Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PPS22-01 Room:103 Time:May 22 14:15-14:30

Lunar and Planetary chronological missions based on the in-situ geochronology instruments

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In-situ geochronology measurements have long been a key goal for planetary science. We propose a mission, which is designed to determine formation age of young crater or young lava flow of the Moon. The correlation of crater frequency measured with remote-sensing data with the obtained age provides information about the cratering history in the inner solar system.

Keywords: Lunar and Planetary explorations, moon, chronology, crater, K-Ar dating

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PPS22-02 Room:103 Time:May 22 14:30-14:45

Sample return from the lunar farside highland proposed for the future lunar exploration mission

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Compositional information of the lunar highland is important for understanding the bulk composition and solidification of the lunar magma ocean and for estimating the internal structure of the Moon. However, recent studies indicate that the previous understanding of the lunar highland composition based primarily on the lunar samples returned from the nearside by Apollo and Luna missions are insufficient for understanding the overall crustal composition because more primitive highland materials with different composition (higher Mg#, which indicates solidification from the more primitive magma) from the current sample collection, which we do not have, are present in the farside highland.

Therefore, we are proposing a sample return mission to the lunar farside highland to fill the gap in our knowledge by obtaining the most primitive highland material and investigating such previously unknown samples. This mission is proposed as a second stage lunar landing mission after a first in-situ measurement mission, which obtains age information and chemical composition of the landing site. Techniques obtained by the first in-situ measurement mission will enable the sample return mission to land on a precisely selected location and to do in-situ compositional measurements and select suitable samples. Information acquired by analyzing these returned samples, such as crystallization age, major and trace element composition, isotopic composition, and crystal texture, are important for understanding the cooling and solidification history of the lunar magma ocean, formation of the crust, degree of differentiation when the highland material crystallized, and composition of the bulk lunar magma ocean.

The proposed mission consists of one lander with return capability, a manipulator to collect both regolith and small (a few centimeters in diameter) rocks from around the lander, and spectral cameras for sample selection. Landing site candidates are investigated by using high resolution spectral data obtained by Kaguya.

Keywords: Next decade for planetary explorations, sample return, moon, highland crust

PPS22-03 Room:103 Time:May 22 14:45-15:00

MELOS1 Mars Landing Exploration Plan

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We have been planning MELOS which is to challange various Mars sciences with a combination of orbiter(s) and lander(s). MELOS can be done as a series of missions by sequentially launching missions of which sciences need not to be simultaneous. Therefore, current planning focuses MELOS1. In general, the larger a mission is, more difficult to get launched. Due to the recent situation, we simplify the MELOS1 mission as a combination of a lander plus a cruise stage, not an orbiter. We need to rely on any orbiter at Mars to send the data back to the earth. Because the U.S.A., after successful landing of Curiosity, is active again with Mars, and European and Russian have ExoMars mission, assuming an orbiter's availability at the time of our arrival may not be unreasonable.

Although the lander's configuration is still somewhat flexible, current plan is to have a 40-50 kg rover with science payload including the life-detection experiment. Landing on Mars is a necessary step for the space exploration, and it is to enable searching extraterrestrial lives. If discovered, it should undoubtedly be the biggest discovery in science. The surface area of Mars is so wide and so different from one place to another. Yet, we had only 7 landers, basically at places similar to each other. The best places for life-detection experimetn, fluvial feasures or mud volcanoes (may be methane hot spots) are still intact. In MELOS1, we will perform high-precision landing to such a place and will search for lives for the first time.

The current status of planning will be presented. In addition, the position in Japan's future missions will be discussed with audience of greater variety.

PPS22-04 Room:103 Time:May 22 15:00-15:15

Exploration of Trojan asteroids and observations of cosmic infrared background radiation by a solar power sail mission

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In this presentation, we propose a solar power sail mission bound for Jupiter Trojan asteroids. The unique location of Jupiter Trojan asteroids enables us to examine compositional divergence of the protplanetary disk and possible migration of outer planets. We will make in-situ flux measurements of interplanetary dust particles and observations of diffuse sky brightness during the cruising phase. The resulting elaborated dust model plays a critical role to study the first generation of stars and circumstellar debris disks.

