CURRICULUM VITAE

Name: **Dr. P. R. Kumaresan**

Qualification: **M. Tech** (Geo-Technology & Geo-Informatics), **Ph.D.** (Remote Sensing).

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Thesis Entitled: "Lithological, Morphological and Chronological Characteristics of Inter-Basinal Region between Imbrium and Serenitatis Basin, Earth's Moon: A Geoinformatics Approach".

Academic profile

COURSE	INSTITUTION / DEPARTMENT	BOARD / UNIVERSITY	YEAR OF COMPLETION	PERCENTAGE OBTAINED
Ph. D. course work	Department of Remote Sensing	Bharathidasan University	2018 – 2021 (Commended)	89.66 %
M. Tech (6_{yrs} integrated) Geo-Technology and Geo-Informatics	Centre for Engineering and Technology and Department of Remote Sensing	Bharathidasan University	2011-2017	75.59 %
HSC	NKM HSS, Sainathapuram, Vellore TN.	State Board of Tamil Nadu	2010-2011	67.75 %
SSLC	V V N K M English medium school (CBSE), Vellore TN.	Central Board of Secondary Education	2008-2009	76.8 %

Computer and Software Proficiency

- OS – Windows Vista, Windows XP, Windows 7 and Windows 8.
- GIS - ERDAS IMAGINE, ARC GIS, QGIS, ENVI, ILWIS.
- Programming software - HTML, VB.Net, C and C++ (Basics)

Additional Qualification

- Worked in Department of Space, Bangalore - ISRO sanctioned project as JRF (06/07/2017 to 05/07/2019) and SRF (06/07/2019 to 31/03/2020) under the guidance of Dr. J. Saravanavel.

- Worked in ongoing project under guidance of Dr. J. Saravanavel, Associate Professor in Department of Remote Sensing, BDU as skilled personnel on Remote sensing coastal applications from 29th feb to 30th sep 2016 for 7 months.

- Had undergone internship program in "The Institute of Seismological Research (ISR), Gujarat" under the guidance of Dr. G. Pavan Kumar, research associate prepared report on "Electromagnetic methods (Active & Passive) in Applied Geophysics".

- Had undergone B. Tech major project in Department of Civil Engineering, National Institute of Technology, Trichy under the guidance of Dr. S. Saravanan on topic "Coastal vulnerability assessment using geospatial techniques -a case study for chennai region".

- Had undergone M. Tech major project in Lab for Spatial Informatics – IIIT-Hyderabad under the guidance of Dr. Rama Chandra Pillutla on topic "Assessment of forest change in Yelagiri and Javadi hills, Tamilnadu using geospatial techniques."

- Six month "UGC sponsored Career Oriented Certificate course in Geographic Information Technologies" in Centre for Geographic Information Technologies, Bharathidasan University.

- NCC 'B and C ' certificate holder.

Workshop Attended

- State Level One day Workshop on "Rain Water Harvesting" held on 6.11.13 at Jamal Mohammed College, organized by Centre for remote sensing, Bharathidasan University, Trichy.

- One day workshop on "INTRODUCTION TO QUANTUM GIS" held on 07th August 2015 in Department of Civil engineering, NIT Trichy.

- One day workshop on "Imaging spectroscopy and Mineral exploration" conducted by Department of Geology, National college (Autonomous), Tiruchirapalli. Date: 31st July, 2017.

- GIAN course on "Spatial modelling and analysis of Environmental system using open source tools" by Department of Civil engineering, IIT Madras. 11-22nd June, 2018.

- GIAN course on "Astrobiology and Science Communication" by IISER Kolkata. 22-26th July, 2019

- Chandrayaan 1 and 2 meets (December, 2018 and October, 2019) and Chandrayaan 2 Data analysis workshop (6-7th January, 2020) conducted by ISRO.

- Attended workshop on analysis of planetary science data sets from Chandrayaan 1 and Mars Orbiter Mission (MOM) missions by Space Application Center, ISRO during 13 to 16th November, 2018.

