MARS SURVEYOR PROJECT LANDING SITE ACTIVITIES. **V. C. Gulick**, NASA-Ames Research Center, MS 245-3, Moffett Field, CA 94035; vgulick@mail.arc.nasa.gov; **Geoffrey Briggs**, NASA-Ames Research Center, MS 239-20, Moffett Field, CA 94035; **R. Stephen Saunders, Martha Gilmore**, Jet Propulsion Laboratory, MS 183-335, 4800 Oak Grove Drive, Pasadena, CA 91109; and **Larry Soderblom** US Geological Survey 2255 N. Gemini Drive Flagstaff, AZ 86001.

Introduction: The Mars Surveyor Program --now a cooperative program led by NASA and CNES along with other international partners -- is underway. It has the primary science objective of furthering our understanding of the biological potential and possible biological history of Mars and has the complementary objective of improving our understanding of martian climate evolution and planetary history. The missions will develop technology and acquire data necessary for eventual human exploration. Launches of orbiters, landers and rovers will take place in 2001 and in 2003; in 2005 a complete system will be launched capable of returning samples to Earth by 2008.

A key aspect of the program is the selection of landing sites. This abstract 1) reports on the status of the landing site selection process that begins with the 2001 lander mission and 2) outlines the opportunities for the Mars community to provide input into the landing site selection process..

Background: Nominally, each mission includes at least a lander and a rover, both instrumented. Currently, the 2001 mission (http://mars.jpl.nasa.gov/2001/index.html) includes a lander carrying a package to measure the surface radiation environment and to extract oxygen from the atmosphere along instruments to be flown on the 2003 Athena rover: PanCam, a panoramic camera, MiniTES, an infrared spectrometer, and a Mossbauer spectrometer. The lander will have a robotic arm and arm camera adapted from the Mars Surveyor '98 mission. The lander will also carry a descent imager to support the 2001 rover, named Marie Curie, which will be essentially the same as Pathfinder's Sojourner rover but with improved, calibrated APXS.

The 2003 rover, named Athena, will be larger, more sophisticated, more capable, and have the ability to aquire surface materials for launch to, and to cache in, Mars orbit. The 2005 rover will be a near copy of Athena and its collected samples will be launched to Mars orbit for recovery along with the Athena samples and transfer back to Earth

The Athena rover science goal is to "determine the geologic and climatic history of a site in the ancient highlands where conditions may have been favorable to the preservation of evidence of possible pre-biotic or biotic processes". To do so the rover objective is to identify, collect, and store martian rocks and soils that have the highest possible chance of preserving evidence of ancient environmental conditions.

Landing Site Engineering Constraints: Three mission aspects drive the landing site selection: (1) The ability of the lander to reach the landing site; (2) the safety of the landing site; and (3) the scientific characteristics of the landing site. The engineering constraints (1 and 2) are set by orbital mechanics, by the capabilities of the lander entry and descent system, and by the characteristics of the rocky martian surface. Table I summarizes the current engineering constraints for the 2001 mission. The size of the landing ellipse and the rover mobility (~ 1km for Athena, 10's of meters for Marie Curie) control how localized the target region may be if it is to be successfully sampled. An areally-extensive target, for example, maximizes the probability that the lander will land on or near the target and minimizes the required rover traverse distance. A precision landing system, if developed, will minimize the landing ellipse and greatly help in the investigation of sites that are small in areal extent. See Golombek et al. [1] for additional information.

Landing Site Selection Procedure. The responsibility for the landing site selection rests with the Surveyor Project Office at JPL and the Project Scientists involved. For the 2001 mission the Project Scientist has appointed a Steering Committee to assess and recommend candidate sites. The Project Scientist is supported both by astrobiologists at NASA's Ames Research Center through its Center for Mars Exploration (CMEX) and by the USGS's Astrogeology Branch in Flagstaff, Arizona. CMEX is responsible for providing an interface with the general Mars science community and assisting in the overall coordination of the landing site selection process. To this end CMEX will host workshops and provide a web site and other support to ensure the participation of the general Mars community. The US Geological Survey has responsibility to compile and provide cartographic databases for potential landing sites, to assemble the engineering requirements associated with the landing site (e.g., altitude, rock frequency), and to evaluate potential sites in light of these constraints.

Table II presents the current preliminary schedule outlining landing site selection milestones for the 2001 mission. A similar procedure is expected to be followed for the subsequent landing site selection processes.

