Mars Exploration Rover

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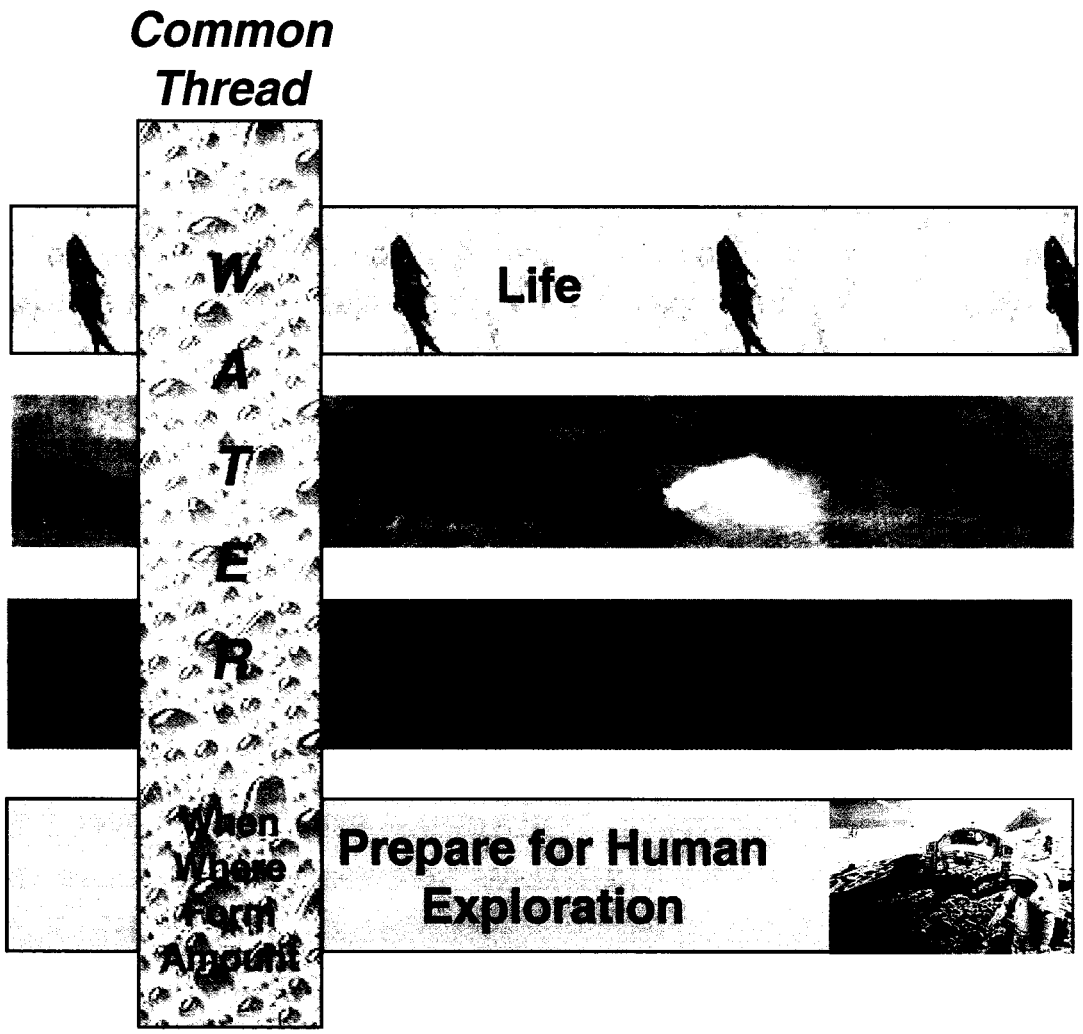
Mission Overview and Mars Time Impact on Project Personnel

The Mars Science Strategy: "Follow the Water"



Understand the potential for life elsewhere in the universe

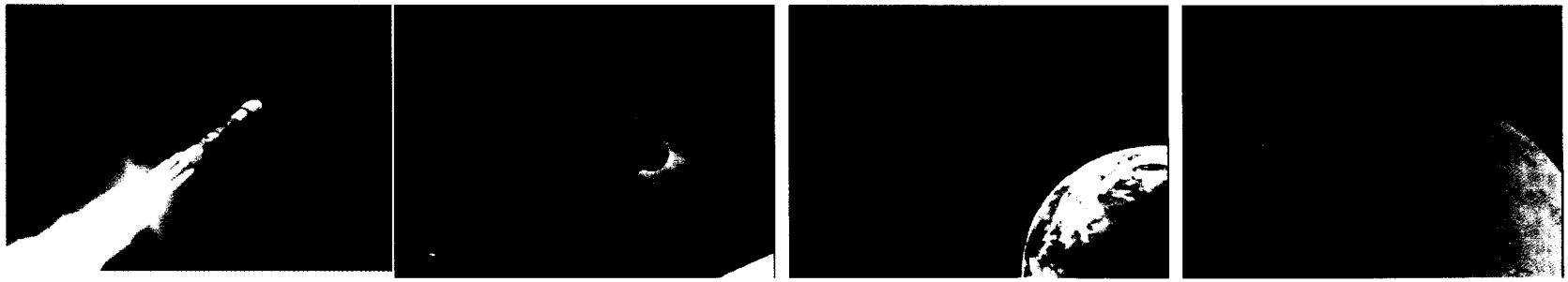
Characterize the present and past climate and climate processes

Understand the geological processes affecting Mars' interior, crust, and surface

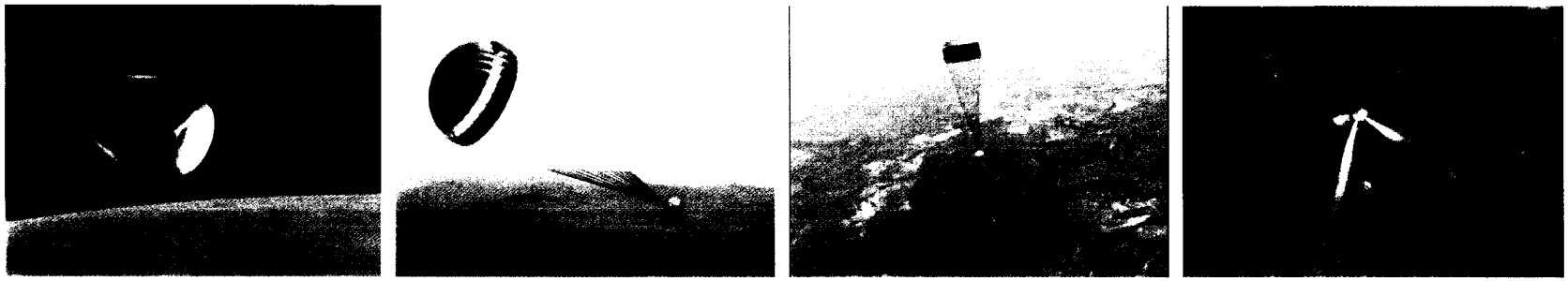
Develop the knowledge & technology necessary for eventual human exploration

Mission Overview (1)

Launch/Cruise



EDL



Surface

Images From Mission Animation by Dan Maas

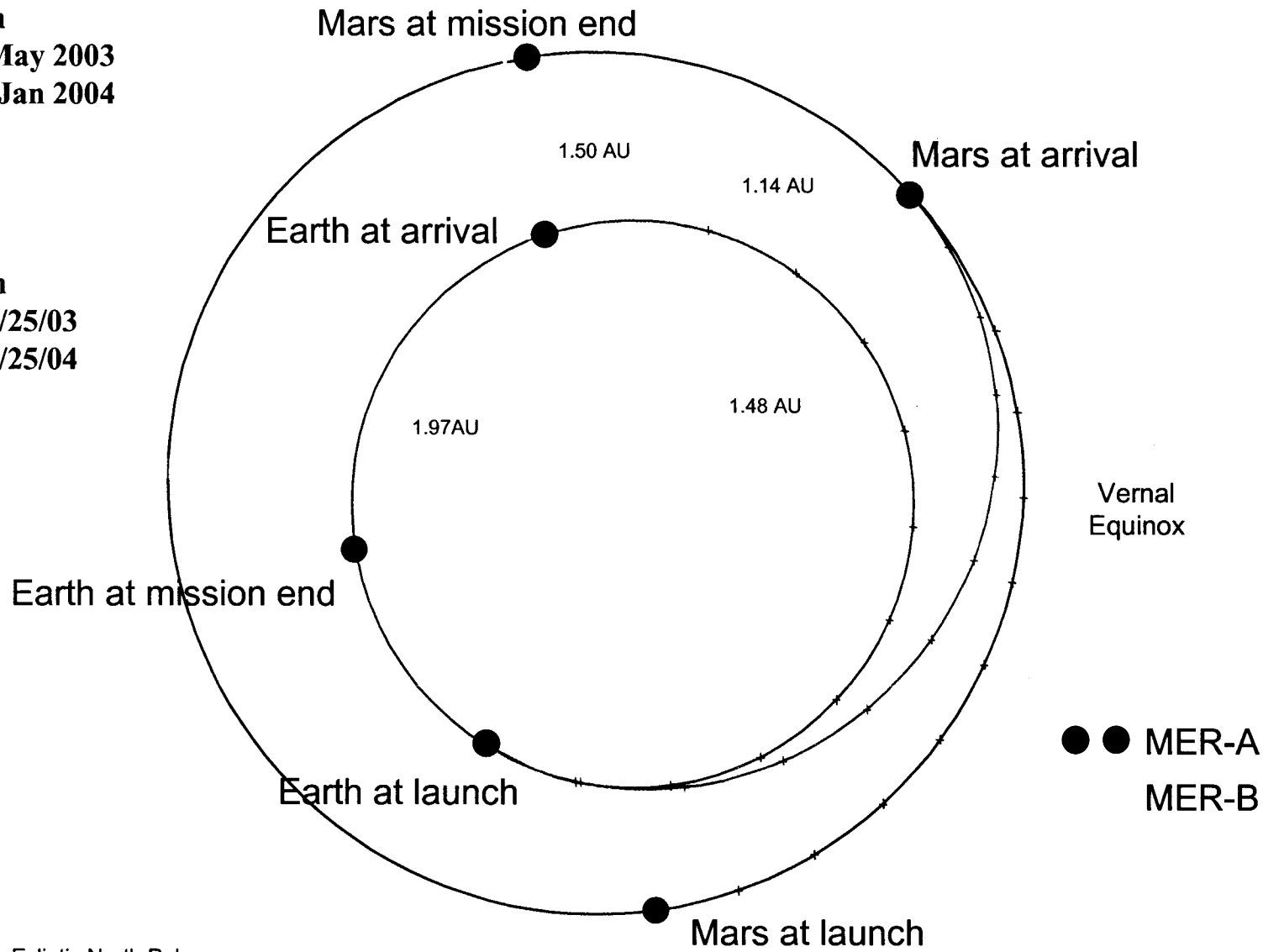
Mission Overview (2)