- Two weeks summer school on Machine and Deep Learning for Remote Sensing Applications held on 05/07/2021 – 16/07/2021 by IEEE GRSS Bangalore section and NIT – Surathkal, Karnataka.

- **Certificate course** in Wildlife Management using Geospatial Techniques held between 07/02/2022 to 19/03/2022 under Green Skill Development Programme (GSDP) by MoES, Govt. of India, Dept. of Environment, Govt. of Tamil Nadu and **Department of Geography, University of Madras**.

Publications (Including Web of science and Conferences)

- **Kumaresan, P. R.,** & Saravanavel, J. (2022). Compositional Mapping and Spectral Analysis of Sulpicius Gallus Dark Mantling Deposits Using Lunar Orbital Data Sets Including Chandrayaan-1 Moon Mineralogy Mapper. Journal of the Indian Society of Remote Sensing, 1-19. DOI: https://doi.org/10.1007/s12524-022-01529-4
- Salem, I. B., Sharma, M., **Kumaresan, P. R.,** Karthi, A., Howari, F. M., Nazzal, Y., & Xavier, C. M. (2022). An Investigation on the Morphological and Mineralogical Characteristics of Posidonius Floor Fractured Lunar Impact Crater Using Lunar Remote Sensing Data. Remote Sensing, 14(4), 814. DOI: https://doi.org/10.3390/rs14040814
- Ranganathan, P. C., **Kumaresan, P. R.,** Nagarajan, J., Kathiresan, P., & Jayaraman, S. (2021). Identification of flow markers in tectonic geomorphic landforms of the Deccan Volcanic Provinces using GIS at part of southern Maharashtra, India. Arabian Journal of Geosciences, 14(21), 1-8. **DOI: https://doi.org/10.1007/s12517-021-08454-9**
- **Kumaresan, P. R.,** Saravanavel, J., (2020) Composition and Mineralogical mapping of Timocharis crater region using orbital data sets in Indian Society of Remote Sensing National symposium, P. 279-280.
- **Kumaresan, P. R.,** Saravanavel, J., & Palanivel, K. (2020). Lithological mapping of Eratosthenes crater region using Moon Mineralogy Mapper of Chandrayaan-1. **Planetary and Space Science**, 182, 104817. **DOI: https://doi.org/10.1016/j.pss.2019.104817**
- **Kumaresan, P. R.,** & Saravanavel, J. (2019). Morphological and Chronological Mapping of Manilius Crater Region Using Chandrayaan-1 Data Sets. **Journal of the Indian Society of Remote Sensing**, 47(5), 839-851. **DOI: https://doi.org/10.1007/s12524-019-00967-x**
- **Kumaresan, P. R.** (2018). Spectral Based Vegetation discrimination and Forest Health Assessment Using Hyperion (EO-1) in Yelagiri Hills, Tamil Nadu. International Journal of Applied Engineering Research, 13(18), 13826-13832.

- **Kumaresan P R**, Saravanavel J, Palanivel K., (2020) "Compositional and Mineralogical Mapping of Taruntius Crater Region Using Hyperspectral Data Sets of Chandrayaan-1" in AGTMNRD 2020, conference paper in Centre for Geoinformatics at GRI-DU.
- **Kumaresan, P. R.,** & Saravanavel, J. (2019, March). Compositional and Mineralogical Characteristics of Archimedes Crater Region Using Chandrayaan-1 M3 Data. In Lunar and Planetary Science Conference (Vol. 50).
- **Kumaresan P R**, Saravanavel J, Palanivel K., (2017) "Monitoring of Environmental changes and its impact over the Forest cover in Yelagiri and Javadi hills of Tamil Nadu using Geospatial Techniques" Conference proceedings in Recent Innovations and Technological Development in Civil Engineering in GRI Uniersity, Gandhigram.

Personal Details

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Declaration: I hereby declare that all details furnished above are true to the best of my knowledge.

