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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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

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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.

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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

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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

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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

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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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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

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Report of the next decade panel.