Exploration schemes of permanently shadowed region on lunar pole

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In the JAXA's long term vision, "JAXA 2025" at last March, the importance of exploration and utilization of the Moon are identified with the goal of the Lunar base around 2025. To realize the Lunar base and Lunar exploration and utilization, the polar region and its PSR (Permanently Shadowed Region) become very important and attractive targets to be explored for the 1st Japanese moon lander within next decade. In this presentation, we will describe the technological study results of the exploration schemes for PSRs in lunar polar region, as the first step to the lunar base. As the landing site for the investigation of lunar utilization possibility, the lunar polar regions are very attractive for the exploration, since there are many peak of eternal or quasi eternal sun lighting regions, and there might be ice/water resource in PSR of craters, that are very close to the ELR (Eternal Light Regions). At the ELR, we could expect the continuous sun lighting, which will enable the lander system to survive the serious low temperature during moon night. If we could utilize the continuous sun lighting on a large scale, it will be technologically available and effective power plant for the moon landers in the initial phase, and for the future lunar base. For the ice/water exploration in the PSR, we examined and compared various concept schemes, those could be put into practice. From the technological view points, PSR has many serious difficulties ; no optical image, very low temperature estimation such as around 40K, no sun lighting, no more than speculated information, and so on. As the quick results of this examination, the ELR are considered as more suitable area for the Japanese 1st landing, which is close to the PSR. From SELENE, LRO, and other lunar orbiters, we could gather the topographical and geophysical data, and utilize them for the safe landing to those ELRs. In addition to those prior data, the active imaging sensor, such as LRF (Laser Range Finder), and the optical imaging cameras could be used for the obstacle avoidance and precise navigation during vertical landing. There are many technological problems of the ELR landing for PSR, which shall be solved before landing. One major problem is that the ELR landing requires the technology to land on the top of the mountain. Actually the ELRs are the crater rims, so they have narrow width and rather long length. Thus for the ELR landing, the navigation, guidance and control subsystem shall keep critical preciseness during the powered descent and vertical descent process from the 100km moon orbit to the crater rim Other major problem is the distance between ELR and PSR. It is estimated as 8km to 20km, with steep slopes at the

crater rim. This long traverse might be rather serious and challengeable requirements for current moon rovers technology. Thus we will also examine the other technological possibilities, such as penetrators, or air bag exploration sub-systems, that would be thrown from the lander during landing, at the upper point of PSR, and/or hopping lander to the ELR on the crater rim. In the presentation, we will also introduce the latest status of Japanese moon lander project for the lunar exploration, utilization and lunar base.