MARS RECONNAISSANCE ORBITER'S FIRST LOOK AT MARS. S.E. Smrekar[1], R.W. Zurek[1], G.M. Keating[2], M.C. Malin[3], D.J. McCleese[1], A.S. McEwen[4], S.L. Murchie[5], R.J. Phillips[6], R. Seu[7], and M.T. Zuber[8], [1]Jet Propulsion Laboratory (ssmrekar@jpl.nasa.gov; Jet Propulsion Laboratory/Caltech, 4800 Oak Grove Dr., MS 183-501, Pasadena CA 91109), [2]George Washington University, Newport News VA, [3]Malin Space Science Systems, Inc., San Diego CA; [4]University of Arizona, Tucson AZ; Applied Physics Laboratory/John Hopkins University, MD; [6] Washington Univ. St. Louis, St. Louis MO; [7]Univ. of Rome, Italy; [8]MIT, Cambridge, MA.

Introduction: The Mars Reconnaissance Orbiter (MRO) is the latest mission to arrive at Mars, beginning its primary science phase on November 8, 2006. All instruments are checked out and are routinely returning excellent data. In the 5 months prior to LPSC, it is expected to obtain over 5 Tb of data from its 6 science instruments. The 3 cameras include the High Resolution Imaging Experiment (HiRISE) camera, the Context (CTX) Camera, and the Mars Color Imager (MARCI), which provides for global daily images. Other instruments are the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) hyper-spectral imaging spectrometer, the Mars Climate Sounder (MCS), and the Subsurface Sounding Shallow Radar (SHARAD) ground penetrating radar, provided by the Italian Space Agency. The detailed specifications for each instrument are given in Table 1. These instrument investigations are augmented by two facility science teams analyzing, respectively, aerobraking phase accelerometer measurements and spacecraft tracking data. New data from MRO is already revealing new insights on a wide range of processes.

Mission Objectives: MRO continues to 'follow the water' through a series of investigations. Specific mission objectives are to 1) characterize seasonal cycles and daily variations of water, dust & carbon dioxide, 2) map global atmospheric structure, transport and surface changes, 3) search sites for evidence of aqueous and/or hydrothermal activity, 4) survey in detail the stratigraphy, geology & composition of Mars surface features, 5) study the Martian ice caps and the polar layered terrains, 6) profile the upper crust while probing for subsurface water and ground ice, 7) determine the Martian gravity field and upper atmosphere in greater detail, and 7) identify and characterize many sites for future landed missions. MRO will undoubtedly yield numerous unexpected discoveries as well.

An important objective for MRO is to help with the selection of safe and scientifically exciting landing sites for the Mars Science Laboratory (MSL) and to help certify sites for the Phoenix lander.

Mission Overview: MRO was launched on August 12, 2005. It arrived on March 10, 2006, and spent 6 months areobraking. The engineering accelerometer was used during areobraking to investigate atmospheric density variations. Following the transition phase in September and October and solar conjunction in October, MRO began its initial 2-year (1 Martian year) primary science phase (PSP), followed nominally by a 2-year relay phase. In practice, MRO and Odyssey will provide relay support for the Phoenix lander in 2008, during the PSP, and MRO will support MSL upon that rover's arrival in 2010. On-board resources could support observations for at least 5 years additional years, and MRO will apply for extended

CRISM **PI: Scott Murchie**	*High-resolution Targets* 18 m/pixel 10.8 km swath width 6.5 nm 0.4 - 3.96 μm *Multi-spectral Survey* 60 channels; ~200 km/bin
CTX **PI: Mike Malin**	6 m/pixel 30 km swath width Panchromatic (minus blue) SNR > 20 Stereo by Revisit
HiRISE **PI: Alfred McEwen**	0.3 m/pixel Red (6 km swath width) Blue-Green & NIR (1.2 km swath) SNR ≥ 150 Stereo by Revisit
MARCI **PI: Mike Malin**	180˚ FOV 7 bands from 0.28-0.8 μm 5 VIS: 1-7 km/pixel 2 UV: 10 – 30 km/pixel Daily Global Mapping
MCS **PI: Dan McCleese**	Broadband Solar Channel & 8 Thermal IR Channels 0 - 80 km range; 5 km vert. res. Globally Distributed, Daily Atmospheric Limb & On-Planet Observation
SHARAD **PI: Roberto Seu** **Deputy: Roger Phillips**	20 MHz (fo, central frequency) 6 km cross track resolution x 1 km along track resolution (SAR processing down-track) Profile to ~0.5 km depth with vertical resolution ~ 10 m (15 m in free space)

Table 1. Instrument specifications.

science mission support. MRO is in a polar orbit (92.65˚ inclination) with a periapsis of 249 km near the south polar and an apoapsis of 313 km near the north pole. The local mean solar time is 3:03 PM. The orbit track is designed to return to within ~30 km of prior orbits every 17 days. This pattern along with the ability to point instruments off nadir up to 30° results in the ability to observe nearly every location on Mars every 17 days.

