Aml
Aps
Apk
Avf
S
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
| Click map to download images & VRMLs
| or click-&-hold on landing sites for ID.
| (Yellow dots are previously proposed sites from
| the '98 and '99 Landing Site Workshops. Most
| can be clicked to access their abstracts.)


IRTM Rock Abundance
(Golombeck & Parker)
0 5 10 15 20 25 30 35 40
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
| Click map to download images & VRMLs
| or click-&-hold on landing sites for ID.
| (Yellow dots are previously proposed sites from
| the '98 and '99 Landing Site Workshops. Most
| can be clicked to access their abstracts.)
XT33A
XT23A
XT22A
XT28A
XT29A
XT30A
XT31A
TM15A
TM16A
TM17A
YM35A
YM36A
YM38A
YM39A

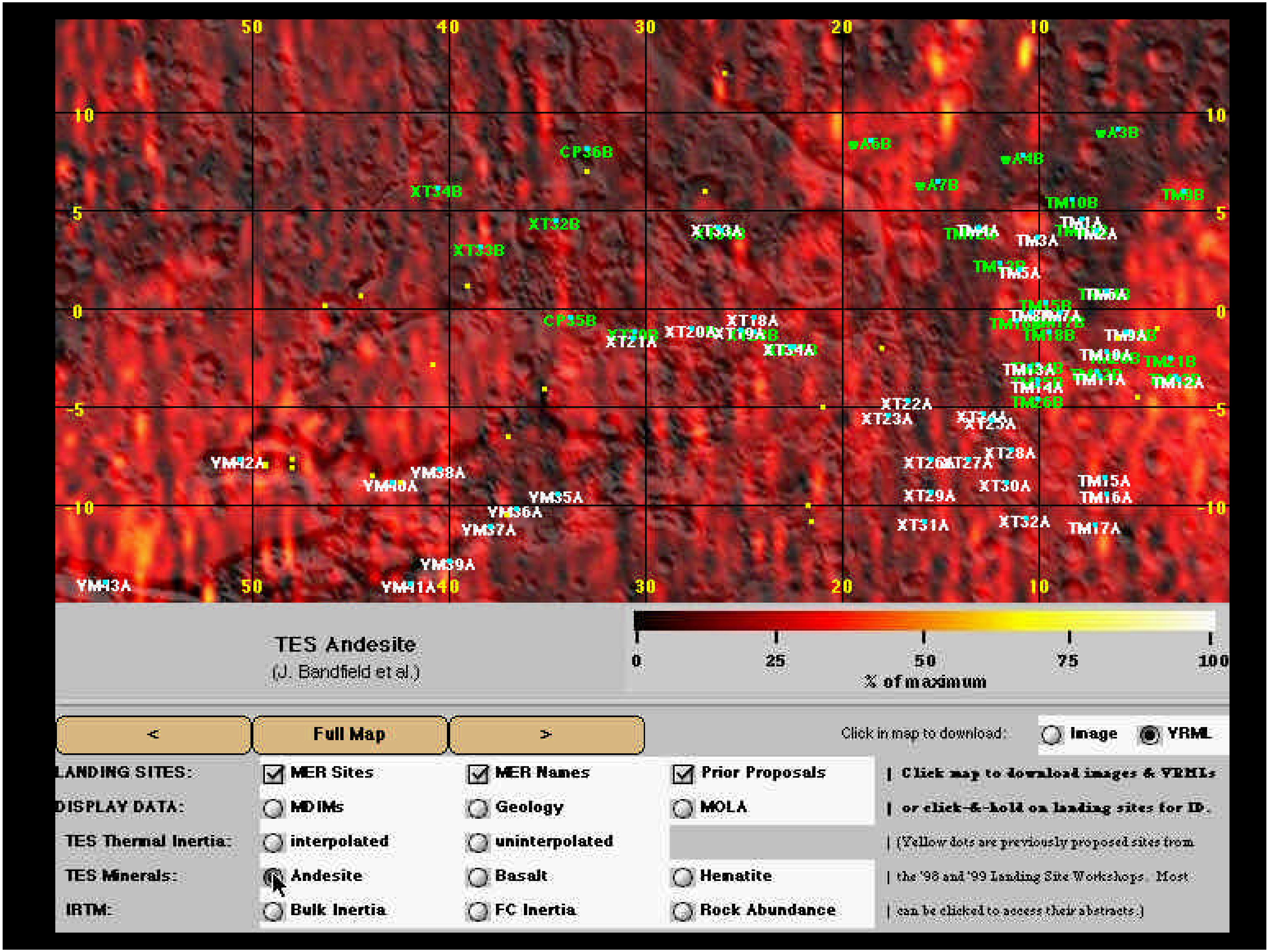


CP36B
XT34B
XT32B
XT33B
A6B
A4B
A3B
A7B
TM10B
TM9B
CP35B
XT18A
XT14A
TM15B
TM18B
TM21B
XT22A
XT23A
XT28A
XT30A
XT29A
XT31A
XT32A
TM15A
TM16A
TM17A
YM42A
YM40A
YM38A
YM35A
YM36A
YM37A
YM39A
YM41A
YM43A
TES Thermal Inertia
[interpolated]
(M. Mellon et al.)
24
179
334
490
645
800
Thermal Inertia (J/m² K s^1/2)
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
