Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS023-01 Room:303 Time:May 26 08:30-08:45

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 last year 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, 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 begins. Proposals for new mission and instruments will be accepted by the second-stage committee who advises the applicants not only to improve the proposal, but also to raise and develop exploration groups.

Keywords: Planetary exploration

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PPS023-02 Room:303 Time:May 26 08:45-09:15

Results of America's Planetary Science Decadal Survey

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Once every ten years, the U.S. National Research Council carries out a "decadal survey" in planetary science. The objective is to recommend a decade-long national strategy for solar system exploration for NASA and the NSF. The most recent planetary decadal survey has placed particular emphasis on formulating a strategy that can realistically be implemented with the funds expected to be available for NASA and the NSF in the decade from 2013 to 2022. Inputs to the decadal survey were provided at a number of "town hall" meetings at professional conferences, and via 199 white papers written and submitted by more than 1600 members of the scientific community. These inputs led to definition of a set of high priority science questions, which in turn prompted study of 28 different mission candidates. Some of these mission candidates were studied in detail by the Applied Physics Laboratory, Goddard Space Flight Center, the Jet Propulsion Laboratory, and Marshall Space Flight Center. Missions studied in detail were also subjected to a cost and technical evaluation conducted by Aerospace Corporation. A recommended set of missions for the decade was then assembled, taking into account science priorities, cost and technical risk, and available resources. The plan also includes recommendations regarding funding for research and analysis, technology development, ground-based and orbital telescope facilities, and other topics. Consideration of possible international collaboration in planetary exploration was an important part of the decadal process. The report will be released in the first part of 2011, and the recommendations from the report will be described in this presentation.

Keywords: Planetary Science, Decadal Survey, The National Academies

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PPS023-03 Room:303 Time:May 26 09:15-09:30

Sciences for the moon and solid planets toward planning future planetary explorations

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Here we report major scientific issues for the future explorations of the moon and solid planets on the basis of the over twenty proposals and workshops opened for the Japanese planetary science community.

Keywords: moon, solid planets, planetray exploration, internal structure, origin and evolution, surface environment

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PPS023-04 Room:303 Time:May 26 09:30-09:45

Panel Report on Explorations for Small Solar System Bodies

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[1]Nagoya University, [2]National Astronomical Observatory, [3]Hokkaido University

The small body panel performed interviews on the opinions on future exploration plans (as an activity for future ten years of planetary explorations) through the explanation of the aim and the hearing to parties concerned to the researcher group (material analysis, collision experiments, observations, and celestial mechanics etc.) that relates widely, and 12 proposals have been discussed. A panel meeting, including the secretariat of the JSPS was held in National Astronomical Observatory and Mitaka on September 1, 2010, and the consolidated opinion was made public in the forum (Kobe University) on September 10. The subcommittee meeting was held in National Astronomical Observatory Mitaka on December 10 after the forum, and then, the intelligence sharing of the explanation of aim and the meaning of the inquiry proposal was aimed at from a main proposer of each proposal. For searching for a top science out of the proposals through the series of discussions, we tried to classify the proposals along two axes of the science targets. One axis is a primitive degree of the material that composes the small celestial body. There is a vague part in the definition, but it is based here on the content of the organism and the ice that conflicts with silicates. Another axis is a structure of the body, that is, the size of the body or a differentiation degree. In addition, the proposals were classified into three categories with the exploration methods. ;(a) sample return or in-site analysis, (b) a geophysical exploration technique like the achievement of the collision experiments etc. , and (c) remote sensing. The graph with two science target axes was made respectively of three categories, and we examined where each proposal locates and how they were distributed. As for the science target examined there, if the different proposals proposed by a different proposer has the same science target distribution, it is important together for a lot of researchers, and, therefore, the effect to the entire planetary science must be also high. As a result, the inquiry of the exploration (if it was possible, sample return) to the primitive and undifferentiating bodies stood out. We enumerate directionality of the exploration to such primitive and undifferentiating bodies as one of the ”Top science” targets such as cometary nuclei and D type planetoids. In addition, we arrived at the common view that the understanding obtained from the re-visit often considered was able to become extremely deep, compared with a single visit of the exploration. The re-visit done in a large bodies wants to strike a note of warning in tending the oversight of going of eyes only to the diversity of the bodies probably because of in the case small bodies. Therefore the importance proceeded from the discovery stage to the understanding step because of ”Revisit” inquiry that visits the same body two or more times as the means to achieve ”Top science” target will be enumerated as this panel. In this presentation, we introduce two directionality and the concrete examples of the top science.