Keywords: Asteroid, Lagrange point, Solar Sail, infrared, sample return

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PPS22-05 Room:103 Time:May 22 15:15-15:30

Proposed mission to asteroid Phaethon

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3200 Phaethon is a B-type asteroid parent of the Geminid meteor shower. Phaethon does not show any cometary feature, unlike parent bodies (comets) for most of the meteor showers; therefore, it is either a dormant comet or an active asteroid. The observed sodium depletion in the Geminid meteoroid suggests that Phaethon/Geminid can consist of primitive cometary materials and locally melted differentiated materials. The nature of Phaethon remains an open question and currently highly debated. Thus, making Phaethon is a critical mission target to understand the chemical, physical and dynamic evolution of planetismals in the early solar system. Because of its scientific importance, Phaethon was a target candidate for NASA's Deep Impact mission and the OSIRIS-Rex mission.

Asteroids 2005UD and 1999YC are likely fragments originated from Phaethon due to their similar orbital properties, called PGC: Phaethon Geminid Complex. Also, a main-belt asteroid Pallas has been recently suggested to be genetically linked with Phaethon. A space mission to PGC can provide us with information on the physical and chemical characteristics of the PGC parent body. The data obtained with such mission is a key to understand the origins of Phaethon and PGC, and solve the fundamental issues in solar system sciences.

The working group of the mission is currently conducting a feasibility study on a possible mission to Phaethon and the PGC, such as a single flyby mission to Phaethon or a multiple flyby mission to PGC. The objective of the study is to design a (multiple) flyby mission based on impulsive and gravity assisted maneuvers performing an analysis that identifies the global minimum energy trajectory taking in account the system design requirements of the Epsilon rocket, Japan's latest launcher. We are also studying variable scientific instruments suitable for the mission. Scientific and technical discussion with domestic and international researchers for Phaethon and PGC are on-going, to support the mission. Here, we present the latest status of our mission plan to Phaethon (or PGC).

Keywords: Asteroid, Mission plan, Phaethon, Phaethon-Geminid-Complex (PGC)

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PPS22-06 Room:103 Time:May 22 16:15-16:30

A space exploration for Enceladus' plumes: importance of sample return and in-situ mass spectrometry

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Here we propose a sample-return mission of water-rich plumes erupting from warm fractures near the south pole of Enceladus. During collection of plume samples, the spacecraft will conduct in-situ gas analyses with a high-resolution multi-turn time of flight mass spectrometer. The mass spectrometry would provide the abundances and isotopic compositions of major gas species included in the plumes. These observational data would allow us to discuss the temperature and isotopic heterogeneity of primordial volatiles in the Saturn-forming region of the protoplanetary disk, geochemical processes occurred in Enceladus' ocean, and possible metabolic reactions and energy for chemithoautotrophy. Once the plume samples are returned safely in 2030's, microscopic analyses for returned samples will be conducted, including synchrotron X-ray analyses, chemical and mineralogical analyses with a nano-SIMS, and calorimetry with radioactive isotopic tracers. In order to achieve both sufficiently high encountering velocity for TOF spectroscopy and low velocity for intact capture of the plume particles, the spacecraft needs to either orbit Saturn and fly-by Enceladus or orbit the satellite itself and still is able to return to the earth after the rendezvous phase.

Keywords: Space exploration, icy satellite, Enceladus, sample return, in-situ analysis

PPS22-07 Room:103 Time:May 22 16:30-16:45

What does it mean to participate in the JUICE mission?

Masaki Fujimoto[1*]

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Boosted by the discovery of exo-planets, the habitabililty issue is becoming more and more of an central issue in planetary science. An icy moon with a sub-surface ocean is a focal point of discussion in this line. In May 2012, ESA selected JUICE as its L-class mission to be launched in 2022. The main target of the JUICE mission is Ganymede, an icy moon that orbits around Jupiter.