- **Entry, Descent and Landing (EDL)**
  - **Posigrade Entry**
  - **MPF-derived EDL System**
    - **Flight system capability: 825 kg entry mass, surface altitude ≤-1.3 km relative to MOLA areoid**
  - **EDL Communications**
    - **Real-time X-band DTE (Direct-to-Earth) communications during EDL (Doppler and M-FSK tones)**
    - **MGS capture of MER telemetry transmitted via UHF-band link during EDL**
- **Surface Mission**
  - **Landing site latitude range:** MER-A: 15° South to 5° North. MER-B: 10° South to 10° North
  - **Science**
    - **Imaging science: Pancam, Mini-TES, engineering cameras**
    - **In-situ science: APXS, Mössbauer, Microscopic Imager, Rock Abrasion Tool**
      - **Instrument placement using Instrument Deployment Device (IDD)**
  - **Operations Strategy**
    - **Daily DTE / DFE (Direct-from-Earth commanding) each morning, daily DTE session each afternoon**
    - **Data return via X-band DTE link and UHF-band link with MGS and Mars Odyssey**
    - **Scenario margins in: activity duration, comm opportunities, DSN coverage, energy, and environments**
  - **Key Mission Success / Mission Return Criteria (per mission)**
    - **90 sols of surface science operations (after the landing sol)**
    - **600 meter odometer traverse (system qualified to 1000 meters)**
    - **~ 4 distinct locations (including landing location)**
    - **~ 6 targets: one soil, five rock (one of which is abraded with RAT)**
    - **~ 3 Gbits total data return (~ 4 Gbits for MER-A)**

Interplanetary Trajectory

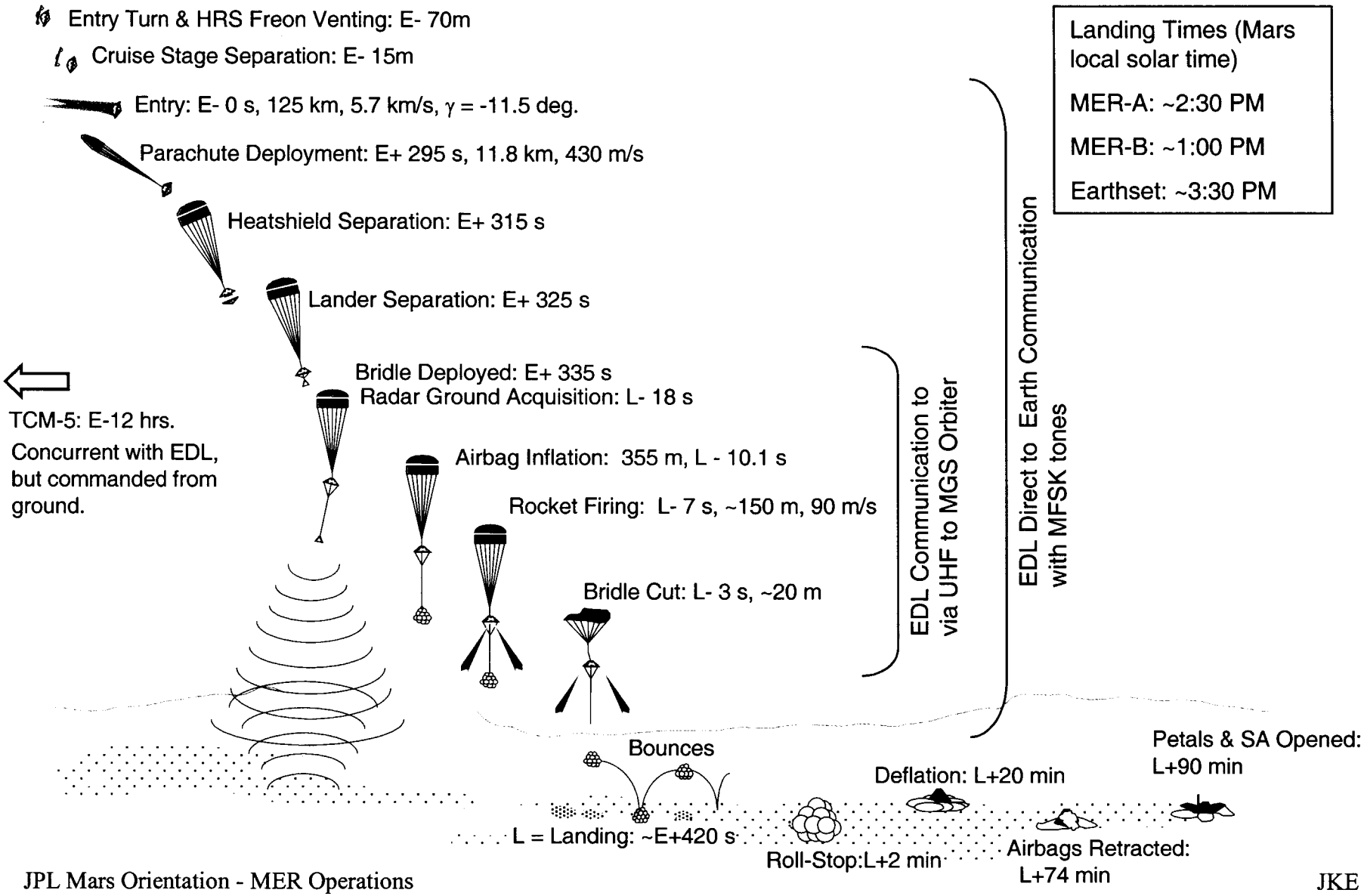
MER-A Open
Launch 30 May 2003
Arrival 4 Jan 2004