(P R Kumaresan)

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References:

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RESEARCH ARTICLE

Compositional Mapping and Spectral Analysis of Sulpicius Gallus Dark Mantling Deposits Using Lunar Orbital Data Sets Including Chandrayaan-1 Moon Mineralogy Mapper

P. R. Kumaresan[1] · J. Saravanavel[1]

Received: 4 May 2021 / Accepted: 19 February 2022

Abstract

Impact cratering and volcanism are two significant processes that shape the lunar surface. Volcanism covers 17% of the lunar surface and has been confined to the near side. The regional dark mantling deposits (DMD) are ancient fire fountains related to volcanic activity. These regional DMD magma source region are deeper than mare basalt lava flows. The Sulpicius Gallus deposits are one among these regional DMD. In this context, remote sensing based lunar orbital data sets were used for compositional mapping, and Chandrayaan-1 hyperspectral data Moon Mineralogy Mapper (M^3) helped unravel the surface chemistry and mineralogy of the investigative site. The Sulpicius Gallus deposits are rich in ferrous and titanium have been recognized by compositional analysis of lunar orbital data sets such as Clementine UVVIS, Kaguya multiband imager, and lunar reconnaissance orbiter camera (LROC) wide angle camera (WAC). Further, the Sulpicius Gallus deposits are enriched in ilmenite content along with volcanic glasses and therefore are potential sites for oxygen extraction and in-situ resource utilization. High-resolution Chandrayaan-1 M^3 is intensively utilized to unravel the study region's composition and spectral analysis. The Sulpicius Gallus deposits M^3 mosaic subjected to intensive hyperspectral image reduction and processing techniques such as principal component analysis (PCA). The 2D Scatterplot was generated between PCA-1 and PCA-2. The density sliced scatterplot morphology was utilized to select and determine Sulpicius Gallus deposits endmembers spectra. Spectral band parameters such as band center and band depth were derived after the continuum removal process. Volcanic glasses also exhibit absorption around 1000 and 2000 nm like pyroxenes, but absorption peaks differ. Absorption position peaks of 1000 versus 2000 nm were compared with synthetic pyroxene and volcanic glasses from Reflectance Experiment Laboratory spectral library. This study indicates that the Sulpicius Gallus DMD are enriched in ferrous, titanium, ilmenite, and volcanic glasses. M^3 based reflectance spectra analysis of Sulpicius Gallus deposits indicates absorption around 1000 and 2000 nm central peaks almost lie within the glass region and are relevant/related to orange and green glass.

Keywords Lunar dark mantling deposits · Sulpicius Gallus deposits · Volcanic glasses · Ilmenite · Reflectance spectra

Introduction

Two significant processes shape the lunar surface: impact cratering and volcanism. Volcanism of the Moon is characterized by a comparatively dark albedo region than surrounding highlands. Volcanism covers 17% of the lunar surface (Head, 1976; Spudis, 1999; Hiesinger & Head, 2006; Spudis, 2015). In contrast to dark volcanic activity, the surrounding high albedo highlands are composed of anorthosite/plagioclase. Lunar Magma Ocean (LMO) has occurred in the Earth's Moon soon after its formation from a Giant-impact. The global differentiation process has produced an accumulation of low-density plagioclase-rich crust as the topmost layer and sinking denser materials below (Warren, 1985; Elkins-Tantonet al., 2011). The mantle is the source region for the mare basalts and DMD (Warren, 1985; Head & Wilson, 2017). So, studying and analyzing the composition of volcanic landforms will give great detail

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Lithological mapping of Eratosthenes crater region using Moon Mineralogy Mapper of Chandrayaan-1

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A R T I C L E I N F O

Keywords:
Moon mineralogy mapper
Lunar lithology
Eratosthenes crater
Mineralogical discrimination

