LUNAR / MARS ACTIVATION - 2
NEEP 533 LECTURE 32

Harrison H. Schmitt

MARS BASE ACTIVATION

NEEP 533 LECTURE 32
Harrison H. Schmitt

NASA HST IMAGE

VARIOUS CLASS MISSIONS
(REVIEW AT YOUR LEISURE)

- SPLIT/SPRINT-OPPOSITION CLASS (1988 NASA OFFICE OF EXPLORATION)
  - ROBOTIC PRECURSORS
  - ONE CARGO VEHICLE/ONE CREW VEHICLE
  - 14 MONTHS
  - 30 DAYS IN ORBIT
  - 20 DAYS ON SURFACE
  - 4 CREW ON SURFACE / 4 IN ORBIT
  - 60 TOTAL HOURS OF EVAS BY 2 CREW MEMBERS
  - 3 MISSIONS

- SPLIT/SPRINT-OPPOSITION CLASS (1988 NASA JSC)
  - ROBOTIC PRECURSORS
  - ONE CARGO VEHICLE/ONE CREW VEHICLE
  - 14 MONTHS
  - 30 DAYS IN ORBIT
  - <20 DAYS ON SURFACE
  - 2 CREW ON SURFACE / 1 IN ORBIT
  - 60 TOTAL HOURS OF EVAS BY 2 CREW MEMBERS
  - 1 MISSION

- VENUS SWING-BY (COLLINS, 1988)
  - ROBOTIC PRECURSORS?
  - ONE VEHICLE
  - 22 MONTHS
  - 30 DAYS IN ORBIT?
  - 40 DAYS ON SURFACE
  - 4 CREW ON SURFACE / 4 IN ORBIT?
  - 120 TOTAL HOURS OF EVAS BY 2 CREW MEMBERS?
  - 3 MISSIONS?

- "MARS DIRECT" CONJUNCTION CLASS (ZUBRIN, 1996, NASA INTEREST, 1999)
  - ONE AUTOMATED CREW RETURN VEHICLE/ONE DELAYED CREW VEHICLE
  - 30 MONTHS
  - MANUFACTURE RETURN FUEL AND OXIDIZER PRIOR
  - TO CREW LAUNCH
  - 0 DAYS IN ORBIT
  - 18 MONTHS ON SURFACE
  - 4 CREW ON SURFACE / 0 IN ORBIT
  - REPEATED MISSIONS

MINIMUM ENERGY -1

- **MINIMUM ENERGY-CONJUNCTION CLASS (NEAL, ET AL., 1989)**
  - **FINAL RECONNAISSANCE FROM ORBIT / NO ROBOTIC PRECURSORS REQUIRED**
  - **ONE ORBITAL VEHICLE / TWO LANDERS**
  - **32 MONTHS**
  - **18 MONTHS IN ORBIT**
  - **90 TOTAL DAYS ON SURFACE**
  - **4 CREW ON SURFACE / 4 IN ORBIT ALTERNATING TO SURFACE**
  - **1200 TOTAL HOURS EVAS BY 8 CREW MEMBERS AT TWO SITES**
  - **4 MISSIONS / 8 SITES WITH FIFTH MISSION THE CREATION OF A PERMANENT MARS BASE WITH 8 INITIAL INHABITANTS**
    - **SYMMETRY WITH LUNAR ACTIVATION**

MINIMUM ENERGY -2

- **MAJOR POSSIBLE ENHANCEMENT OPTIONS**
  - **LAUNCH FROM THE MOON WITH LUNAR DERIVED CONSUMABLES (GREATER PAYLOAD) (SEE STANCATI, ET AL., 1991)**
  - **He-3 FUSION / NUCLEAR FISSION / SOLAR ELECTRIC PROPULSION (SHORTENED TRANSIT TIME)**
  - **TRAJECTORY SHAPING (FLEXIBLE STAY TIMES AT MARS)**
  - **AERO-BRAKING (MARS ORBIT INSERTION AND ON RETURN TO EARTH**
  - **RETURN PROPELLANT DERIVED FROM MARS ATMOSPHERE (ZUBRIN, ET AL., 1991, AND SEE STANCATI, ET AL., 1991)**

MINIMUM ENERGY -3

FLEXIBILITY IN TRANSIT AND ORBIT

- **LANDING DELAY DUE TO EQUIPMENT OR WEATHER PROBLEMS**
- **SURFACE EXPLORATION DELAY DUE TO EQUIPMENT, WEATHER, ADAPTATION, OR BIOLOGICAL HAZARD PROBLEMS**
- **ASCENT DELAY DUE TO EQUIPMENT PROBLEMS**
- **EARLY ASCENT DUE TO DEGRADING SYSTEMS OR A CREW HEALTH PROBLEM**
- **DESIRE EXPLORE PHOBOS AND / OR DEIMOS(?)**
- **"MISSION CONTROL" AND COMMUNICATIONS RELAY IN MARS ORBIT**
- **LANDING SITE VERIFICATIONS FROM MARS ORBIT SENSORS AND ANALYSIS**

MINIMUM ENERGY -4

- **OTHER ISSUES**
  - **IN-ROUTE, IN-ORBIT, ON-SURFACE SIMULATION AND TRAINING REQUIRED**
  - **MISSION RELEVANT AND VALUABLE SCIENTIFIC ACTIVITIES IN-ROUTE**
  - **NON-TIME CRITICAL MISSION MONITORING AND DATA PROCESSING ON EARTH**
  - **NEED HIGH RATE DATA TRANSMISSION MARS-EARTH-MARS**

- **PROBLEMS**
  - **MASS COST TO SUPPORT CREW OF 8 (COULD REDUCE TO 4 AND ONE LANDING WITH INCREASE OVERALL RISK TO MISSION SUCCESS)**