MER-B Open
Launch 6/25/03
Arrival 1/25/04

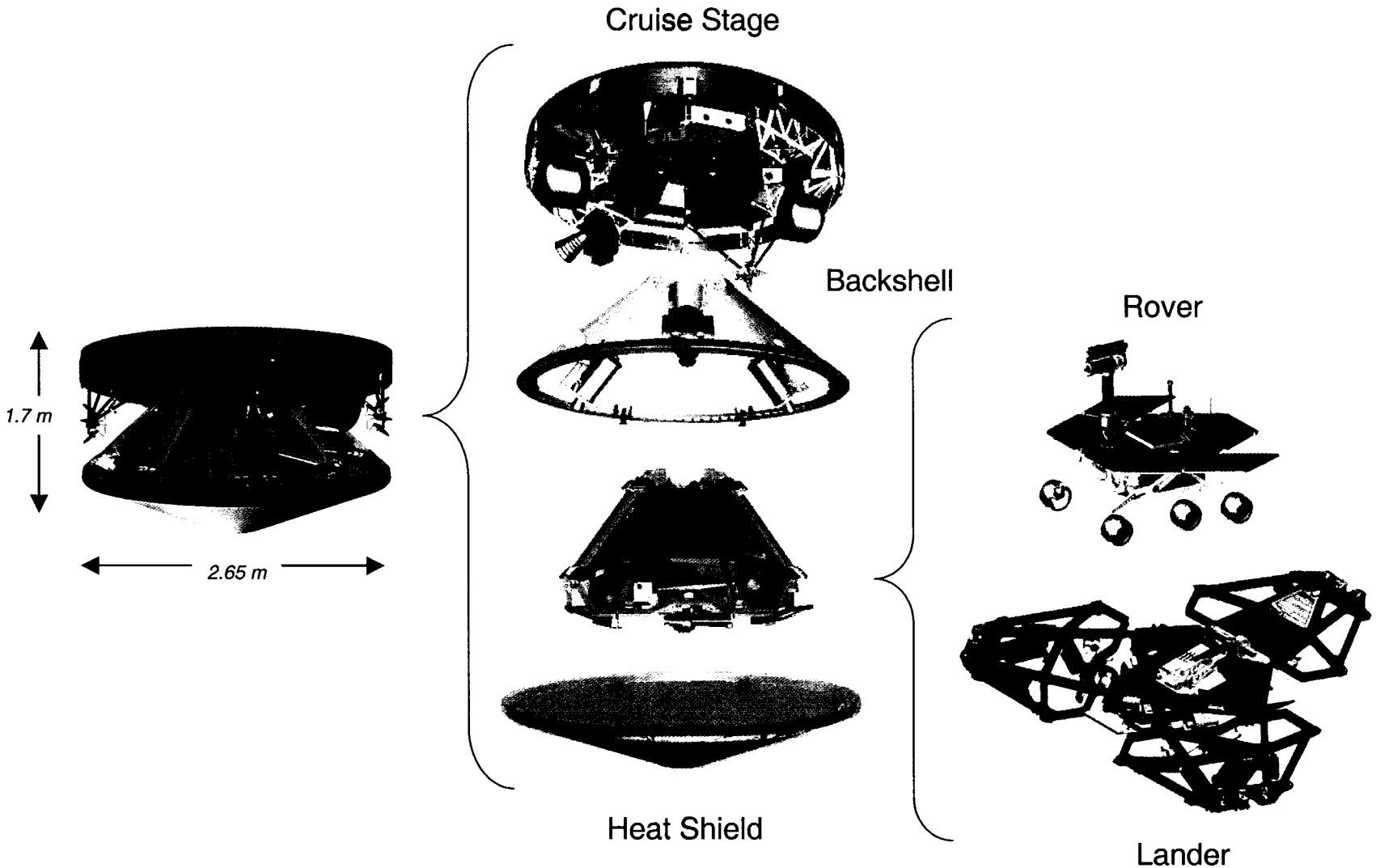


View from Ecliptic North Pole
20 day tick marks

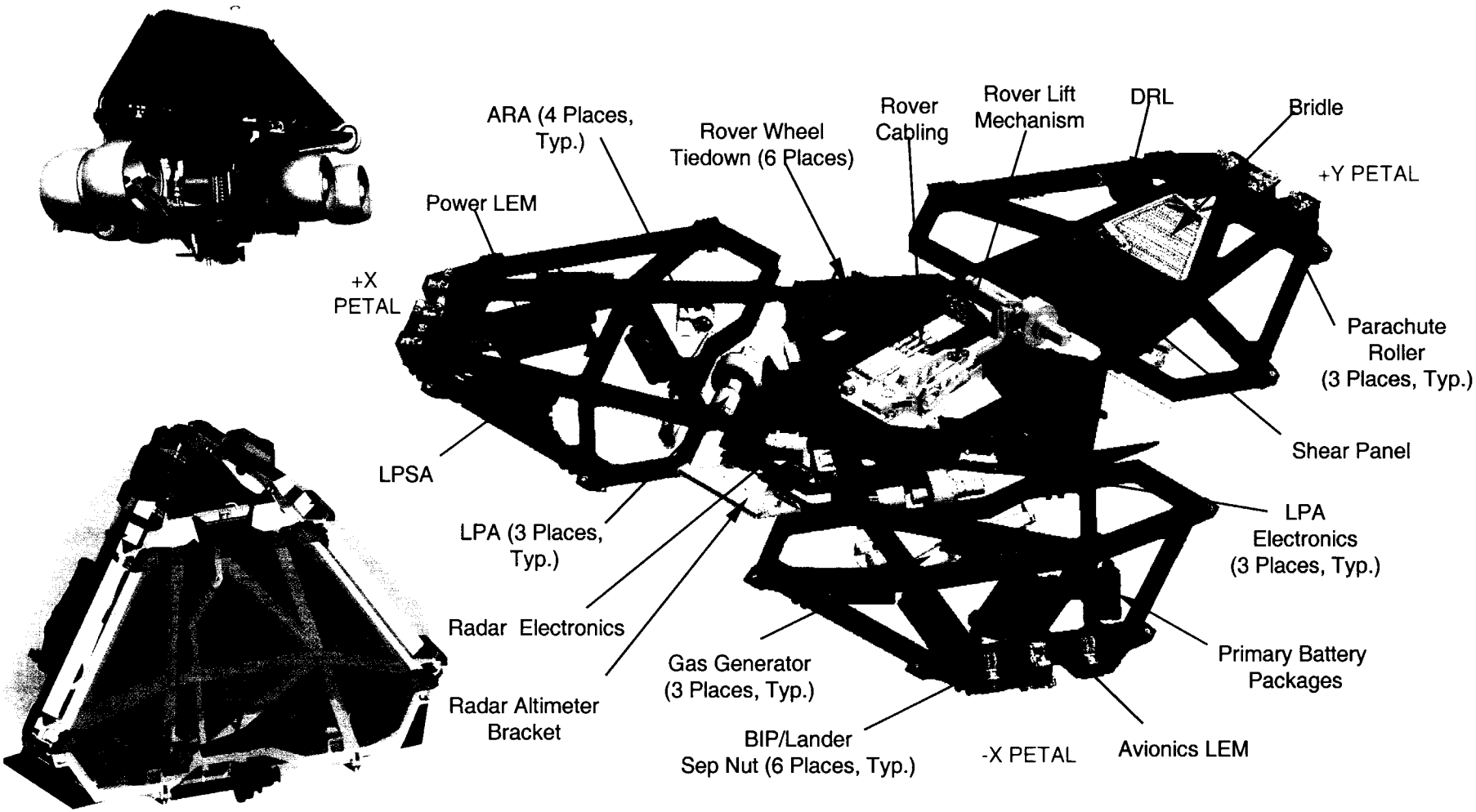
Entry, Descent & Landing (EDL) Scenario



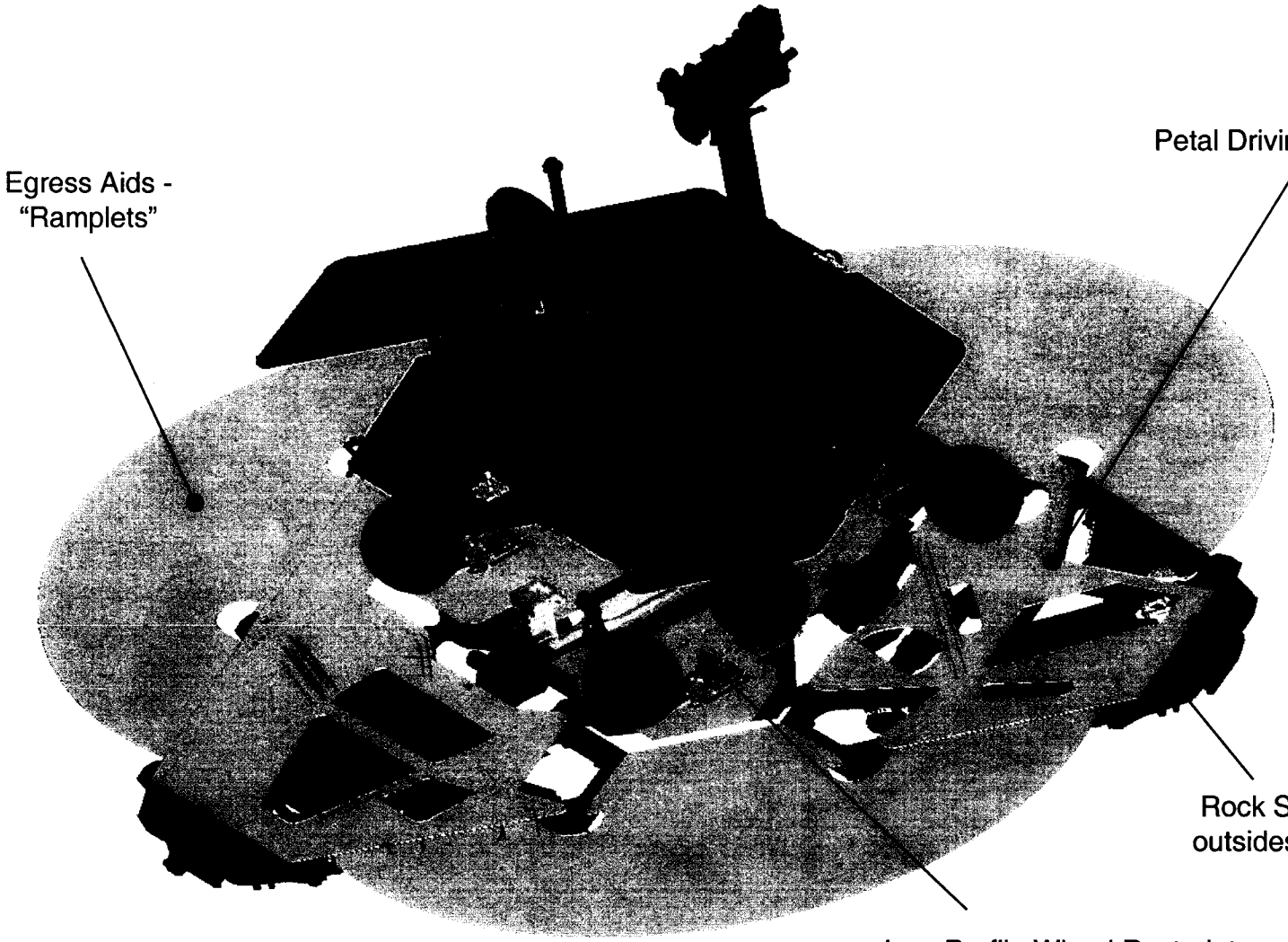
Spacecraft Configuration



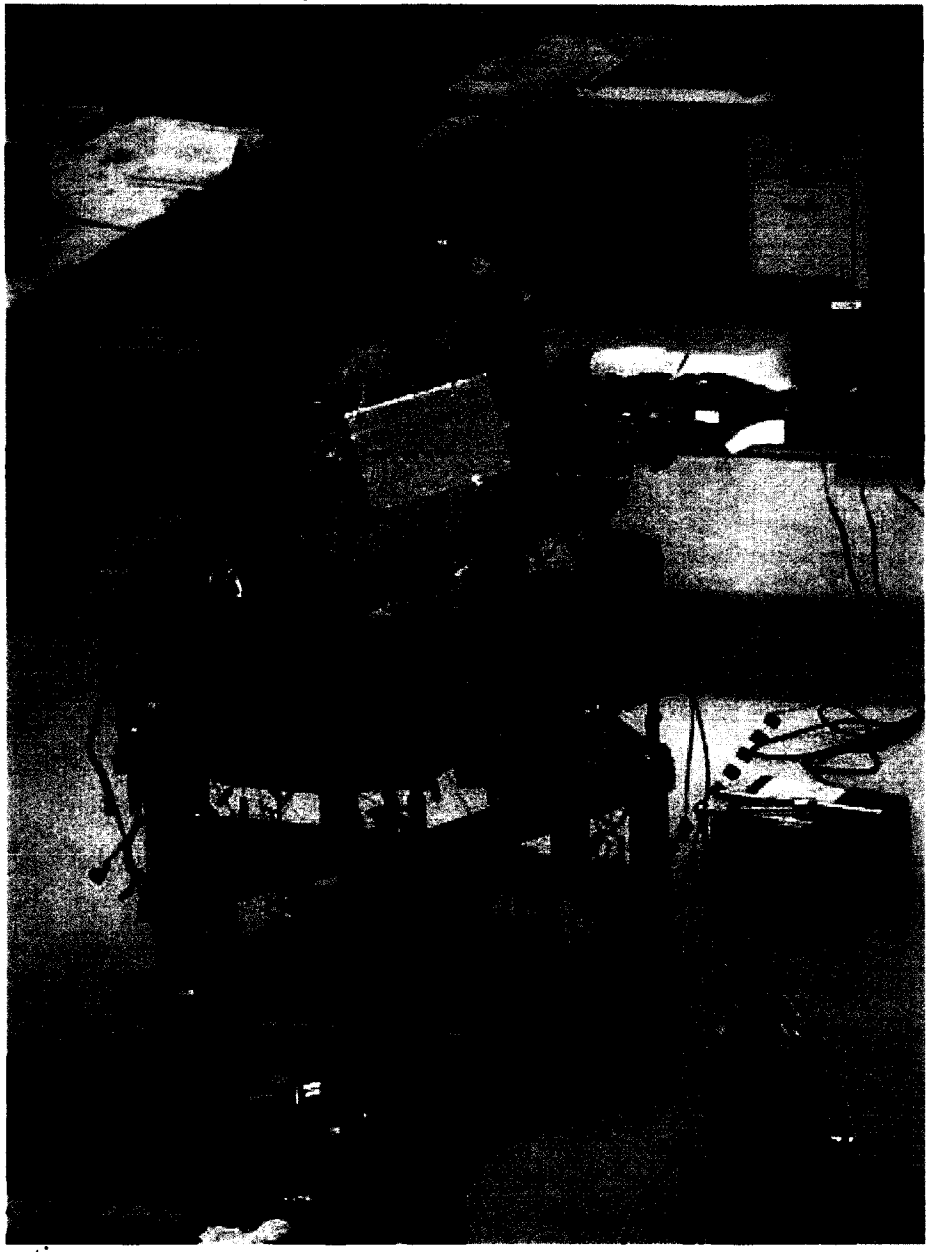
