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Research Article

CHRONOLOGICAL STUDY OF MARE MOSCOVIENSE BASIN ON MOON USING LROC WAC DATA

Chinnamuthu M., Gowthaman A.T and Anbazhagan S

Centre for Geoinfomatics and Planetary Studies, Periyar University, Salem 636 011. India

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ABSTRACT

The Lunar geological time scale divides the history of Moon into five recognized periods: the Copernican, Eratosthenian, Imbrian, Nectarian and Pre-Nectarian. The boundaries of the periods were related to the large impact events that modified the lunar surface. The absolute ages of these periods have been constrained by radiometric dating of samples obtained from the lunar surface. Surface Age determination is necessary for understanding and to reconstruct the Geological Time scale of any planetary body. Radiometric dating, fossils, lithological correlation can be used to determine age of terrestrial rocks. Whereas in the case of planetary bodies, accessibility is limited to extract information from the rock samples, The Crater counting is a technique used to identify the surface ages using remote sensing data. The lunar cratering chronology uses crater size-frequency distributions (CSFDs) to derive absolute model ages for geological units across the Moon, and is adapted for use on the surfaces of various other Solar System bodies. LROC (Lunar Reconnaissance Orbiter Camera) is a system of three cameras mounted on the Lunar Reconnaissance Orbiter (LRO) that capture high resolution photos of the lunar surface. Two NACs (Narrow Angle Cameras) capture high resolution black and white images. The third WAC (Wide Angle Camera) captures moderate resolution images using filters to provide information about the properties and color of the lunar surface. Here, CSFD is used to identify the age of Mare Moscoviense using LROC WAC image and correlated with the Lunar Geological Time Scale. Mare Moscoviense fills a part of the 445 km diameter Moscoviense basin (27N, 146E), which is in the northern hemisphere of the lunar far side.

INTRODUCTION

The Moscoviense basin is the most prominent mare basalt filled multi-ring impact basin on the lunar farside which is located at (26°N, 148°E) and has a diameter ranges from 420 to 445 km. Some concentric circular structures of the Moscoviense basin (140, 220, 300, 630 km in diameter) were inferred from Remote Sensing studies. Mare basalt of Mare Moscoviense is divided into four individual basalt flows using nomenclatures, age relationships and surface composition. Haruyama *et al*. (2008) reported there was active mare volcanism at the Moscoviense basin until 2.57 Ga. The thickness and age of individual basalt units of Mare Moscoviense was identified by Morota *et al*. (2009a).

Data Used

Lunar Reconnaissance Orbiter Camera (LROC) is a system of three cameras mounted on Lunar Reconnaissance Orbiter (LRO) mission which can capture the lunar surface at higher resolution. There were two Narrow Angle Cameras (NAC) that are designated to take images with higher resolution in black and white images. Wide Angle Camera (WAC) captures moderate resolution images using filters to provide information about the properties and color of the lunar surface. In this study, LROC WAC Data for the Mare Moscoviense Basin has been used to identify the relative age of the basin.

METHODOLOGY

Four methods have been used to derive the age of planetary surfaces, i.e. radiometric study of lunar samples, studies of crater degradation stage, stratigraphic approach and CSFD measurement. Radiometric study of lunar sample rocks in the laboratory is restricted to a relatively small number of returned samples and provides ages only at close vicinity of the Luna and Apollo stations. Data derived from crater degradation stages can give us the ages of the entire lunar surface, but numerous endogenic and exogenic processes can influence the appearance of lunar impact craters, decreasing the certainty of

Corresponding author:* **Chinnamuthu M
Centre for Geoinfomatics and Planetary Studies, Periyar University, Salem 636 011. India

age estimation. Ejecta blanket of the impact crater as a stratigraphic marker enabled us to reconstruct a moon wide relative stratigraphy. This provides relative age of the entire lunar surface.