Keywords: Planetary Exploration, Future Plan, Top Science

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PPS023-05 Room:303 Time:May 26 09:45-10:00

Report of Jupiter, Icy satellite, Extrasolar planets panel of next decade initiatives for lunar planetary explorations

Yukihiro Takahashi[1*], Kensuke Nakajima[2], Jun Kimura[1], Taishi Nakamoto[3], Yoshizumi Miyoshi[4]

[1]Hokkaido University, [2]Kyushu University, [3]Tokyo Institute of Technology, [4]Nagoya University

Jupiter, Icy satellite, Extrasolar planets panel members

One of the panels of Next decade initiatives for lunar planetary explorations has dealt with topics of future exploration, including Jovian atmosphere, icy satellite, extrasolar planets, and Jovian magnetosphere. Panel leaders with experts of broad range of related-science discussed possible explorations basically from the pure scientific point of view, taking into account both near future missions that have been already planned and ideas for far future exploration. Not only the direct explorations but also the space and ground-based telescopic observations, as well as theoretical studies, were argued.

Keywords: exploration, Jupiter, icy satellite, extrasolar planets, atmosphere, magnetosphere

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PPS023-06 Room:303 Time:May 26 10:00-10:15

Summary of the Astrobiology Panel in the first stage

Kensei Kobayashi[1*], Akihiko Yamagishi[2]

[1]Yokohama National University, [2]Tokyo University of Pharm. Life Sci.

Top sciences in the lunar and planetary missions in the next ten years were discussed from the point of view of astrobiology. Astrobiology targets life's origin, evolution, distribution and future of life. We selected (1) Mars life detection missions and (2) missions for detection of life and organics in ice satellites and small bodies. Recent finding of methane on Mars has made life on Mars more plausible. Several missions are in progress in USA and Europe, but we can expect Japan's own Mars mission (MELOS). In the mission, living organisms can be targeted since we have unique life detection methodologies. Among many ice satellites, Europa, Titan and Enceladus are major targets since they could have their own biosphere. In addition, it is expected to have fossils of chemical evolution toward the generation of life which were lost on Earth. Missions to ice satellites may not be prepared in the next 10-15 years, but we should develop instrumentation to detect life and organic compounds in extreme cold environments in the coming 10 years. Cultivation of Japanese community for this purpose is strongly required.

Keywords: planetary missions, astrobiology, Mars, ice satellites, life detection, organic compounds

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PPS023-07 Room:303 Time:May 26 10:45-11:00

SGEPSS's activities toward planetary exploration

Masaki Fujimoto[1*], Naoki Terada[2], Yoshizumi Miyoshi[3]

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SGEPSS's activities toward planetary exploration will be presented.

Keywords: Planetary exploration, SGEPSS

Japan Geoscience Union Meeting 2011
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PPS023-08 Room:303 Time:May 26 11:00-11:15

Plans for planetary atmosphere exploration in Japan

Takeshi Imamura[1*]

[1]Japan Aerospace Exploration Agency

This talk will introduce the status of the planning of planetary atmosphere explorations in Japan. The exploration will start with the Venus orbiter Akatsuki, followed by a Mars exploration MELOS which is under discussion. Further Venus explorations and missions to other planets are also candidates.

Keywords: planet, atmosphere

Japan Geoscience Union Meeting 2011
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PPS023-09 Room:303 Time:May 26 11:15-11:30

Toward future magnetic exploration of moons and planets

Masaki Matsushima[1*], Futoshi Takahashi[1]

[1]Tokyo Institute of Technology

Exploration of lunar and planetary interiors aims at clarifying their origin and evolutionary processes. The present interior structure of moons and planets is a consequence of their thermal history after their formation. It is also possible to understand the dynamics of the Moon and planets if their precise structures are known.

