THE SEIS EXPERIMENT : A PLANETARY SEISMOMETER FOR MARS … AND THE MOON

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Scientific objectives: The ExoMars GEP Seismometer will study the seismic activity of the Planet and frequency of meteorites impacts. These seismic events will be characterized by their approximate distance and azimuth, as well by their magnitude. The seismometer will also allow also to characterize shallow and deep interior of the planet, and especially the **water environment as a function of depth in the deep subsurface**, **the crustal thickness** of the landing site, the **core size** and possibly, if the seismic activity is between the middle and upper bound of present estimates, the **mantle str**ucture. The sensitivity and noise floor of the seismometers in the expected Martian environment are such that the detection of about 20 quakes with Ms magnitude from 4 to 5 and 10-20 impacts per year are expected for a mean model of seismic activity; our working hypothesis is based on the thermoelastic cooling of the lithosphere, which does not consider any tectonic activity possibly related to volcanoes.

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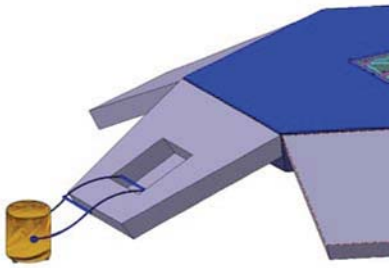

Fig 1. Example of deployment from a petal.

Instrument Configuration: The seismometer will be powered and serviced by the GEP. It is based on an hybrid 4 axis instrument, composed of 2 Very broad Band (VBB) sensors and 2 Short Period (SP) sensors and has a mass of about 1700 gr, excluding all margins. This design reflects a significant mass reduction compared to design studied by previous ESA projects (i.e. MarsNet and InterMarsnet), while offering very little science return reduction as compared to a more classical 3 VBB +3 SP design.

Programmatic Status

The Seismometer has been recommended for implementation on the European Space Agency's Exomars mission during the 2005 Birmingham meeting. Following this meeting, an unsolicited proposal has been submitted to ESA by DLR and IPGP for the inclusion of a Geophysics Package (GEP) to the initial ExoMars Rover Payload. We are currently during the Payload Confirmation review phase, which will result in the finalization of the payload selection end of April 2007. On the technical point of view, the TRL level of the instrument is around 6/7 for the sensing part, and 2/3 for the deployment system, which is strongly linked to the descent module interface.

A breadboard has been delivered by industry (EADS-Sodern) in July 2004. Most critical parts have been tested, including shock tests (200g, 20 ms) for pivot, electronics components and displacement sensors. The electronics breadboard has also been delivered and tested.

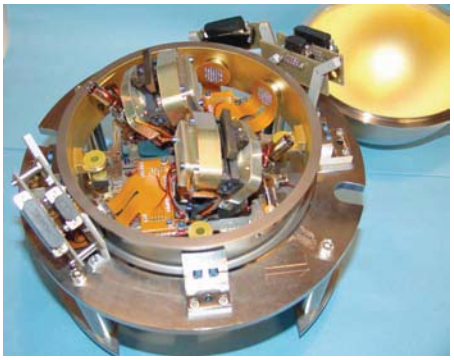

Fig 2 : SEIS Breadboard (CNES/IPGP/SODERN)

Performances: functional results are satisfying and noise optimization is under process. Preliminary noise results are encouraging. Noise Figure is close to our STS2 reference instrument.

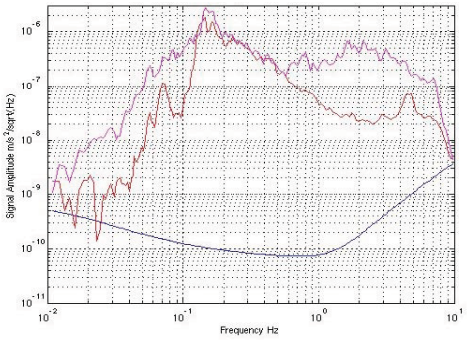

Fig 3 : Noise figure vs typical M=4.5 Earthquake

Moon version of the SEIS instrument

The current specifications of SEIS seismometer allow, with a certain number of non-critical modifications, to make it operational on the Moon (Slight modification of the mobile mass). The development of a seismometer VBB adapted to the lunar conditions, as well as the security of planning and the associated performances could thus be reached relatively simply.
Apart from environmental sensitivity (about 1 mm /K), the theoretical performance shows that vertical Moon noise is already resolved.

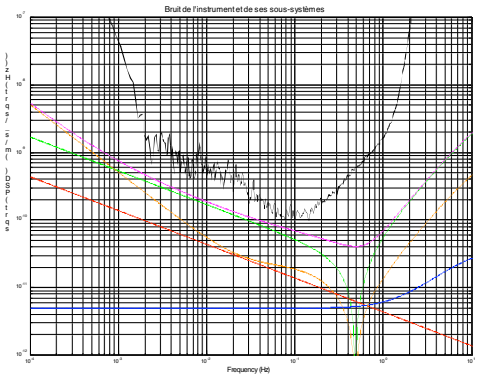

Fig 4 : Moon Noise figure vs Apollo vertical Moon noise

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