A B S T R A C T

Selenological exploration (lunar geology) involves mapping and delineation of different rock types and minerals present in the Moon. Various lunar missions with multi-spectral sensors provided preliminary information about the lithological and mineralogical occurrences on the Moon. The Chandrayaan-1 Moon Mineralogy Mapper (M^3), provided hyperspectral data having high spatial resolution of 140 m and 85 continuous spectral bands of Electro Magnetic Spectrum from 430 to 3000 nm. This data utilized for identification of distinctive absorption bands near 1000, 1250, 2000 and 2500 nm regions. These absorption features are playing vital role in mapping of various minerals and rock types on the lunar surface with higher precision. The present study aimed to map the compositional diversity in and around the Eratosthenes crater region of the lunar surface using M^3 data of Chandrayaan-1. The initial studies carried out using Clementine ultraviolet and visible (UVVIS) warped color-ratio mineral map and M^3 data based band shape, band depth and band ratio algorithms have led to understand the lithological diversity of the study area. These preliminary studies revealed that the Eratosthenes crater region contains mare basalt, anorthosite, highland soil, pyroxene, Olivine, etc. At the next stage, the detailed compositional variability of the study area was analyzed using Spectral Information Divergence (SID) algorithm using various thresholds. Finally, The SID analysis showed that the spatial distribution of olivine, pigeonite, augite and norites present within the study region. The present study further revealed that the SID could be an effective detection tool rather than as a classification tool.

1. Introduction

Hyperspectral remote sensing techniques have high potentials to derive significant information about the lithological and mineralogical composition of the earth and planetary surface by analyzing the subtle changes in spectral curve and its absorption features. The mineral composition, crystal structure, grain size, space weathering, regolith cover, etc., controls the shape, strength and absorption features of the spectra (Burns and Burns, 1993). Therefore, distinguishing and delineation of the composition of lunar minerals using hyperspectral data is a challenging task. Distinct absorption features near 1000, 1250 and 2000 nm in visible and near-infrared spectral region can identify the lunar minerals. Chandrayaan-1 Moon Mineralogy Mapper (M^3) is an imaging spectrometer that provides data on 85 continuous and narrow spectral regions in between 430 and 3000 nm with 140 m spatial resolution. This spectral region is very much useful in identification of various lunar minerals and lithological units such as olivine, pyroxenes, plagioclase, basalt, anorthosite, norite, etc. A lot of information on the mineralogical and lithological compositional diversity of lunar surface have been brought out using the Chandrayaan-1 Moon Mineralogy Mapper (M^3) data by several researchers. For example, Mustard et al. (2011) brought out the central peak of the Aristarchus crater is consist of plagioclase and the rim part of the crater enriched by Olivine. Besse et al. (2011) examined the Marius hill volcanic region and distinguished the olivine and pyroxene rich basaltic units in the plateau region. Klima et al. (2011a) identified prominent distribution of low-Ca pyroxene in South Pole–Aitken Basin (SPA), north and south of Mare Frigoris region. Bharti et al. (2014) have brought out the compositional variation of near and far-side transition zone of the lunar surface. Varatharajan et al. (2014) assessed the temporal and spatial heterogeneity of Mare basalts in western nearside, Moscoviense, and Orientale basin.

For the prese't research work, a study area covering 15, 060 sq. km, extending from 17°0′ N-12°0′ N to 13°0′ W-11°0′ E, has been selected in the equatorial region of near side of the Moon (Fig. 1a). The Eratosthenes crater and its related impact materials are covering most part of the study area. This is a deep impact crater named after the ancient Greek

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RESEARCH ARTICLE

Morphological and Chronological Mapping of Manilius Crater Region Using Chandrayaan-1 Data Sets

