EPSC Abstracts
Vol. 6, EPSC-DPS2011-849, 2011
EPSC-DPS Joint Meeting 2011


# MMSR – a study for a Martian Moon Sample Return mission

**P. Michel (1)**, D. Agnolon (2), J. Brucato (3), B. Gondet (4), O. Korablev (5), D. Koschny (5), N. Schmitz (6), K. Willner (7), A. Zacharov (4)

(1) Univ. of Nice-Sophia Antipolis, CNRS, Obs. Cote d'Azur, France; (2) ESA/ESTEC, Noordwjik, The Netherlands; (3) INAF, Obs. Firenze, Italy; (4) IAS, Orsay, France; (5) Space Research Institute (IKI), Moscow, Russia; (6) DLR Berlin, Germany; (7) TU Berlin, Germany

## Introduction

We are entering into a new era of space exploration defined by sample return missions. The study of extraterrestrial samples in the laboratory has given us many insights to Solar System formation and evolution, but is hampered by having to rely on the arrival of meteorites – fairly random samples from asteroids, the Moon and Mars. There is now increased interest from the scientific community in the acquisition of samples from specific parent bodies; this is reflected by proposals for an increasing number of sample return missions within Solar System exploration programs.

As part of the Mars Robotic Exploration Programme, the European Space Agency ESA is studying a mission to return a sample from one of the Martian Moons, either Phobos or Deimos. Part of the mission goal is to prepare technology needed for a sample return mission from Mars itself; but the mission should also have a strong scientific justification which is described here.

## 1. Science goal

Several different compositions are envisaged to be responsible for the low albedos and red spectral slope of the Martian moons. The closest match in the asteroid population is found among asteroids from the outer belt and Trojan asteroids, D-type objects interpreted as rich in organic compounds and possibly having ice-rich interiors. Such objects are thought to be ultraprimitive, and to have experienced very little processing over solar system history.

This led to the hypothesis that the Martian moons are really captured asteroids. However, the chances for capturing two objects in near-equatorial circular orbits is very small. Thus, several different formation scenarios are currently discussed:

(a) co-accretion of material with chondritic composition that also formed Mars

(b) capture of objects coming close to Mars

(c) Impact of a large body onto Mars and formation from the impact ejecta

This leads to the main science goal of this mission will be to

*Understand the formation of the Martian moons Phobos and Deimos and put constraints on the evolution of the solar system.*

To do this, samples from one of the Martian moons from the formation time of the moon have to be returned to Earth.

We will show in this paper how the science goal can be achieved and in particular why a sample return mission is crucial for this.

## 2. Mission

Spacecraft and payload will be based on experience gained from previous studies to Martian moons and asteroids. In particular the Marco Polo mission study performed at ESA will be used as a starting point. In particular Phobos has been well characterized already by Mars orbiters. Thus, some payload like an IR spectrometer may actually not be needed for this mission.