Japan's Lunar Exploration Program

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SAC Lunar Exploration WG

- The Space Activities Commission (SAC) of Ministry of Education, Culture, Sports, Science and Technology (MEXT) revised the Japanese Long Term Programs of Space Activities (LTP).
  - Japan' s long-term strategy for space development and utilization for next decade.
  - JAXA's new five-year plan started from April 2008.
- LTP Panel established Lunar Exploration Working Group in Sept. 2007, as one of the WG for LTP Panel to contribute LTP panel discussion.
- The Lunar Exploration Working Group concluded a strategy for lunar exploration in Nov. 2007.
- This report was taken in the LTP report.

Revised "Japanese Long Term Programs of Space Activities (LTP)"

S A C finally issued new LTP in Feb.2008

- Japan shall conduct the space exploration program, actively and boldly.
  - Acquisition of new knowledge and expansion of frontier are two wheels
  - Balance International Cooperation mechanism and select autonomous activities
  - Focus on the unmanned (robotic) lunar exploration for the present
  - Examine the necessity of human exploration with international cooperation properly
  - Set forth R&D for autonomous human exploration

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Organizational chart
-past and present of JAXA-

President

- ***Space Transportation Mission Directorate***
- ***Space Applications Mission Directorate***
- ***Aerospace Research and Development Directorate***
- ***Institute of Space and Astronautical Science***
- ***Aviation Program Group***
- ***Human Space Systems and Utilization Mission Directorate***
- ***Lunar and Planetary Exploration Program Group (JSPEC)***

Lunar Exploration Roadmap

- 2010	2011 - 2015	2016 - 2020	2021 - 2025	2026 - 2030	

International Space Station

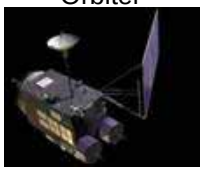


JEM Flights

HTV Flights

SELENE Series

KAGUYA (SELENE) Orbiter



SELENE-2 Lander

SELENE-X Advanced Lander

Int'l Human Lunar Exploration

Japanese Astronaut to the Moon

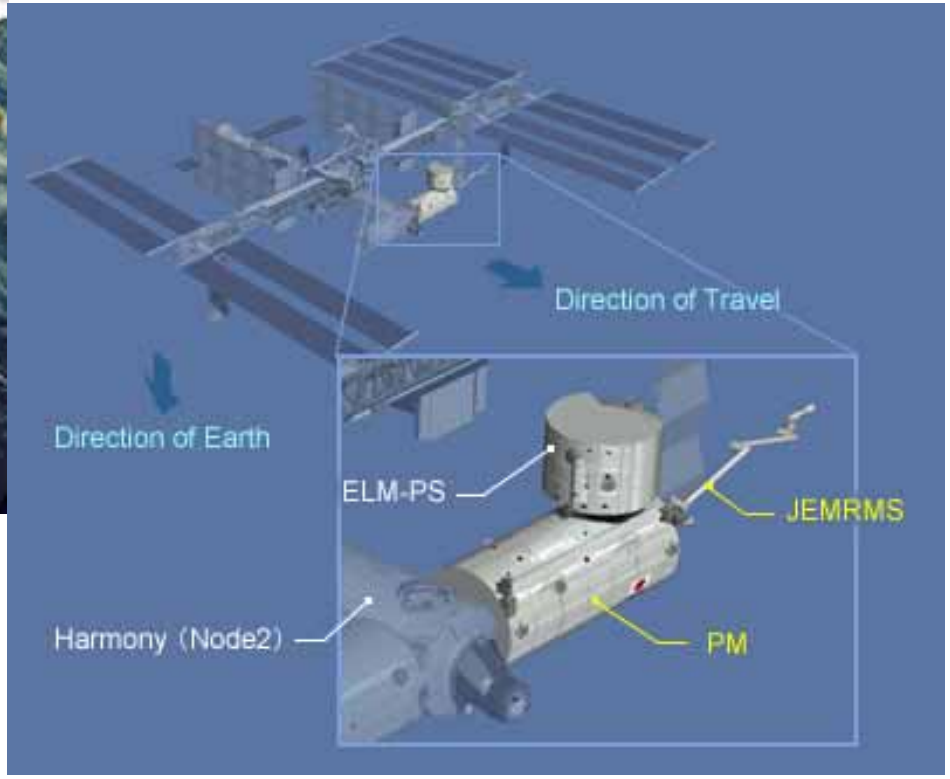
Human Lunar Exploration Technology Demo Using SELENEs, JEM, and HTVs

