**Present Status of the Lunar Lander Project SELENE-2.** S. Tanaka[1], T. Mitani[1], H. Otake[1], K. Ogawa[1], N. Kobayashi[1], T. Hashimoto[1], T. Hoshino[1], M. Otsuki[1], S. Wakabayashi[1], J. Kimura[2], K. Kuramoto[2], [1]JAXA (3-1-1 Yoshinodai, Chuo-ku, Sagamihara-shi, Kanagawa 252-5210, JAPAN, tanaka@planeta.sci.isas.jaxa.jp), [2]CPS/Hokkaido Univ. (Kita 8, Nishi 5, Kita-ku, Sapporo, 060-0808, JAPAN).

**Introduction:** SELENE-2 lunar landing mission is one of the series of Japanese lunar exploration program of the next two decades[1](Fig.1). In the previous meeting, we introduced candidate instruments on board a lander, a rover, and an orbiter respectively [2], and discussed science concept (scenario). At this time, we report up-dated status of the project and some progress of development of technological aspect of the system and instruments on board.

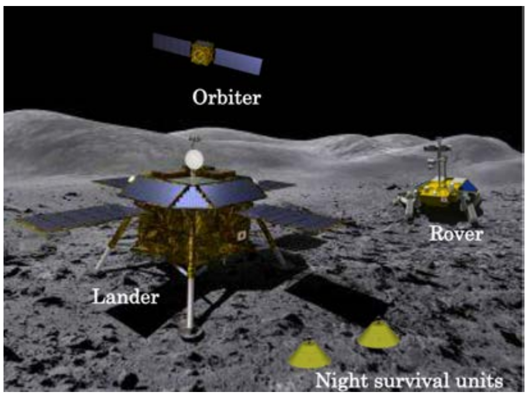


Fig.1 An image view of the SELENE-2 system

**Outline of the mission and basic concept and strategy of deployment of the instruments on board the SELENE-2:** SELENE-2 project has been started from 2007 as the first Japanese lunar lander. The main prior object of the SELENE-2 mission is to develop safe and precise landing system on middle to large planets and satellites such as the Moon, Mars for a future lunar and planetary exploration. Another key technologies under investigation are surface mobility by a rover, and long night survival module without using nuclear power. An outline of the system is shown in Table1. In addition, some instruments for lunar science and future utilization have been so far investigated.

As for the science regime, the basic concept of observation strategy is as the following three items;

a) Investigating radial variation(s) of structure and chemical composition, hopefully, to the center of the Moon by the combination of in-situ Geophysical and Geological measurements,
b) Detailed geological observations which are motivated by the recent progress of the lunar remote sensing observations, and
c) Proceeding the first step of astronomical observations in the lunar (unique) environment.

On the other hand, the basic concept of future utilization and other purposes are;

a) Supplying useful informationfor the future manned mission to the Moon, and
b) Promoting outreach activity following the successful result of the Kaguya mission which deployed High Definition TV (HDTV).

Table 1 Tentative mass budget of the spacecraft (GTO launch case)

| | | | |
|---|---|---|---|
| Orbiter | Bus system | | 600 kg |
| | Mission payload | | 100 |
| | Fuel | | 2400 |
| | Total | | 3100 |
| Lander | Bus system | | 700 |
| | Mission payload | | 200 |
| | Rover | Bus system | 80 |
| | | Mission payload | 20 |
| | | Total | 100 |
| | Fuel | | 1700 |
| | Total | | 2700 |
| Total | | | 5800 |

**Present status of the project:** The Strategic Headquarters for Space Policy of Japanese government established "Basic Plan for Space Policy" in June, 2009 [3]. Following the plan, a concrete strategy of Japanese lunar exploration had been discussed in "Study group for lunar exploration" of Japanese government which was organized from August, 2009 to July, 2010. The final report of the group indicates that a spacecraft should land on lunar surface in around 2015 to promote lunar exploration using advanced robot technology in 2020 [4]. Despite of this result, the SELENE-2 is delayed and still remains as the Phase-A study because of the severe budgetary situation of the Japanese government. Presently, the earliest launch date is 2018 when we successfully proceed to Phase-B within the fiscal year 2013.

**Development of key technologies of the SELENE-2 system:** Throughout this phase-A period, technical development in both system and candidate science instruments on board have been proceeded so far. We introduce some of the remarkable development of the system as shown in Fig.2;

Landing gear: We are conducting some drop tests, changing the parameters of horizontal velocity, vertical velocity, pad size, and surface hardness. Shock acceleration, sinking depth, and spacecraft touch-down dynamics are observed.