| Click map to download images & VRMLs
| or click-&-hold on landing sites for ID.
| (Yellow dots are previously proposed sites from
| the '98 and '99 Landing Site Workshops. Most
| can be clicked to access their abstracts.)


TES Hematite
(J. Bandfield et al.)
0
25
50
75
100
% of maximum
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
| Click map to download images & VRMLs
| or click-&-hold on landing sites for ID.
| (Yellow dots are previously proposed sites from
| the '98 and '99 Landing Site Workshops. Most
| can be clicked to access their abstracts.)
CP36B
XT34B
XT32B
XT33B
CP35B
XT18A
XT20A
XT21A
XT22A
XT23A
XT28A
XT29A
XT30A
XT31A
XT32A
TM3A
TM5A
TM10B
TM9B
TM14A
TM15A
TM16A
TM17A
TM26B
YM42A
YM38A
YM35A
YM36A
YM37A
YM39A
YM43A



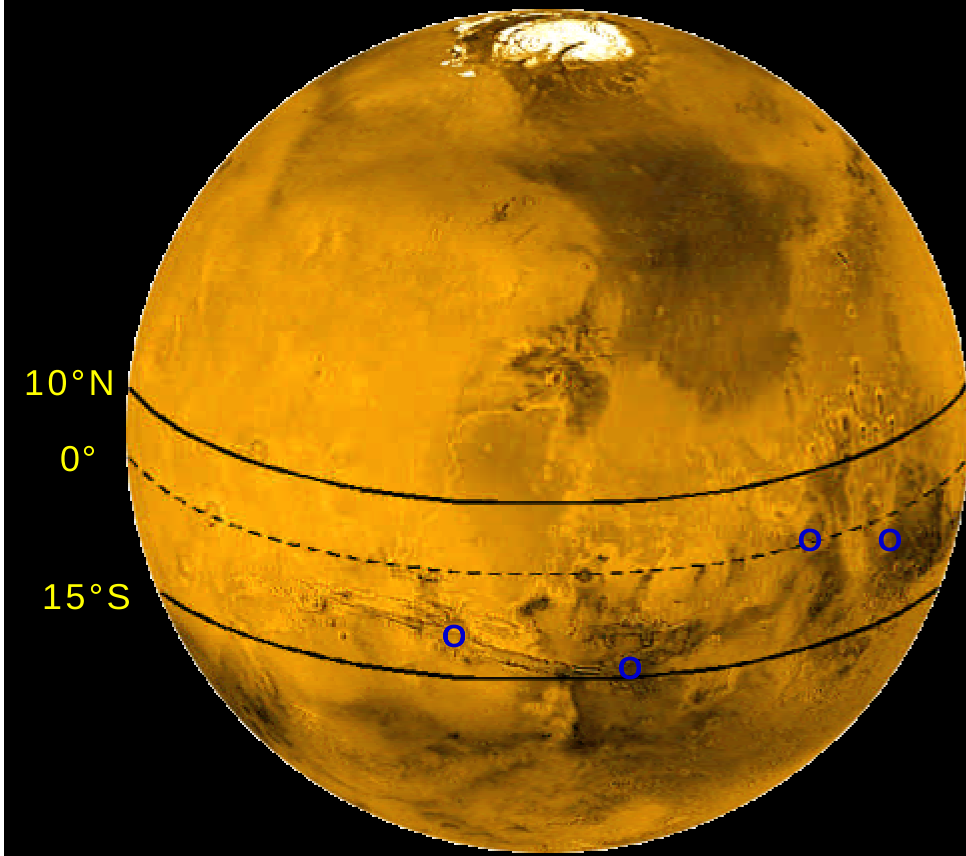
TES Basalt
(J. Bandfield et al.)
0 25 50 75 100
% of maximum
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
| Click map to download images & VRMLs
| or click-&-hold on landing sites for ID.
| (Yellow dots are previously proposed sites from
| the '98 and '99 Landing Site Workshops. Most
| can be clicked to access their abstracts.)


