Exomars entry and descent science

Conference or Workshop Item

EXOMARS ENTRY AND DESCENT SCIENCE. F. Ferri[1], **S. R. Lewis[2],** A. J. Ball[2], G. Colombatti[1], A. Aboudan[1], F. Angrilli[1], I. Müller-Wodarg[3], B. Hathi[2], M. R. Leese[2], J. C. Zarnecki[2] and the EDLS Science Team. [1]CISAS "G. Colombo", University of Padova, Via Venezia 15, 35131 Padova, Italy. (francesca.ferri@unipd.it) [2]Centre for Earth, Planetary, Space and Astronomical Research, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK. (S.R.Lewis@open.ac.uk)[3]Space and Atmospheric Physics Group, Imperial College London, Prince Consort Rd, London SW7 2BW, UK.

The entry, descent and landing of *ExoMars* offer a rare (once-per-mission) opportunity to perform *in situ* investigation of the martian environment over a wide altitude range. We present an initial assessment of the atmospheric science that can be performed using sensors of the Entry, Descent and Landing System (EDLS), over and above the expected engineering information. This is intended to help fulfill the concept of an Atmospheric Parameters Package (APP), as mentioned in the *ExoMars* draft Science Management Plan [ESA, 2005].

Mars' atmosphere is highly variable in time and space, due to phenomena including inertio-gravity waves, thermal tide effects, dust, solar wind conditions, and diurnal, seasonal and topographic effects. Atmospheric profile measurements, drawing on heritage from the *Huygens* Atmospheric Structure Instrument (HASI), which encountered Titan's atmosphere in 2005 [1], should allow us to address questions of the martian atmosphere's structure, dynamics and variability.

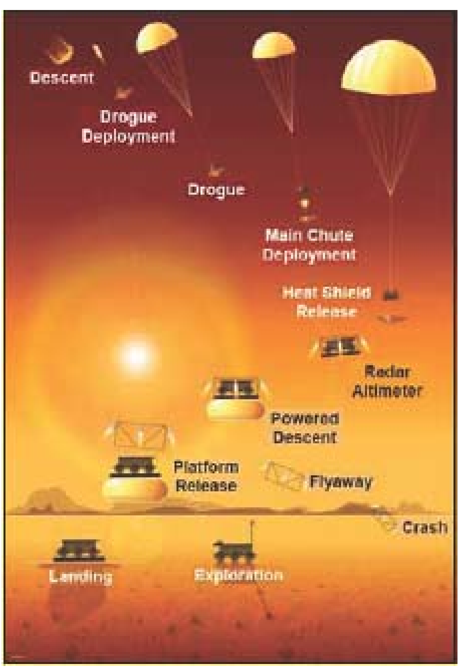

Figure 1: *ExoMars* EDLS sequence

By careful definition of EDLS measurements to yield science as well as a successful landing, we aim to obtain continuous atmospheric density, temperature and pressure profiles over the widest ever altitude range, with the highest sensitivity and spatial resolution.

Extrapolation to the *ExoMars* case of the flight performance of the HASI entry accelerometry experiment is encouraging.

Up to now, only three high vertical resolution and high accuracy vertical profiles of density, pressure and temperature of the martian atmosphere have been derived from *in situ* measurements performed by *Viking 1* and *2* in day-time [2] and by *Mars Pathfinder* in night-time [3, 4]. Two more vertical profiles have been retrieved from the deceleration curves and aeroshell drag properties of the two Mars Exploration Rovers (MER) during atmospheric entry [5], but with a much lower accuracy.

Such profiles are vital for testing of atmospheric models used in numerous studies of atmospheric variability, on a range of temporal and spatial scales, as well as for the practical issue of reaching the martian surface reliably.

New data from different site, season and time period are essential to investigate the thermal balance of the surface and atmosphere of Mars, diurnal variations in the depth of the planetary boundary layer and the effects of these processes on the martian general circulation.

A better understanding of the martian environment and meteorology is also essential for refining and constraining landing techniques at Mars and to evaluate the possible hazardous to machines and humans in view of future Martian explorations.

As the *ExoMars* project definition proceeds, the entry, descent and landing sequence may offer further science opportunities. We would be interested in exploring these and welcome additional members to the consortium. The joint team co-ordinators are Francesca Ferri (Univ.. Padova, Italy) and Stephen Lewis (Open University, UK).

References:

[1] Fulchignoni, M. *et al.* (2005), *Nature, 438(7069),* 785-791.
[2] A. Seiff, D.B. Kirk, (1977) *J. Geophys. Res., 82,*. 4364-4378.
[3] Schofield, T., *et al.* (1997) *Science, 278,* 1752-1758.
[4] Magalhães, J.A., J.T. Schofield, A. Seiff, (1999) *J. Geophys. Res,.104*, 8943-8945.
[5] Withers, P. and M. D. Smith (2006) *Icarus, 185,* 133-142.