Political Decision

Japanese own Human Lunar Exploration

Human Lunar Exploration System Development

Kibo (JEM) Facility in ISS



HTV will be launched soon.

Human Lunar Exploration Joint Task Force (1)

To examine human lunar exploration with international cooperation, JAXA established a preparatory task force internally.

Objective:

- Survey of human lunar exploration mission
- Study of options for the human lunar exploration architecture

The task force consists of engineers from:

- JSPEC
- Human Space Systems and Utilization Mission Directorate (ISS) Directorate
- Space Transportation Mission Directorate

Human Lunar Exploration Joint Task Force (2)

Plan:

- To conduct 2nd cycle of internal architecture study and mission study by the next ISECG (Mar. 2009).
- To join the international architecture study multilaterally and bilaterally.
  - Multilateral coordination at the Interface Standard Working Group (ISWG) as an ad-hoc WG in ISECG
  - Bilateral architecture study with ESA

Human Lunar Exploration Joint Task Force (3)

Lessons learned from ISS considered in the internal exploration study:

- Quick achievements for sustainable political and public support.
- Importance of the robustness of transportation (crew and cargo) for program risk mitigation
- Appropriate interdependency desirable for program stability.
- Mission requirements to be clearly defined in the beginning of the study.

JAXA's strategy for human lunar exploration

- To evolve partnership obtained through the ISS program, and to participate in the human space program continuously.
- To participate in the study and pre-coordination for the International human lunar exploration, and aim to transition to actual Japanese participation.
- To acquire and improve the autonomous human transportation capability step by step leveraging international cooperation.
- To leverage "Kibo", HTV, SELENE series and/or other robotic exploration mission for the development, demonstration, and application of technologies and medical knowledge necessary for human lunar exploration

JAXA's Lunar Exploration Roadmap

▽NASA Humans Mission

06	07	08	09	10	11	12	13	14	15	20	25	30
H18	H19	H20	H21	H22	H23	H24	H25	H26	H27	H32	H37	H42

▲Kaguya　　SELENE-2 (plan)　SELENE-X (plan)

Robotic

Kaguya (SELENE)
Orbiter

SELENE-2
Lander

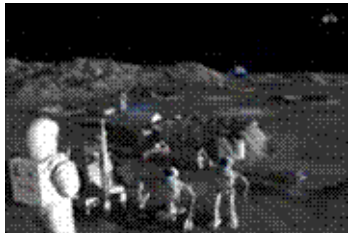
SELENE-X
Advanced Lander

Japanese Own Long Term Surface Activity

Human

J. Astronaut

On the Surface among International Crews



Human-related Technology through ISS, HTV,etc.

SELENE(KAGUYA) launch

“Kaguya” Selenological and Engineering Explorer (SELENE)

Launched by the H-IIA on September 14, 2007 (JST) from Tanegashima Space Center.