SPACE BIOMEDICAL ISSUES IN MICROGRAVITY

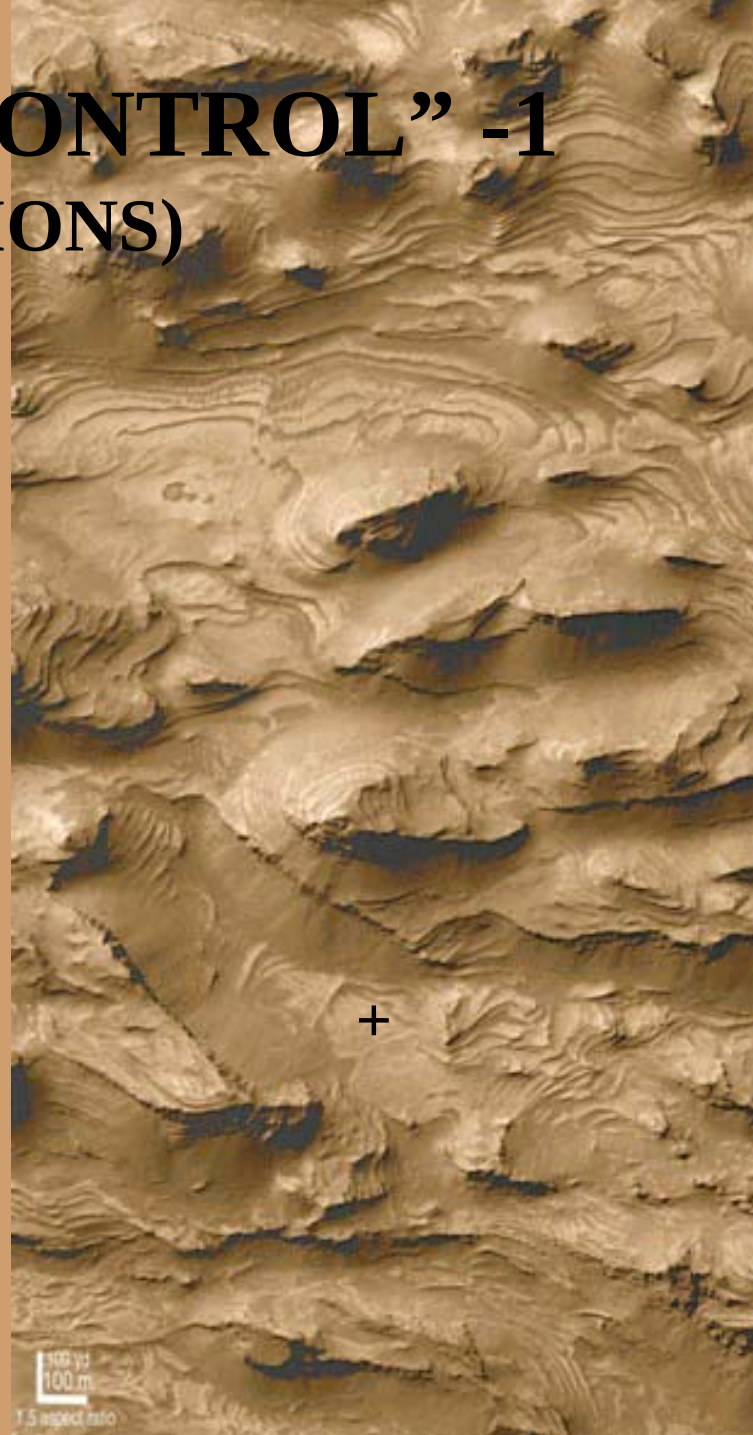
- **MAJOR KNOWN PROBLEMS**
  - **MUSCLE ATROPHY**
    - **HEART**
    - **SUPPORT**
  - **BONE AND OTOLITH DE-MINERALIZATION**
  - **RATE OF RE-ADAPTATION TO GRAVITY ENVIRONMENT**
  - **IMMUNE SYSTEM COMPROMISE (?)**
  - **RADIATION PROTECTION**

- **COUNTER-MEASURE OPTIONS**
  - **HEAVY, ANAROBIC EXERCISE**
  - **CENTRIPETAL FORCE**
  - **DRUG THERAPY**
  - **EXERCISE**
  - **CENTRIFUGAL FORCE**
  - **DRUG THERAPY**
  - **EXERCISE IN GRAVITY**
  - **ALL OF THE ABOVE**
  - **IN-TRANSIT AND IN ORBIT**
    - **“WATER” SURROUNDED STORM CELLAR**
  - **ON-SURFACE**
    - **“REGOLITH” COVER FOR ZENITH**

NOTE: NO SCIENTIFICALLY CREDITABLE UNDERSTANDING OF THESE PROBLEMS AND OPTIONS HAS BEEN DEVELOPED TO DATE DUE TO THE LACK OF A SYSTEMATIC RESEARCH PROTOCOL AND USE OF INAPPROPRIATE TEST SUBJECTS.