The AO for the intruments to be onboard the JUICE mission was issued in July 2012. At the time of writing, the results of the AO is yet to be released in Febuary 2013. There are several groups from Japan that are playing roles in the proposal teams led by European-PIs. When (any of) these teams win, that is the time that the door for the outer-solar system exploration is opened for Japanese planetary science community. Furthermore, it is the first mission ever to orbit around an icy moon and it goes without saying that JUICE is a world-class mission.

What does this opportunity means for the Japanese community? In parallel to this participation to the world-class international collaboration project, what others should be planned and executed by the community? It is designed that this talk will trigger such a discussion.

Keywords: International collaboration, Exploration of icy moons

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PPS22-08 Room:103 Time:May 22 16:45-17:00

Moon Landing Mission SELENE-2

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JAXA plans SELENE-2 moon landing mission and SELENE-X more sophisticated mission (Sample return, etc.) following SELENE (Kaguya) lunar orbiter. Mission objectives of SELENE-2 are as follows,

1.Technology development and demonstration for future lunar and planetary exploration

Though soft landing itself was performed by U.S. and U.S.S.R. 40 years ago, future lunar exploration requires 100m accuracy to designated landing point. To realize the accuracy, new technologies such as landmark navigation are needed. An exploration rover is also essential for wide area exploration. Though large-scale rovers were realized on moon, a small rover for science exploration is easy to stuck and technologies to overcome that is required. To survive during two-weeks lunar night, nuclear energy was used in the past missions. Since public consensus on the usage of nuclear power in space has not yet reached in Japan, solar power and battery with sophisticated thermal control are used for SELENE-2.

2.Scientific observation to know the origin and evolution of Moon

To solve the questions on the origin of Moon, the material of it should be known. On the other hand, to make the evolution of Moon clear, detailed geological observation is essential. For the former purpose, SELENE-2 plans seismic, thermal, and electro-magnetic measurements. For the latter purpose, imaging and spectrograph by instruments onboard the rover are planned.

3.Environment investigation for future lunar exploration such as human missions

For astronauts to stay on Moon surface for long time, more accurate measurement of radiation environment, dust environment, and soil mechanics than Apollo era is required.

4.Public interest and international cooperation and contribution

Kaguya's HDTV proved that high definition movies aroused public interest. Since exploration, especially human exploration is performed under international collaboration lately, how Japan can contribute is important issue form the view point of policy.

To realize the mission objectives, H-2A rocket is assumed as a launch vehicle. The size of the lander will be about one-ton dry mass. It means that the total payload mass will be 200 to 300 kg including the rover.

SELENE-2 pre-project has started since 2007 and continues the conceptual design (phase-A study). Because of the severe economical situation in Japan, the start of phase-B study has delayed. Since other countries make progress on lunar exploration, however, we continue research for critical technologies.

Keywords: Precise landing, Exploration, rover, Night survival

PPS22-09 Room:103 Time:May 22 17:00-17:15

Future earth and planetary explorations envisioned in the SGEPSS subgroup on future explorations

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The SGEPSS subgroup on future explorations was established in November 2011 by interested members to discuss the future vision and research strategies of earth and planetary exploration, to share scientific objectives and to foster researches concerning ongoing and future explorations. In addition, SGEPSS established the SGEPSS future survey working group in May 2012 with the goal of surveying and summarizing the current status and future vision of the geomagnetism and earth, planetary and space sciences. The working group released the document that summarizes the current status and future vision on the homepage of SGEPSS in January 2013 and booklets are ready to be distributed. In this presentation, we will introduce future exploration plans listed in the document and talk about activities conducted by the subgroup toward future explorations.

Keywords: Earth and planetary exploration, SGEPSS subgroup

PPS22-10 Room:103 Time:May 22 17:15-17:30

Lunar and Planetary Science Consortium Plan

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The missions Kaguya and Hayabusa have brought us many of scientific discoveries about the solar system. As a result, a new stream of research is growing in the Japanese planetary sciences which have been chiefly driven by theoretical researches and ground-based experimental ones so far. On the basis of scientific and public expectations for the future missions, many new plans are being proposed and examined extensively. On the other hand, it becomes urgent need to construct an infrastructure in the planetary science community, which is relatively young in our country, so as to involve and support the lunar and planetary exploration missions being of big science. Here we present our Lunar and Planetary Science Consortium Plan as a solution for this need.