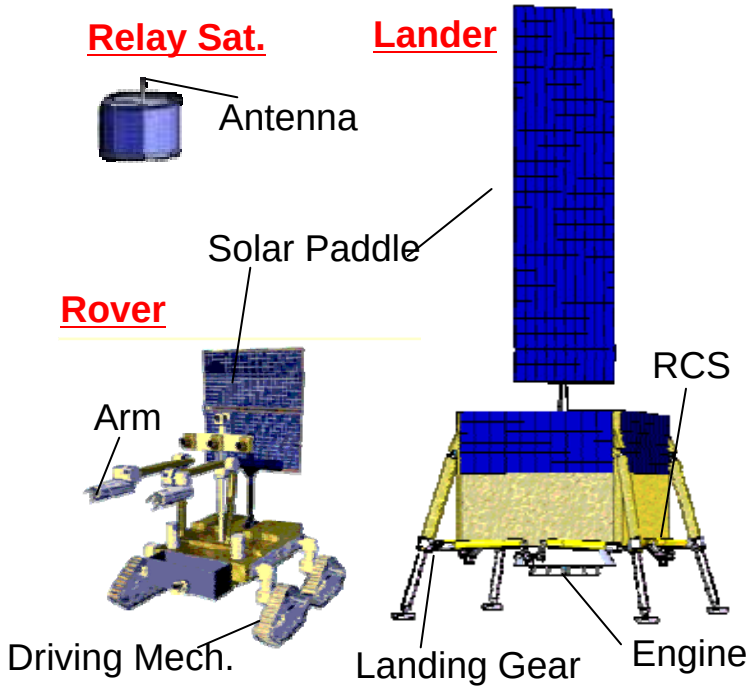
The major objectives are to obtain scientific data of the lunar origin and evolution and to develop the technology for the future lunar exploration.

It consists of a main orbiting satellite at about 100km altitude and two small satellites (Relay Satellite and VRAD Satellite) in polar orbit. The orbiters will carry instruments for scientific investigation of the Moon, on the Moon, and from the Moon.

Future Program
SELENE-2: Landing Observation

The landing area anticipated is at such as Quasi- eternal sun-lit area either in polar region or some other locations, and the mission life for the Lander shall last one month at least.

- Infrastructure for Exploration
  - Landing
    - Eternal light zone at polar
  - Rover
- Lunar Science & Technology
  - Origin and evolution of Moon
  - Moon night survival without RTG
- Environmental study for future utilization
- Int. collaboration and cooperation
- Launch: H-2A @ 2010s'
  - 1000kg (Dry)
  - 200 ~ 400kg Payload



