

MEMO: Mars Escape and Magnetic Orbiter

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There are several reasons to believe that Mars could have become an Earth like planet rather than the present dry and cold planet. In particular, many elements suggest the presence of liquid water at the Martian surface during a relatively short period at an early stage of its history. Since liquid water may have been the birthplace for life on Earth, the fate of Martian water is one of the major key and yet unanswered question to be solved.

Mars Escape and Magnetic Orbiter (MEMO) is a low periapsis orbiter of Mars devoted to the measurement of present escape and the characterization of the fossil magnetic field of Mars. The use of a low periapsis altitude orbit (120-150 km) is required to detect and quantify all populations of atoms and molecules involved in escape. It is also required to measure the magnetic field of Mars with an unprecedented spatial resolution that would allow getting a more precise timing of the dynamo and its disappearance.

Achieving a full characterization of atmospheric escape, and extrapolating it back to the past requires: (i) to measure escape fluxes of neutral and ion species, and characterize the dynamics and chemistry of the regions of the atmosphere where escape occurs (thermosphere, ionosphere, exosphere), as well as their responses to solar activity, and (ii) to characterize the lateral variations of the magnetic field of lithospheric origin, and by extension, the timing of the Martian dynamo. Of particular interest is the extinction of the dynamo that is thought to have enhanced the atmospheric escape processes still operating today. The proposed low-periapsis orbiter will consist of the following elements:

- An "Escape Package" to characterize by both in-situ and remote measurements the thermosphere, ionosphere, exosphere and solar wind interaction regions (from one hundred to several thousand km), including thermal, suprathermal

and energetic particles.

- A "Magnetic Field Package", to characterize the magnetization of the lithosphere, and in particular the contrasts between magnetized and demagnetized areas, which cannot be accomplished with the present MGS coverage. This package will also serve for the characterization of escape processes.
- A "Preparing to Aero-assistance Package", to measure atmospheric and meteorological parameters (density, temperature, wind) in the aerocapture region (which extends down to about 40 km altitude), to allow physical 3-D fields of parameters from the middle atmosphere up to the high thermosphere to be built.

A mission like MEMO would ideally complete the present European program for the exploration of Mars by contributing to our understanding of what has made the Earth suitable for life and not Mars.