**THE EXOMARS – HUMBOLD PAYLOAD SEIS EXPERIMENT :** D. Mimoun[6,1], P. Lognonne[1], J. Gagnepain - Beyneix[1], D. Giardini[2], D.Mance[2], P.Zweifel[2], W. T. Pike[3], S.Calcutt[7], U. Christensen[4], R. Roll[4], A. van den Berg[5], J.M.Smit[8], A.Selig[6], P. Schibler[1], T.Nebut[1], T.Gabsi[1], S.Tillier[1], O.Robert[1],O.Pot[1], A.Anglade[1], P.E.Godet[1], R.Bulow[1] , B.Banerdt[9] and the SEIS team.

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**Scientific objectives:** The ExoMars Seismometer is one of the major instruments of the Humbold payload on board the next ESA Mars mission "Exomars". It is dedicated to the study of the seismic activity of the red planet and will allow to evaluate the frequency of meteorites impacts.

The seismometer will also allow 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** structure.

With the lack of Mars quake detection by Viking [*1, 2*] and the failure of the Mars96 mission with its two small autonomous stations [3] and two penetrators (all equipped with seismometers) shortly after launch, in 1996, no past missions have returned seismic information on the Martian interior, despite several efforts to revive such missions [4,5]. Consequently, the level of seismic activity is unknown and the internal structure of Mars is very poorly known. Despite several orders of magnitude of uncertainty, a "mean" activity of the planet has been nevertheless predicted [3]. The sensitivity and noise floor of the ExoMars seismometer 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 (Figure 1) are expected for a mean model of seismic activity; our working hypothesis is based on thermoelastic cooling of the lithosphere, which does not consider any tectonic activity possibly related to volcanoes, but very large uncertainties exist in the seismic activity.

By deploying the first seismometer on Mars, ExoMars will therefore offer a unique opportunity to prepare, from both scientific and instrument point of view, the future geophysical exploration of Mars. It will provide key information on seismic noise, propagation properties and the possible location of more active areas on Mars, which will be crucial for future major geophysical network mission.

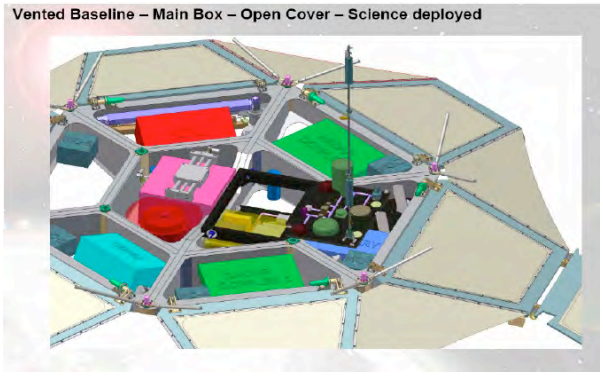


Fig 1. Example of SEIS accommodation (courtesy Thales-Alenia-Space). The SEIS is the red cylinder located near the center of the lander platform

**Instrument Configuration**: The seismometer will be powered and serviced by the Lander service module. It is based on an hybrid 4 axis instrument, composed of 2 Very Broad Band (VBB) sensors and 2 Short Period (SP) sensors, and relies on the heritage of the Netelander study [6]. Its mass in the ExoMars configuration is about 2200 gr, including margins. The instruments encloses also a 24 bits acquisition electronics, and a mass memory to store the data during the night, when then Humbold payload service module is in sleeping mode. The main software is foreseen to be implemented in lander service module.

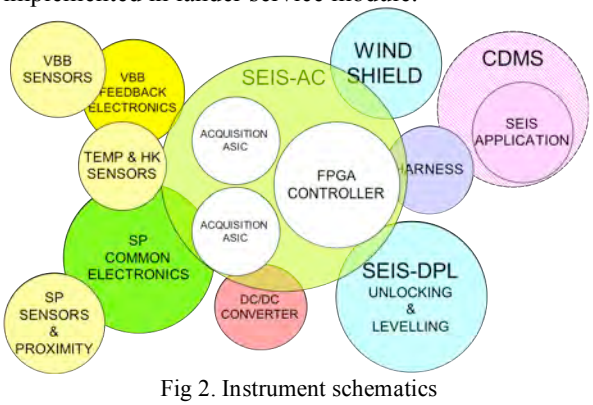


Fig 2. Instrument schematics

**Deployment trade-off**

The ExoMars system team is still iterating on two options for seismometer deployment.

The baseline is to deploy the seismometer *outside* of the service module, using a deployment arm. This optimizes the coupling with the ground, but exposes the seismometer to the strong daily thermal variations and to the wind impact. Optionally, the seismometer may be deployed *within* the service module. This reduces the impact of the environment on the seismometer, but on the other hand complexifies the "short-term" coupling with the ground, as airbag-retraction is not possible yet

**Programmatic Status**

The Seismometer is currently selected for implementation on the 2013 ESA's ExoMars mission. It has successfully completed the PCR (payload confirmation review). On the technical point of view, we are implementing several minor modifications with respect to the NetLander initial design in order to comply with the ExoMars requirements. The Technology Readiness Level (TRL) of the modified instrument will be around 5 for the instrument PDR in mid 2008.

A breadboard in the NetLander configuration 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. Electronics changes with respect to the former Netlander configuration lies in the use of ASICS technology to optimize mass and power consumption.

Fig 3 : SEIS Breadboard (CNES/IPGP/SODERN)

**Performance**: Preliminary results on both functional point of view and performance level ( including thermal compensation calibration) are satisfying, but noise optimization is under process, especially at low frequencies. Preliminary noise results demonstrate that the noise of the SEIS is close to our STS2 reference instrument, despite a much smaller mass.

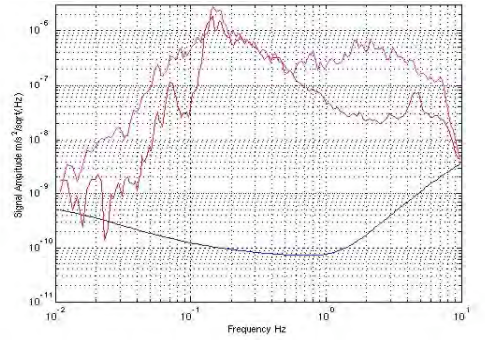


Fig 4 : Noise figure vs typical M=4.5 Earthquake

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