start of Phase-A team

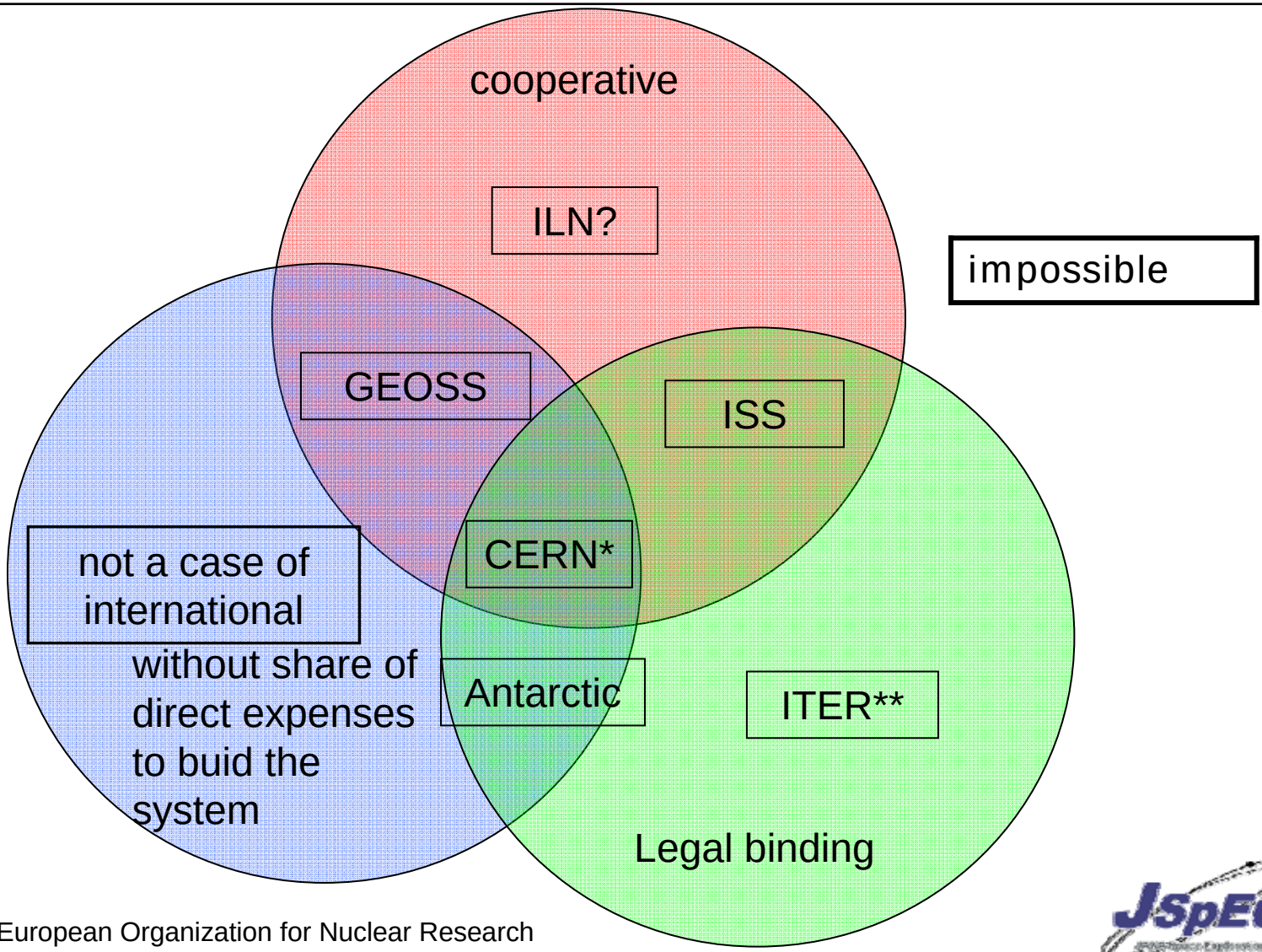
ISECG

International Space Exploration Coordination Group

- Established in Nov. 2007 based on the Global Exploration Strategy (GES) and its Framework Document.
- Participation from 12 space agencies as of today, may expand to 14 agencies
- Mechanism for the long term international cooperation and coordination
- Realize efficient and effective space exploration through common standards, interface, coordinated activities

- JAXA works not for only participating role but also for leading role in some subject, for example, data archive and coordination mechanism study

Collaboration Mechanism Interpretation Example



*European Organization for Nuclear Research
**International Thermonuclear Experimental Reactor

ISECG: Chronology & Milestone

2007

- Apr.: JSPEC started (as promotion office)
- Sep.: SELENE(KAGUYA) launch
- Sep.: SAC Lunar Exploration WG
- Nov.: #1 ISECG