Lander Configuration



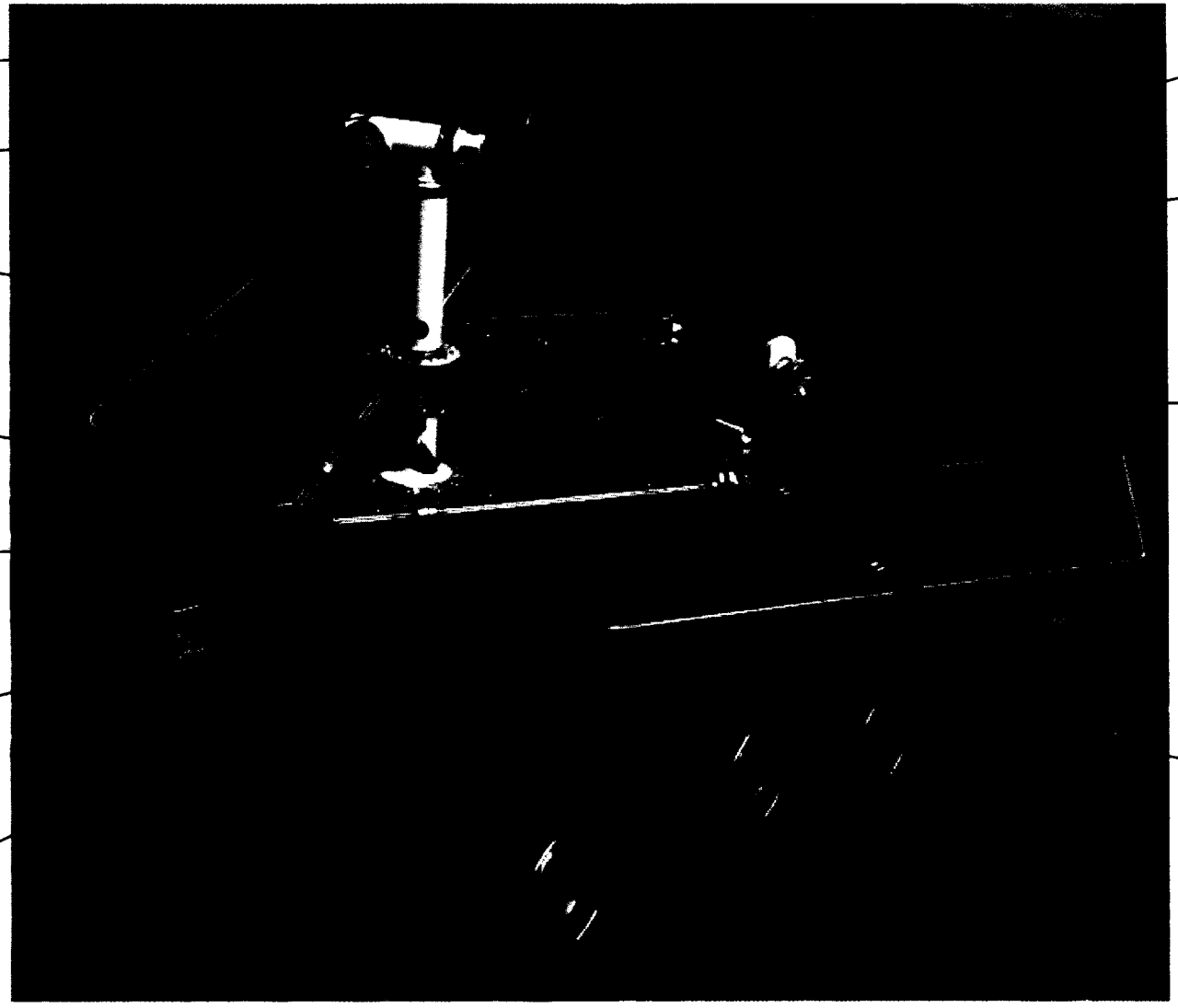
Deployed Rover on the Lander



Flight Rover ready for installation on Lander

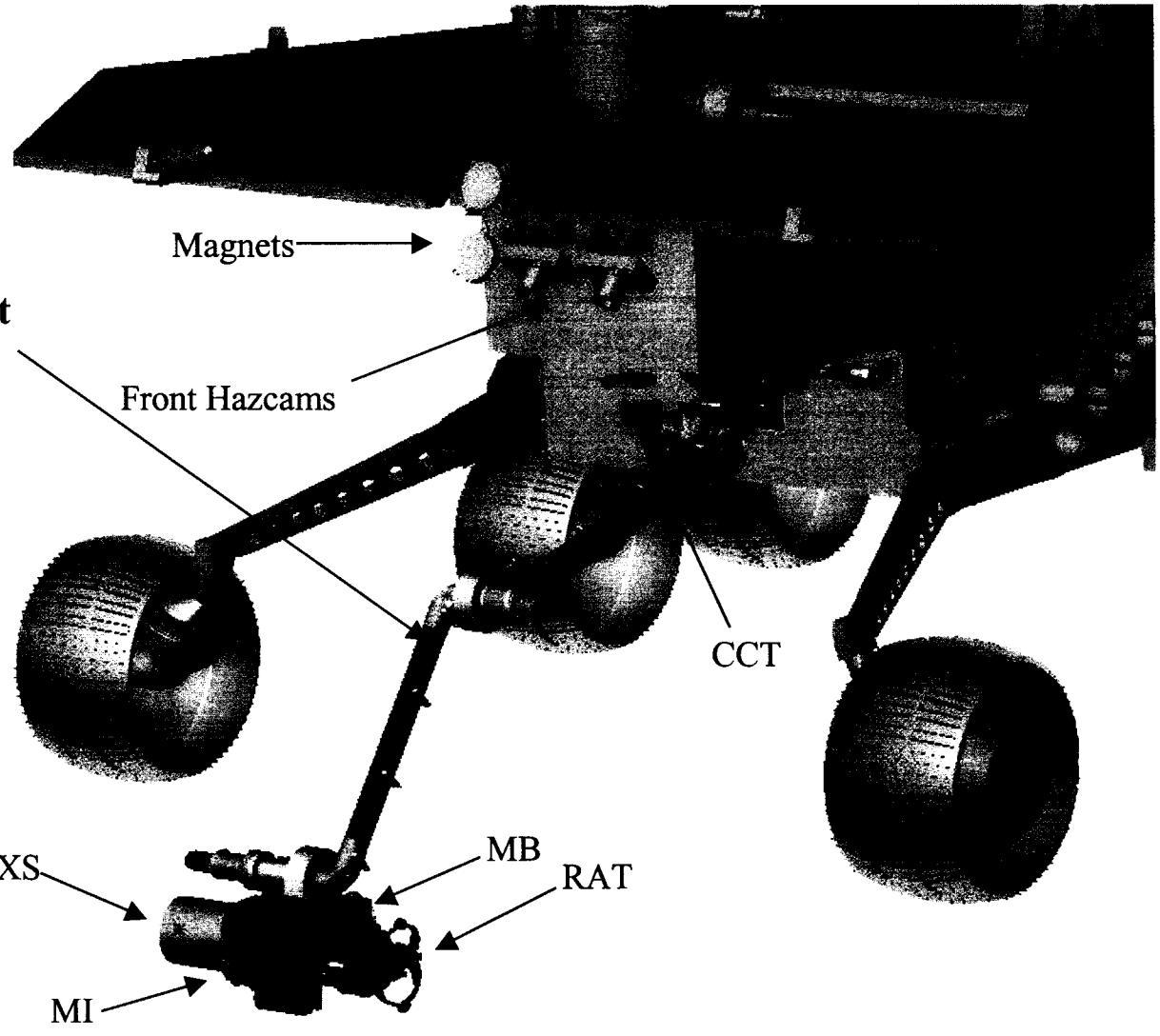


Rover Configuration



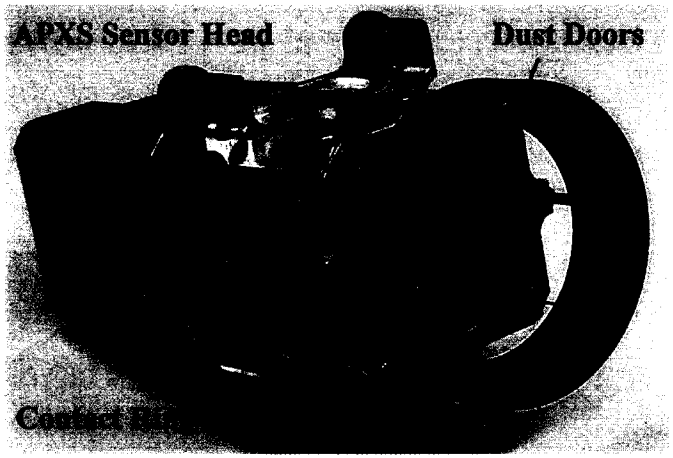
Instrument Positioning System