Magnetic exploration enables us to obtain information on lunar and planetary interior structure, which is independent of those estimated through seismic measurement, heat-flux measurement, and gravity measurement. Existence of lunar and planetary intrinsic magnetic field implies that there is energy to generate magnetic field by dynamo action in their interior. Magnetic anomalies can be a clue to investigate a possibility of ancient dynamo process. Electromagnetic response of moons and planets contains information on their electrical conductivity structure, from which thermal structure can also be inferred. Thus, lunar and planetary magnetic exploration is very important to understand their interior structure, origin and evolution.

In the future, based on the above, we should promote the following plans; electromagnetic sounding at the lunar surface to estimate lunar interior structure; determination of the origin and age of lunar magnetic anomalies to understand lunar evolution; detail mapping of Martian magnetic anomalies to understand Martian evolution; and electromagnetic sounding at the Martian surface to estimate Martian interior structure.

Keywords: magnetic exploration, planets, moons, interior structure

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PPS023-10 Room:303 Time:May 26 11:30-11:45

A future image of lunar and planetary explorations from the viewpoint of a young scientist

Tomokatsu Morota[1*], Yoshiaki Ishihara[2]

[1]JAXA/ISAS, [2]NAOJ

We will argue future designs for lunar and planetary explorations from the viewpoint of a young scientist.

Keywords: lunar and planetary explorations, young scientists

Japan Geoscience Union Meeting 2011
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PPS023-11 Room:303 Time:May 26 11:45-12:00

Planetary exploration and space science community

Sei-ichiro Watanabe[1*]

[1]Nagoya University

I will discuss how the science community is involved to planetary exploration.

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PPS023-12 Room:303 Time:May 26 12:00-12:30

The role of ISAS in the Japanese Exploration

Masato Nakamura[1*]

[1]Inst. of Space and Astronautical Science

ISAS has important role in Japanese exploration. Details are given in Japanese.

Keywords: Exploration

Japan Geoscience Union Meeting 2011
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PPS023-P01 Room:Convention Hall Time:May 26 16:15-18:45

Planetary explorations and community: a case study

Naoki Kobayashi[1*], Hideki Murakami[2], Masahiko Hayakawa[1]

[1]ISAS/JAXA, [2]Dept. Applied Sciences, Kochi Univ.

For an efficient progress of lunar-planetary explorations, roles of a community around an exploration project are very important in addition to an existence of strong team developing a payload instrument. Making a community does not directly relate to a future plan of the explorations but it would be an important factor on realization of them and strengthening scientific gains and repercussions. In this presentation, we introduce two attempts building a community. One is a community developing a broadband seismometer for a future lunar-planetary exploration and the other is a school of data analyses of lunar-planetary missions such as ”HAYABUSA” and ”KAGUYA”.

Lunar-A was the Japanese mission to explore the lunar interior by building an observation network with penetrators having short period seismometers and heat flow probes. It was however cancelled in 2007 due to a large delay in completion of penetrator technology. Although the seismometer technology is applied in commercial seismometers, scientists working in the projects had severely less gains from the project. A lunar-planetary exploration is very expensive and often forced to be ambitious with hard technical hurdles, and does often not go as scheduled. We should have a strategy in development of an instrument that scientists participating the project can get gains in such a situation. We currently develop a broadband seismometer for a future lunar-planetary exploration and manage that the development team is not specialized to a specific project and has intention to apply it to terrestrial seismology from the lesson in the Lunar-A project. The team consists of not only scientists developing the broadband seismometer but also researchers in ocean bottom seismology and terrestrial broadband seismology, seismological analysts and theorists, and those in planetary sciences. We have a monthly meeting in which we report recent progress in the development of the seismometer, current situation of lunar-planetary exploration projetcs, that of the OBS project and topics in seismology and planetary sciences. We hope and enjoy the discussion producing a new science and technology in the development process.