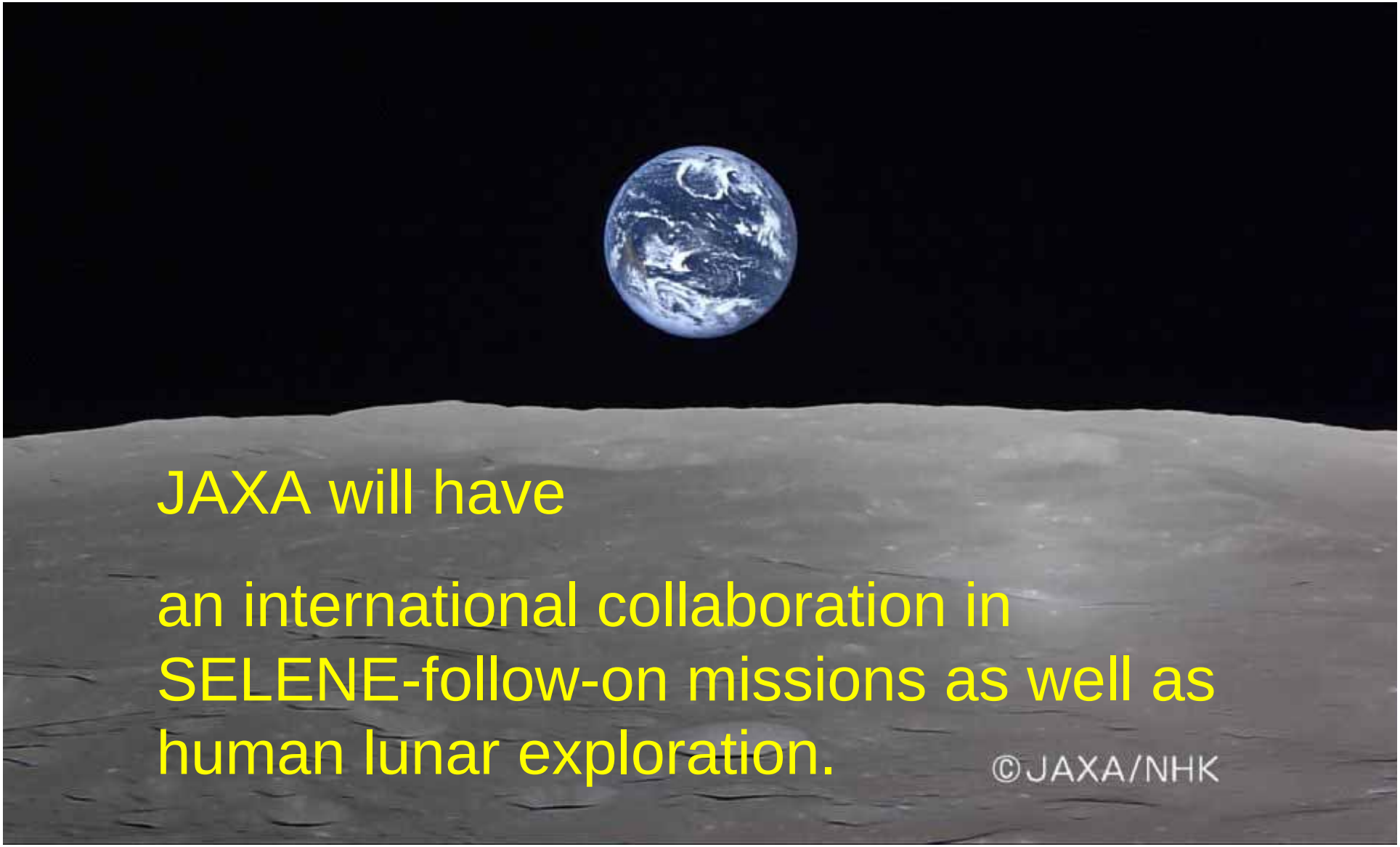
2008

- Mar.: Manned Exploration TF (JAXA in-house study)
- Apr.: JSPEC expanded (as program office)
- Jul.: #2 ISECG
- Sep.: #1 Interface Standard WG* workshop
- Oct.: #2 Interface Standard WG* workshop
- Comparative Arch. Studies (ESA bilat. & NASA bilat.)

