STUDY OF PLAUSIBLE YOUNG LUNAR DOMES IDENTIFIED IN THE MARE NECTARIS USING ORBITER HIGH RESOLUTION CAMERA (OHRC) IMAGE AND DATASETS FROM CONTEMPORARY MISSIONS. R.P. Rajasekhar*, A. K. Dagar, R. Nagori, S. Bhattacharya, Space Applications Centre, Indian Space Research Organisation (ISRO), Ahmedabad-380015, India. (*rajasekhar@sac.isro.gov.in)

Introduction: Obiter High Resolution Camera (OHRC) on-board Chandrayaan-2 mission images lunar surface at low sun elevation angles and, at highest spatial resolution among the contemporary missions [1-3]. The spatial resolution of the images is 0.25 m when acquired from the spacecraft altitude of 100 km. High spatial resolution images acquired at low sun elevation angle are very much useful for studying recent volcanic, tectonics and impact cratering processes.

Remote sensing data sets from recent missions of Chandrayaan-1,2 and SELENE, Lunar Reconnaissance Orbiter (LRO) provided the images and DEM at a moderate to high spatial resolutions of 5m, 8m, 0.5 m and 10 m respectively [3]. These data sets are used for characterization of volcanic features (domes, cones, sinuous rilles, etc.) and assessment of chronology of features through impact Crater Size-Frequency Distribution (CSFD) technique [4-6]. Recent studies revealed wide distribution of young lunar volcanic landforms like Irregular Mare Patches (IMP) and Ring Moat Domes (RMDs), possibly formed during Copernican period [4-6]. Height and diameter of RMDs varies from few meters to 20 m and 10s to 100s of meters, respectively [6].

In this study, a cluster of four plausible domes are identified in the Mare Nectaris basin (around 41.5° E and 20.32° S) using high resolution OHRC image and datasets from contemporary missions, such as images of LRO’s Narrow Angle Camera (LRO-NAC); image and Digital Elevation Model (DEM)s of Kaguya’s Terrain Camera. Surface ages of selected domes are estimated based on Crater Size Frequency Distribution (CSFD) technique [7] to understand the period of formation of these domes. Surface ages of the four domes obtained in this study varies between 59-66 Ma (Fig.3), indicating these might have formed around 60 Ma during Copernican period. Regional and residual separation of gravity anomalies is useful for understanding the sources of deeper and shallower origin. High pass filtered (residual) gravity anomalies are computed using wavelength based filtering technique below 364 km. Rims of the Mare Nectaris basin are mapped as 271 km, 449 km, 624 km and 884 km (Fig.2), indicating these might have formed around 60 Ma during Copernican period. Regional and residual separation of gravity anomalies is useful for understanding the sources of deeper and shallower origin. High pass filtered (residual) gravity anomalies are computed using wavelength based filtering technique below 364 km. Rims of the Mare Nectaris basin are mapped as 271 km, 449 km, 624 km and 884 km (Fig.2), respectively in this study using the topography, gravity (Freeair, Bouguer, residual gravity) anomalies and crustal thickness maps, and these are comparable to previous studies [10]. Domes mapped in this study are located near to the second rim of the Nectaris Basin (~450 km). Hence, these domes might have evolved to the surface through weak zone near to the second rim of the Mare Nectaris basin.

Datasets used: In this study, OHRC image acquired on 31st March, 2021 are used for mapping of domes. LRO’s NAC images (M1157486507LE, M1380886589LE) acquired at different sun elevation angles and Kaguya’s Terrain Camera (TC) Evening and Morning images covering this region are also used as ancillary data sets to ascertain the mapped domes. TC Digital Terrain Model (DTM) data of 10 m spatial resolution is used for analyzing the topographic variations, as high resolution DTM at finer scale is not available for this region. The gravity anomalies [8] and crustal thickness maps derived from data [9] obtained from dedicated GRAIL mission is used for mapping the rims of the Mare Nectaris basin.

Analysis and discussion: Cluster of four plausible circular domes are identified using OHRC image in a relatively topographically plain unit in the Mare Nectaris basin around 41.55° E and 20.32° S (Fig. 1a, b) of spatial resolution 0.27 m. These domes are not reported earlier. OHRC image of these domes are shown in Fig. 2. These domes are further ascertained after analysis of LRO-NAC images acquired at different sun elevation angles and Kaguya’s TC Evening and Morning images. Topographic variations are studied using TC DTM data. The diameter and height of these four domes varies between 1.12 to 1.54 km and 20-50 m, respectively.

Surface ages of these four domes identified using OHRC image are estimated based on CSFD technique [7] by mapping the craters, to understand the period of formation of these domes. Surface ages of the four domes obtained in this study varies between 59-66 Ma (Fig.3), indicating these might have formed around 60 Ma during Copernican period. Regional and residual separation of gravity anomalies is useful for understanding the sources of deeper and shallower origin. High pass filtered (residual) gravity anomalies are computed using wavelength based filtering technique below 364 km. Rims of the Mare Nectaris basin are mapped as 271 km, 449 km, 624 km and 884 km (Fig.4), respectively in this study using the topography, gravity (Freeair, Bouguer, residual gravity) anomalies and crustal thickness maps, and these are comparable to previous studies [10]. Domes mapped in this study are located near to the second rim of the Nectaris Basin (~450 km). Hence, these domes might have evolved to the surface through weak zone near to the second rim of the Mare Nectaris basin.

Figure 1. Topographic map of a) Mare Nectaris and b) plain unit around the region of interest. White box shows the study region and black colored circles indicate the domes mapped by OHRC.

Figure 2. OHRC image showing the cluster of four domes mapped in this study (yellow colored circles).

Figure 3. Crater Size Frequency Distribution (CSFD) plots of four domes, showing the ages of four domes (1-4).

Figure 4. Topography map of Mare Nectaris basin, showing the rims (blue circles) of the basin derived from gravity anomaly and crustal thickness maps.