Project “Phobos-Soil”: A complex sounding of the Phobos moon.

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The primary goal of the ”Phobos Soil” mission is investigation of the Phobos moon and particularly its internal structure. These studies are based on the an following measurements which are performed by various instruments carried by the spacecraft: - gravitational field variations caused by librations fluctuations of Phobos moon and tidal effects; - seismic noise at frequencies between 0,1 and 100 Hz for revealing how their intensity and spectral structure depends on thermoelastic effects, artificial and natural influences on the Phobos moon surface (Ð- and S-waves from working GZU (manipulator for automated testing for soil and rock properties); dust and gas fluxes from the torus around the Phobos moon orbit, solar wind pulsations, impacts of small meteoroides et etc); - magnetic (3 components) and electric (2 components) field fluctuations in the frequency range from 0.1 to 1000 Hz which allows to determine an impedance on a surface of the Phobos moon (magnetotelluric sounding) and to investigate electrodynamic properties of rocks from which the Phobos moon is made; - remote sounding of the subsurface layers of the Phobos moon by the long-wave radar at frequencies around 145 ÌHz from distances of 50-100 km, then from those of 10-100 ì and, finally, directly at the Phobos moon surface. The available photometric data gathered earlier show rather complex character of both Phobos moon surface and it’s subsurface structure.. In 1998 - 2005 , a novel hardware for deploying onboard the spacecraft (landers) and related numerical methods has been developed for magnetotelluric sounding of the subsurface layers of Mars, particularly for an investigation of the planetary cryolitozone. Similar methods are planned to use for studying of the internal structure of the Phobos moon. The developed toolkit is proposed for low-frequency sounding in the MARSES experiment onboard the Martian balloon, rover and landing module. The magnetotelluric sounding of the Phobos-moon is based on measurements of electric and magnetic fields carried out by the PhPMS plasma-magnetic system flown onboard the “Phobos-Soil” spacecraft. The advantage of the “Phobos-Soil” mission is simultaneous observation of various physical parameters: dust and solar wind flux, interplanetary magnetic field, electric field fluctuations and seismic activity at the surface of the Martian moon et etc. Further statistical and correlation studies will allow to reveal their mutual interconnection and to illuminate the peculiarities of the Phobos internal structure. Measurements of velocity distributions of ions sputtered from the Phobos surface will provide information on the composition variation across the surface thus complementing other measurements of Phobos properties. In situ measurements of a magnetic susceptibility and conductivity of rocks from the surface layer of Phobos is performed directly in the GZU probing channel. It allows to obtain an aprioristic information about the top layer of Phobos rocks (down to 0.5m) which facilitates, then, an interpretation of data recorded with the electromagnetic sounding by means the long wave radar. The complex sounding of the Phobos moon provides not only the information about its structure (important for understanding of the origin of the Mars -Phobos - Deimos system) but also an outstanding experience of sounding at surface of celestial body. This experience is of particular importance for further investigation of subsurface structures of Mars and its paleoclimatic history which will be carried out in the future space missions. References: [1] Clifford S.M. (1993) JGR, 98, 10973-1016. [2] Fanale F.P. (1986) Icarus, 67,1-18.[3] Ozorovich Y.R., Linkin V.M., Smythe W., " Mars Electromagnetic Sounding Experiment - MARSES ", Proceedings of LPI Conference, Houston, 1999. [4] Skalsky A., E. Dubinin, M. Delva, R. Grard, S. Klimov, K. Sauer, and J.-G. Trotignon, Wave observations at the foreshock boundary in the near mars space, Earth Planets and Sun, v.50, 3, 439, 1998.