ORBITAL "MISSION CONTROL" -1
(FIRST FEW MISSIONS)

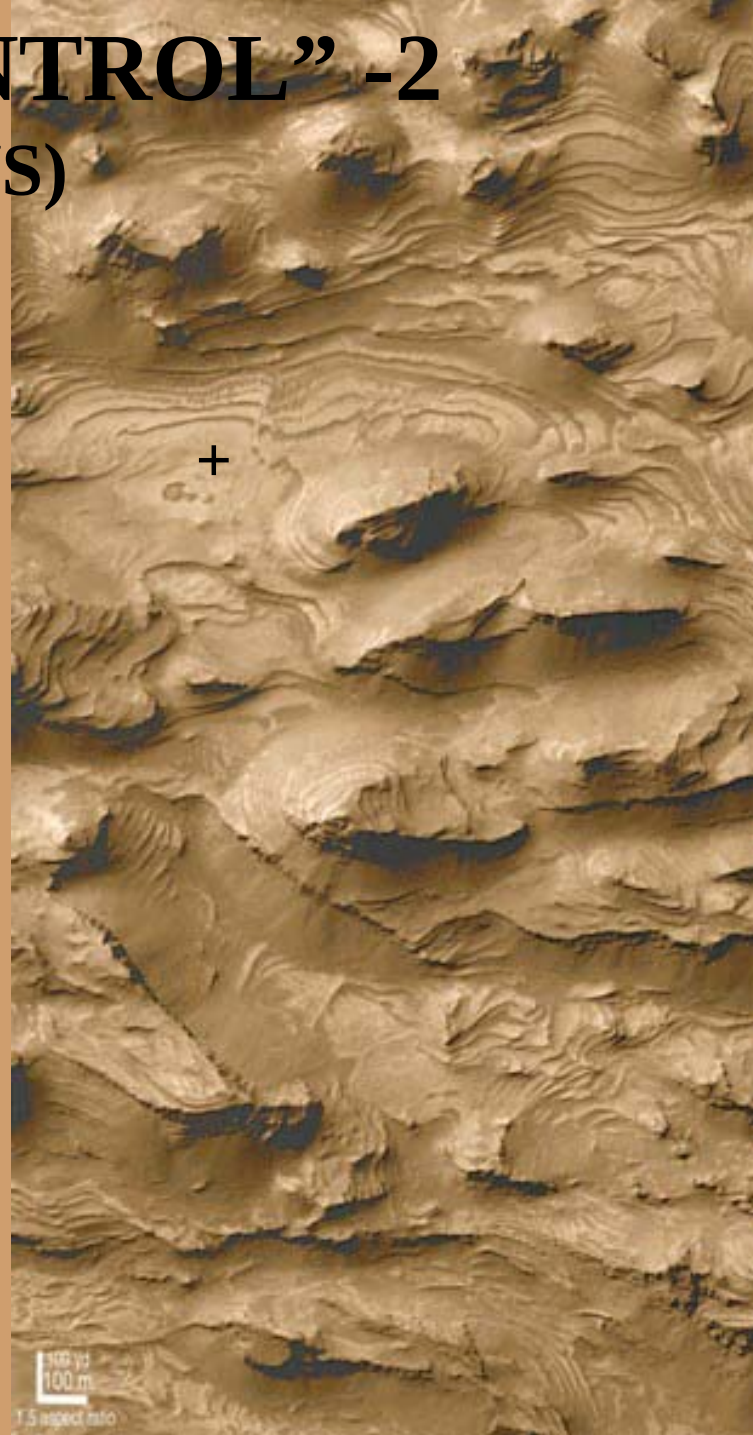
- **OVERALL SUCCESS NOT DEPENDENT ON SUCCESS OF PRECURSORS**
- **COMMUNICATIONS DELAY OF 8-40 MINUTES AND SUN PUTS EARTH "OUT OF THE LOOP"**
- **TAKE ADVANTAGE OF CONJUCTION CLASS MARS-STAY REQUIREMENT**
  - **16 MONTHS IN ORBIT**



ORBITAL “MISSION CONTROL” -2

(FIRST FEW MISSIONS)