Results of First Landing Site Workshop. Ames hosted a first Surveyor landing site workshop in January 1998. Abstracts from this meeting have been posted to the web and can be found at http://cmex.arc.nasa.gov/Mars_2001/2001_abs_vol.html.

A primary goal of the workshop was to choose a latitude band in which the most promising sites lie in order to facilitate engineering design studies. Of the 65 landing sites presented at the meeting, 51 fell into the latitude band between 5N to 15S. At the time of the meeting, the focus was on choosing a landing site for the 2001 mission under the assumption that the Athena rover would fly on that mission. While this is no longer the case, the range of proposed sites provides insight into the selection process.

Most sites fell into one of 5 broad categories:

(1) basins & lakes;
(2) sites of potential hydrothermal mineralization;
(3) highland/lowland boundary sites;
(4) sites at channel mouths or deltaic deposits; and
(5) younger impact crater on older material.

In general each site presented one or more of the following

characteristics:

(1) evidence of water,
(2) fossil concentration mechanism,
(3) thermal energy source,
(4) a preservation mechanism (e.g., rapid burial, mineralization), and
(5) an excavation mechanism (e.g., crater, erosion).

Suggested sites representing some of the broad catergories listed above include W. Arabia Terra, Mangala Valles, "White Rock" Crater, Kayne Crater, and Apollinaris Patera.

The next workshop will be held in the summer of 1999 with additional annual workshops to follow. Individuals interested in subscribing to the site selection mailing list should contact Virginia Gulick (vgulick@mail.arc.nasa.gov).

Reference: [1] Golombek et al. (1999) LPSC, this vol. [2] Gulick, V.C. (edit(1998)or) Moars Surveyor 2001 Landing Site Workshop abstract vol., NASA-Ames, Jan 26-27, 1998.

Table I: Engineering Constraints Input for '01 mission

Constraint	Current value	Comment
Latitude band:	15°S to 15°N	will be narrowed
Landing ellipse:		
ballistic :	120 × 20 km	this has not been finalized
precision:	20 × 20 km	
Slopes	< 11°	
Albedo	low	
Thermal inertia	high	
Rock abundance:	<1% chance of rock >35 cm	

Table II: Preliminary Schedule: Mars Program Site Selection Process For 2001

Function	Responsibility	Schedule
MGS Assessment Phase	MSOP	10/13 - 11/7/97
SPO-1 Ends	MSOP	5/1/98
SPO-2 Data Collection	MSOP	5/26/98 - 9/11/98
MGS Assessment Phase CD available	PDS	7/1/98
Identify Engineering Constraints (*Rocks, temperature range, elevation, etc.*)	MED, Projects	10/98
Collect Surface Environmental Data (*Roughness, rocks, topography, slopes, thermal inertia*)	MEDSO	10/97 - 11/98
SPO-1 Release to Archive	MSOP	10/15/98
Assembly of existing data	PSG	12/1/98
MSP'98 Orbiter Launch	NASA	12/10/98
Solicitation of Science Community for Additional Landing Sites	Project	12/98
Steering Group Committee Meeting	Steering Group	1/99
MSP'98 Lander Launch	NASA	1/3/99
MSP'98 Ops	MSOP	1/00 - 12/01
MSP'98 Release to Archive	MSOP	12/00, 6/01, 12/01
SPO-2 Release to Archive	MSOP	1/15/99
Steering Group Committee meeting (LPSC)	Steering Group	3/99
MGS Mapping begins	MSOP	4/1/99
MGS Data Releases	MSOP	10/1/99, 4/1/00
Collect MOC data from some selected targets, analyze MOC data		4/99 - 6/99
Science Evaluation	Science Community	Continues
Landing Site Workshop	Science Community	1/98, 7/99, 1/00, 1/01
Initial selection of a few sites	Steering Group	7/99, 1/00
Focus study on selected sites	Steering Group and Science Community	7/99 - 12/99
Final Project Selection	PSG, Project, MED	3/00
NASA selection/approval	NASA	4/00
MSP'01 Lander Launch	NASA	4/7/01

MSP = Mars Surveyor Program; PDS = Planetary Data System; MEDSO = Mars Exploration Division Science Office; MGS = Mars Global Surveyor; PSG = Project Science Group; MED= Mars Exploration Division