P. R. Kumaresan[1] · J. Saravanavel[1]

Received: 19 February 2018 / Accepted: 6 March 2019

Abstract
Fine-resolution morphological mapping aided by ortho-images and digital elevation model from Chandrayaan-1 Terrain Mapping Camera and 3D GIS visualization has revealed scientifically diverse characteristics of lunar surface features, due to unique topographical significance of morphological features, i.e., highlands, basaltic plains and craters, which are very well manifested in 3D GIS environment. The distribution of various morphological features provides insights into the sequential evolution and surface process of the study area. The highland region represented by the Fra Mauro formation in the study area exhibits high albedo with distinct topography. The northern part of the study area falls in the southern part of major basin Serenitatis, and exhibits the dark mantling material with low albedo. The morphological features, i.e., wrinkle ridges and rilles, indicate volcanic flow events consequence to the loading of basaltic materials in the interior of the Serenitatis and Imbrium Basins and related extensional failure. The Manilius crater, which occupies the central part of the study area, is a complex crater with a central peak and asymmetric ejecta deposit. The ages of the major surficial features were determined based on size, frequency and distribution pattern of craters using crater size-frequency distribution model. Age of the Fra Mauro highland, Manilius crater, Mare Serenitatis and Mare Vaporum is, respectively, 3.9, 3.5, 2.8 and 1.7 Ga years, indicating that the lunar surface of this region evolved in Imbrian to Eratosthenian age of lunar selenological timescale.

Keywords Chandrayaan-1 · 3D GIS visualization · Lunar surface morphology · Manilius crater · Chronology of lunar surface

Introduction

The Moon is the nearest celestial body and clearly observed object in the night sky with naked eye from the Earth. The invention of the telescope by Lippershey in 1609 has given the first detailed look of the Moon and greatly increased human curiosity. The Moon is a probable base station for space programs in the near future (Jin et al. 2013) and scientifically very significant for understanding and exploring our solar system (Hiesinger and Jaumann 2014). The near side of the Moon is only visible from the Earth because of the synchronous rotation. The near side of the Moon is characterized by dark-colored large basins, generally called as Maria, and terrae of lighter-toned regions are commonly referred as highlands (Hörz et al. 1991).

The various Moon missions such as Apollo, Luna, Clementine, Lunar Prospector, Lunar Reconnaissance Orbiter, Kaguya and other missions have explored the Moon's surface and brought out lot of information. Data received from the above various missions have been extensively used to map and analyze the Moon surface morphological and compositional studies (Gold 1962; Shoemaker 1966; Heather and Dunkin 2000; Lawrence et al. 2006; Mitrofanov et al. 2010; Robinson et al. 2010; Mazarico et al. 2012). On this occasion, India's national space agency, Indian Space Research Organization (ISRO) has launched Chandrayaan-1, an unmanned lunar orbiter, on October 22, 2008. The Chandrayaan-1 spacecraft

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remote sensing

MDPI

Article

An Investigation on the Morphological and Mineralogical Characteristics of Posidonius Floor Fractured Lunar Impact Crater Using Lunar Remote Sensing Data

Imen Ben Salem [1,†], Manish Sharma [1,*,†], P. R. Kumaresan [1,2], A. Karthi [1,3], Fares M. Howari [1], Yousef Nazzal [1] and Cijo M. Xavier [1]

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Abstract: Lunar floor-fractured craters (FFCs) are a distinguished type of crater found on the surface of the Moon with radial, concentric, and/or polygonal fractures. In the present study, we selected the Posidonius FCC to explore the mineralogy, morphology and tectonic characteristics using remote sensing datasets. The Posidonius crater is vested with a wide moat of lava separating the crater rim inner wall terraces from the fractured central floor. Lunar Reconnaissance Orbiter's (LRO) images and Digital Elevation Model (DEM) data were used to map the tectonics and morphology of the present study. The Moon Mineralogy Mapper (M^3) data of Chandrayaan-1 were used to investigate the mineralogy of the region through specified techniques such as integrated band depth, band composite and spectral characterization. The detailed mineralogical analysis indicates the noritic-rich materials in one massif among four central peak rings and confirm intrusion (mafic pluton). Spectral analysis from the fresh crater of the Posidonius moat mare unit indicates clinopyroxene pigeonite in nature. Integrated studies of the mineralogy, morphology and tectonics revealed that the study region belongs to the Class-III category of FFCs. The lithospheric loading by adjacent volcanic load (Serenitatis basin) generates a stress state and distribution of the fracture system.