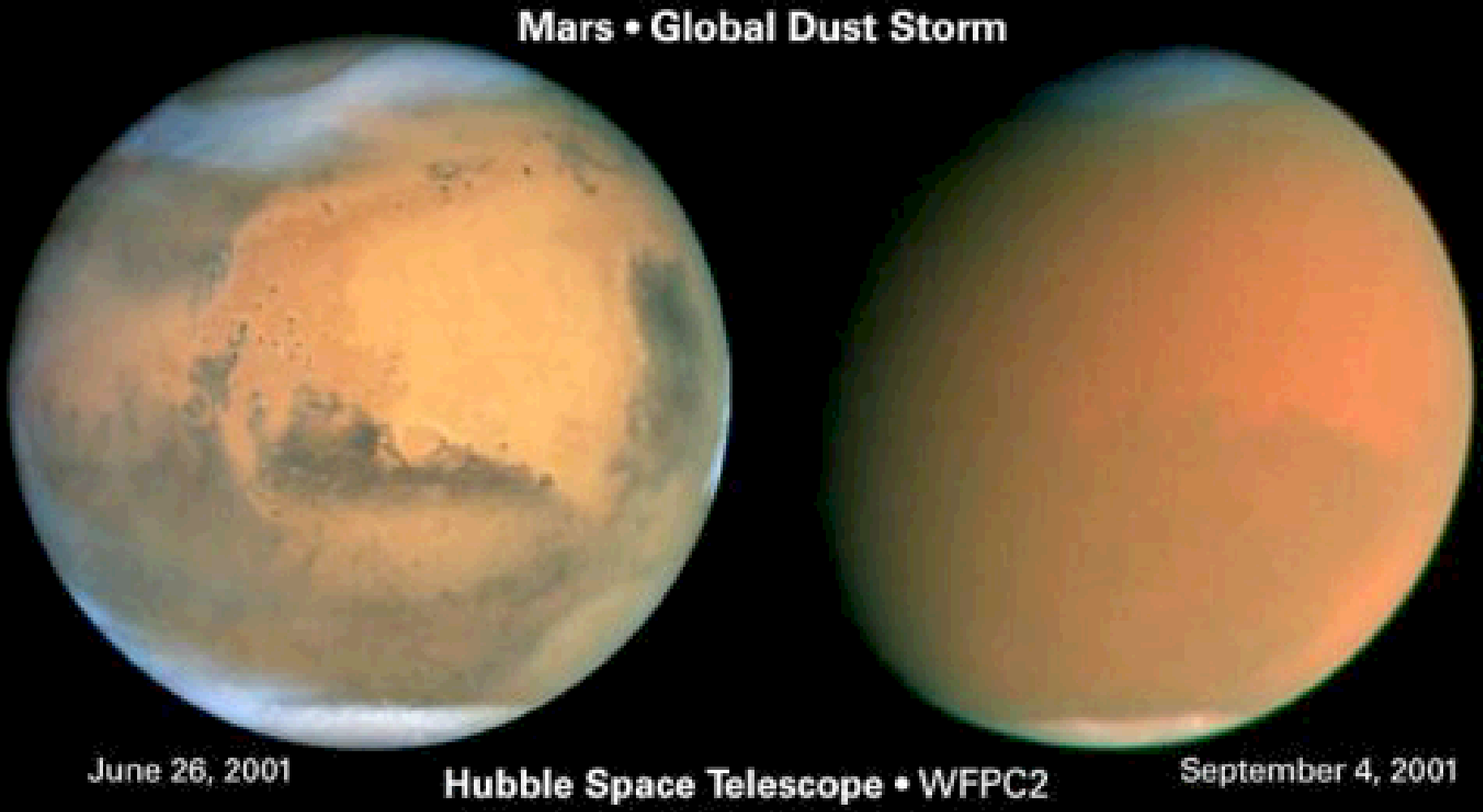
- **PROVIDES CURRENT LANDING DATA AND HUMAN COGNITIVE ANALYSIS**
  - **– LANDING SITE SELECTION AND VERIFICATION AND DETAILED SURFACE MISSION PLANNING**
  - **– SPECTRAL DATA**
  - **– RADAR DATA**
  - **– SURFACE PROBES**
  - **– LANDING BEACON DEPLOYMENT**
  - **– LANDING TRAJECTORY PRECURSORS THROUGH ATMOSPHERE**
  - **– DATA FUSION SOFTWARE**
  - **– SAMPLE RETURN TO ORBIT VS. TESTS AFTER LANDING (?)**
  - **– REFINE LANDER PAYLOAD**



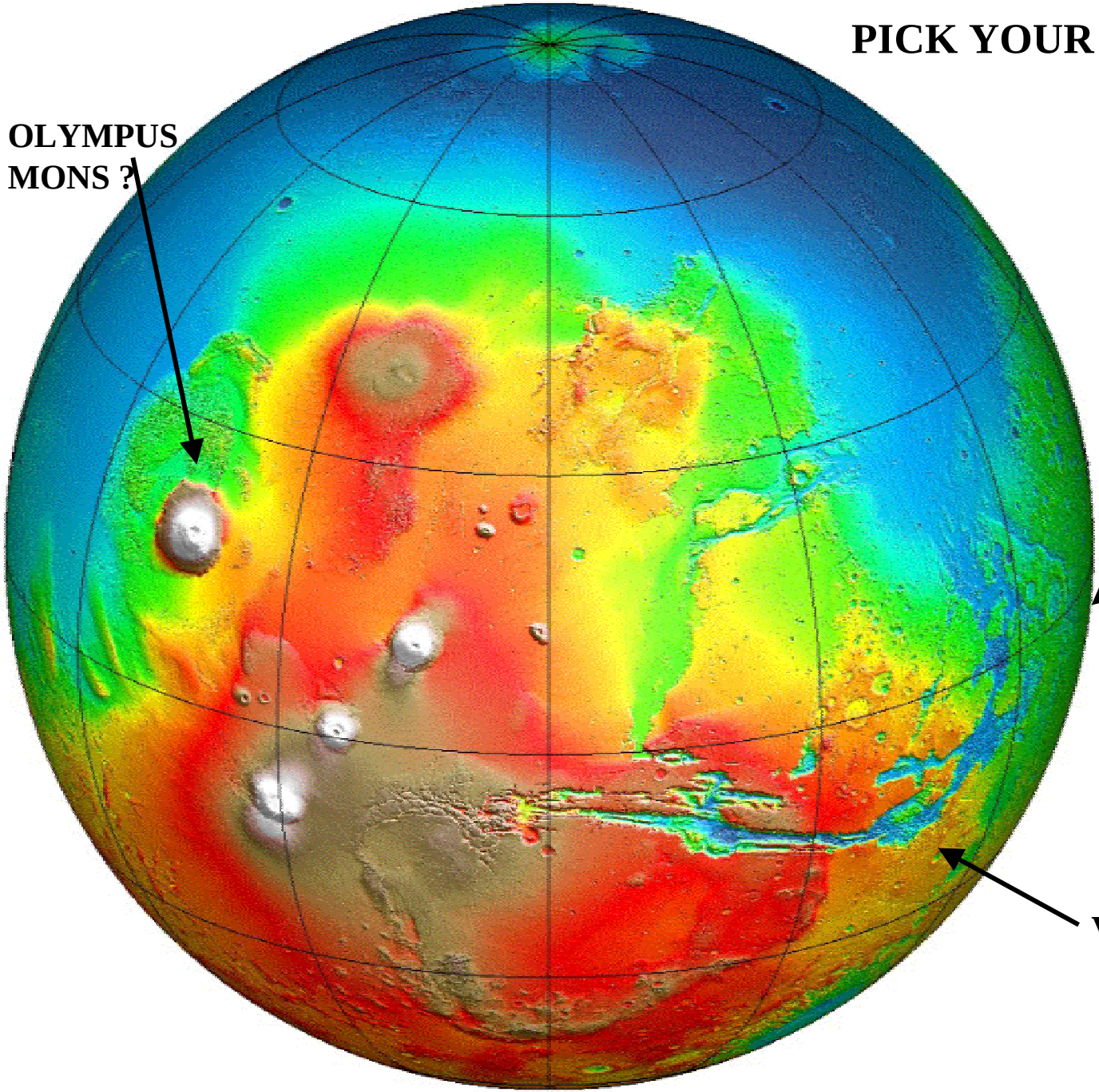
ORBITAL "MISSION CONTROL" -3
(FIRST FEW MISSIONS)