The other attempt is the school of data analyses of lunar-planetary missions. We feel that there is a gap of thinking between a project team and its surrounding community in the previous missions to the moon and the asteroid Itokawa. It is however necessary for us to have a sense of unity between them in progress of a large project, and it will be more and more. The school is managed that we provide young researchers and students with an opportunity to deal with data from the missions and enjoy them. Through the school activity, we hope they will be main players in a future mission and strong supporters leading the surrounding community. In planning a future mission, it must be a common obligation in both the project teams and community to make use of the data from the previous missions as much as possible. We also hope the school is a help in that point. We however feel concern that only the school is not enough powerful to realize future plans discussed in ”the coming 10 years”. In this presentation, we would discuss how we can raise utilization of the data from ”KAGUYA” and ”HAYABUSA” maximum and how we can build a strong community.

Keywords: lunar and planetary explorations, community, Lunar-A, broadband seismometer, data analyses, school

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PPS023-P02 Room:Convention Hall Time:May 26 16:15-18:45

Future prospect of planetary exploration by penetrator technology

Hiroaki Shiraishi[1*], Naoki Kobayashi[1], Satoshi Tanaka[1], Hideki Murakami[2], Akio Fujimura[1]

[1]ISAS/JAXA, [2]Kochi University

A hard landing probe ”penetrator” has been thought to be a very useful tool for the constitution of network stations on the planetary surface and subsurface, because it provides light-weight and cost-effective capabilities of deploying scientific instruments. A long-lived network science by penetrators gives unique possibilities for monitoring the global scale phenomena and for studies requiring simultaneous measurements (seismic, geodetic, magnetic, and meteorological observations) from several sites in one mission. In addition, utilization of penetrators for planetary explorations has some advantages over soft landing probes. The penetrator will make it possible to deliver scientific instruments into the planetary subsurface for in situ chemical analysis and/or heat-flow measurements; otherwise those measurements would require drilling holes from the surface. In situ geochemical measurements with higher resolution can also provide ground truth of remotely sensed data. For the reasons cited above, several planetary missions to use penetrator system have been proposed for a long time and developed by several space agencies. However, the actual space flight has not yet to be fulfilled, except for the European Rosetta spacecraft which has a penetrometry experiment and now under cruising.

ISAS/JAXA of Japan had planned to undertake a lunar mission named as LUNAR-A. The main objective of former LUNAR-A mission was to explore the lunar interior using seismometry and heat-flow measurements. The LUNAR-A penetrator mission had aimed to be the first demonstration to implement the geophysical network. To apply the penetrator system for planetary explorations, the most significant technical issue is an achievement of the shock-durability of the onboard instruments. Therefore, we need the understanding of dynamical aspect at the high-speed impact process into geological materials. And also, a sophisticated potting procedure is required under the severe limitation of weight and power supply.

On the other hand, the present design and manufacturing process of lunar penetrator which we developed for the former project have some disadvantages. One is the prolongation of potting procedure and only a few test trials. The second is the difficulty in partial repairs of payload instruments and their refurbishment. In addition, we have found difficulty to simulate the actual flight condition on the ground test facilities. In these years, we have been studying promising measures to improve the redundancy and robustness as well as multiple uses of penetrator system. Some of them were investigated in the laboratory environmental tests and others were fired for the verification of shock-durability in the high-speed impact tests.

In this study, we will report the application of penetrator technology to the future space program, and propose some mission configuration with the associated model payloads for the achievement of essential scientific objectives.