Keywords: lunar; Posidonius impact crater; floor fractured crater; lunar morphology; mineralogy; spectral analysis

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1. Introduction

The impact cratering process and volcanism are two major geological processes of the Moon that shape its surface morphological features. A crater is a circular depression formed due to the hypervelocity impact of a smaller body, i.e., meteoroids [1,2]. Impact cratering processes are not only restricted to the Moon but are also found on the surfaces of other planetary bodies of the solar system [3]. In contrast to impact craters, volcanic processes also lead to circular depressions, but their formation is related to explosions or internal collapse. The Moon is vested with enormous impact craters on the surface ranging from small-sized simple craters to large complex craters/multi-ringed basins. The size of craters range from micrometers to more than 2500 km [4]. The morphology of an impact crater depends upon several factors, such as the size of the specific crater, rheological properties, and the erosional and degradational processes of the planetary surface [2,5].

The near-earth objects (NEO), namely asteroids and comets, present in the main asteroid belt (between Mars and Jupiter), bombard the Moon and other terrestrial bodies of

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S. I. – CEC FRAMEWORK

Identification of flow markers in tectonic geomorphic landforms of the Deccan Volcanic Provinces using GIS at part of southern Maharashtra, India

Paramasivam Chellamuthu Ranganathan[1] · Kumaresan Pachaiappan Rajeswari[2] · Jeyachandran Nagarajan[2] · Palanivel Kathiresan[2] · Saravanavel Jayaraman[2]

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Abstract
The mother Earth has given a lot of vistas in a variety of forms, both on the surface and subsurface. Each and every continent has obtained different natural resources. India has varied potential resources. Due to the multifaceted morphological and tectonic characters have produced a variety of landforms due to earth system processes and carved out by the different geomorphological and environmental parameters. One such vast resource is located in the Middle Western part of India, well known as the Deccan Traps. These traps are high potential for a variety of natural resources such as secondary mineral deposits, building stones, and evergreen dense forests. However, the study region shows different tectonic-activated geomorphological flow markers as indication of different patterns of landforms. Nowadays, geospatial technology will strengthen the study of geomorphic flow markers mapping with the help of different parameters. Topographic elevation-based geomorphic features exhibit lineament density maxima zones which fall under <560 m and 560 to 600 m prone to tectonic geomorphic landforms that tends to form undissected plateau. These results will obtain the flow markers fringes in the study region.

Keywords LISS III · Landsat TM · Lineaments · Tectonic geomorphic landforms · Topography

Introduction

Geological dynamic processes brought out different Earth's landforms with surficial expressions due to weathering, erosion, plate tectonics, and combined process that produced destructive and constructive geomorphological landforms. The tectonic geomorphology is the principal tool to identify active tectonic landforms (Cox 1994; Keller and Pinter 2002; Caputo and Pavlides 2008; Ramasamy 2005). The tectonic process produced different geomorphic landforms such as escarpment, dissected and undissected plateau, and flow plain. In addition, drainage and lineament produce drastic changes in the landforms with different topography and surficial expression. The geomorphological research of the Deccan ranges from a regional landscape survey of analytical studies of tectonic and fluvial landforms (Wescoat 2019). The Earth's continental landscapes drainage patterns of the spatial arrangements of channels in the landscape can be determined by the slope and structure formed with different contour elevation (Twidale 2004). Thus, the analysis of the drainage pattern is an important tool in the study of active fault systems (Audemard 1999; Keller and Pinter 2002). The tectonic process tends to build topography variation and surface expressions with various geomorphic landforms and flow markers particularly in the undissected region. The topographic offset brings out local gradient changes due to river redundancy (Burbank and Anderson 2009). The geomorphological or tectonic factors on drainage systems and landscape development form as an integrated neotectonics, an essential in the field of landform evolution and tectonically active regions. The structural and lithological variations have influenced tectonic movement which is either slow or long term geological

This article is part of the Topical Collection on *Recent advanced techniques in water resources management*

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