Mars Robotic Exploration

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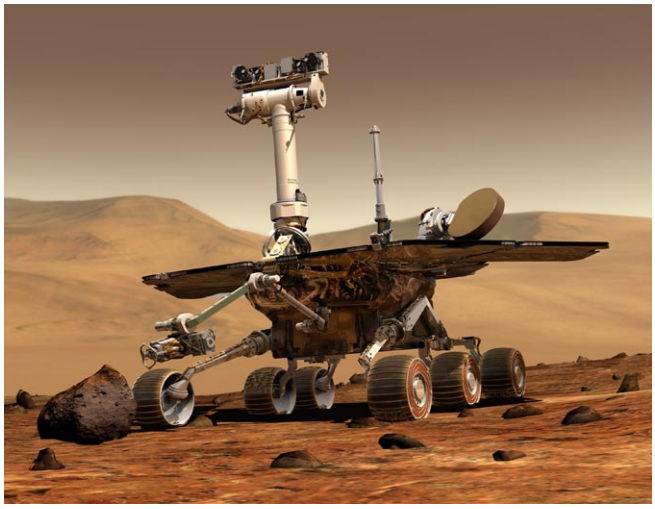
Astromaterials Research and Exploration Science (ARES) scientists are actively involved in all aspects of Mars Robotic Exploration, including the 2003 Mars Exploration Rovers (MERs) Mission, 2003 Mars Express/Beagle 2, 2005 Mars Reconnaissance Orbiter, 2007 Phoenix Scout Mission, and 2009 Mars Science Laboratory (MSL).

Two ARES scientists, Dick Morris and Doug Ming, are on the science team as coinvestigators and participating scientists for the twin MERs. The two rovers landed on Mars in January 2004 in the Meridiani Planum and Gusev Crater regions. The mineralogy and chemistry of the two landing sites are being characterized via the Athena remote sensing instruments on each rover. ARES scientists developed a target of well-characterized samples to validate the performance of the Athena remote sensing instruments. During mission operations, ARES scientists are responsible for developing daily scientific observations and commands for uplinking to the rovers as well as preparing downlink data products from several of the Athena instruments.



Artist's rendering of a Mars rover.

Morris was on the team for the Moessbauer spectrometer instrument on the Beagle 2 Mars Express Lander, and Gibson participated as the interdisciplinary scientist. Beagle 2 landed in December 2003, breaking all communication. This loss is unfortunate, since the Moessbauer spectrometer would have provided key information about the mineralogical composition of iron-bearing phases in the Isidis region of Mars.

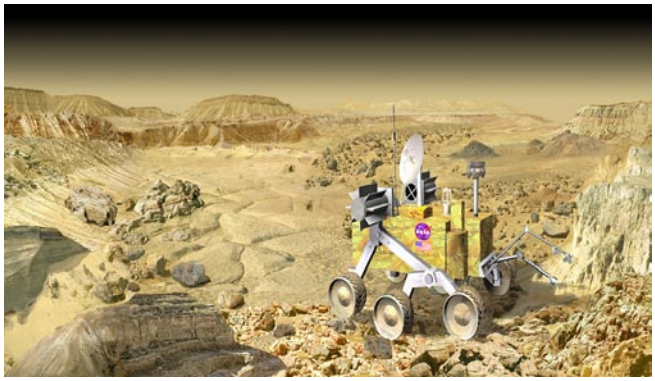
Morris is also a collaborator on the OMEGA instrument— a visible-infrared hyperspectral mapper—on the Mars Express orbiter. The ARES scientist participates in interpretation of data and in development of spectral libraries for the mission.

Morris is also a coinvestigator on the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument that is one component of the Mars Reconnaissance Orbiter 2005 mission. CRISM, a visible-infrared hyperspectral mapper (~25 m/pixel), will "follow the water" by searching for evidence of aqueous and hydrothermal deposits and by mapping the geology, composition, and stratigraphy of surface features. CRISM will also characterize seasonal variations in opacities of dust and ice aerosols, and will track any seasonal changes in the water content of surface materials. Morris participates in the instrument calibration, mission operations, and data interpretation, the latter of which is based in part on databases developed at Johnson Space Center.

Ming and Morris are also coinvestigators on the 2007 Phoenix Scout Mission, which will land at the high northern martian latitude in search of the near-surface ice that was discovered by the Mars Odyssey science team from neutron and alpha-particle spectrometer measurements obtained from the orbiter. Phoenix will follow the water and study the history of water in all of its phases with chemical, geological, and meteorological

measurements. In addition, Phoenix will search for habitable zones by assessing the organic or biological potential of the landing site. Morris and Ming will be responsible for the calibration of the Phoenix instruments and will develop science strategies for the mission. In addition, Ming currently chairs the Phoenix Chemistry and Mineralogy Science Theme Group.

The 2009 MSL will likely have an analytical laboratory on a rover that will have much greater roving and analytical capabilities than the Mars Exploration Rovers. The analytical laboratory will be able to:

- Assess biological potential, such as the nature and inventory of organic carbon compounds and the inventory of chemical building blocks of life.
- Characterize the geology of the landing region at all appropriate spatial scales by determining chemical, isotopic, mineralogical compositions and characterizing rock and regolith forming processes.
- To investigate planetary processes that influence habitability, such as atmospheric evolution and the present state, distribution and cycling of water and carbon dioxide.

Ming and Morris are actively working with several instrument teams to design analytical instruments that address the objectives for the 2009 MSL.