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Elemental analysis of planetary surface materials by laser-induced breakdown spectroscopy

Ko Ishibashi[1*], Shingo Kameda[1], Yuichiro Cho[2], Seiji Sugita[3], Yayoi N. Miura[4], Sohsuke Ohno[1], Tomoko Arai[1], Koji Wada[1], Masanori Kobayashi[1], Hiroki Senshu[1], Kazuhisa Goto[1], Noriyuki Namiki[1], Takafumi Matsui[1]

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Lunar and planetary exploratrions start from remote sensing orbiters,then proceed to in-situ measurements by lander and rover, sample return, and human explorations. Japan had great successes in remote sensing observations by Kaguya and Hayabusa missions, however, Mars missions led by NASA and ESA are already finishing the stage of in-situ measurements, are planning future sample return mission. As for the lunar exploration, the stage of remote sensing has ended by US LRO mission. China, India, and US have announced next plans to be landing and sample return missions. This internatinal trend continues, sooner or later, for other objects in our solar system. JAXA is also planning the first landing mission in SELENE-2, yet development of instruments on lander and rover is slow. As one of such instrument developing team, we propose LIBS as a very important instrument to measure elemental abundances of planetary surface materials.

Keywords: planetary exploration, elemental analysis, laser, spectroscopy

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PPS023-P04 Room:Convention Hall Time:May 26 16:15-18:45

”Small is beautiful” planetary missions

Yasuhito Sekine[1*], Akihide Hibara[2], Kojiro Suzuki[1], Seiji Sugita[1], Takafumi Matsui[3]

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Micro-Total Analysis System (micro-TAS) describes a miniaturized chip-sized device that automates all necessary steps for chemical analysis of a sample, such as sampling, transport, filtering, dilution, reactions, separation, and detection. Such micro-TAS technology has been originally developed in analytical chemistry and recently has started to be widely applied in many fields, e.g., medical care, marine technology, and police investigation. Because of its very small size, micro-TAS can be placed close to a sampling site, where human cannot reach easily. In this paper, we discuss possible applications of micro-TAS to space and planetary explorations. Together with our small and distributed FS landers, we propose a new type of planetary explorations with the aim of detection of biomarkers and volcanic gases on Mars, Titan and Enceladus.

Keywords: planetary explorations, chemical analysis, Mars, Titan, methane, volcano

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PPS023-P05 Room:Convention Hall Time:May 26 16:15-18:45

Exploration of collisional history and material evolution in the inner region and the main belt of the solar system

Naru Hirata[1*], Hirohide Demura[1], Tatsuaki Okada[2], Shinsuke Abe[3], Tomoko Arai[4], Sho Sasaki[5]

[1]Univ. of Aizu, [2]JAXA, [3]NCU, [4]Chiba Institute of Technology, [5]NAOJ

We propose a series of asteroidal exploration missions to investigate collisional history and material evolution in the inner region and the main belt of the solar system. The aim of this proposal is to answer two important questions of planetary sciences: Why asteroids could not grow up to planets? and What is constituents of the earth and other inner planets?

Keywords: Asteroid exploration, impact history, material science, remote sensing, sample return

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Lunar palnetary exploration by carbon- and choline-bearing materials

Yasunori Miura[1*]

[1]Yamaguchi University

The followings are summary on this project.
1) There are many volatile elements such as carbon and chlorine which are remained in the lunar breccias.
2) Carbon shows micro-and nano-textures with combined with various cations of Ca, Mg, and Fe in the solid states.
3) Chlorine and trace heavy elements are remained in crushed and quenched textures of solid mineral rocks.
4) On the surface of the moon without the atmosphere, carbon shows strongly the influences of the solar winds from the Sun and asteroid collisions, as well as planetary impacts.
5) A magnetism change is considered originally by state-changes of a carbon-bearing magnetic minerals and the magnetic field of the Moon.
6) Carbon is specifically remained in almost all the lunar Apollo impact breccias and also Ca-rich anorthite plagioclases of the lunar highlands and breccias.
7) The next exploration of the carbon- and chlorine-bearing materials with volatiles will be significant for the lunar formation analyses.
8) On the lunar interior without Earth-type activity, carbon-bearing materials are related with formation of depression hole-structure by gas evaporation after shock wave explosion (with lunar volcanic or moonquake origin).
9) The present study technique is used for every global exploration applied for Mars, Asteroids and other planetary probes.

Keywords: lunar exploration, carbon-bearing materials, chlorine-bearing materials, magnetic minerals and magnetism, planetary impacts, solar wind transportation