

HERACLES mission: Returning to the Moon by an ESA-JAXA-CSA Joint Study

*Yuzuru Karouji¹, Hiroshi Nagaoka¹, Yoshiaki Ishihara², Masahiro KAYAMA³, Satoru Yamamoto⁴, Nobuyuki Hasebe⁵, Ko Hashizume⁶, Yoshiko Ogawa⁷, Toru Yada¹, Junichi Haruyama¹, Masanao Abe¹, Makiko Ohtake¹, HERACLES Science Working Group, HERACLES International Science Definition Team

1. Japan Aerospace Exploration Agency, 2. National Institute for Environmental Studies, 3. Faculty of Science, Tohoku University, 4. J-spacesystems, 5. Advanced Research Institute for Science and Engineering, Waseda University, 6. Faculty of Science, Ibaraki University, 7. The University of Aizu

Global Exploration Roadmap published in January 2018 by the International Space Exploration Coordination Group (ISECG) clearly identify the Moon as the next logical destination and defined strategic goals and objectives for its exploration. Returning to the Moon not only yields fundamentally important science opportunities for our understanding of the Solar System but also allows us to test hardware and operational procedures for the exploration and utilization of space beyond Low Earth Orbit (LEO). The Human-Enhanced Robotic Architecture and Capability for Lunar Exploration and Science (HERACLES) is a joint mission under study by European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA) and Canadian Space Agency (CSA) with NASA and Roscosmos having observer status [e.g., 1]. Thus, HERACLES is an international effort in preparation of returning humans to the Moon and providing opportunities for unprecedented science utilizing the Lunar Orbital Platform-Gateway (Gateway). It is a sub-scale demonstration mission of human lunar exploration aiming for launch in the mid-2020's, and the vehicle is composed to test key components including the three following elements: The Lunar Ascent Element (LAE) will be provided by the ESA, the Lunar Descent Element (LDE) will be provided by the JAXA, and the rover will be provided by the CSA.

The coordination of the planning of science opportunities is performed by the multi-agency HERACLES Science Working Group (SWG). The SWG is also responsible for developing a mission science management plan to describe science themes and science payload instruments selection processes, and data/sample allocation policies. The SWG engaged the science communities of each country and organized the HERACLES international Science Definition Team (iSDT). The iSDT will generate a prioritized list of investigations and will provide input for the landing site selection.

Recently, the iSDT discussed the science scope of the HERACLES mission. The iSDT agreed that the following five non-prioritized topics are the most important lunar science themes that should be addressed by HERACLES; (1) crustal anorthosite composition and crystallization age, (2) mantle composition, (3) improvement of chronology with crater counting of young basalts (<2.5 Ga), (4) internal structure: surface, subsurface, crust, mantle and core, (5) mechanism of material transport (e.g., water) to the Moon. Furthermore, the iSDT has identified several potential landing areas to accomplish these science themes: Jackson crater, Moscoviense basin, Copernicus crater, Schrödinger basin and some young basalts in the Flamsteed region [2, 3].

By the way, the International Space Exploration Program Committee of the Advisory Committee for Space Science and Engineering organized the HERACLES Task Force and independently of SWG, is compiling to recommendations on science and engineering of HERACLES mission. These reports will be submitted at the end of February 2019. These recommendations will also be taken deeply as opinions of the Japanese scientific community and SWG will discuss how to reflect it in the SWG discussion in the future. In this presentation, we are going to report outcome of previous activities related to the HERACLES SWG and planned discussion within Japanese lunar science community of study in this SWG.

- [1] Landgraf et al. (2018) LPSC 50th, abstract 1030; [2] Hiesinger et al. (2018) LPSC 50th, abstract 1327;
[3] Karouji et al. (2018) LPSC 50th, abstract 1736.

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