CHANDRAYAAN-2 SUCCESSFULLY COMPLETES ONE YEAR IN LUNAR ORBIT

Chandrayaan-2, India's second mission to Moon, launched on July 22, 2019 by the indigenous GSLV MkIII launch vehicle from Shriharikota launch centre, successfully completed one year in lunar orbit on August 20, 2020. Chandrayaan-2 spacecraft was launched with the goal of further expanding the scientific knowledge about the Moon through detailed studies of lunar topography, mineralogy, surface chemical composition, thermo-physical characteristics and the exosphere.

Though the soft-landing attempt by Chandrayaan-2's *Vikram* lander could not be accomplished subsequent to the orbit insertion, nevertheless, the orbiter, which is equipped with eight scientific instruments, successfully continued the study from the lunar orbit. It has now completed more than 4400 orbits around the Moon and all its instruments are performing well.

Moon provides the best linkage to understand Earth's early history besides offering an undisturbed record of the inner solar system environment. It could also be a staging post for future human space exploration of the solar system and a unique laboratory, unlike any on Earth, for various scientific investigations.

In spite of several robotic and crewed missions to the Moon, there remains several unanswered questions about Earth's only natural satellite. Continued high resolution studies of its surface, sub-surface/interior and its low-density exosphere are essential to address diversities in lunar surface composition and to trace back the origin and evolution of the Moon.

Chandrayaan-1, India's maiden mission to the Moon, provided conclusive evidence on the extensive presence of surface water and the indication for subsurface polar water-ice deposits. This argued for more focused studies about the water on the lunar surface, below the surface and in the tenuous lunar exosphere, to address the true origin and extent of availability of water on Moon. This led to Chandrayaan-2 mission equipped with an orbiter, lander and rover.

The eight payloads of Chandrayaan-2 orbiter, their unique capabilities and accomplishments are:

- **Terrain Mapping Camera 2 (TMC-2)** capable of facilitating high-resolution topographic maps and Digital Elevation Models (DEMs) of the lunar surface, has acquired images during 220 orbits consisting of nearly 4 million sq. km area of the lunar surface and generated DEM and Ortho-images.

- **Orbiter High Resolution Camera (OHRC)** with the capability to take highest resolution optical images ever (~30 cm) from a lunar orbiter platform, has acquired images of lunar surface consisting of nearly 1056 sq. km area in 22 orbits. It is also used to characterise landing sites for future missions.

- **Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS)** is capable of the highest resolution surface composition study of the Moon using X- rays leading to generation of global elemental maps and monthly studies of geotail at the Moon with high time resolution particle spectrum and flux mapping. Operating from September 2019, CLASS has unveiled new elemental maps at kilometre scales like never before.

- **Solar X-ray Monitor (XSM)** has the capability to obtain high time cadence and resolution solar flare spectrum for supporting CLASS payload and for independent studies of the solar corona. It has observed several flares, including many low-intensity events. Modelling these spectra with theoretical models helps us in understanding the evolution of physical properties of the Sun's Corona during solar flares.

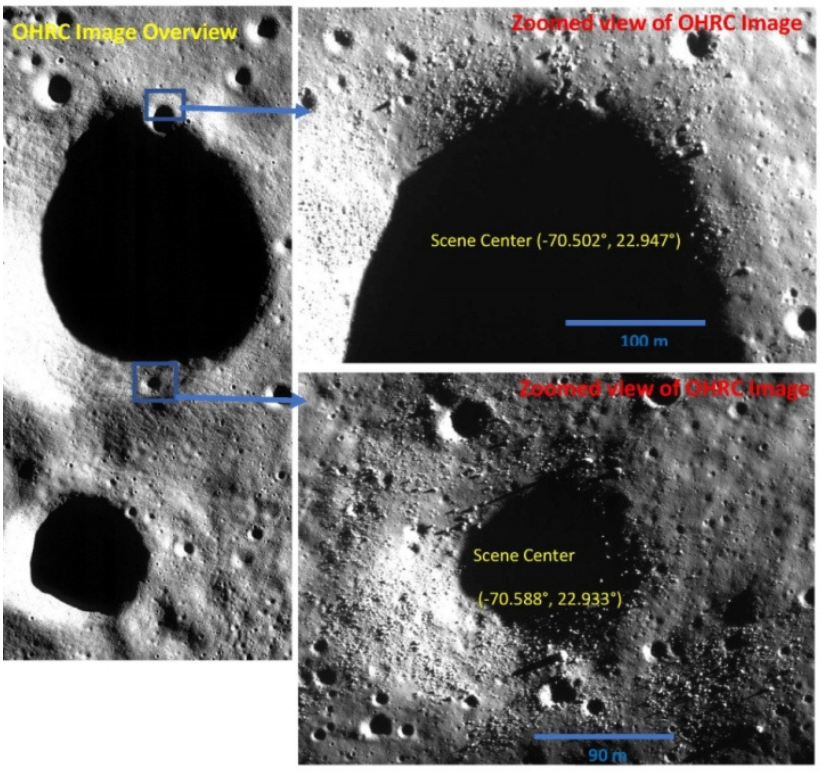
- **Imaging Infra-Red Spectrometer (IIRS)** capable of mapping minerals in 0.8 to 5.0 micron with a focus on extracting clear signature of surface presence of hydroxyl and/or water. This payload has been mapping the mineralogy of the Moon and sent valuable data.

- **Dual frequency Synthetic Aperture Radar (DFSAR)** is capable of full polarimetric measurements of permanently shadowed regions of the Moon, with the first L-band observation of Moon and along with S-band, providing better identification of sub-surface water. This instrument has been imaging the lunar surface and the full-polarimetric imaging capability of DFSAR will provide new insights into the nature and distribution of lunar water-ice deposits.

- **Chandra's Atmospheric Composition Explorer-2 (CHACE-2)** for studying neutral species in the lunar exosphere and its spatial and temporal variations, has detected signatures of Argon-40 at 100 km altitude. Over a period of 6 months, CHACE-2 made observations in different orbit geometries.

- **Dual Frequency Radio Science Experiment (DFRS)** is intended for lunar charged and neutral environment studies using the radio occultation technique.

Chandrayaan-2 orbiter craft is healthy and performance of its subsystems is normal. The orbiter is being maintained in 100 +/- 25 km lunar polar orbit with periodic orbit maintenance (OM) manoeuvres. By August 20, 2020, seventeen such manoeuvres had been carried out since achieving 100 km lunar orbit on September 24, 2019. There is adequate onboard fuel to remain operational for about seven years.



OHRC Image Covering the Region Between Manzinus C and Simpelius N Acquired on 02 March 2020

Boulders can be easily identified using OHRC images due to its very high spatial resolution. Hundreds of boulders, ranging from 1m to 50m in diameter, are distributed within an ejecta close to the crater rim. These boulders represent the deepest material excavated during crater formation. Boulders on the Moon surface are often found around young impact craters. Apart from characterising the landing sites, the OHRC images allow scientists to study boulder populations in the region of interest and help them interpret geologic features and derive geological history for a region.

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