

LANDING SITE SELECTION FOR THE MARS SCIENCE LABORATORY AND IMPLICATIONS FOR MARS SAMPLE RETURN. H. E. Newsom¹, N. L. Lanza¹, and A. M. Ollila¹. ¹Institute of Meteoritics, MSC03 2050, University of New Mexico, Albuquerque 87131.

Introduction: The scientific success of a Mars Sample Return (MSR) mission will be greatly enhanced by returning well characterized materials from several outcrops on Mars. This is important for a wide spectrum of studies, ranging from understanding habitable environments to finding materials suitable for geochronology. The possibility of sending an MSR to a site previously studied during the extensive mission of the Mars Science Laboratory (MSL) is therefore attractive. This becomes even more so given the likelihood of serious financial constraints on the MSR mission, which may limit the duration and scope of a sampling rover associated with MSR. MSL can contribute to a future sample return mission by 1) exploring and defining interesting targets for future sampling and return from that site, and 2) collecting a sample cache, as planned for the MSL rover and probably the ExoMars mission. There are a number of important considerations involving the selection of landing sites for these precursor missions that could substantially influence the success of an MSR mission to one of these sites.

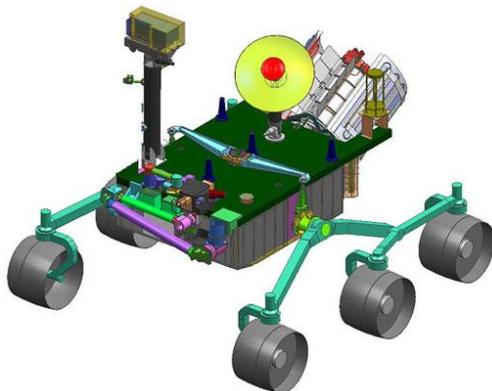


Fig. 1.Diagram of the Mars Science Laboratory, which will contain a sample cache for potential return to Earth by an MSR mission. From JPL/NASA.

Sample return missions to sites already studied – There are a number of obvious advantages and some potential disadvantages to having the MSR mission return to a previously studied site, with or without a sample cache. Being able to revisit outcrops that in-situ study has identified and characterized will greatly enhance the probability of returning significant samples. The alternative of providing an MSL class rover for a new MSR site may be unaffordable. There are some disadvantages to revisiting sites as well. Visiting a previously studied site increases the potential that a site could have biological or biochemical contamination from the prior investigation. This could be minimized by sampling for return portions of outcrops at some distance from the areas earlier investigated.

Types of landing sites – There are several classes of landing sites under consideration for MSL. These sites fall into several types relevant to MSR:

1. Landing sites with prime targets in the landing site ellipse.
2. Go-to landing sites with prime targets in terrains surrounding the landing site ellipse. For go-to sites the rover must travel to reach the prime sites.
3. Go-to landing sites with prime targets in terrains outside the landing site ellipse, but only on restricted azimuths from the center of the ellipse .

Clearly, the landing sites where the prime targets are located in the landing site ellipse are the most suitable as candidate sites for future MSR. In contrast, the go-to sites are problematic for MSR if the available landing site ellipses are far from the science targets. The situation may be improved if the MSR

ellipses are smaller than the MSL ellipse. Also, if a cache is present the MSL or ExoMars rover will need to be accessible at the end of its mission, which is discussed further below.

Location of landing sites and MSR - Other considerations for landing sites relevant to MSR include the latitude of the landing site. This could greatly affect the potential for returning a cache. Sites at high latitudes are not favorable for operations during a significant part of the martian year. Therefore, there may be problems with scheduling an MSR mission to coincide with the warm part of the martian year at a given site.

Sample Cache issues – The collection of a sample cache by the MSL and ExoMars rover has the advantages of allowing recovery of samples from areas that would probably not be accessible to the rover on an MSR mission. However, a sample cache can result in cross contamination of samples within the cache. In addition, the cache may be subject to contamination from the rover that collects the cache, as well as from the rover that collects the cache for the return.

The presence of a sample cache may also influence the operation of the rovers. Returning to the original landing site will be very undesirable. Such a plan could impact the nature of an extended mission for some of the science targets that require long traverses from the landing site ellipse. The identification of possible sample return ellipses at the ends of the planned science traverses at go-to sites would certainly enhance their desirability in this regard, especially if there was good science to do during an extended mission at these locations. Otherwise, following the prime mission, there will be real or perceived pressure to drive back to the landing site with no substantial extended mission.

Mars Science Laboratory landing sites and MSR – There are currently six final sites under consideration for MSL. These sites have different implications for an MSR mis-

sion. The near equatorial Miyamoto Crater site is the most benign in terms of environmental conditions and may have important science outcrops within the landing site ellipse. There are also good targets for an extended mission outside of the nominal ellipse. A north Meridiani site has been retained for landing site safety issues, but may be less interesting scientifically. The northern Nili Fossae and two southern sites, Eberswalde and Holden are go-to sites (less so for Eberswalde) and have many issues including low winter temperatures. The Mawrth Vallis site has potential for interesting materials in or close to the landing site ellipse, but is relatively far north and may also have low temperatures for part of the martian year.

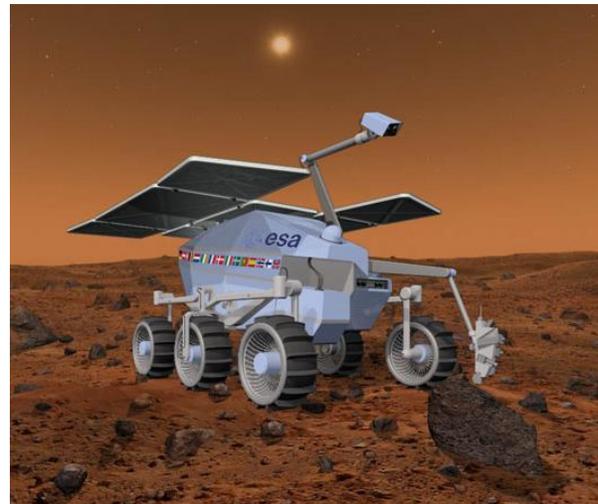


Fig. 2. Possible configuration of the European Space Agency's ExoMars rover. From ESA.

Conclusions – The selection of landing sites for rover missions prior to MSR will have an important bearing on the potential scientific success of the Mars Sample Return mission. Discovery of interesting materials at these sites in locations accessible to sample return missions will provide additional enthusiasm for an MSR mission.