European Network of Geophysical Planetary Observatories

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Despite 40 years of planetary exploration, very little is known about the deep interior of the planets. The composition and size of the Moon's core is not well known, due to the location of all Apollo seismic stations on the near side. For Mars, even basic parameters like the state and size of the core, the thickness of the crust, and the depth of phase discontinuities are unknown. These informations are however crucial to understand planetary formation and evolution. A crucial step before the start of Cosmic vision, will be the GEP pathfinder network payload onboard ExoMars, able to retrieve the science lost by the failure of the Mars96's small stations and to get other exciting geophysical observations, such as tides, geodesy and heat flux. But we also hope that Cosmic vision will be able to perform new steps, including some of the projects extensively studied during Horizon 2000+ and never implemented (e.g. MarsNet, InterMarsnet). We propose therefore for Europe two major initiatives despite their difference of size in a sequence of a smart size and a medium size mission, the later being related to international collaboration or collaboration with ESA's Human Flight activities. These two initiatives are: (1) A Smart size contribution to future ESA, US or Chinese robotic landers or Human mission to the Moon with the development and provision of a new generation of Autonomous Lunar Surface Experiment Package (ALSEP), comparable to the ALSEP package deployed by NASA during the Apollo missions. In addition to the science objectives, the major technological objective will be the development and flight-test of long lived power sources possibly compatible with international missions. (2) A Medium size mission for a Long-lived, dense seismic network on Mars in order to determine the three-dimensional structure of the interior and possibly the Martian convection regime.

Despite their differences in size and budget, both missions will in fact be able to address network science. This will be surprisingly the case of a single new ALSEP Moon station. It will indeed be able to detect the same deep moonquakes as the 4 Apollo ALSEP stations, will provide a 3rd heat flux measurement and will deploy new laser reflectors, in addition to other non-network experiments. And of course, network science will be the core of the dense long lived Martian network, especially if the later can be done in collaboration with NASA in 2018. A possible core payload might be based on ultra-sensitive very broad band seismometers, heat flux package compatible with deep deployment capacity, ultra-precise geodetic beacon and radio-science system, ultra-sensitive flux gate and absolute magnetometers and a subsurface sounding package in addition to atmospheric sensors. This suite of instrument will be able to perform a passive sounding of the deep and shallow planetary interior and to retrieve the temperature profile and mineralogical profile in the planet and 3D mantle lateral variation by a joint inversion of the seismic, conductivity profiles and heat flux and geodetic data. 8 landers operating for 4 to 10 years will be necessary to obtain a detailed tomographic picture of the mantle convection. These models will be then used to understand the planetary formation processes, the geological evolution, the mantle convection, the lithospheric structure and the type of tectonic. Of course, in addition to these geophysical objectives, meteorological objectives on Mars will also be reached by a meteorological package.