Instrument Deployment Device (IDD) - 5 DOF Robotic Arm with 4 instrument turret at end



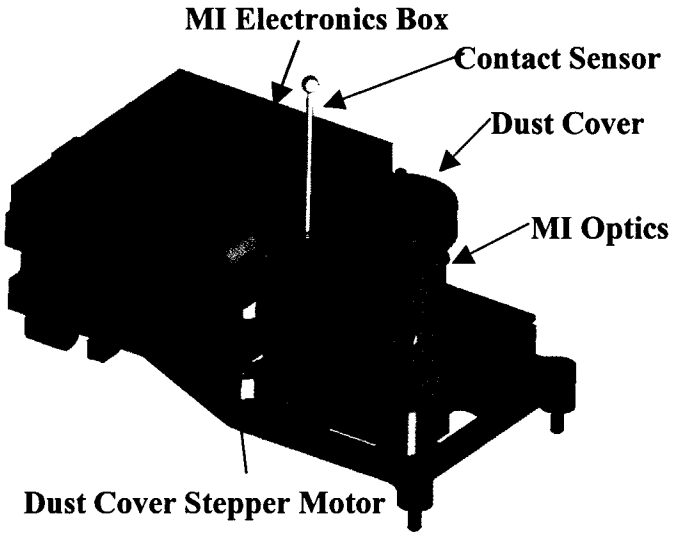
In-Situ Instruments

Alpha Particle X-Ray Spectrometer (APXS)

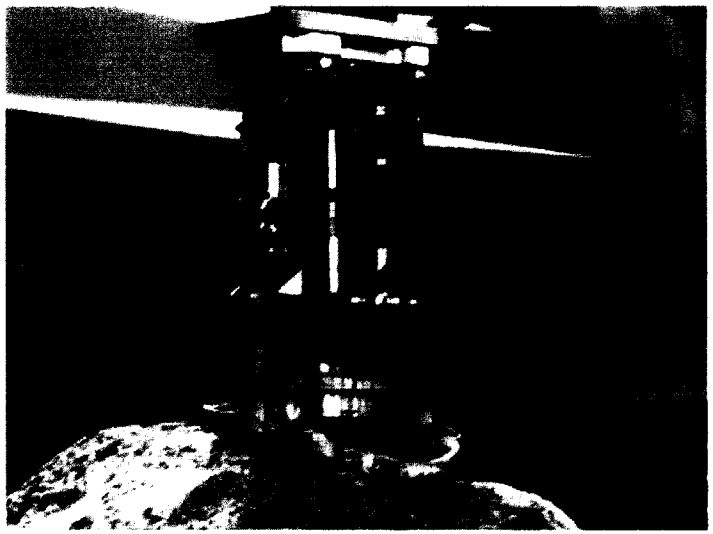


Mössbauer Spectrometer (MB)

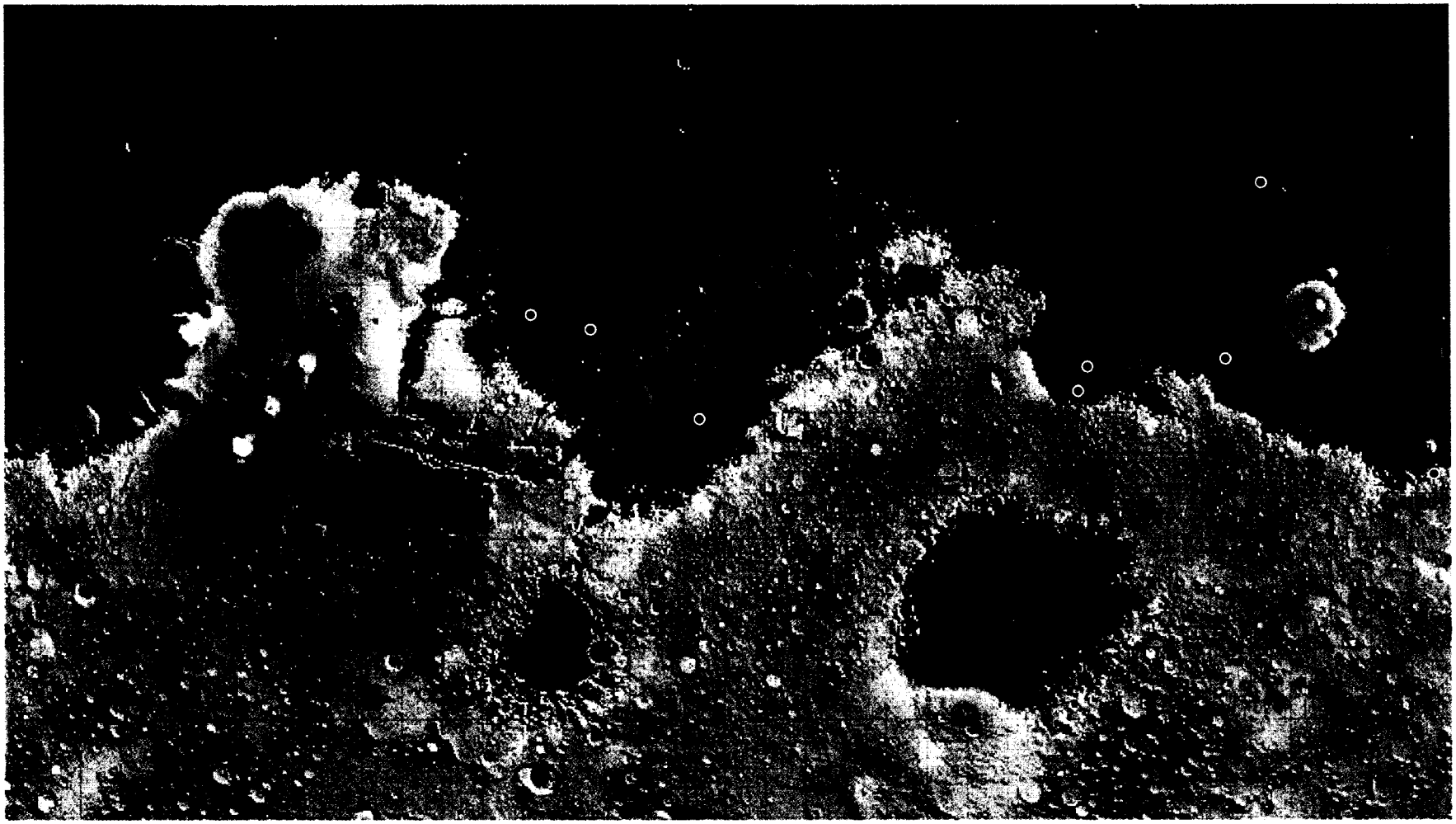
Microscopic Imager (MI)



