

Past, present, and very exciting future of the lunar exploration

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We are in an extremely exciting time for the lunar exploration in which, multiple unmanned and manned missions are planned in near future based on the knowledge derived by previous exploration missions. In this presentation, past (major findings derived by the SELENE and other previous missions), present (objectives, instruments, and challenges of the upcoming missions), and future (ARTEMIS program, a smaller version of the International Space Station, crewed pressurized rover, and more) of the lunar explorations will be discussed hoping to encourage anyone (especially for young scientist/engineers) to directly participate and contribute to the lunar missions.

Past: SELENE (Kaguya) was the first Japanese lunar exploration mission with 14 instruments, which aims to understand origin and evolution of the Moon. It was launched in 2007 and it derives numerous datasets of the moon during 18-month mission period. From these datasets, we obtained information about composition of the lunar crust, mantle, identified ancient lunar dynamo, found increase of volcanic activity in around 2.0 Ga, and much more to be discussed.

Present: After the successful orbiter mission of SELENE (Kaguya), JAXA decided to launch the Smart Lander for Investigating the Moon (SLIM) mission in FY2022. It is a technology demonstration mission to pinpoint landing within a hundred meters in radius. The SLIM carries one scientific instrument (Multi-Band Camera; MBC), which will observe boulders on the lunar surface in 10 bands from visible to infrared wavelength with high spatial resolution. Target of the MBC observation is the olivine-rich lithology found by SELENE (Kaguya) spectral observation, which is possibly originated from the lunar mantle. To directly investigate this unexplored olivine-rich lithology, one of the small fresh craters named as “SHIOLI” (diameter is ~200 m) at the nearside of the Moon is selected as a landing site for the SLIM. The camera is going to derive modal abundance (ratio of minerals) of the boulders and composition (Fe/Mg ratio) of the olivine to estimate composition of the lunar mantle. The pinpoint landing technology of the SLIM mission is important for the future mission. After the SLIM, JAXA is planning a lunar polar exploration mission (LUPEX). Recently, multiple datasets indicated presence of water condensation at the lunar polar region. The goal of this mission is to obtain information for evaluating possibility to use the water as a resource by conducting in-situ measurements at the lunar surface. ISRO and JAXA have been jointly studied this mission, in which each agency will develop a lander and a rover respectively.

Future: Recently, NASA-proposed “Gateway” ; a cis-lunar platform concept. It is like a smaller version (approximately one-sixth the size) of the ISS. And some crewmembers will be sent to the Gateway for ~30-day missions before the end of 2020’ s with the cooperation of international and industrial partners. And JAXA is continuing discussions for participation in the Gateway. To enhance international collaborations for sustainable human space exploration, JAXA establish a Space Exploration Center (JSEC). And last year, JAXA opened a call for astronaut with consideration of the future human explorations. Also, multiple private companies are planning their own missions to the Moon. So, we can say that we are in an extremely exciting time in which, there are many ways to participate and contribute to the lunar and Mars missions if you are interested in.

Keywords: lunar exploration , Smart Lander for Investigating the Moon, lunar polar exploration mission