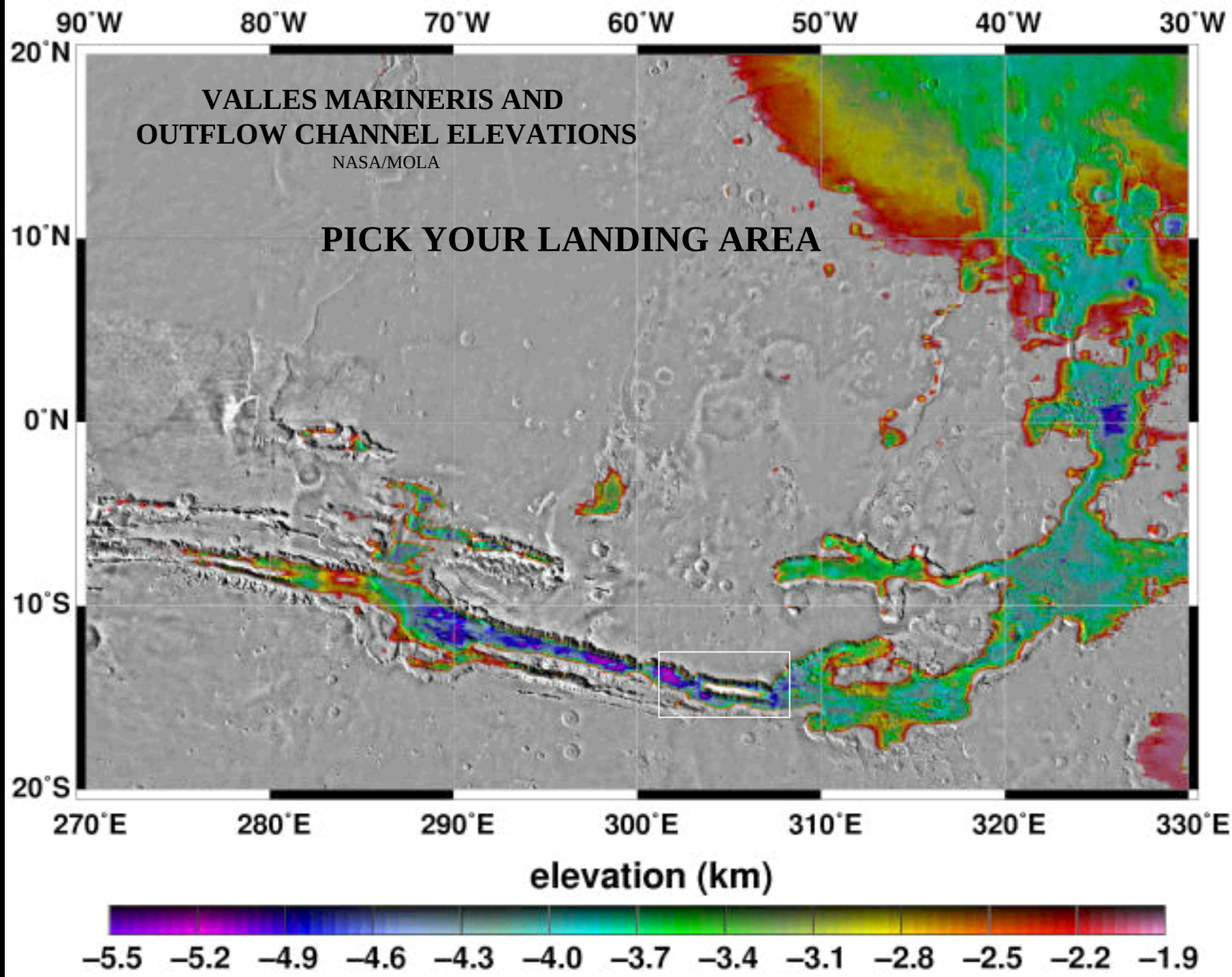
- BUILD ON EXISTING ROBOTIC DATA BASE
- USE EARTH DATA PROCESSING AND CONSULTATION
- MARS ENVIRONMENT AND SURFACE BETTER CHARACTERIZED THAN BEFORE APOLLO 11
  - EXCEPT FOR POTENTIAL PATHOGENS IN ISOLATED ECOSYSTEMS
- LANDING SYSTEMS MONITORING
- LANDER-EARTH DATA RELAY AS REQUIRED
- EVA PLANNING ASSISTANCE
- PHOBOS-DEIMOS EXPLORATION (SEE NEAL, ET AL, 1989)

IMAGINE, YOU ARRIVE IN MARS ORBIT AND
THIS IS WHAT HAS HAPPENED SINCE LEAVING EARTH!

