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THE NETLANDER SEISMIC EXPERIMENT

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- Our present understanding of the interior structure of Mars is mostly based on the interpretation of gravity and rotation data, or on the chemistry of the SNC meteoroids, and its comparison with the much better–known interior structure of the Earth (e.g. Schubert and Spohn, 1990; Longhi *et al.*, 1992). On the Earth, most of the internal structure was determined by seismic studies: this started at the beginning of the century with Oldham by the early discovery of the velocity increase with depth and, in 1906, by the detection of a low P velocity zone in the centre of the Earth [Oldham, 1906], identified latter as the Earth's core.
- Mars is unfortunately a seismically unexplored planet. Most of the past seismic experiments have indeed failed, either due to a launch failure, as for the Optimism seismometer [Lognonné *et al.*, 1998] onboard the small surface stations of Mars 96 [Linkin *et al.*, 1998], or after a failure on Mars, as for the seismometer onboard one of the two Viking landers. The only attempt to address seismology on Mars was therefore made with the Viking seismic experiment onboard the remaining Viking 2 lander [Anderson *et al.*, 1977]. However, it did not result in convincing marsquake detection, basically due to too strong wind sensitivity, as well as a too low resolution during non-windy conditions.
- The Very Broad Band seismometer will perform both the seismic and tidal measurements. It was proposed onboard the NetLander by a large team of scientists, mostly involved only in Earth seismology and Earth tides. The seismic data analysis will determine the mean values of the shear and bulk elastic moduli and seismic attenuation as a function of depth, mainly from the transmitted phases. The reflected phases will mainly constrain the position of the interfaces between the mantle and core, the state of the core, the position and characteristics of mantle discontinuities and crustal thickness.

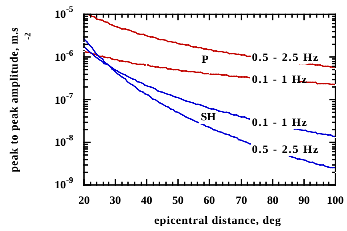
A PRIORI SEISMIC SOURCES

Marsquake: This activity is about 100 times greater than the shallow moonquake activity detected by the Apollo seismometers with good signal-to-noise ratio. The amplitude of the Mars seismic signal is still expected to be about 4 orders of magnitude lower than on the Earth. It was detailed by Golombek *et al.* [1992] from surface fault observation and by Philipps *et al.* [1991] from a theoretical estimate of the thermo-elastic cooling of the lithosphere. It might provide about 14 quakes of seismic moment 10^{15} Nm per year, with an increase/decrease of the frequency by 5 for a decrease/increase of the seismic moment by 10.

Atmospheric turbulences: As recently discovered by Nawa *et al.* [1998], Suda *et al.* [1998], these turbulences on the Earth excite indeed continuously the fundamental branch of spheroidal Earth normal modes. As shown by Kobayashi & Nishida [1998], such excitation process on Mars might be almost as strong as on the Earth. The inversion of the detected free frequencies of the excited normal modes might then, without any quake, provide information on the shear structure of the upper Martian mantle, as well as on the state and size of the core for the gravest modes [e.g. van Hoost *et al.*, 2000]

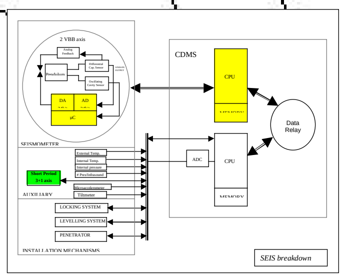
Tides: The observation will focus on the tides produced by Phobos and the Sun, the latter producing a displacement of a few cm associated with a tidal forcing of the order of 10^{-7} m/sec^2. These observations do not only give information on the direct attraction of these bodies on Mars, but also on the surface deformations (Love number h) and on the induced mass redistribution (Love number k). The contribution of the core to the sun tidal response could be of the order of half a mm. Here, the signal used will be the amplitude of the tidal gravimetric factor, which is a linear contribution of the Love numbers h and k. It corresponds to the Mars transfer function to the external tidal forcing. Details on this transfer function are given in Dehant *et al.* [2000].

Amplitude estimates for body waves [Mocquet, 1999]. The rapid decrease of S waves is due to the attenuation in the mantle. Peak to peak amplitudes for 2 frequency bandwidth. Below are the detection coverage of the Network assuming a noise of 10^{-9} ms^{-2}/Hz$^{1/2}$.



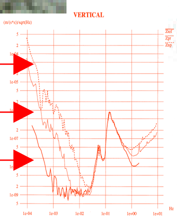
Technologie and collaboration

The experiment is done by a consortium between France (White), Switzerland(Yellow) and USA (Green). Funding by PRODEX for CH, NASA for USA and CNES/INSU for France.



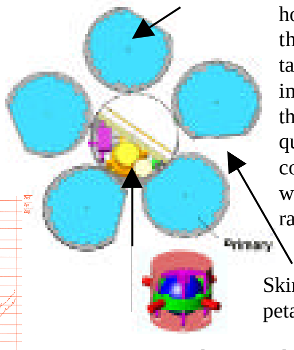
DATA TRANSMISSION: We expect a daily transmission of LP data (1 sps) for a volume of 2.5 Mbits/day. The seismometer team in at least two geographical locations will perform the quick-look on the Earth of these data, in order to maximise the turn-around time during regular shift hours (Paris and Pasadena, UT+1 and UT-8). From these data, a set of time will be identified, and a table of parameters will be up-linked to each lander in order to flag and to save the interesting data in the general memory of the CDMS (e.g. when quakes are tentatively identified). The corresponding VBB (20 sps) and SP data (100 sps) will then be progressively sent as EVENT data at a rate of about 5 Mbits/day.

A PRIORI SEISMIC NOISE



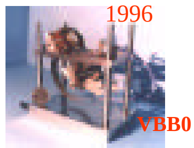
surface
Shield
Vault

Petals produce shadow around the sensor



Skirt will be deployed between each petals for a full wind/shadow protection

Seismo is protected against direct wind by wind and mylar sheet and IS DECOUPLED from lander. Direct contact with ground by 3 spike.



The SP will be the third generation of sensors developed by JPL

The VBB sensor will be the 4th generation of sensors designed by IPGP after OPT, lost onboard Mars96