COMPARISON OF LUNAR ANALOG ROCK SPECTRA WITH CLEMENTINE DATA. S. Arivazhagan[1] and S. Anbazhagan[2], [1]PLANEX, Physical Research Laboratory, Ahemedabad - 380009, India, E-mail:arivusv@gmail.com [2]Department of Geology, Periyar University, Salem – 636 011, India, E-anbu02@gmail.com.

Introduction: Global assessment of lunar mineralogy at high spatial resolution has been a long standing goal of lunar exploration. Currently, the global data available for such study is multispectral imagery from the Clementine mission and high resolution global data expected from Chandrayaan1 mission. Clementine estimates were useful for defining scientific or exploration targets for imaging spectrometer sensors that are specifically designed to characterize mineralogy [1]. The analysis presented here further explores the strengths and limits of using multispectral imaging to investigate compositional parameters across the Moon.

From visible through near-infrared (NIR) wavelengths, the diagnostic absorption bands in reflectance spectra that allow mafic minerals such as olivine and pyroxene to be identified remotely in lunar materials [2]. The Clementine ultraviolet-visible (UVVIS) camera acquired global multispectral images with pixel resolutions of 100-300m, for five spectral channels between 0.4 and 1.0µm. Tompkins and Pieters (1999) [2] have done direct comparison of mineral absorption bands between locations across the Moon. In the present study, the laboratory spectra of lunar analog rocks such as terrestrial basalts and anorthosites were compared with the model spectra from Clementine images of central peaks obtained by Tompkins (1998) [3].

Methodology: The analog rocks were collected from Deccan basaltic terrain and Sittampundi Anorthositic complex. Laboratory spectra were obtained for massive, vesicular and amygdaloidal basalts and different types of anorthosites under 350nm to 2500nm. The five band Clementine data are in multi spectral mode and hence the spectral plots provide only downward and upward curves with spectral curvature. However the contiguous bands in hyperspectral mode and the spectral plots are more useful to discriminating the lunar geology. In that case, Chandrayaan1 Hyperspectral imager (HYSI) could provide valuable information on lunar geology with high spatial resolution. The lunar analog rock spectra were convolved through five band Clementine spectra for comparison with Tompkins model classifications and Clementine spectra published by Evans (2008) [4].

Results: Lunar analog rock spectra convolved through five band Clementine spectra. Spectral curvature indicates the shape of absorption band, which differentiate low and high Ca pyroxene, olivine and lunar minerals through Clementine filters (Fig. 1 & [2]).

Tompkins and Pieters (1999) [2] have classified the lunar rocks as Norite, Gabbro Norite, Gabbro, Anorthosite Norite (AN), Anorthosite Gabbro Norite (AGN), Anorthosite Gabbro (AG), Gabbro Noritic Tractolite Anorthosite1 and 2 (GNTA1 &2), Anorthosite (A), Anorhosite Tractolite (AT), Tractolite (T) based on the content of pyroxene, plagioclase and olivine and spectral pattern of the Clementine UVVIS data (Fig. 1). Evans (2008) [4] determined the composition by use of absolute reflectance and normalized reflectance plots generated from Clementine UVVIS 5 band data according to the method described by Tompkins (1998) [3]. Absolute reflectance was useful in determining albedo differences between light and dark bands in the crater walls. Normalized reflectance was useful in assessing mafic band depths and could be directly compared to reference spectra for different lunar mineral compositions ([5] and [3]).

In the present study, Clementine five band (415nm, 750nm, 900nm, 950nm, 1000nm) equivalent laboratory spectra extracted and absolute and normalized reflectance spectra were plotted. These laboratory spectral plots were compared with Tompkins (1998) [3] model spectra from Clementine images of central peaks and Evans (2008) [4] Clementine spectra.

The laboratory spectra of vesicular basalt is matches with the Tractolite (T) component (Fig. 2), which could be correlated with presence of olivine, plagioclase and pyroxene. Similarly, the spectra of other analog basalts (massive and amygdaloidal) are almost coincides with tractolite spectra of Tompkins (1998) [3] model spectra. The spectra of Aristarchus Central peak obtained by Evans 2008 [4] is matching with analog (vesicular basalt) rock spectra.