MRO has immense potential for returning data, with transmission speeds of up to 5 megabits/sec. In the first 2 months of operations, over 3 TB have been returned. Approximately 50 TB of data are anticipated in the primary science phase. First deliveries of data to the Planetary Data System are due in June.

Observing Objectives and Modes: MRO instruments have objectives ranging from coordinated images of local sites by imaging instruments (HiRISE, CTX, and CRISM) to global survey by CRISM, to continuous atmospheric monitoring by MCS and MARCI. The highest priority targets are observed simultaneously by HiRISE, CTX and CRISM.

In addition to team science objectives, MRO has supported the Phoenix landing site certification process, acquiring more than 100 HiRISE, CRISM, and CTX observations of potential landing sites. The Phoenix site is expected to be observable only through January, after which lighting conditions and haze degrade imaging quality. A key part of supporting Phoenix was imaging of the Viking Lander 1 and 2 sites, where rocks counts were done using lander images. The rock counts from lander images were used as 'ground truth' to validate rock counts done using HiRISE images. Additionally, the 3 imaging instruments have observed the Pathfinder, Spirit and Opportunity rover sites to support their operations or provide further information on landing dynamics. These sites also provide 'ground truth' for orbital data.

Initial Results: The imaging instruments have taken advantage of northern summer to observe the northern polar layered deposits (PLD), revealing new details about the deposits structure and composition. Combined results from multiple data sets are especially powerful. HiRISE images show that some layers extend down to the resolution of the camera, while others are more massive. CTX images help map the extent and continuity of specific layers. The CRISM spectra show that the upper portion of basal unit of the PLD is more ice-rich than the lower portion. The scarp of the PLD contains rich-ice areas, and is distinct from the top-most layers of the PLD. Spectra of the gypsum dunes seen by OMEGA in the north polar erg show that the gypsum is concentrated on the dune crests. SHARAD radargrams of the northern and southern PDLs show complex, non-horizontal layers in the subsurface. The northern PLD has many interfaces in the upper unit, and fewer in lower unit. SHARAD sees the base of the northern PLD at a depth of ~ 2 km.

One focus for MRO instruments is the continuing 'follow the water' theme of the Mars program. Within this theme, numerous images have been acquired of features such as layered deposits, gullies, outflow channels and deltas. HiRISE's ability to discern small-scale (~1 m diameter) boulders is already providing insight on fluvial processes. Examples include the presence of boulders in the Vastitas Borealis formation, arguing against an origin via fine sediments from a deep, long-lived ocean, and the absence of boulders in some eroded sedimentary rocks, suggesting removal by wind or other processes. CTX imaging is focusing on meter-scale processes, especially layered terrains and observing changes on the surface. MARCI provides a daily image of the entire planet, documenting changes in frost, albedo, clouds, and dust storms.

Compositional information revealed by the CRISM spectrometer is revealing new insights into the origin and distribution of water-related minerals such as clays and sulfates. The combination of CRISM and HiRISE is data is very powerful for interpreting the origin and history of different compositional units. An initial example is in Nili Fossae, which shows that olivine is concentrated in dunes while clays form the bedrock.

MSC is constantly scanning the atmosphere from nadir to the limb. Specifically MCS will map out atmospheric changes in dust, ice, CO_2, and water, as well as study the radiative balance of the polar caps.

The atmospheric density investigation using the engineering accelerometer was conducted during the areobraking phase of the mission, sampling the upper atmosphere (>100 km) during the southern fall and the minima in the solar cycle. These data will be used to investigate upper atmospheric circulation models and high-latitude variability and transport mechanisms. Gerry Keating is the team leader for this investigation.

The lower altitude of MRO (~280 km on average) relative to ~400 km for other Mars orbiters means the Doppler tracking data can be used to derive a higher resolution gravity field. Currently the noise in the Doppler data is relatively high because Mars is close to solar conjunction. These data will be used to investigate the atmospheric density and static and time-variable gravity field variations. Maria Zuber is the team leader.

References: See related abstracts in the MRO special session, and other Mars sessions. A special issue of Journal of Geophysical Research Planets is due out soon that provides detailed information on each instrument and facilty science investigation.