EPSC Abstracts
Vol. 5, EPSC2010-795, 2010
European Planetary Science Congress 2010

Geological and geochemical complex Moon investigation

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1. Abstract

Current methods of planet investigation in the Solar system do not vary a lot. The majority of research programmes includes landing a station in a certain region of space body and studying of the region around point of landing with a small expansion due to rover use. Such programmes, besides extremely high costs, are ineffective for obtaining information about surface and undersurface structures as a whole, and point of module landing in a certain planet region is determined by very few amount of initial data. Returning probes to Earth is not even discussed.
It is necessary to find methods, allowing to construct atlases of chemical and geological composition of a space body surface, in the first place by returning microprobes, with lower costs and higher reliability. It is most easily fulfilled for planets that do not have atmosphere or Moon. Also, as it is shown in this case, seismical studies of the Moon are simultaneously used for geological and geochemical investigation. For this it is necessary to complete the orbital research station with a returning capsule.

2. Description of principle

Orbital research station (ORS) consists of laser-spectral, control, capsular, intake and returning modules. ORS is launched onto circular orbit around Moon by means of known methods. Apparatus height with respect to surface is chosen to be minimal and is determined by landscape and gravitational anomalies. Then a chemical analysis of surface is conducted in the vicinity of orbital plane. For this a powerful laser impulse is sent from the station to a certain point on the surface.

Absence of atmosphere and ray focusing allow to concentrate all radiation energy in a small area. After absorbing laser radiation energy, which is equal to ~100 J, some soil will evaporate and a subsequent radiation of light energy will take place. For orbit height of ORS equal to 10 km, and intake surface of registrating fotoelement ~1 m^2 solid angle is about ~10^{-8} steradian. If irradiated energy E_T is equal to at least 1 % of impulse energy, and radiation is isotropic in all directions than registered energy is ~10^{-11} J.

Sensitivity of up-to-date fotomultipliers is ~10^{-19} J which is much lower than amount of energy radiated on fotoelement.

For increasing effectiveness of this method, laser impulse is sent to the region where capsule has exploded. So, step by step, spectrum of evaporated ground is written not only in the orbital plane, but all space body by rotating orbital plane. Registered spectras together with data regarding their location are either analyzed by on-board system or sent to Earth directly

Obtained data regarding chemical composition of surface allows transferring to investigation of planet surface's geological composition, which is done by probe intake and/or seismic impulse. In this case, function of this method is not only to ensure seismic impulse, but also at the same time to use energy of explosion for vertical outburst of fragmented ground upward to ORS's orbit.

Taking into consideration trajectory parameters, characteristics of launch charge, a capsule is delivered on studied planet's surface, which is turned onto trajectory of collision with planet's surface with help of rocket engine or by ballistic method. Meeting point is calculated by on-board computer. In the simplest case capsule should be launched from ORS so that it would be moving in the same direction of trajectory which is tangent to surface of the planet in a point opposite to launch point (so that its trajectory would be a half-ellipse).

3. Summary and conclusions

Mass of space research lab for realization of this method is significantly less compared to mass of currently used systems. Thus, detailed atlases of chemical and mineralogical composition of planet's surface and undersurface regions can be obtained.

Suggested program of geologo-physical and geochemical space bodies investigation for planets without atmosphere, is targeted to Moon, but can be effective with slight modifications for all planets of Solar system, and using new principles of capsule returning allows Mars investigation as well.

References

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