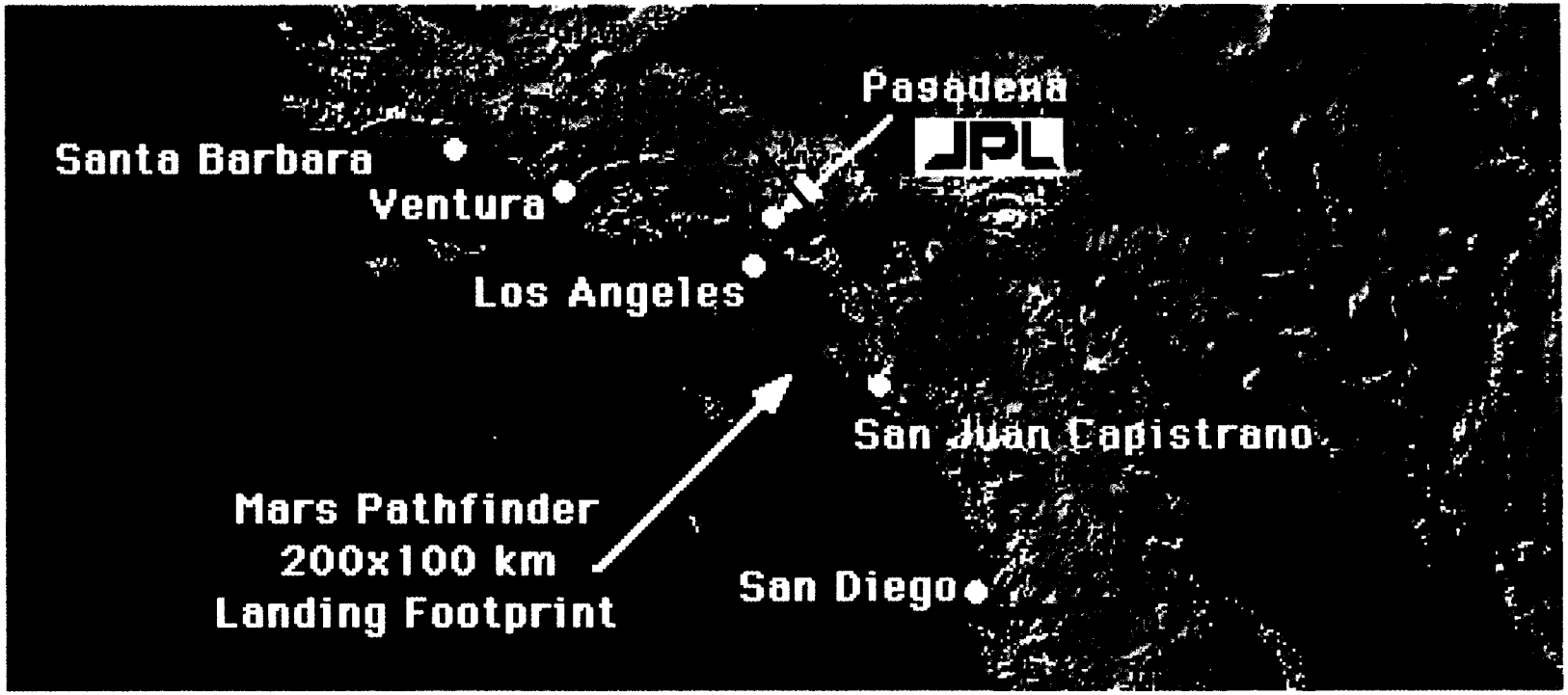
Rock Abrasion Tool (RAT)



Possible Landing Sites

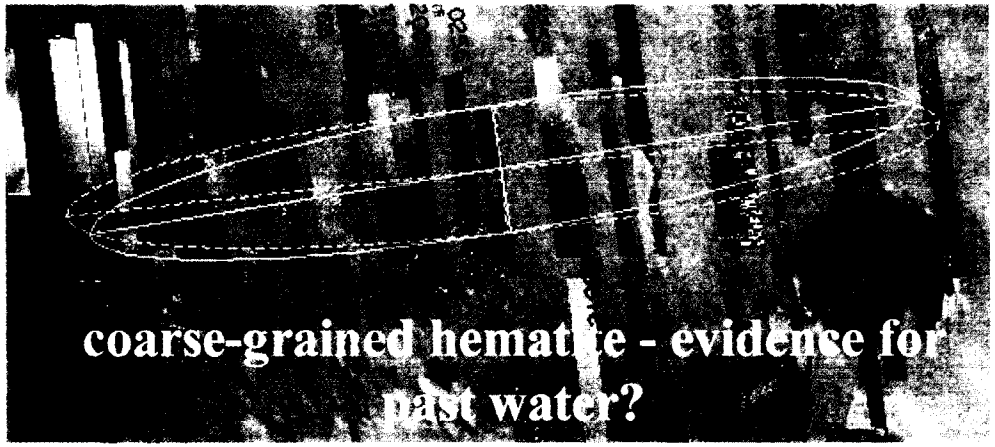


Typical Landing Error Ellipse

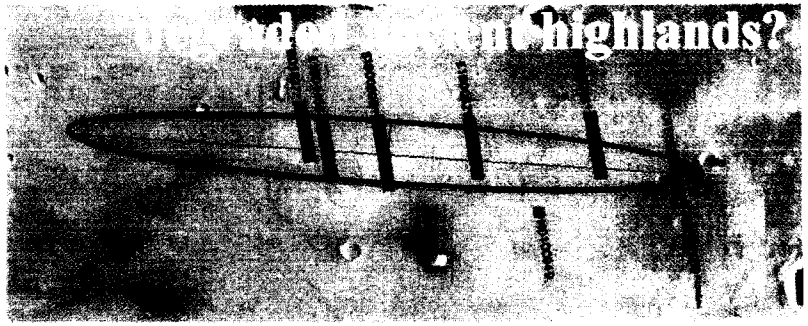


The Four Candidate Landing Sites for MER:

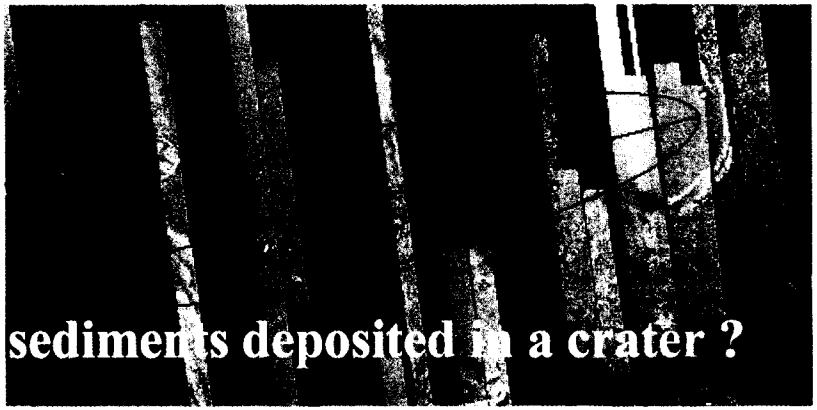
as of September 2002



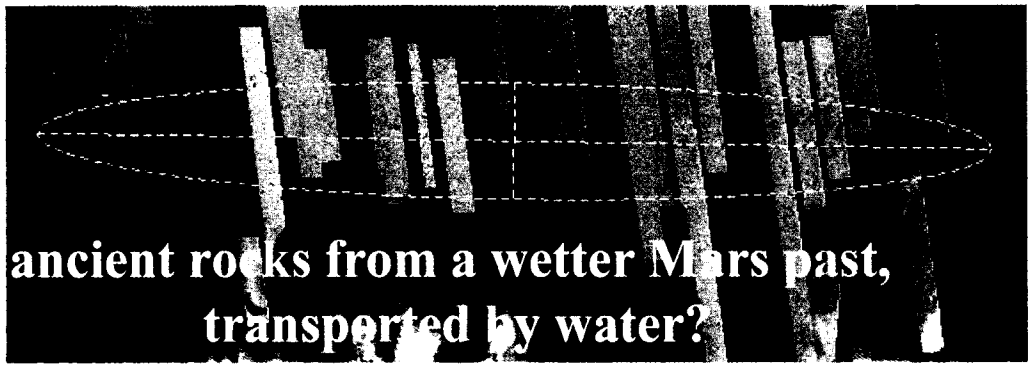
Hematite: safest site (low rock abundance, winds and slopes), high science priority



