



Sinus Meridiani (Hematite) Landing Site for 2003 MER

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Overview

- Key Questions
- Site Selection Considerations
 - Engineering Constraints
 - Instrumental Capabilities
- Sinus Meridiani Hematite
- Proposed Mechanisms of Formation
- Conclusions



Key Questions

- Focus on water & sites of exobiological interest -- where, when, how long?
 - Existence of aqueous or hydrothermal deposits
 - Existence/location of carbonates
 - Composition and abundance of weathering products



Site Selection Considerations

- Engineering constraints
- Instrumental capabilities
 - PanCam
 - Mini-TES spectrometer
 - Mossbauer spectrometer
 - Alpha Proton X-ray spectrometer
 - Microscopic Imager



Engineering Constraints

- Latitude
 - MER-A -15° to $+5^{\circ}$
 - MER-B -10° to $+10^{\circ}$ (new)
- MOLA elevation < -1.3 km
- Slope $< 15^{\circ}$
- Rock abundance $< 20\%$
- FCI $< 125\text{-}165 \text{ J m}^{-2} \text{ s}^{-1/2} \text{ K}^{-1}$
- No high albedo sites



Instrument Capabilities

- Rock, coating, and soil analyses
- Optimal conditions for all instruments favor low dust
 - Spectral discrimination
 - Surface texture discrimination
- Sinus Meridiani site has known surface materials useful for *in situ* “calibration” of both landed instrument packages (*Christensen et al.* [2000])
 - Crystalline hematite
 - Basaltic material



Sinus Meridiani Hematite

- Unique deposit of crystalline hematite
 - Coarse-grained (10-100's μm)
 - Not nanophase
- Covers ~10-15% of surface
- Excellent correlation of hematite with smooth, layered, friable unit
 - Probable sedimentary origin
 - MOC images confirm layering in smooth unit



Hematite Formation Mechanisms

I) Chemical precipitation - extensive near-surface water

- 1) Precipitation from ambient, Fe-rich water (oxide iron formations)
- 2) Precipitation from hydrothermal fluids
- 3) Low-temperature dissolution and precipitation through mobile groundwater leaching
- 4) Surface weathering and coatings

II) Thermal oxidation of magnetite-rich lava



Hematite Summary

- Crystalline hematite in Sinus Meridiani occurs *in situ* in a sedimentary rock formation composed primarily of basaltic material with 10-15% hematite
- Hematite formed by precipitation from aqueous fluids under either ambient or hydrothermal conditions
- Evidence for aqueous mineralization indicates long-term stability of near-surface water on early Mars



Conclusions

- Sinus Meridiani sites meet engineering constraints
- Unique mineralization in Sinus Meridiani presents intriguing, water-linked environment for further investigation
- Current knowledge of Sinus Meridiani mineralogy presents a rare opportunity for MER instruments on both rovers