2009

- Jan.: #3 Interface Standard WG* workshop
- Mar.: #3 ISECG Japan hosts

*Subworking group under ISECG


JAXA will have
an international collaboration in SELENE-follow-on missions as well as human lunar exploration.
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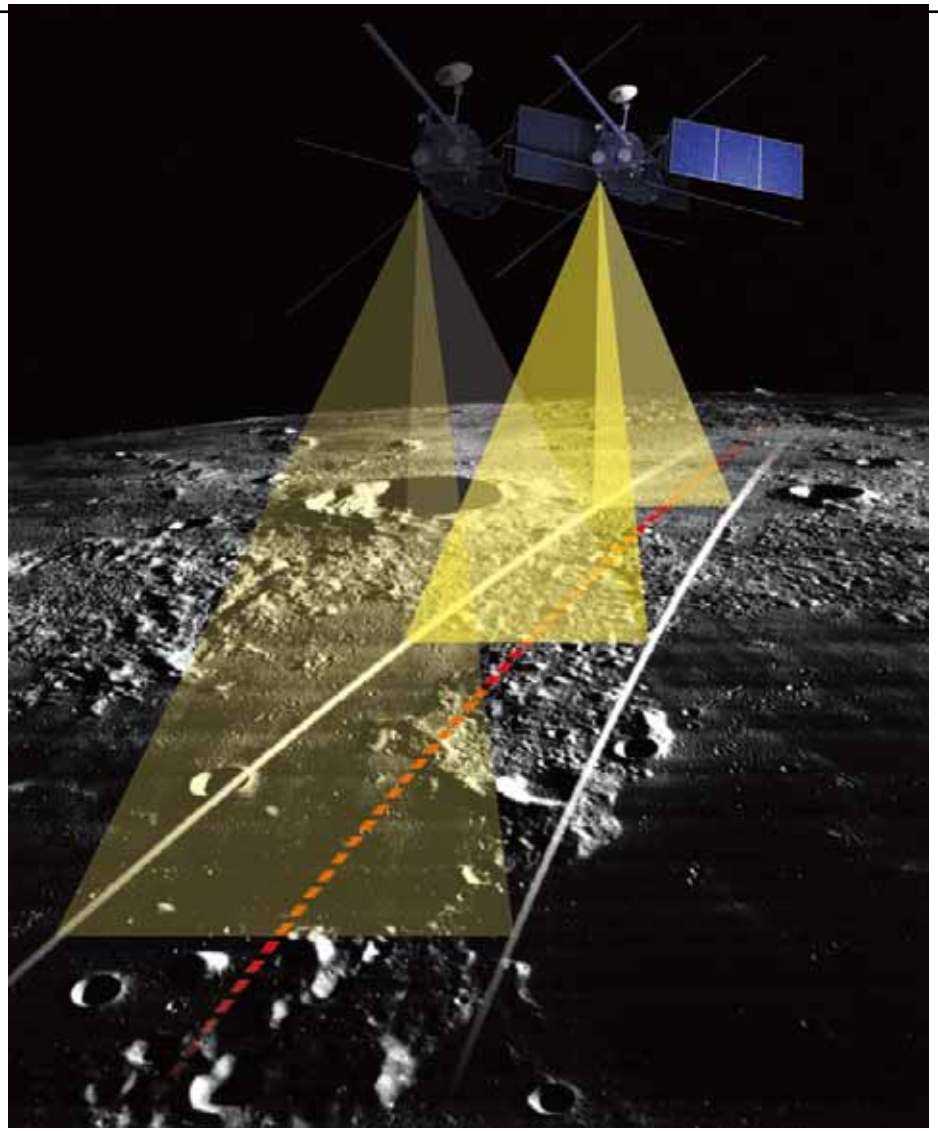
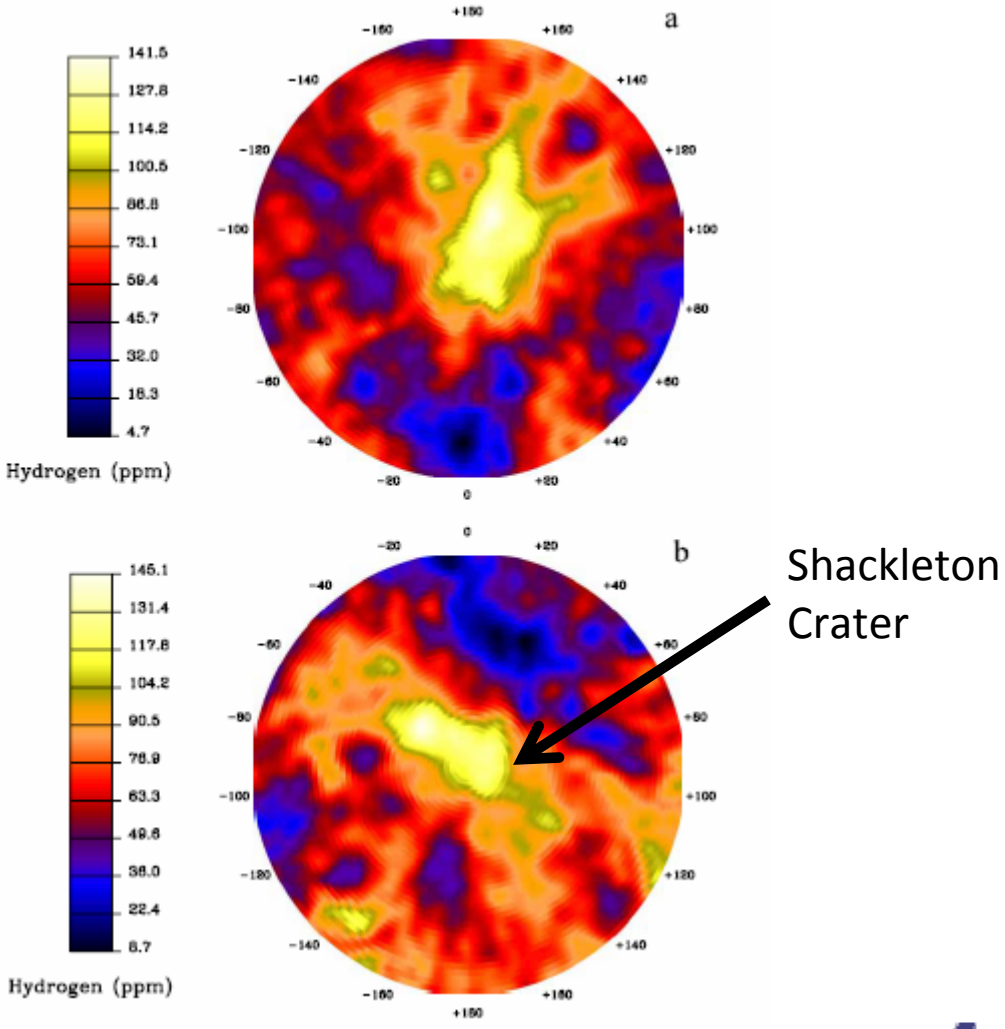
Terrain Camera aboard Kaguya



