

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

Author: Prof. Jitendra Goswami
Physical Research Laboratory, India

CHANDRAYAAN-1 MISSION: SIGNIFICANT SCIENCE RESULTS

Abstract

The Chandrayaan-1 mission, launched on 22nd October, 2008, carried five payloads, Terrain Mapping Camera (TMC), Hyper-spectral Imager (HySI), Lunar Laser Ranging Instrument (LLRI), High Energy X-ray spectrometer (HEX) and Moon Impact probe (MIP), designed and developed in India, and two Indo-Foreign collaborative payloads, Chandrayaan-1 X-ray Spectrometer (C1XS) and Sub-Atomic Reflection Analyser (SARA). In addition four foreign payloads, two from USA [miniature Synthetic Aperture Radar (mini-SAR) and Moon Mineralogy Mapper (M3)] and one each from Germany [Smart Infrared Spectrometer (SIR-2)] and Bulgaria [Radiation Dose Monitor (RADOM)] were also flown in the mission. The mission operation was relatively smooth until August 28, 2009, when loss of communication with the spacecraft led to termination of the Mission. Most of the payloads have collected significant data of excellent quality during the mission duration. Chandrayaan-1 represents a truly international effort in planetary exploration.

The detection of Hydroxyl and water molecule on the lunar surface material is a major discovery by the Chandrayaan-1 Mission. These findings were confirmed by analysis of both new and archived data obtained by Deep Impact and Cassini missions. The imaging spectrometers on the Chandrayaan-1 and on Kaguya missions established widespread presence of crystalline feldspar in lunar highlands that validates the lunar global magma ocean hypothesis. The TMC provided unprecedented details of lunar topography and identified a well preserved lava tube extending a few km that could be an ideal site for possible future human habitat. HySI, M3 and SIR-2 data, coupled with TMC data on DEM, are providing new insights on lunar surface composition and led to the unexpected detection of refractory (Mg-spinel) rock types of lunar origin. Data obtained by SARA payload suggest that up to 20% of the incident solar wind (SW) protons on the moon are reflected back as neutral hydrogen. It has also detected variations in intensity of reflected SW protons from regions of localized magnetic fields. Mini-SAR observations yielded data suggesting presence of sub-surface ice at the base of a large number of permanently shadowed small craters near the lunar North Pole. C1XS payload detected signals of Mg, Al, Si, Ca and Fe from the lunar surface even during weak solar flares.

Chandrayaan-1 mission has contributed significantly to our understanding of the lunar evolution, made path breaking discovery, provided significant new results and generated an excellent data set using a multitude of payloads that will be very useful for lunar and planetary scientists across the globe.