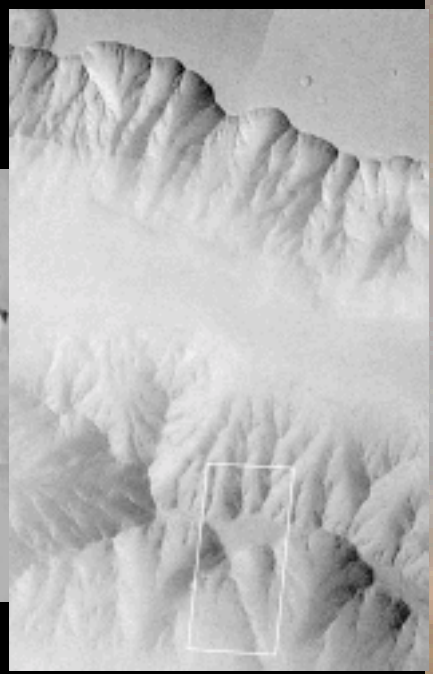


PICK YOUR LANDING REGION




VALLES MARINERIS AND
OUTFLOW CHANNEL ELEVATIONS
NASA/MOLA
PICK YOUR LANDING AREA
90˚W
80˚W
70˚W
60˚W
50˚W
40˚W
30˚W
20˚N
10˚N
0˚N
10˚S
20˚S
270˚E
280˚E
290˚E
300˚E
310˚E
320˚E
330˚E
elevation (km)
–5.5 –5.2 –4.9 –4.6 –4.3 –4.0 –3.7 –3.4 –3.1 –2.8 –2.5 –2.2 –1.9

...VALLES MARINERIS MAY PRESENT AN EXCITING APPROACH, LANDING, AND EXPLORATION TARGET!