Keywords: lunar and planetary exploration mission, infrastructure, organization, cooperation

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PPS22-11 Room:103 Time:May 22 17:30-17:45

Next decade initiatives for lunar planetary explorations: The third stage

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The third stage of next decade initiatives for lunar planetary explorations is now on-going.

Planetary science community in Japan has not been much experience of the self-selection of a mission proposal integrated through tough discussion and corroborative works. Recent Japanese budget crunch in space science have induced severe competition for few opportunities with other communities. To win the competition our community should improve the fascination of the mission proposal and persuade other science and engineering communities. We should reconstruct a mid-range future vision to clarify the best mix of medium- to large-sized flagship missions, small-sized missions, and internationally corroborated missions.

The third stage aims at sharing a mid-range future vision of planetary science, selecting a flagship planetary mission according to the vision, and making the compelling mission concept.

I will report on progress of the third stage of next decade initiatives for lunar planetary explorations.

Keywords: planetary science, space science, future planning

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Approach of the next decade panel

Hirohide Demura[1*]

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Report of the next decade panel.

PPS22-P01 Room:Convention Hall Time:May 22 18:15-19:30

Development of an in-situ K-Ar dating instrument

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We have been developing an in-situ dating method based on the K-Ar system for future planetary landing missions. The K-Ar dating method employs radiometric decay of 40K into 40Ar with half-life of 1.25 Gyr [Steiger & Jager, 1977]. Our system measures K and Ar with two techniques at the same laser irradiation spot on a sample: laser-induced breakdown spectroscopy (LIBS) and quadrupole mass spectrometry (QMS), respectively (LIBS-QMS system). Potassium and argon are extracted from a sample simultaneously by the laser ablation, in which the sample is vaporized by a series of intense (> 1GW/cm2) laser pulses. We used a Nd:YAG laser with 6 ns of pulse width and 1064 nm of wavelength (Surelite I, Continuum). The laser energy was set at 100 mJ and the spot diameter was ~500 micron. The pulse repetition rate was 2 Hz. We used a small spectrometer with a charge couple device (CCD) (HR 2000+, Ocean Photonics Inc.), to simulate a small and simple spectrometer for the spacecraft missions. The light emission from plasma was collected by a lens and transmitted through an optical fiber to the entrance slit of the spectrometer. The spectral acquisition time was 1 ms and the shutter was opened before the laser pulses reached the sample; time-integrated plasma emission was observed to simulate a non-gated operations on the planetary missions. The intensity of the K line at 769 nm was normalized by that of the O emission line at 777 nm in order to reduce signal fluctuations.

The gas extracted from the sample was purified with a Ti-Zr getter. The purified Ar gas was trapped on the charcoal trap cooled by liquid nitrogen. The Ar isotopes, 36Ar, 38Ar and 40Ar, are measured with the quadrupole mass spectrometer. Blank mass spectra were also acquired and subtracted from the main data. Finally, the volume of laser ablation pit was measured with a laser microscope to obtain the concentration of 40Ar within the pit.

In order to construct a calibration curve for K2O, 24 geologic samples with known K2O concentration were measured with our LIBS system. The calibration line can be fitted by a power law: I=0.11C$^{0.55}$-0.00686, where I and C are the signal intensity and K2O concentration (wt%). The detection limit and the quantification limit of our LIBS system were 300 ppm and 1 wt%, respectively. Also the detection limits of 36Ar and 40Ar were measured to be 2x10^{-12} and 2x10^{-11} [cm3 STP], respectively, in this study. As a result, if a rover encounters a rock with K2O=1 wt%, as Mars Exploration Rover found at Gusev crater, our instrument is expected to measure K and Ar from a rock sample; i.e., the error in LIBS measurement would be <20% and the S/N for QMS signals would be sufficient (=200).

