# LITHOLOGICAL DISCRIMINATION OF REINER GAMMA USING REMOTE SENSING TECHNIQUES

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## Introduction

- The Reiner Gamma region on the lunar nearside (7.5 N, 301.4 E) has an unusual surface feature called "lunar swirl."
- Lunar swirls have a higher albedo than the surrounding lunar surface with a magnetic field [1].
- The magnetic field at this site may account for the survival of this albedo feature[2].
- Mineralogical mapping of the surface helps in understanding the composition and evolution of the crust which contribute to high magnetic field [3].
- Spectroscopy is the analytical technique that can be used to identify minerals especially remotely based.
- The variety of absorption processes and their wavelength dependence allow us to derive information about the chemistry of a mineral from its reflected or emitted light [4].
- In the present study, mineralogical mapping of Reiner Gamma region was attempted to know the variation in mineralogy of this unusual feature with respect to its surroundings.

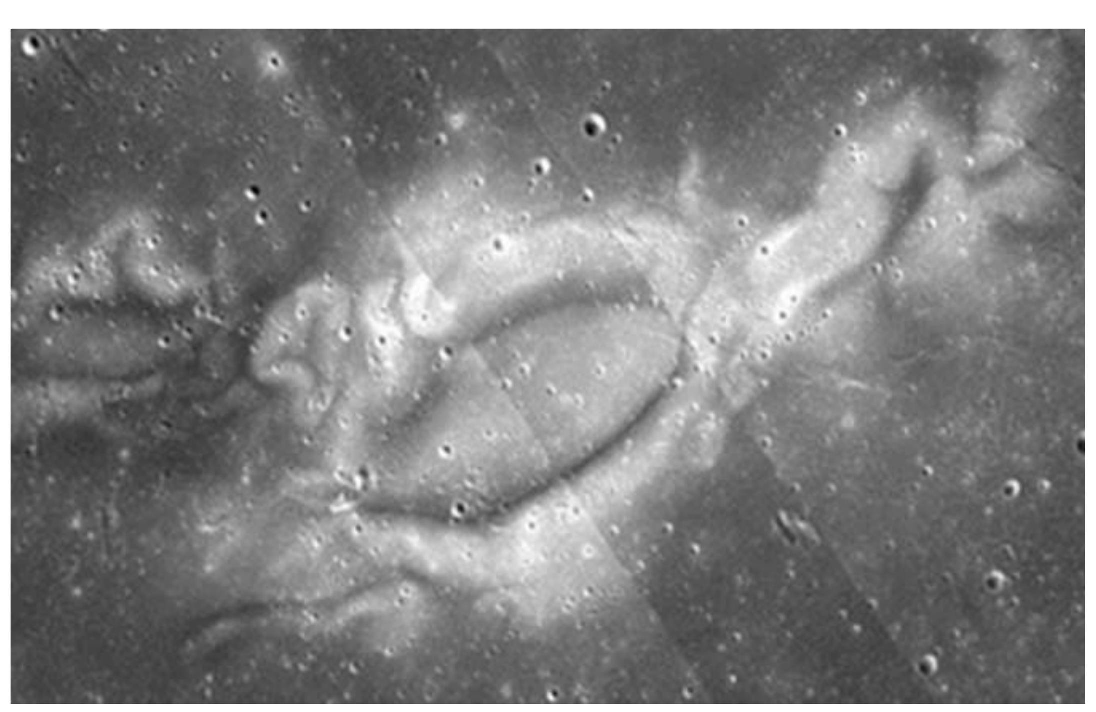


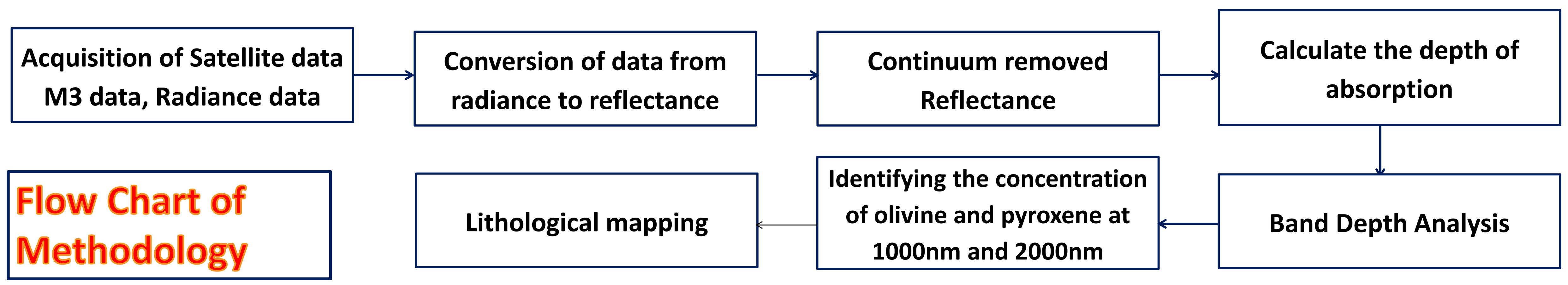
Figure 1: Study area Reiner Gamma

## Methods and Materials

- The Moon Mineralogy Mapper (M3) Level1B on board Chandrayaan-1 data has been used to study the mineralogy of Reiner gamma.
- Olivine has absorption features near 1000 nm wavelength and Pyroxene is characterised by two prominent absorption features near 1000nm and 2000-nm that vary in accordance with the composition [5].
- The 1000 nm absorption feature shift towards longer wavelength region with an increase in Fe and Ca [6].
- The band depth is computed using formula given by [7].

$$\text{Band depth} = 1 - \frac{R_b}{R_c}$$

Where, $R_b$ is the reflectance value of a normalized spectrum at band center and $R_c$ is the reflectance value of the continuum line at band centre.




Flow Chart of Methodology

## Results

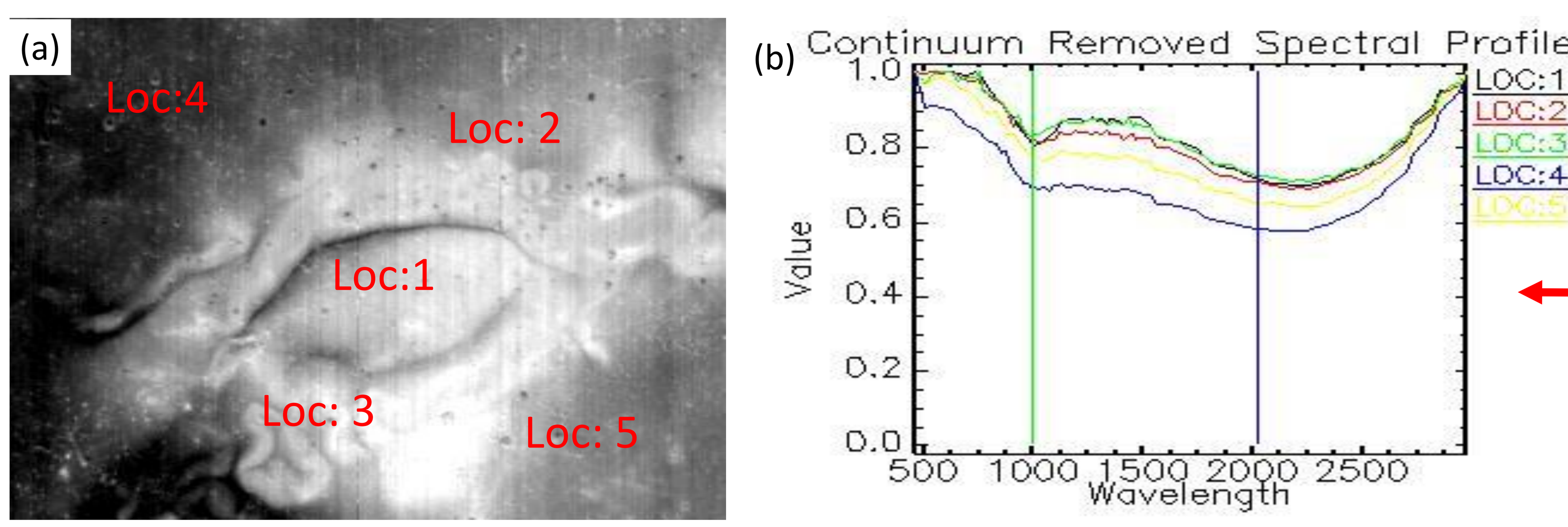



Figure 2: (a) Continuum removed M3 image of Reiner gamma (b) Continuum removed spectra of different location.