PICK YOUR LANDING SITE

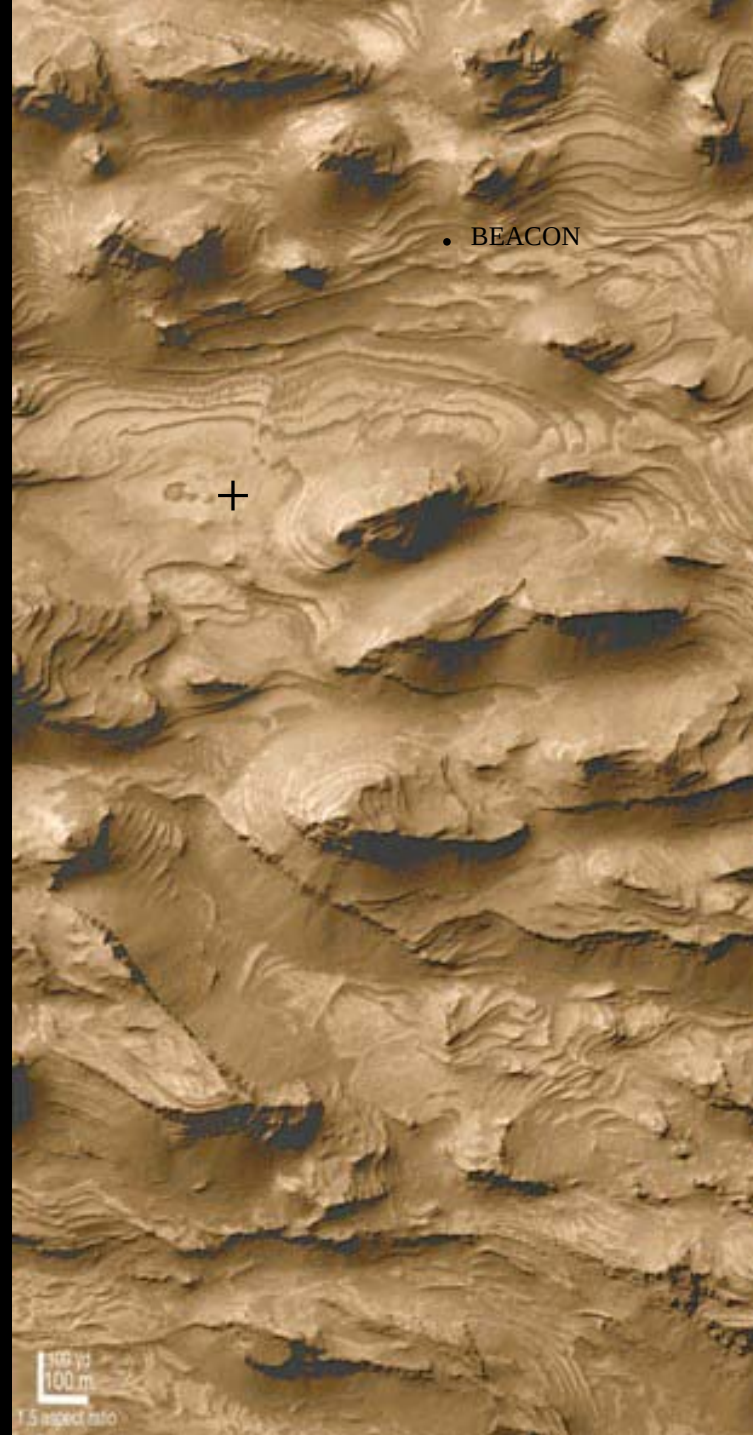
- BEACON

+

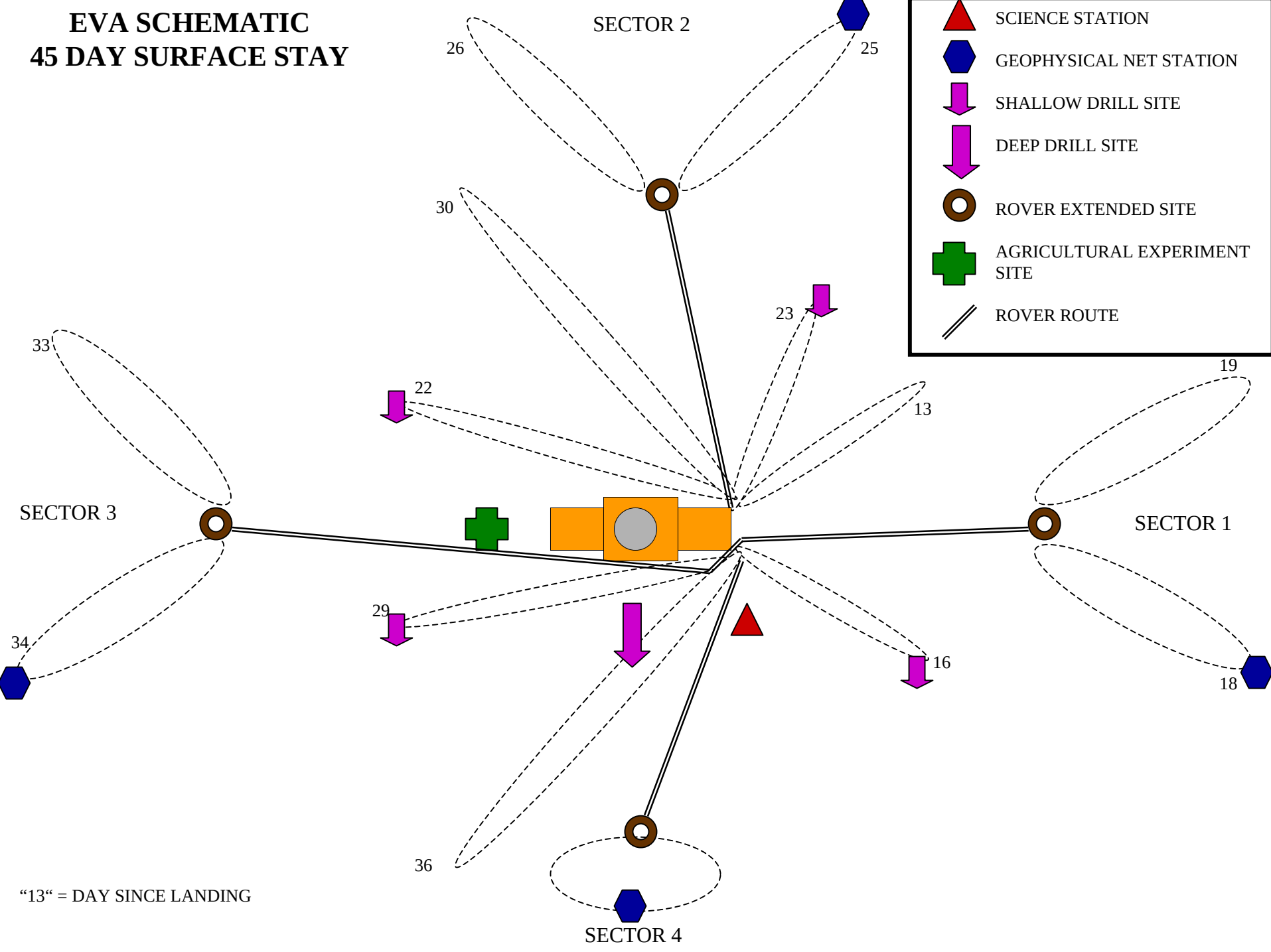
NASA/JPL/MALIN SPACE SCIENCE SYSTEMS.

WITH A LANDING AMONG THE LAYERS AND FOSSILS (?) OF CANDOR CHASMA

100 METERS OR A LITTLE LESS THAN A SATURN V OR A LITTLE MORE THAN A FOOTBALL FIELD



EVA SCHEMATIC
45 DAY SURFACE STAY



"13" = DAY SINCE LANDING

45 DAY HUMAN EXPLORATION FOR MARS BASE SITE EVALUATION

- WEEK ONE (DAYS 1-6)
  - READAPTATION
  - ENVIRONMENTAL TESTS
  - ACTIVATION OF EXTERIOR SENSORS
  - PHYSICAL MONITORING
  - PLANNING
- WEEK TWO (DAYS 8-13)
  - SHORT/SIMPLE PROXIMITY EVAS
  - DEPLOY COMM ANTENNA / SCIENCE STATION / AGRICULTURAL TEST STATION
  - START DEEP DRILL SYSTEM
  - SELECTED SAMPLE ANALYSIS
  - PHYSICAL MONITORING
  - PLANNING SESSIONS
- WEEK THREE (DAYS 15-20)
  - SECTOR 1 EXPLORATION
  - MID LENGTH EVAS USING ROVER
  - EXTENDED RANGE EVA WITH TWO ROVERS
  - SHALLOW DRILLING/DEPLOY GEO. NET
  - SELECTED SAMPLE ANALYSIS
  - PHYSICAL MONITORING
  - PLANNING SESSIONS
- WEEK FOUR (DAYS 22-27
  - SECTOR 2 EXPLORATION
  - DITTO WEEK THREE
- WEEK FIVE (DAYS 29-34)
  - SECTOR 3 EXPLORATION
  - DITTO WEEK THREE
- WEEK SIX (DAYS 36-41)
  - SECTOR 4 EXPLORATION
  - ASCENT SIMULATIONS
  - DITTO WEEK THREE
- WEEK SEVEN (DAYS 43-45)
  - MOTHBALL FACILITY
  - PREPARE ROVER FOR REMOTE OPERATION
  - FINAL ASCENT SIMULATIONS
  - SAMPLE SELECTION AND STORAGE