TES Andesite
(J. Bandfield et al.)
0
25
50
75
100
% of maximum
<
Full Map
>
Click in map to download:
Image
VRML
LANDING SITES:
MER Sites
MER Names
Prior Proposals
DISPLAY DATA:
MDIMs
Geology
MOLA
TES Thermal Inertia:
interpolated
uninterpolated
TES Minerals:
Andesite
Basalt
Hematite
IRTM:
Bulk Inertia
FC Inertia
Rock Abundance
| Click map to download images & VRMLs
| or click-&-hold on landing sites for ID.
| (Yellow dots are previously proposed sites from
| the '98 and '99 Landing Site Workshops. Most
| can be clicked to access their abstracts.)
CP36B
XT34B
XT32B
XT33B
CP35B
XT18A
XT21A
XT22A
XT23A
XT29A
XT30A
XT31A
XT32A
XT28A
TM10B
TM3A
TM5A
TM15A
TM16A
TM17A
YM35A
YM36A
YM37A
YM38A
YM39A
YM40A
YM41A
YM42A
YM43A

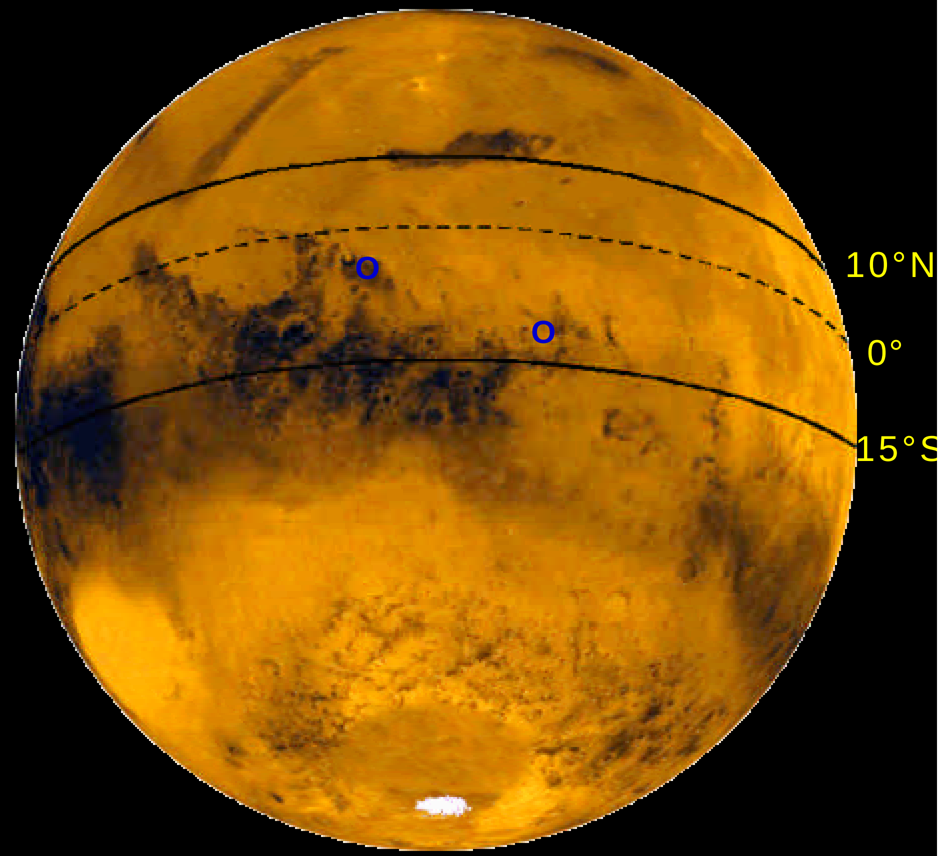
Sites Reviewed In Today's Videocon:

- Fluvial sites - **Ron Greeley**
  - Eos Chasma
- Paleolake basins sites - **Nathalie Cabrol**
  - Gusev Crater
  - Gale Crater
- "Hematite" sites - **Vicky Hamilton**
  - Terra Meridiani
  - Aram Chaos

Proposed Landing Sites for MER A & B



West Hemisphere
Centered at:
30°N, 30°W



East Hemisphere
Centered at:
30°N, 210°W

Where next?