Using our instrument, we measured three samples whose K concentrations and ages have been measured previously with flame photometry and a sector mass spectrometer: a hornblende (K2O=1.12 wt%, 1.75 Ga), a biotite (K2O=8.44 wt%, 1.79 Ga), and a plagioclase (K2O=1.42 wt%, 1.77 Ga) [Nagao, unpublished data]. We obtained the model ages of 2.1+/-0.3, 1.8+/-0.2, and 2.0+/-0.3 Ga, respectively.

Since the three samples have similar ages and different K concentrations, we should be able to construct a "virtual" isochron by plotting the concentrations of K and 40Ar$_{rad}$. The slope of the isochron simulated with our experimental data yields 1.34 Ga of age. The data with known values yields 1.79 Ga. Such underestimation probably results from both overestimation for K and underestimation for 40Ar in the biotite data, which have large weight for the regression. Nevertheless, a positive correlation between [K] and [40Ar$_{rad}$] is obvious. Although further improvement in the accuracy of our measurements is necessary, the data obtained in this study demonstrate that our LIBS-QMS method can reproduce the trend essential for quantitative isochron-based age measurements.

Keywords: Decadal Survey, In-situ age measurements, Planetary landing missions, K-Ar dating

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Elemental analyzer for landed lunar and planetary explorations: Laser-induced breakdown spectrometer (LIBS)

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A laser-induced breakdown spectrometer is one of the elemental analyzers, which is composed of a laser, a spectrometer, and an optical system. The measuring principle of LIBS is as follows: Samples are irradiated with pulsed laser beams in order to generate plasma plumes of a small amount of the sample. When atomic and ionic species excited in the plumes are deexcited, the emission of lights occurs according to the difference in energy levels before and after the deexcitation. These lights are measured with a spectrometer as emission lines on spectra. The wavelength of emission lines is unique to each element, and the intensity of emission lines is correlated with the elemental abundance. Both qualitative and quantitative analyses, such as elemental abundance determination and mineral classification, are carried out by analyzing the acquired spectra.

LIBS has several advantages such as (i) capability of remote analysis (up to ten meters or more depending on laser intensity), (ii) rapid data acquisition (a few second to a few minutes), (iii) ability to analyze almost all elements including light elements, (iv) high spatial resolution (several tens to several hundred of micrometers), and (v) unnecessity of sample preprocessing. LIBS has potential for being a powerful elemental analyzer in landed lunar and planetary explorations. Actually, LIBS is loaded on Mars Science Laboratory, which is the first use of LIBS in space. LIBS would be a standard elemental analyzer in landed missions.

Now we are developing a LIBS for landed lunar explorations. We have had decided basic design of the LIBS and finished detailed designing of the measurement distance variable optical system. We have had also done the improvement of spectral analysis method for determining elemental composition with high accuracy. Then, last year we carried out two types of field tests with LIBS test models. One is an elemental composition measurement test, and the other is an onboard LIBS test on a rover. These tests were conducted at Mount Mihara on Izu-Oshima island.

We made a small portable LIBS, and carried out the field elemental composition measurement test with it. The LIBS we made is for a short range measurement and has a fifty-millimeter fixed focal length. Standard igneous rock samples have been measured with the LIBS in the laboratory in advance to make regression models for spectral analysis to determine elemental compositions. In the field we measured many samples such as bounding stones and lava flows under the Sun and obtained spectra with high signal-to-noise ratio. The elemental compositions determined with those spectra shows reasonable values for basalt. The determined values had, however, large error bars, which may be due to a small number of standard igneous rock samples used for making the regression models. We are going to prepare more standard samples to improve the determination precision.

We also carried out the LIBS onboard test on a rover (Micro 6 rover, JAXA). A test model of the measurement-distance adjustable optical system was made, and autofocus test and laser irradiation test through the optical system were carried out on the rover.

We plan to carry out field test with a test model of the measurement-distance adjustable LIBS. We are going to perform a sequence of measurement with it on a rover: Selecting a measurement point, autofocusing, laser irradiation, spectra acquisition, elemental composition determination. Through this we will confirm the operational procedure and quantitative measurement under onboard and natural terrain conditions.