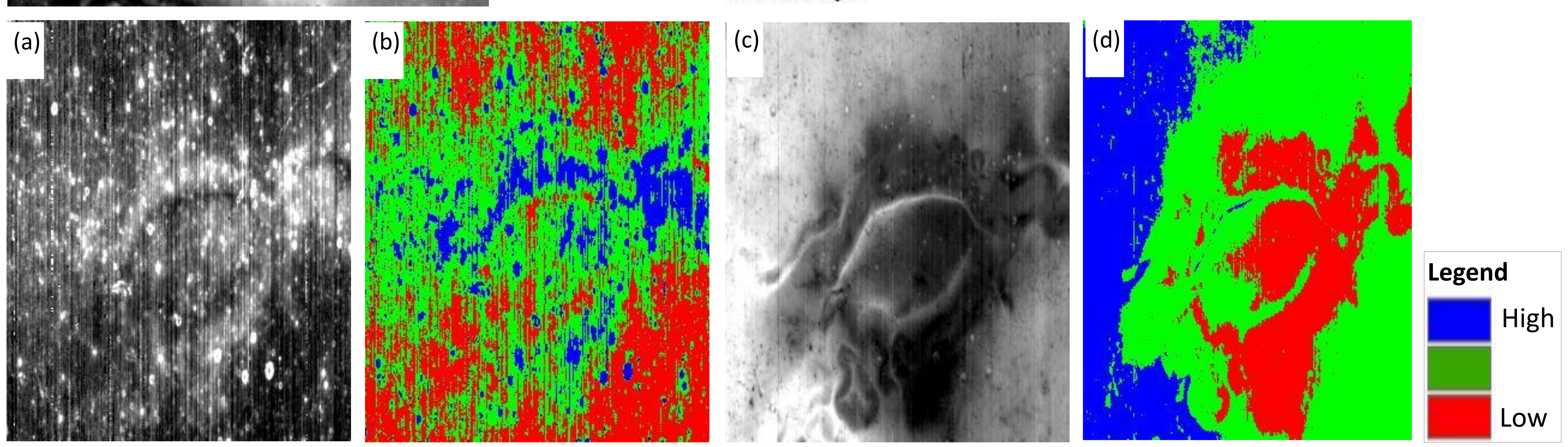



Figure 3: (a) Image in grey scale at band 22 showing BDA for 1000nm (b) Density slice image of BDA for 1000nm (c) Image in grey scale at band 61 showing BDA for 2000nm (d) Density slice image of BDA for 2000nm.

## Results and Discussion

- The M3 has been processed to obtained the continuum removed reflectance data. The continuum removed spectra of different location has been shown in figure 2.
- The Band depth analysis (BDA) has been obtained for Reiner Gamma at two band centers as shown in figure 3 for 1 µm and 2 µm band center respectively.
- It has been observed from BDA at 1 µm band center as shown in fig 3 (b) that the highest absorption is shown towards the central part of swirl. Hence, it could be assumed that the concentration of olivine is likely to be more at the central region of SWIRL as compared to the surrounding region.
- The variation of pyroxene could be analyzed using BDA for 2000 nm as shown in fig 3 (c) and (d) with low concentration of pyroxene observed around the central SWIRL region and high concentration of pyroxene towards the western part surrounding the Swirl.

## Conclusions

- The mineralogical analysis of M3 hyperspectral data of the lunar swirl Reiner Gamma indicates that the brightest areas of the swirls have the stronger mafic absorptions especially due to olivine.
- The presence of olivine are mainly concentrated over the region where high albedo is obtained whereas pyroxenes are concentrated more towards the surrounding region.
- Higher concentration of olivine and pyroxenes suggest higher concentration of iron and magnesium.
- High magnetic field of the central swirl region suggest higher concentration of iron.

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## Acknowledgements

The authors would like to express their gratitude to IIT Guwahati and ISRO, SAC Ahmedabad for the support given for the project.