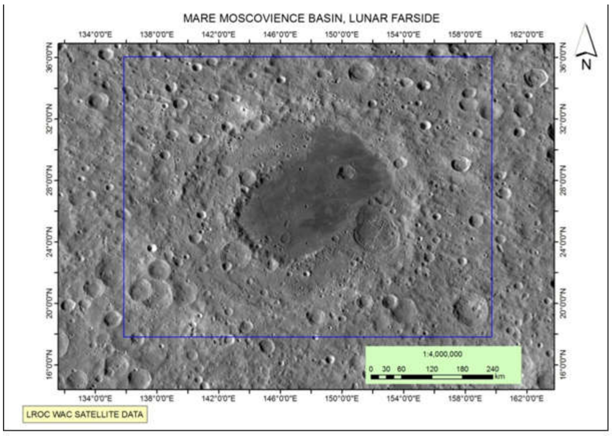

Fig 1 LROC WAC Image of Mare Moscoviense Basin

CSFD is widely accepted method and used for finding absolute model ages for the lunar surface as well as in other planetary bodies. Crater counting is a well established technique to derive relative and absolute ages of planetary surfaces. Based on the simple idea that older surfaces accumulate more craters, we can infer relative ages by measuring the crater size-frequency distribution (CSFD) with image data. In using CSFD as a dating tool, two key assumptions were made, i.e. crater formation is a geographically random process and processes destroying the craters operate much slower than the crater-forming processes. Steps have to be carried out, i.e. measurement of the surface area of the unit and measurement of crater diameter within each primary lithological unit (Arya *et al* (2012). The cratering chronology formulated by relating crater frequencies to the radiometric ages of Apollo and Luna samples enables us to convert the crater frequencies into absolute ages. In this study the craters starting from 5 km diameter were demarked for the identification of the relative age of the Mare Moscoviense basin. Totally there were 315 craters were Interpreted and deployed for age discernment.

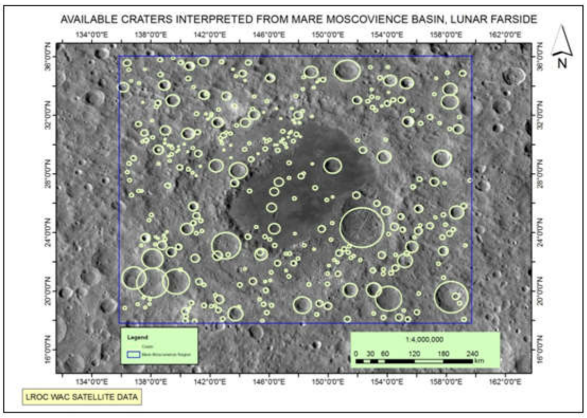

Fig 2 Available craters in the Mare Moscoviense Basin

RESULT

The craters demarcated were equally distributed over the region to get the accurate age of the formation. The craters inferred from the Mare Mosvociense Basin were plotted based on their diameter and cumulative frequency together. The model used to find the relative age is from Neukum *et. al* (2001). From the observed CSFD the age of Mare Moscoviense basin is estimated to be µ4.0 ±0.009 Ga. According to stratigraphy of Neukum & Ivanov (1994), this is classified as Nectarian System, which is consistent with the classification of Wilhelms (1997). The basin comes under Nectarian Epoch.

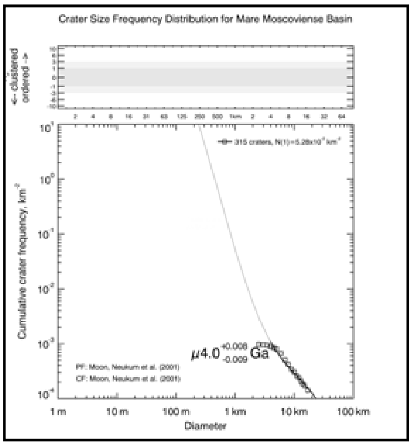

Fig 3 CSFD Plot for Mare Moscoviense Basin (after Neukum *et. al*, 2001)

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