Keywords: landed exploration, elemental analyzer

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Investigation of Martian surface and internal structure by multiple penetrator probes

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A new mission to investigate the Martian surface and interior structures using multiple penetrator probes is proposed. As a decelerator and a heat shield during the Martian atmospheric entry, a flare-type thin membrane aeroshell sustained by an inflatable torus frame will be applied to attain a compact and low-weight space vehicle. The most significant advantage of the aeroshell is to reduce the aerodynamic heating during the atmospheric entry due to its low ballistic coefficient. In addition, even though dependent on the spacecraft configuration (in most cases), there is no need to equip with the conventional thermal protection system like an ablator or a heat-resistance material. Concerning to the aeroshell system, a flight validation test was successfully concluded using a sounding rocket in the summer of 2012. The Martian penetrator is a missile-shaped instrument carrier and is planned to have about 80 cm in length, 15cm in diameter, and 14 kg in weight, which would be almost identical with the lunar penetrator. Its development was completed in 2010 through several times impact penetration and thermal cycle tests at the ground test facilities after cancellation of the former LUNAR-A project. A 3-axis stabilized satellite with four identical penetrator modules, which should play roles of the carrier of penetrator modules and of data-relay orbiter, is assumed to revolve in a circular orbit of 300 km altitude around Mars. After separation from the carrier spacecraft, four penetrators will be deployed at intervals of a few hundred kilometers from each other, due to the limited number of probes and ability to detect of seismometer on-board. Each penetrator installed seismometer and heat-flow probe will operate on the potential active regions in volcanism or seismic fault zones, associated with magmatic tectonics, crustal structure and current thermal state of Mars. An optical camera onboard the spacecraft will search for impact craters and landslides around the network, which occurred during the observation period of penetrator seismometer. These detected landmarks will be available for seismological study as known earthquake foci. A meteorological sensor package embedded in a backside of aeroshell will observe the atmospheric structure and possibly monitor the environment on the surface. These monitoring data would be useful for data reduction of seismic and heat-flow data. This paper describes the martian penetrator design, the sequence of its deployment phase, onboard instruments, and their operational strategy.

Keywords: Mars Exploration, surface Environment, internal Structure, penetrator, seismometer, heat flow probe

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A proposal of a small scientific satellite mission to validate penetrator systems

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We propose a new mission to validate the penetrator technology and to investigate the surface and subsurface structures on the far side of the Moon, using a miniaturized penetrator probe. The miniaturized penetrator is a missile-shaped instrument carrier and is planned to have a shape of about 60 cm in length and 10 cm in diameter, and a weight of 8 kg, which would be two thirds scale model of the lunar penetrator developed for the former LUNAR-A project. The major objective of this mission is to demonstrate the technical issues in penetrator system; (1) holding and separation mechanisms, (2) a sequence of de-orbit, attitude control and subsurface deployment, (3) data-relay and remote operation by way of an orbital spacecraft, and (4) simultaneous long-term geophysical observations. Furthermore, the developed miniaturized penetrator system can be applied to a future mission for a more distant planetary body than the moon.

A tri-axial stabilized satellite with two identical penetrator modules, which should be play roles of the carrier of them and of data-relay orbiter, is assumed to revolve in a near-circular orbit of 100 km by 25 km altitude around the Moon. After the separation from the spacecraft, the two penetrators will be deployed at an interval of a few hundred meters or a few kilometers from each other on the far side equatorial regions. The penetrator will hit on the lunar surface with a velocity of 250 to 300 m/sec and penetrate into the regolith up to a depth of 2 or 3 meters. Each penetrator can carry some of a short-period seismometer, heat-flow probe, magnetometer, and gamma-ray spectrometer and observe the sub-surface and internal structure on the most ancient geological unit, in which the initial product from a differentiated magma ocean might be still remain.

