EPSC Abstracts,
Vol. 4, EPSC2009-86, 2009
European Planetary Science Congress,

Marco Polo, a sample return mission to a primitive Near-Earth Object

M. A. Barucci (1), M. Yoshikawa (2), D. Koschny (3), H. Böhnhardt (4), J. Brucato (5), E. Dotto (6), I. Franchi (7), S.F. Green (7), J.-L. Josset (8), J. Kawaguchi (2), P. Michel (9), K. Muinonen (10), J. Oberst (11), H. Yano (2), R. P. Binzel (12), D. Agnolon (3), J. Romstedt (3)

(1) LESIA, Observatoire de Paris, France (antonella.barucci@obspm.fr / Fax: +33-145077144) (2) JSPEC, JAXA, Japan, (3) ESA/ESTEC, The Netherlands, (4) MPS Katlenburg-Lindau, Germany, (5) INAF, Napoli, Italy , (6) INAF, Roma, Italy, (7) Open University, UK, (8) Space Exploration Institute, Neuchatel, Switzerland, (9) Univ. Nice-Sophia Antipolis, Côte d'Azur Observatory, France, (10) Univ. Helsinki, Helsinki, Finland, (11) DLR Berlin, Germany

Abstract

Marco Polo is a sample return mission to a primitive Near-Earth Object (NEO), proposed as joint JAXA/ESA mission, and selected in 2007 by ESA in the framework of COSMIC VISION 2015-2025 programme, for assessment and industrial studies.

Marco Polo is one of the six candidates of Cosmic Vision Medium missions with down-selection end of 2010 for entering the Definition phase and with final selection early 2012 for launch in 2017-2018.

The main objective of the mission is to return unmodified material from a primitive NEO (such as a C or D type asteroid) to the Earth to allow the analysis of the material in ground-based laboratories. These primitive NEOs are part of the small body population that represent the leftover building blocks of the Solar System formation process. They offer important clues to the chemical mixture from which the planets formed about 4.6 billion years ago and carry records both of the Solar System's birth and early phases. In addition, the mission will allow studying the geological evolution of small bodies.
These primitive bodies appear to be rich in organic carbon. It is likely that some of these bodies are the source of the carbonaceous chondrites, from which much of our current knowledge of Solar System formation has been derived. However, our meteorite collections are heavily biased towards tough and coherent specimens that have survived the violent process of atmospheric entry. As a consequence, our collections contain materials that are the result of some combination of thermal and shock metamorphism and aqueous alteration on the parent asteroid. Primitive material less processed on the parent body is likely to be largely destroyed during atmospheric entry – and therefore we anticipate material returned from a primitive asteroid will contain materials without any known meteorite analogue. Such materials offer an un-rivaled opportunity to investigate the precursor materials to the solar system, the processes and chronology in the solar nebula and as accretion progressed.

Marco Polo will provide the first opportunity for detailed laboratory study of the most primitive materials that formed the terrestrial planets and advance our understanding of some of the fundamental issues in the origin and early evolution of the Solar System, the Earth and possibly life itself.

Marco Polo is based on a launch with a Soyuz Fregat. The Mother Spacecraft MSC will perform global characterization from low (a few km) orbit for several months before descending to one or more selected locations on the surface for the sampling activities. Several sampling attempts can be performed. The possibility of sampling multiple sites is being analysed. The samples will be transferred to a Sample Return Capsule (SRC) which will be released from the MSC on a re-entry trajectory into the Earth's atmosphere. The sample of the NEO will then be available for detailed investigation in ground-based laboratories.

The science requirements for the mission have been defined and will be presented in detail as well the technical development status of the mission.