Exomars entry and descent science

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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.

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 pe-
riod 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 con-
straining 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 en-
try, descent and landing sequence may offer further science opportunities. We would be interested in ex-
ploring 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- 
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