The magnetometer will monitor the time-series of magnetic field as a stationary point, and the gamma-ray spectrometer buried in the lunar regolith will be able to observe the abundance of heat-producing elements, under a condition of the significant low-level cosmic ray background. These data would be also useful for data reduction of seismic and heat-flow data. An optical camera onboard the spacecraft will search for impact craters and landslides around the network, which occurred during the observation period of penetrator seismometer. These detected landmarks will be available for seismological study as known earthquake foci. This paper describes the miniaturized penetrator design, the sequence of its deployment phase, potential onboard instruments, and their operational scenario.

Keywords: penetrator system, lunar interior exploration, small scientific satellite

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PPS22-P05 Room:Convention Hall Time:May 22 18:15-19:30

Fluorescent microscopy for searching extraterrestrial life

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Fluorescent microscopy is a method to detect localized biosignatures *in situ* and a potentially powerful tool to detect extraterrestrial life. It is highly sensitive and will provide clear evidence for extraterrestrial life as images. Stained objects are observed with an epifluorescence microscope with a resolution of 1 micrometer. Many types of fluorescent dyes are commercially available and used in various biological studies. In this study, fluorescent dyes were selected based on the basic characteristics of life: genetic information, metabolism, and discrimination of self from non-self. Each characteristic was detected using a different type of fluorescent dye that was specific for nucleic acids, enzymes, or cytoplasmic membranes. The range of detectable molecules of the selected dyes was investigated with various samples: cultured bacteria, miniature cells which were deficient in DNA, proteins, protenoids, PAH, and Martian soil simulants. The optimum combination of dyes that had the potential to distinguish biological objects from non-biological compounds and useful to search extraterrestrial life especially on Mars will be discussed.

Keywords: fluorescence, microscope, Mars, astrobiology

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Astrobiology Exploration Research Institute

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In this paper, we discuss our proposed Astrobiology Exploration Research Institute. The primary role of this institute is to lead research in ”soft material” analysis research for remote-sensing observation from an orbit, in-situ analysis on planetary surfaces, and returned-sample analyses in laboratories. ”Soft material” analyses hold the key for the upcoming era of astrobiology planetary missions.

Keywords: planetary exploration, astrobiology, center of exellence, industry-academia collaboration, Onboard instrument development, soft material

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Lunar and planetary explorations in a coming decade: Current status and ongoing schedule

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Future Planetary Exploration Working Group of Japanese Planetary Science Society is discussing planetary explorations that will be strongly supported by this community. Then we started "Planetary Exploration in a Coming Decade" activity in 2010 aiming to organize a new mission to be launched between 2017 and 2027. The first stage of the activity is ending in March, 2011. A summary of the first stage will be reported by 5 panels; (1) terrestrial solid planets, (2) terrestrial atmosphere and magnetosphere, (3) minor body, (4) Jovian planets, icy satellites, and exoplanets, and (5) astrobiology. Each panel received proposals regarding "top sciences" of each category from the community in the summer of 2010. On September 10 in 2010, an open meeting was held at Kobe University to discuss top sciences among the community of planetary scientists. From the summer of 2011, the second stage began. Proposals for new mission and instruments were submitted by 13 groups and were adivsed by the second-stage committee not only to improve the proposal, but also to raise and develop exploration groups. In 2012 May, the thrid stage started. The main purpose of the third stage is to polish up the proposls in the view of feasibility. In September 14 and 15, 2012, we held a workshop to integrate individual proposals into a few comprehensive mission plans, such as in-situ chronology and interior exploration of the moons and planets, primitive small body exploration, and sercha of life on Mars. The mission concepts of these comprehensive mission plans will be discussed for later evaluation by the third stage committee.

Keywords: Planetary exploration

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Scientific goals for sample-return mission from 107P/Wilson-Harrington

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We propose Sample Return mission from 107P/Wilson-Harrington. The target object is a near-Earth dormant comet that potentially preserve pristine minerals, ice, and organics in the early solar system, which may not be intact in target asteroids for Hayabusa-2, Osiris-REx, and MarcoPolo-R. Samples from 107P/Wilson-Harrington will contribute significantly to our understanding of the evolution of the early solar system.

Keywords: sample return, comet, asteroid