Return to the Moon (02)
Scientific Highlights and Lessons from Recent Lunar Missions (1)

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LORE LUNAR ORIGINS AND RESOURCE EXPLORER SCIENCE PAYLOAD

Abstract

The Moon, our closest celestial neighbor, is of scientific interest to understand the impact history associated with the evolution of the Earth-Moon system, a waypoint to exploring more distant planets, a vantage point to study our own planet, and a proving ground for planetary technologies. The lunar subsurface stratigraphy could hold a record of the interplanetary transport of various volatiles via meteorite impacts, similar to ice core samples taken on Earth. This requires in-situ subsurface measurements of the pristine samples before they are affected by the intense surface VUV environment. In addition, the identification and mapping of in-situ resources, such as ilmenite (FeTiO3), is crucial to assist future sustained lunar manned presence.

The Japanese-led JAXA Kaguya Selene-1 mission, launched in 2007, targeted the global characterization of the lunar surface and detailed gravimetry from an orbiter platform. JAXA's Selene-2 proposes to follow the success of Kaguya with a landed lunar mission consisting of an orbiter, 1000 kg lander and a 100 kg rover. In particular, the Selene-2 lander will include the Lunar Soil Mechanics Investigation System (LSM) subsurface geophysics package. This incorporates a deployable drill to enable systematic lunar subsurface studies at several different points near the lander to a depth of 1 m.

A Canadian potential contribution studied under a contract with the Canadian Space Agency consists of a bore-hole probe with a fiber-optic coupling to a miniature guided-wave spectrometer that would be mounted on the Selene-2 lander. This combination can provide substantial key new lunar science and would be the first in-situ study of the lunar subsurface. The LORE bore-hole sensor functions include:

• down-hole colour images for stratigraphy and particle size distribution;

• spectroscopy from 900 to 3400 nm of the bore-hole walls as a function of depth to provide data on the subsurface composition and mineralogy;

• direct detection of the location of subsurface water/ice and other volatiles using characteristic optical absorption peaks;

• mapping the subsurface ilmenite distribution for in situ resource studies.

This paper provides an overview of the proposed LORE science payload and the relevant prototyping that has been accomplished in collaboration with CSA.

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