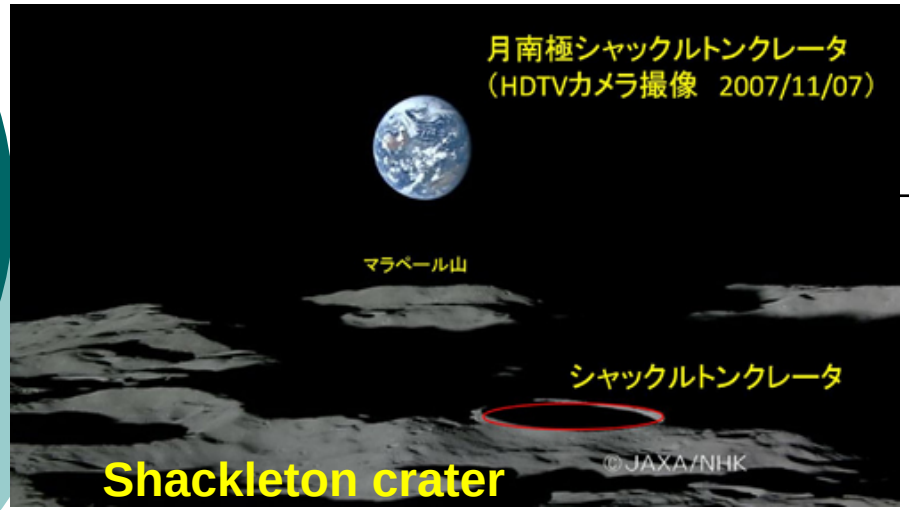
Luanr Prospector (1998) Observation

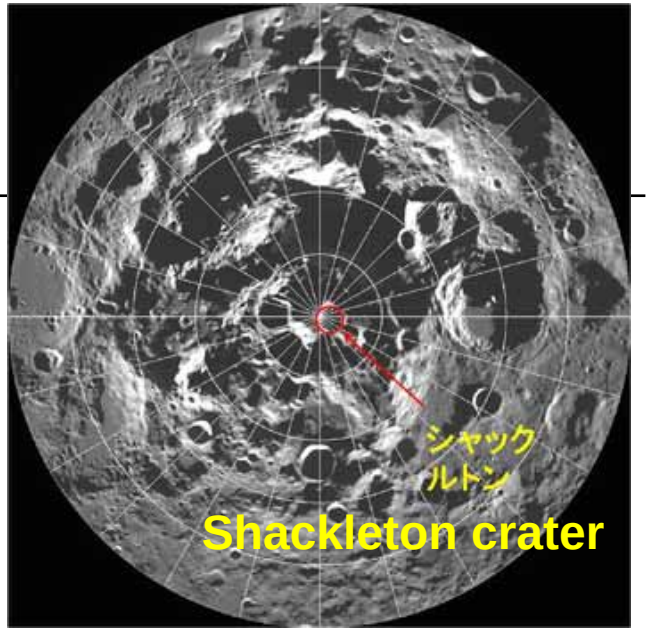
North Pole

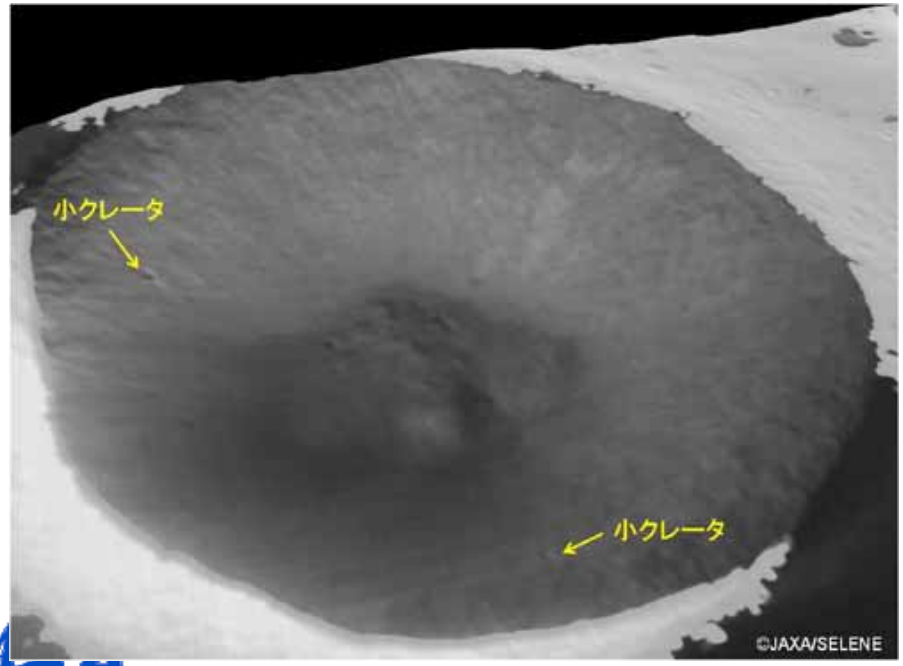
South Pole



Lawrence et al., *JGR* (2006)







Images taken by the Japanese lunar explorer satellite Kaguya show the Shackleton crater at the moon's south pole may not contain any exposed ice.

The crater, permanently shadowed, has been thought to hold water-ice deposits since a U.S. satellite detected the presence of hydrogen in the 1990s. If the water-ice exists, it may be in a small amount and mixed with soil or buried.