



National Aeronautics and  
Space Administration

Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California



*Mars Exploration Directorate*

# MEPAG

# Mars Exploration Program Analysis

# Group

July 29-30, 2009

Dr. Fuk Li



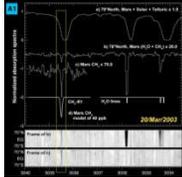
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# Mars Exploration Program Architecture: Science Goals/Drivers

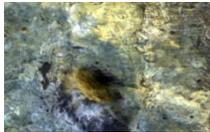


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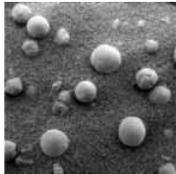
## Methane



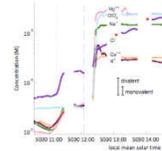
## Martian Surface Diversity



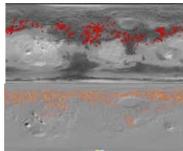
## Water, Water, Water



## Perchlorate



## Salt Deposit



LIFE



CLIMATE



GEOLOGY



Prepare for Human Exploration

Seek  
 Signs  
 of Life

Understand Trace Gas Origin:  
 Detection, Characterization,  
 Localization

Habitability in Diverse  
 Martian Environments

Martian Interior Structure/Composition

Analyses of Returned  
 Martian Sample



## Mission Concepts to Address Key Science/Program Drivers: Building Blocks for Program Architecture

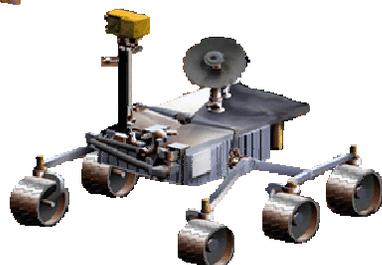


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### Trace Gas Orbiter

- Detect a suite of trace gases with high sensitivity (ppt)
- Characterize their time/space variability & infer sources
- Replenish orbiter infrastructure support for Program



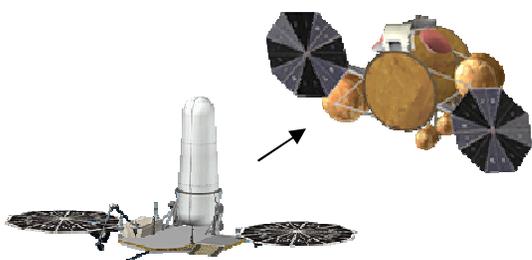
### Mid-Range Rover

- Explore Mars habitability in the context of diverse aqueous environments provided by a new site
- Select and prepare samples for return



### Network Landers

- Determine the planet's internal structure and composition, including its core, crust and mantle
- Collect simultaneous network meteorological data on timescales ranging from minutes to days to seasons



### Mars Sample Return

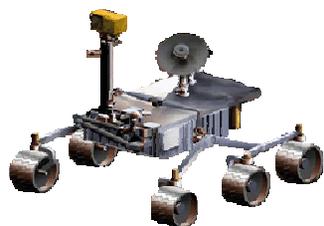
- Make a major advance in understanding Mars, from both geochemical and astrobiological perspectives, by the detailed analysis conducted on carefully selected samples of Mars returned to Earth



# A Potential Multi-Element Campaign for Returning Samples From Mars



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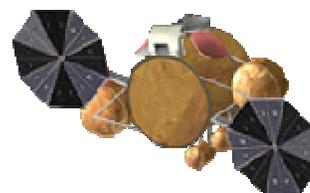
## Sample Caching Rover

- Acquire/encapsulate scientifically exciting samples for return
- Conduct scientific exploration of Mars habitability



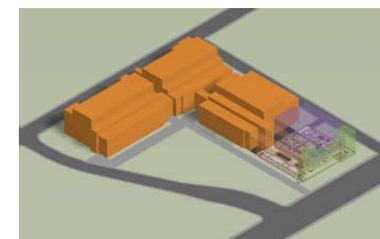
## Mars Sample Return Lander

- Retrieve sample cache/ additional sampling
- Launch sample container into Martian orbit



## Mars Sample Return Orbiter

- Capture sample container
- Return sample container to Earth



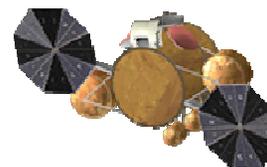
## Mars Sample Receiving and Curation Facilities



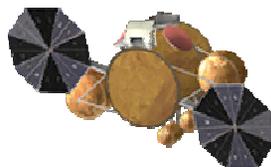
# Mars Sample-Focused Program Architecture Options