Elysium: 2nd-safest site, low science priority



Gusev: high science priority, high wind shear, moderate slopes



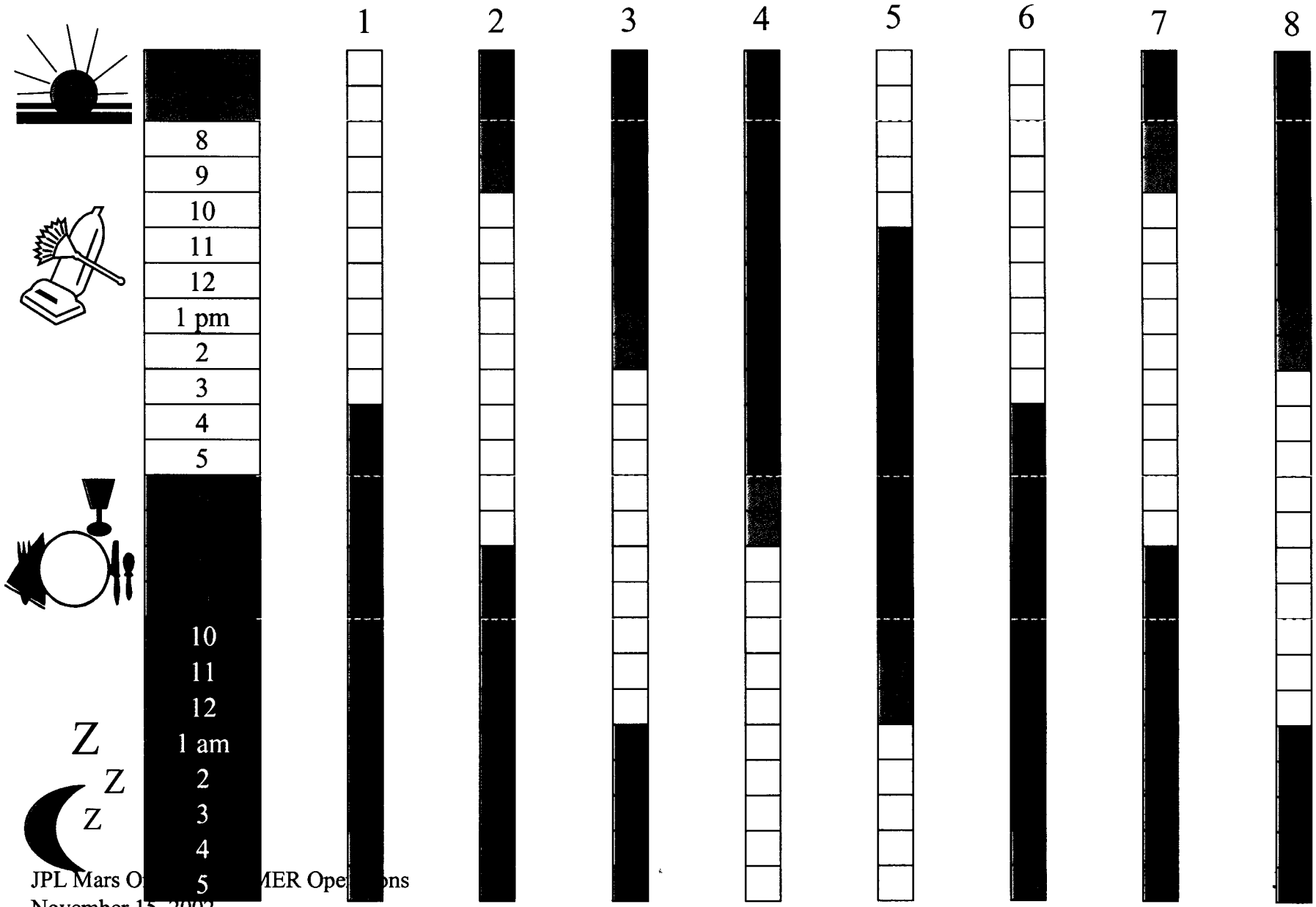
Isidis: moderate science priority, high horizontal winds and wind shear, high rock abundance, low slopes

Grey Strips = MOC coverage. Ellipses are 100 to 150 km long

Mars Time Impact on Project Personnel

- **Mars Time - What a difference 39 minutes makes!**
- **A Martian Day is 24 hours, 39 minutes long (called a "Sol")**
  - **Almost exactly an Earth day, but not quite**
  - **MER is Solar powered - we operate when the Sun is up on Mars**
  - **Sunrise on Mars changes by 39 minutes (later) every day**
  - **Our team will wake up and go to work on Mars time, 39 Earth minutes later every day**
- **There are three basic shifts Martians will work**
- **And just to make it worse, we've got two different rovers on two different parts of Mars**
  - **Similar to one landing in England, and the other in New York**

Mars Schedule At *Odds* with Rest of World



What does Mars Time mean to Housing Providers (1)

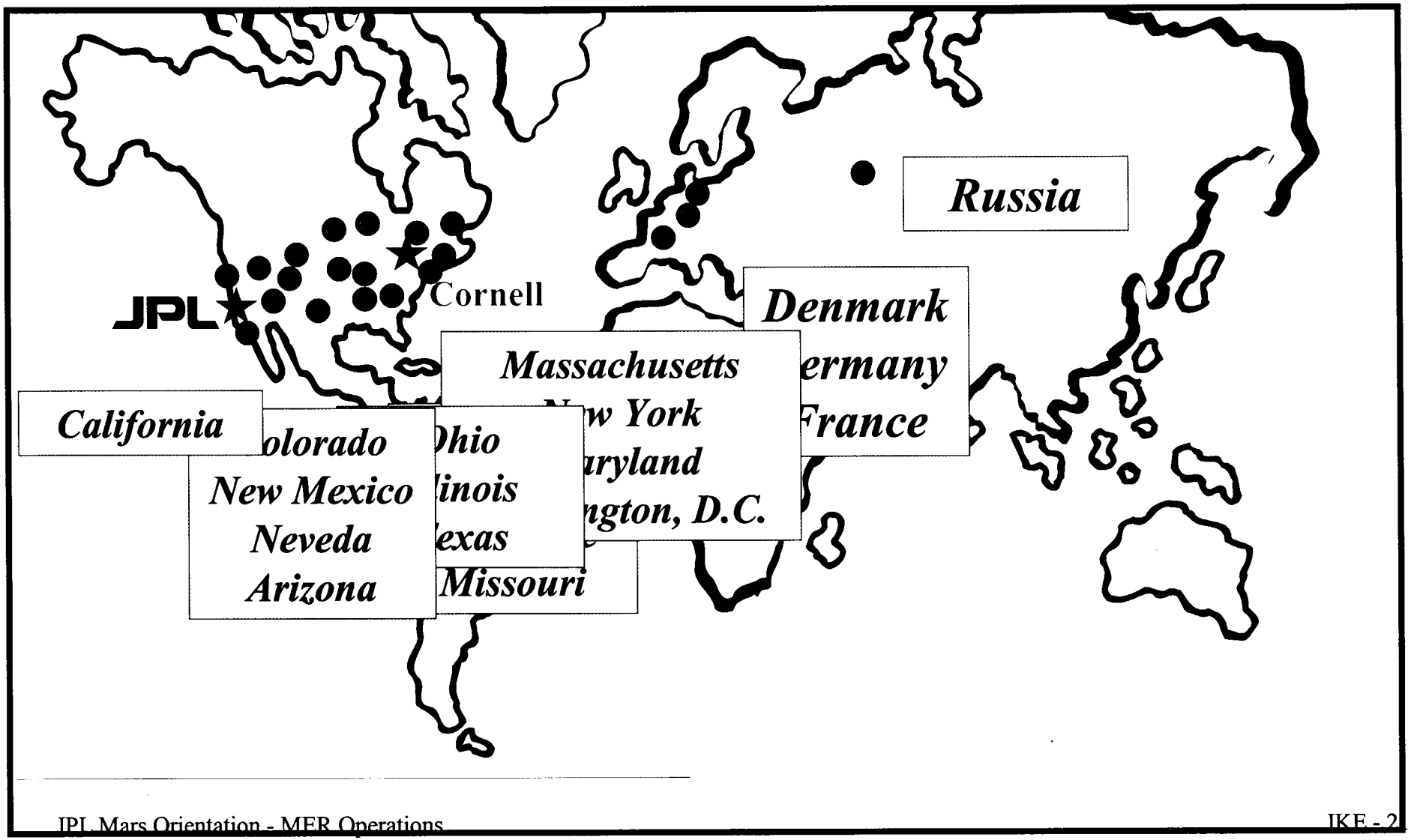
- Martians want to sleep during the day one third of every month - we want dark, quiet bedrooms, even during the day! This means we want the quietist places you have, and help controlling housekeeping and gardening personnel with leaf blowers!
- Martians want to have breakfast, lunch and dinner at weird times
- Martians will want to buy groceries at weird times
- Close to JPL!