- NOTE: ONE REST DAY PER WEEK
  - FOUR PERSON CREW
  - TWO PERSON EVAS, ALTERNATE BETWEEN PAIRS

EARLY LANDINGS STRATEGY GOAL: PERMANENT BASE

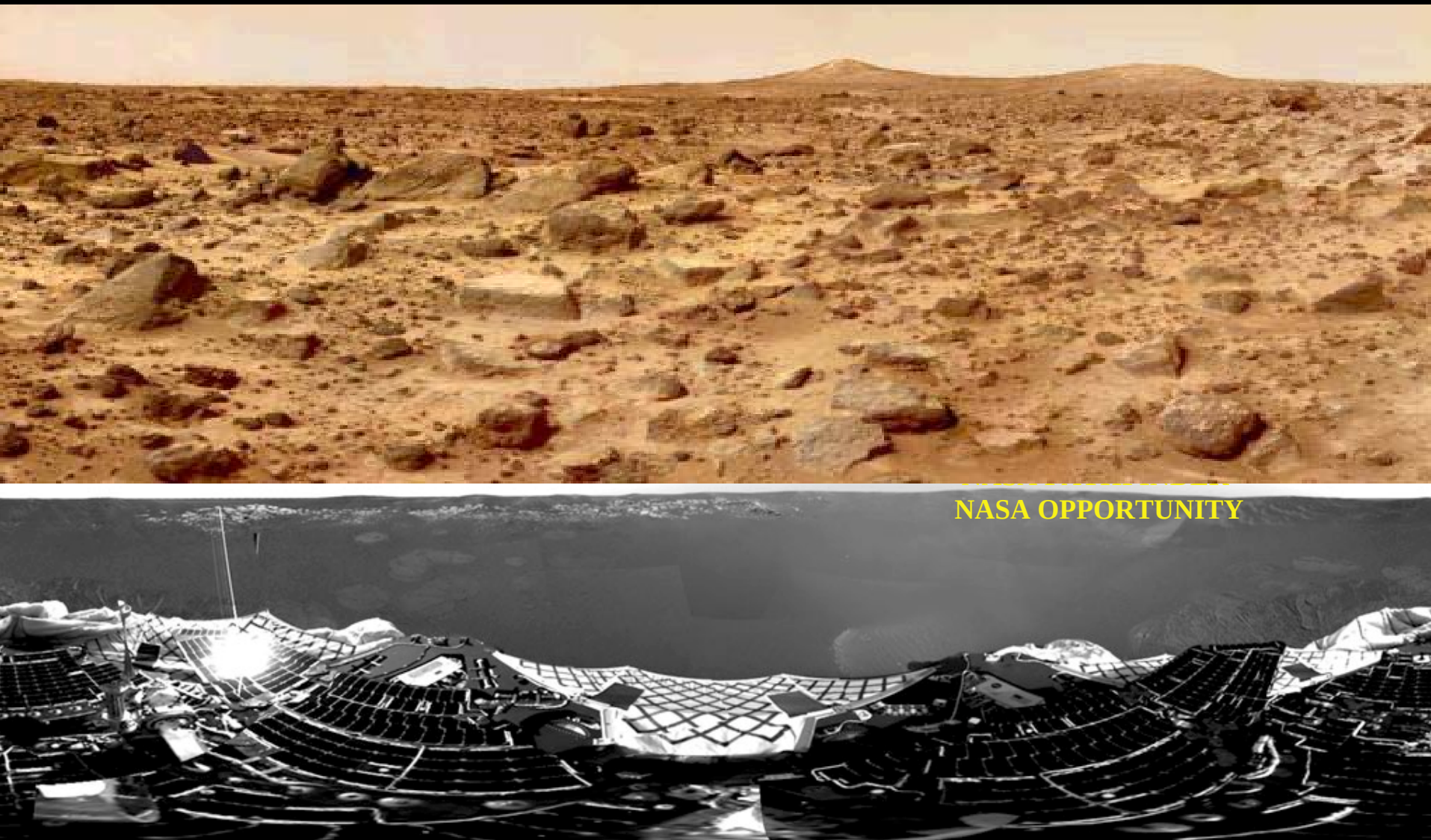
- **FIRST AND SECOND MISSIONS (POSSIBLE FOUR LANDINGS)**
  - **GENERAL EXPLORATION AND RECONNAISSANCE**
    - **AUTOMATED ROVER AFTER CREW DEPARTURE**
  - **DEVELOPMENT OF CRITERIA FOR BASE SELECTION**
  - **POTENTIAL TO ACCELERATE DECISION ON BASE SITE SELECTION**
    - **CORRELATION OF ORBITAL RECONNAISSANCE WITH DATA FROM SURFACE**
- **THIRD AND FOURTH MISSIONS (POSSIBLE FOUR LANDINGS)**
  - **EXAMINATION OF CANDIDATE BASE SITES**
    - **AUTOMATED ROVER AFTER CREW DEPARTURE**
  - **USE FOURTH LANDING TO SET UP CONSUMABLES PLANT AT SELECTED BASE SITE**
  - **GENERAL EXPLORATION AND RECONNAISSANCE**

IF A LUNAR HELIUM-3 INITIATIVE BEGAN BY 2005 WITH ASSURED FUNDING, THE FIRST HUMAN MISSION TO MARS COULD BE LAUNCHED BY 2020, LARGELY USING TECHNOLOGY PAID FOR BY THE HELIUM-3 INITIATIVE.

ENJOY THE VIEW WHEN YOU GET THERE!!!!!

“TRUE COLOR OF MARS”
PATHFINDER LANDER VIEW
NASA/JPL

A POSSIBLE REPRESENTATIVE VIEW FROM THE "MARTIAN MODULE"
BEFORE THE FIRST EVA, HOWEVER….
VALLES MARINERIS WILL BE A TAD MORE SPECTACULAR



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