THE MARS SEIS EXPERIMENT : A MARS SEISMIC PACKAGE. D. Mimoun [1], P. Lognonné [1], W. B. Banerdt [2],P. Schibler [1], D. Giardini [3], G. Pont [4] and the SEIS Team. [1]Institut de Physique du Globe de Paris (Departement de Géophysique Spatiale et Planétaire 4 avenue de Neptune 94100 Saint Maur des Fossés, France mimoun@ipgp.jussieu.fr, lognonne@ipgp.jussieu.fr ,schibler@ipgp.jussieu.fr) , [2] Jet Propulsion Laboratory, California Institute of Technology (Mail Stop 183-501, 4800 Oak Grove Drive, Pasadena, CA 91109, bruce.banerdt@jpl.nasa.gov), [3]ETHZ (ETH Hönggerberg, HPP P 6.1 Schafmattstr. 30 8093 Zürich , giardini@seismo.ig.erdw.ethz.ch), [4]CNES (18 avenue Edouard Belin 31401 Toulouse Cedex 09 Gabriel.Pont@cnes.fr)

The Mars SEIS experiment. The SEIS experiment was first proposed by IPGP (and accepted) for the NetLander mission. It integrates two VBB (Very Broad Band) seismometers, a three axis Short Period seismometer and a series of environmental sensors for pressure, infra-sounds and temperature. IPGP (France) has the overall responsibility of the experiment and is responsible for the seismic and environmental sensors. ETHZ (Switzerland) is responsible for the electronics of the experiment and JPL (USA) for the SP (Short Period) sensors. As NetLander mission has been cancelled (while fortunately the development still goes on), this seismic package can be proposed for future Mars missions.

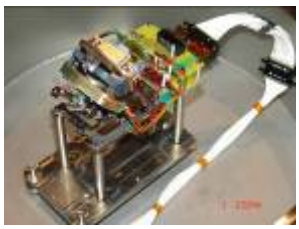
Scientific objectives : The SEIS instrument is proposed by a large team of scientists. It will perform both seismic and long term tidal measurements. The seismic data analysis will determine the mean values of the shear and bulk elastic moduli and seismic attenuation as a function of depth, mainly from 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. The initial configuration was of four landers on Mars. However, a dramatic increase of Mars interior knowledge is awaited even with two or one single station.

Performances The sensors package will allow :

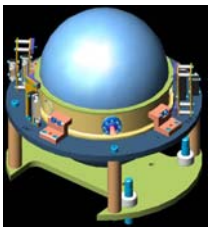
- to measure signals in an ultra-broad band, from the tidal frequencies (0.05 mHz) up to the short period frequencies (50 Hz)
- to perform environmental decorrelations of the temperature and pressure variation on Mars, allowing the sensor to operate in a thermal environment with daily variations of about 40°K
- to search for infra-sounds which might be associated to dust devils and atmospheric discharge.

SEIS description : The overall mass of the SEIS experiment is 2.3 kg. (Measured) power budget is about 3 W, but a power need reduction action is in progress (target is about 1 W). This budget includes all sensors and a dedicated (decentralized) avionics, based on a powerful LEON core. Acquisition will be performed by a series of 24 bits A/D, while the thermal and drift control will be performed by a feedback generated by a 24 bits D/A.

Industrial development : We are currently at the end of the B phase, with a breadboard of the axis already delivered by industry (EADS-Sodern) in July 2004. Most critical parts have been tested, including shock tests (200g, 20 ms) for pivot, electronic components and displacement sensors. The electronics breadboard has also been delivered and is currently under extensive performance tests at ETH facilities. The Sphere (phase B Breadboard), including the 2 VBB axis, will be delivered by industry (EADS-Sodern) in June 2005. Structural and Thermal Model (STM) of Sphere will be be delivered in June 2005. Full Seismic calibration and environmental tests are planned in 2005.

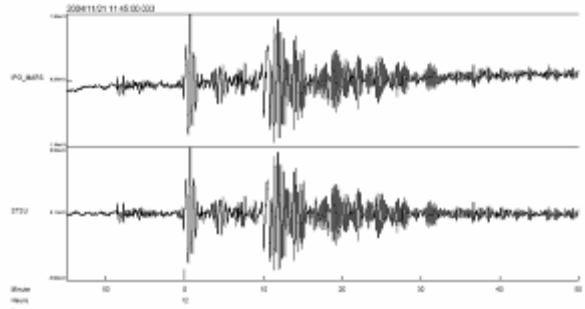


Single axis under tests



CAD model of breadboard

Preliminary results: Functional results are satisfying and noise optimization is under process. Preliminary noise results are encouraging. We expect to demonstrate that we have reached the STS2 noise level in the incoming monthes.



Guadalupe 6.2 Earthquake: VBB axis vs ref STS 2 (recorded in St Maur, France)

References: Lognonné P. & B. Mosser, Planetary Seismology, 14, 239-302 Survey in Geophysic, 1993. P. Lognonné et al. The NetLander Very Broad band seismometer, Planet. Space Sc., 48,1289-1302, 2000.