Examination of water observation procedure in lunar polar exploration

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In recent years, the lunar polar region has been attracting attention as a lunar exploration target. Multiple remote sensing datasets from lunar exploration missions [e.g., 1, 2] suggested that water ice might be widely present in the lunar polar regions. For this reason, several space agencies are investigating the availability of water ice resources that might exist in the lunar polar region. The availability of water ice as propellant is expected to have a significant impact on future lunar exploration scenarios and activities. Also, it is known that some hills and crater rims of the lunar polar region have areas of continuous sunshine for more than half a year and more than 80% sunshine ratio [3], therefore the lunar polar region is considered to a useful base for sustainable activities.
In this situation, Japan Aerospace Exploration Agency (JAXA) is planning a lunar polar exploration mission that aims mainly to confirm the abundance of water ice resources and to establish the technology of planetary surface exploration in collaboration with the Indian Space Research Organisation (ISRO)[e.g., 4]. This presentation describes the examination status of the water ice observation method for this mission.
To achieve the objectives of the mission, the following parameters are listed as constraints for selecting a landing site, taking into account the unique conditions of the lunar polar region; presence of water, surface topography, communication capability, and duration of sunshine. By superimposing these analysis results, the candidate for landing sites is selected [5]. Currently, around 30 sites of the north and the south pole of the Moon have been identified as landing site candidates.
In this mission, the "course observation" will investigate the horizontal distribution of the surface and subsurface of the water ice existing area while traveling with the rover. And the "fine observation" will investigate the vertical distribution of underground of the water ice existing area by excavating with a drill. In the course observation, neutron spectrometer, ground-penetrating radar and imaging spectroscopy camera are being considered as model payload instruments. In the fine observation, regolith is excavated by earth auger and sampling of excavated regolith is carried out by the rover working system. And the concentration of gas generated by sample heating and the molecular species contained in the gas is measured using thermogravimetric analyzer, mass spectrometer and cavity ring-down spectroscopy analyzer, which are assumed to be model payload instruments. By performing these observations in multiple exploration areas (waypoints), ground truth data on water abundance and resource availability around the landing site will be obtained.

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Keywords: lunar polar exploration, lunar water, volatile

