ESTIMATION OF OPTICAL MATURITY AND EVOLUTIONARY HISTORY OF INTER-BASINAL REGION BETWEEN IMBRIUM AND SERENITATIS BASIN.

P. R. Kumaresan¹ and J. Saravanvel², ¹Research Scholar and ²Associate Professor, Department of Remote Sensing, Bharathidasan University, Tamil Nadu. e-mail: prkumaresan@bdu.ac.in; drsaraj@gmail.com

Introduction: The Earth's Moon outer surface (Crust) is shaped by impact cratering, volcanism and tectonic activity. Analysis of literatures shows that the researchers were carried out the extensive work on the morphology, chronology and compositional characteristics of the lunar surface. However, the inter-basinal region generally vested with unique morphological features and diversified lithological rock types have not been studied to its deserving limit. Hence, in this research study, major inter-basinal region falls in between the giant and large impact basins Imbrium and Serenitatis were taken for investigation and estimated optical maturity (OMAT) using Clementine multispectral data. Finally, evolutionary history of the region was brought out (Figure. 1).

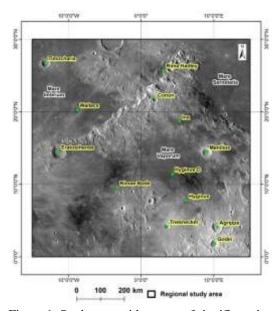


Figure 1. Study area with names of significant impact craters, rilles and Mare regions.

Geology of study region: Serenitatis is the oldest impact event in this investigative region, which occurred at Lunar Heavy Bombardment (LHB) period. Analysis of Apollo 17 felsic clast of breccia rocks age dating concluded that Serenitatis impact event occurred at 3.87 ± 0.04 Ga [1]. Serenitatis shows mass concentrations (Mascon) inside it and filled with several series of magmatic activities [2,3,4]. Imbrium basin is second most large impact basin in the study region and also most significant event in shaping the near side of the lunar surface. The Impact occurred at 3.85 Ga [5]. The

main rim of Imbrium stands as Montes Apenninus (MA) with diameter range of 1160 km [6,7] for several millions years. Mare Vaporum occupies the central portion of study region and shows 6 distinct types mare units within it and age ranging from 3.1 to 3.6 [8]. Dark mantling deposits (DMD) are dark albedo regions of pyroclastic deposits [9]. Wrinkle ridges and lobate scarps are due to compression (contraction) of the moon [10]. Rilles and garben are due to extensional stress process [11]. Wrinkle ridges are low elevated and sinuous ridges formed on the mare surfaces due to contraction of the lunar interior and basaltic lava cooling. It extend up to several hundred kilometers, some are even extends to neighboring highlands [12,13,14]. Rilles are lava tubes/ channels formed around active sources of lava outflow with low viscosity [15]. Which could be described as thermal and mechanical erosion of lava flows [16,17,18]. Grabens are linear landforms with down dropped block in the center associated with adjacent blocks due to fault. Normal faults, are planar surface discontinuities due to extensional stress expressed as fractional sliding is found across the lunar surface [19,20,21,22,23]. Later the net crustal expansion of moon is covered to net crustal contraction of moon [24]. Evidences of contraction features lobate thrust fault scarps are estimated to be less than 0.5 Ga old. These are young features recently discovered widespread on the moon [25,26,27].

Data Set Used and Methodology: The 1994 clementine mission to moon has produced enormous amount of data. One among them is ultraviolet-visual (UVVIS) camera [28,29]. This Clementine UVVIS data of 415nm, 750nm, 900nm, 950nm, and 1000nm wavelength provided first time global mineralogical diversity map of the lunar surface [29,30,31].

Optical Maturity (OMAT) is calculated by Euclidean distance from the dark red origin point utilizing the reflectance bands of 950 and 750 nm by applying below formula is proposed by [32]:

OMAT=[(R750 - x_0) 2 + ((R950 / R750) - y_0)2]1/2 Where x_0 is the reflectance of the origin point, y_0 is the ratio value of the origin. For the elementine data the constants (x_0 and y_0) were used as 0.08 and 1.19.

Results and discussion: The optical maturity (OMAT) depicts the exposure of surface to the space weathering process. The lunar surface is covered with fine grained particles called as lunar regolith or soil,

produced by product of meteoroid impacts ranging from nanometer to kilometers. These regolith particles will react with the solar wind from sun and galactic cosmic rays forms iron agglutinates. This will affect the optical properties, prolonged exposure to space leads to darkening and reddening. The reflectance spectra from matured region exhibits low value. Fresh craters shows higher OMAT value and brighter in tone indicates lower matured region with fresh materials. Regional dark mantling deposits are lower OMAT value and darker in tone indicates highly matured region (1a-d, Figure 2). Ejecta blanket of south-eastern Serenitatis basin (2) shows lower OMAT value indicates this part of terrain is prolonged exposure to the space weathering process (Serenitatis impact event 3.87 Ga).

Serenitatis impact is first multi-ring impact event in the study region excavated the anorthositic highland terrain. Later, imbrium is also multi-ring impact event that shaped the nearside of the moon. Imbrium may be one among inducing factor in basaltic lava flows into surface. Probably after the two major impact events, fire fountain volcanism had erupted with explosive nature. These explosive volcanism had brought the deeper mantle materials into surface and composed of quenched volcanic glasses, pyroclastic deposits and even spinel in Sinus aestuum. Later to this basaltic flows is erupted is various episodes. In recent lunar geological period (Copernican period) the degassing of carbon monoxide was inferred from Irregular Mare Patches morphology. Cooling of interior moon and basaltic lava flows had created lobate scarps recently was observed from the high resolution data sets like LRO LROC NAC images.

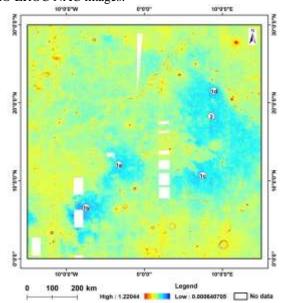


Figure 2. The optical maturity (OMAT) map of the study region with colour coded. Higher value of

OMAT indicates these are unwethered and fresh materials (Red in colour coded image). Lower value of OMAT indicates weathered zones and highly matured region (Blue in colour coded image). 1(a-d) – Matured dark mantling deposits (DMD); 2 – Matured southeastern ejecta blanket of serenitatis basin.

Conclusion: Clementine multispectral global data sets is capable in compositional analysis and calculation of optical maturity variations. Evolutionary history of the region was finally brought out for the Interbasinal region between Imbrium and serenitatis basin.

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