What does Mars Time mean to Housing Providers (2)

- **We will need housing for about TBD (40-60?) Science personnel during the training period from 7/15/03 to 12/1/03, and housing for 60 to 80 personnel during mission operations from 12/1/03 until about 5/30/04**
  - **This includes several Holiday periods!**
  - **We may also want some housing for JPL personnel too tired to drive home**
- **Martians are going to be coming from different countries - cultural differences will exist.**
- **Personnel will come and go. Who will do the reservation scheduling?**
- **What are your thoughts?**

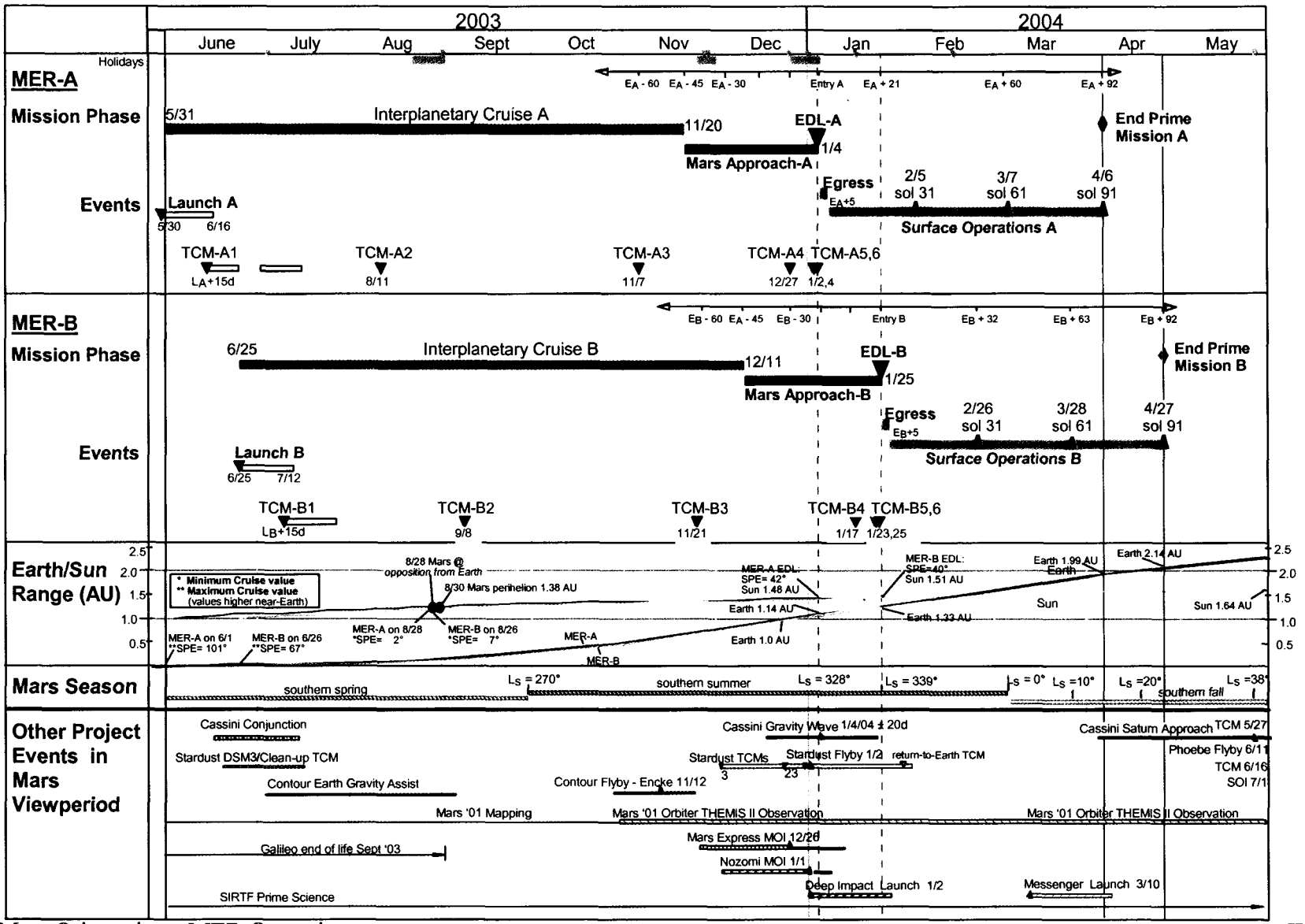
A Global Endeavor

World-renown Scientists from Many Places



Backup

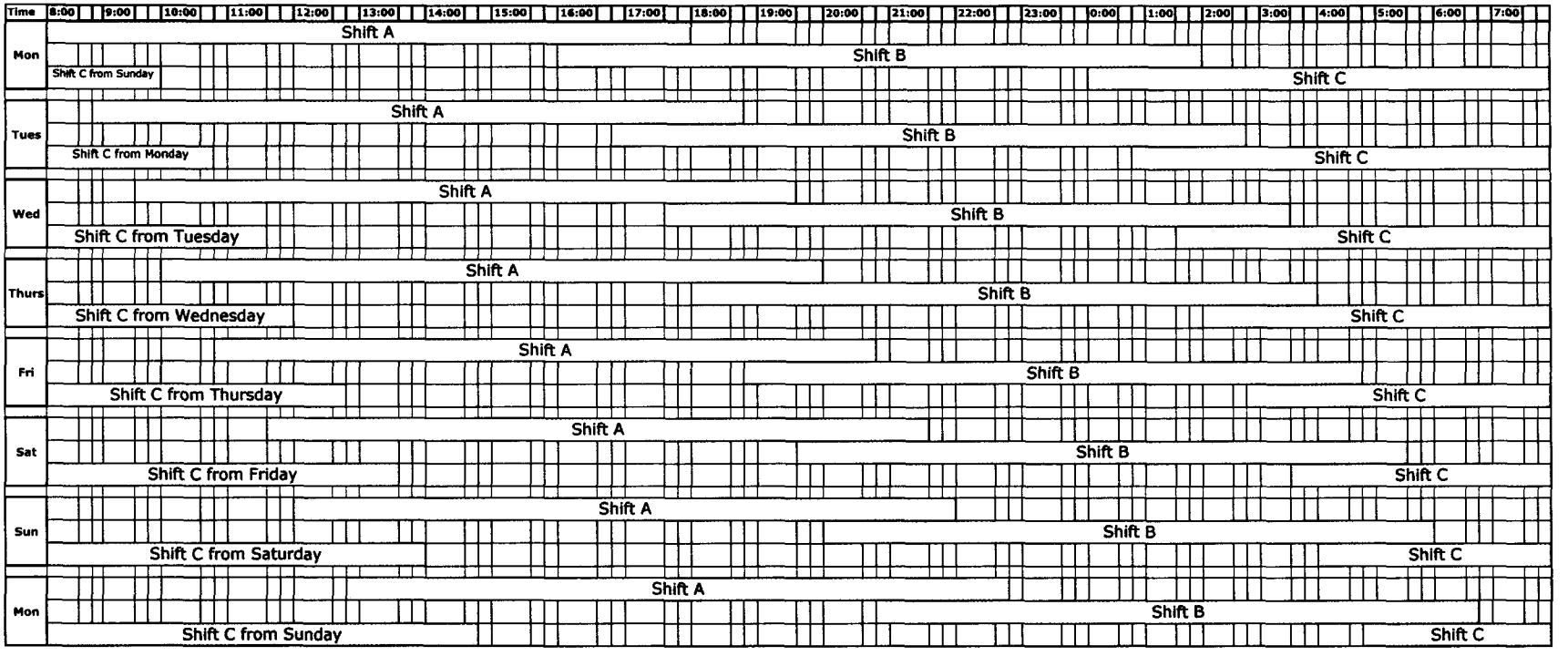
Mission Timeline



Mars is Hard!!

- **The international community has sent 33 missions to Mars**

	USA	USSR/Russia*	Successful	Failure
Orbiters/Flyby	12	-	8	4 (2 LV)
	-	15	4	11 (5 LV)
Landers	6	-	3	3
	-	8	0**	8 (2 LV)
Totals	18	23	15 37%	26 63%

* Japanese Nozomi mission is expected to arrive in Dec 2003
** Mars 3 in 1971 apparently transmitted for 20 sec after landing but no significant information was returned

Tactical Mission Operations Timeline