

SPACE EXPLORATION SYMPOSIUM (A3)

Mars Exploration – Part 1 (3A)

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THE EUROPEAN ROBOTIC EXPLORATION OF THE PLANET MARS

Abstract

The ESA Mars Express mission was launched in June 2003 and has been orbiting Mars for over six years providing data with an unprecedented spatial and spectral resolution on the surface, subsurface, atmosphere and ionosphere of the red planet. The main theme of the mission being the search for water in its various states everywhere on the planet. Mars Express will be followed by the new joint ESA-NASA Mars Exploration Programme, starting in 2016 with an Orbiter focusing on atmospheric trace gases and in particular methane. The ExoMars and MAX-C rovers will follow in 2018 to perform geochemical and exobiological measurements on the surface and the subsurface. Later, potential missions may include a Network of 3-6 surface stations, in order to investigate the interior of the planet, its atmospheric dynamics and the geology of each landing site. This Network would address: i) the internal geophysical aspects, i.e. the structure and dynamics of the interior of Mars including the state of the core and composition of the mantle; the fine structure of the crust including its paleomagnetic anomalies; the rotational parameters (axis tilt, precession, nutation, etc) that define both the state of the interior and the climate evolution; ii) the atmospheric physics aspects, i.e. the general circulation and its forcing factors; the time variability cycles of the transport of volatiles, water and dust; surface-atmosphere interactions and overall meteorology and climate; iii) the geology of each landing site, i.e. the full characterization of the surrounding area including petrological rock types, chemical and mineralogical sample analysis, erosion, oxidation and weathering processes to infer the geological history of the region, as well as the astrobiological potential of each site. To complement the science gained from the Martian surface, investigations need to be carried out from orbit (possibly using the 2016 Orbiter) in a coordinated manner, such as global atmospheric mapping to study weather patterns, opacity and chemical composition, as well as study of the planet rotation and climate evolution. The Network Mission concept is based on the fact that some important science goals on any given terrestrial planet can only be achieved with simultaneous measurements from a number of landers located on the surface of the planet (primarily internal geophysics, geodesy and meteorology) coupled to an orbiter. The long-term goal of Mars robotic exploration in Europe remains the return of rock and soil samples from the Martian surface before Humans go to Mars.