Anorthosite does not have detectable mafic minerals and are comparable to those traditionally identified as anorthosites in NIR spectra [6] [7]. Reflectance spectra are sensitive to very small amounts of mafic minerals in an anorthositic rock, and such rocks are believed to contain <10% mafic minerals [8]. Similar to basalt, the absolute and normalized laboratory spectra of anorthosites were plotted and compared with Tompkins (1998) [3] model spectra of clementine data. The

Laboratory spectra of anorthosite coincides with AG in Aristarchus crater of Tompkins (1998) [3] classification, indicate Anorthosite Gabbro with clinopyroxene as mafic mineral (Fig. 3)

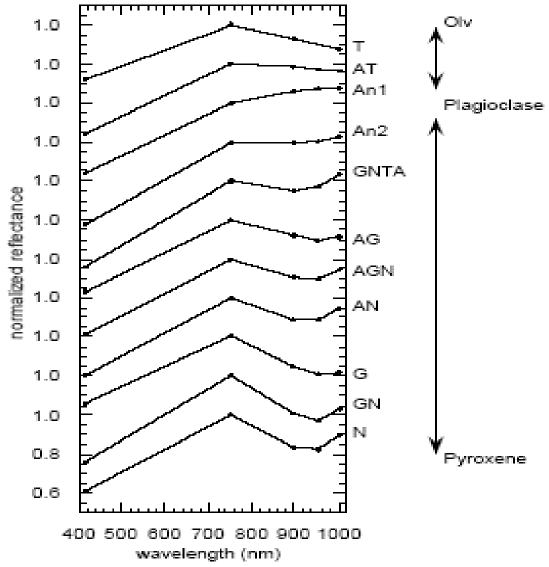

Figure 1: Model spectra from Clementine Images of central peaks (after Tompkins 1998)

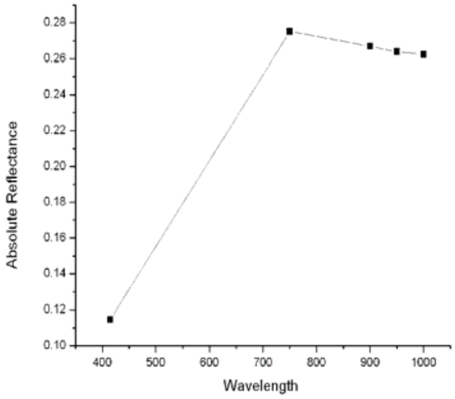

Figure 2: Absolute reflectance spectra of analog basalt matching with tractolite (T) composition of model spectra.

Conclusion: The study reveals that the laboratory spectra obtained for lunar analog rocks (basalt and anorthosite) have coincide with Tompkins (1998) [3] model spectra and Evans (2008) [4] Clementine Data. The results show that the classification of spectra based on spectral curvature and spectral angle has more meaning and supporting Tompkins (1998) [3] spectral classification. However, it is finding difficult in comparison of the contiguous hyperspectral laboratory spectra convolved with the coarse band Clementine data. More accuracy could be obtained if laboratory spectra correlated with the high resolution data like HySi of Chandrayaan1 which have contiguous hyperspectral mode for lunar region.

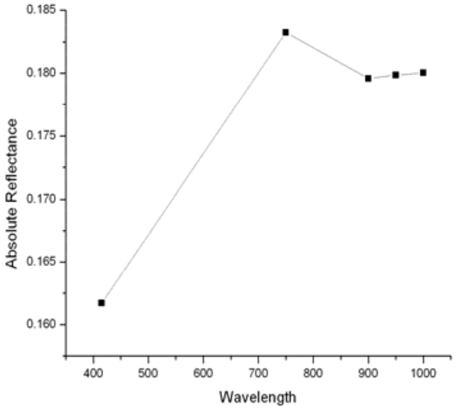

Figure 3: Absolute spectra of analog anorthosite matching with Anorthosite Gabbro (AG) composition of model spectra.

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