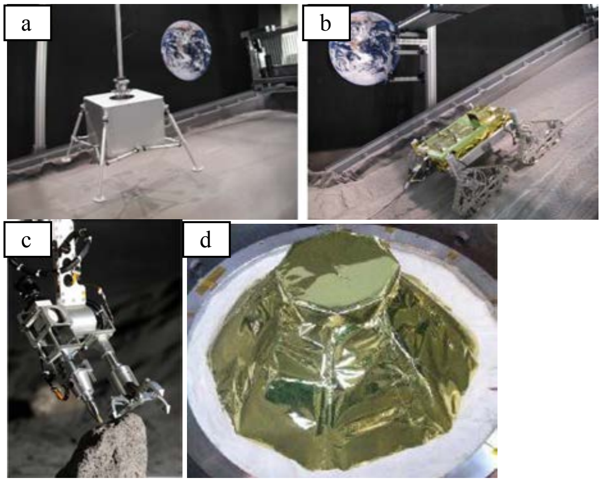


Fig.2. Some exampls of technical development of the SELENE-2 system, a) Landing gear, b) Rover system, c) Tool changer on borad the rover, and d) BBM of the night survival module.

Rover system: We developed prototypes of the mobile gear and performed some hill climbing tests and rock get over tests. Considering weight and power resources, we are tuning the mechanics of the mobile gear. Development of onboard tools supporting observation support is also important. They are Rock abrasion tool, Brush, Optical camera, Infrared imagery camera, Vane shearing measure, Hand, and Force torque sensor.

Night survival module: To confirm the feasibility of the night survival unit, we are conducting both numerical simulations and thermal vacuum tests. Though the temperature at the moon surface outside the unit varies from –200 deg C to +100 deg C, the inside of the unit is kept from 0 to 50 deg C.

**Present status of the development of the candidate instruments:** We have also promoted technological development of the candidate instruments as shown briefly in Table 2. Especially, we have progressed in developing seismometry system and camera system, both of which were considered to be main scientific instruments for geophysical and geological instruments. As for the seismometry system, we have almost successfully performed interface tests which were done by international collaboration (short period seismometers from Japan, broad band seismometers from France, gimbal system from Germany and data acquisition system from Switzerland)(Fig.3). Development of a sensor of the visible to near infrared camera system, on the other hand, also conducted good performance under the suitable temperature condition on board the rover.

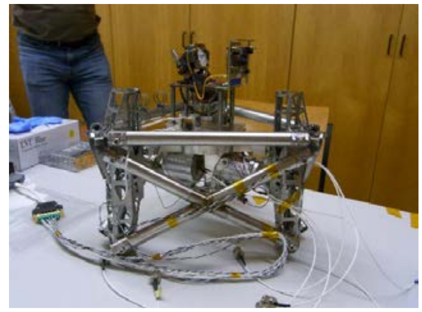

Fig.3. Interface test of seismometry system.

Table 2 List of candidate instruments. The middle column indicates the mounting device of the instrument(s) such as ;L:lander, R:Rover, and O:Orbiter.

| Name of the instrument | | Category |
|---|---|---|
| Radio transmitter (VLBI) | L+O | Geophysics |
| Raser Reflector | L | Geophysics |
| Magnetometer | L+O | Geophysics |
| Heat flow probe | L | Geophysics |
| Broad band seismometers | L | Geophysics |
| Visible to NIR camera | L+R +O | geology |
| Laser induced breakdown spc | R | geology |
| Active X-ray spectrometer | R | geology |
| Gamma ray spectrometer | R | geology |
| Dust detector | O | astronomy |
| Low frequency radiometry | O | astronomy |
| High Definition Television | L+R | outreach |
| Lunar soil mechanics | L | utilization |
| Radiation monitoring | O | utilization |

**Future activity plan:** We are preparing for the upcoming review board to proceed to phase-B study. In order to achieve it, we are under investigation to make high reliable system, and realistic scenario of the mission profile assuming some appropriate landing sites which have been selected among the Japanese lunar scientists[5]. Further technical development is also to be aggressively continued for reducing risks.

**References:** [1] Hashimoto T. et al., (2011) Proc. IAC meeting -10.A3.2B.1. ; [2]Tanaka S. et al., (2012) LPSC XXXXIII Abstract #1651.; [3]Basic Plan for Space Policy: http://www.kantei.go.jp/jp/singi/utyuu/basic_plan.pdf [4] Study Group for Lunar Exploration, Strategic Headquarters for Space Policy, the Cabinet Secretary of Japanese government: Lunar Exploration Strategy of Japan, July 29, 2010 (in Japanese); [5] Saiki et al., (2012) Yuseijin 21,45-56 (in Japanese)