Objectives and Investigations for Mars Exploration

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MARS GEOLOGY-GEOPHYSICS GOAL

Objective: determine formation and evolution of crust (in priority order)

- present water
- sedimentary processes
- absolute time-scale
- igneous history
- surface-atmosphere interactions
- crustal structure
- tectonic history
- crustal composition

Objective: characterize the interior (in priority order)

- configuration of the interior
- magnetic field history
- thermal evolution
- mantle evolution
Investigation 1: Search for water

- global mapping
- global search for subsurface water
- search for subsurface water from surface
- drill for water
- in situ measurements, mineralogy, etc.

Investigation 2: Evolution of sedimentary processes/materials

- global mapping
- in situ study
- drilling
  - ? 100m
  - ? 1 km
- returned samples
FORMATION AND EVOLUTION OF THE CRUST

Investigation 3: Absolute time scale/cratering record

- isotopic dates for 2 or more sites
- determine current impact flux

GEOLeGIC HISTORY OF MARS

Investigation 4: Evaluate igneous processes through time

- global mapping
- in situ analyses, 3 sites
- returned samples, 2 sites
- search for thermal anomalies
FORMATION AND EVOLUTION OF THE CRUST

Investigation 5: Surface-atmosphere interactions
(polar, aeolian, weathering, mass-wasting, etc.)

- global mapping
- global SAR mapping
- in situ measurements, sediments
  - 3 sites
- weather network, 16 stations
- returned samples, 3 sites

FORMATION AND EVOLUTION OF THE CRUST

Investigation 6: Vertical crustal structure/regional variations

- global mapping
- global SAR mapping
- in situ measurements, 3 sites
- seismic monitoring, 2 sites
- returned samples, several sites
- global gravity surveys
Investigation 7: Tectonic history and present activity of crust

- global mapping
- global magnetic measurements
- regional magnetic surveys
- seismic monitoring

Investigation 8: Bulk composition and evolution of crust

- global mapping
- global SAR mapping
- in situ measurements
- seismic monitoring
- returned samples, 3 sites
CHARACTERIZE THE INTERIOR

Investigation 1: Determine interior configuration
- global gravity survey
- global magnetic measurements
- concurrent rotational dynamics, 2 landers
- global seismic monitoring, 12 stations

Investigation 2: Magnetic field history
- global magnetic measurements
- regional magnetic surveys

Investigation 3: Thermal evolution of the crust
- global gravity survey
- global magnetic survey
- concurrent rotational dynamics, 2 landers
- global seismic monitoring, 12 stations
- in situ heat flow

Investigation 4: Chemical and thermal evolution, mantle
- as above
- returned samples, igneous rocks

GEOLOGY-GEOPHYSICS GOAL

- Will require >decades of work
- Progress will be iterative
- Few investigations will be 100% completed
- For some investigations, humans are more efficient and provide higher quality results
- Need to determine unique aspects of human exploration (e.g., real-time adaptability...?)