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OR



## Trace Gas Orbiter

- Detect a suite of trace gases with high sensitivity (ppt)
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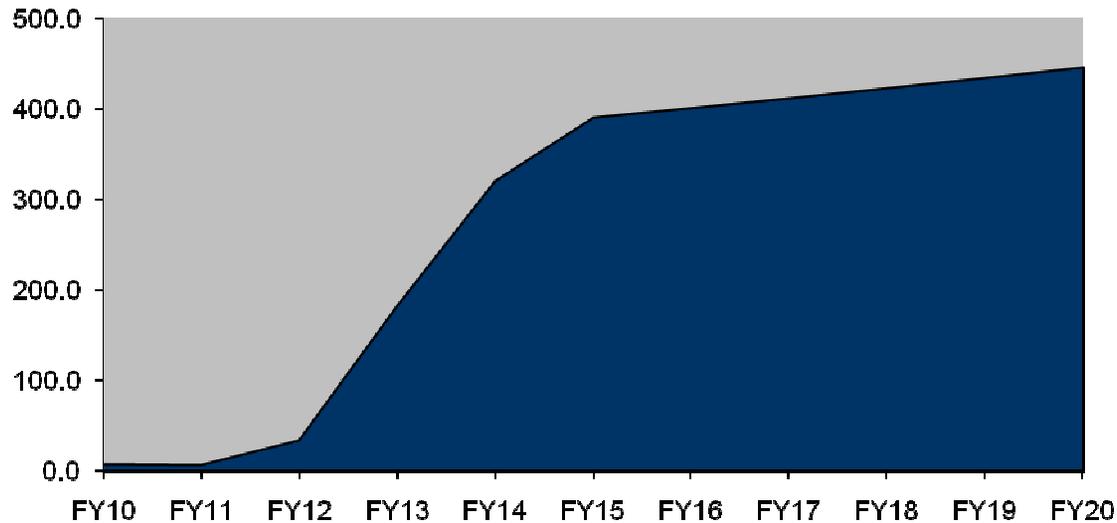
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# Potential Program Approach for Next Decade and beyond



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Future mission funding wedge



- '16 Trace Gas Orbiter
- '15-'20: Mars sample return technology development
- '20 Mid-range rover/sample caching
- '24 Mars sample return orbiter
- '26 Mars sample return lander



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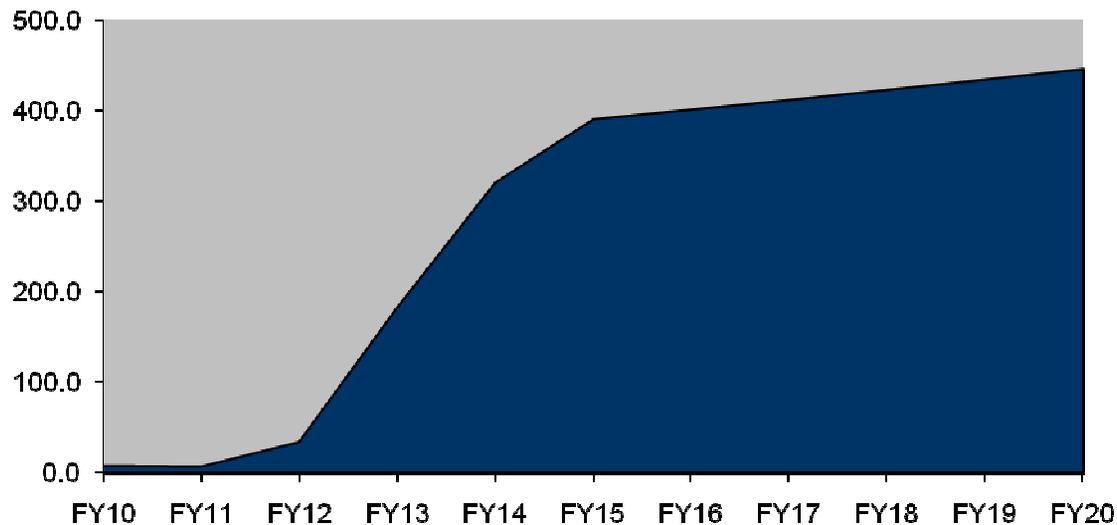
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# Potential Program Approach at an accelerated pace with international partnership



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Future mission funding wedge



- '16 Trace Gas Orbiter
- '18 Mid-range rover/sample caching
- '15-'20: Mars sample return technology development
- '20 Network
- '22 Mars sample return orbiter
- '24 Mars sample return lander