CLEMENTINE 2.7 μm DATA: MAPPING THE MARE AND SEARCHING FOR WATER. J. J. Gillis, and P. G. Lucey, University of Hawai‘i at Manoa, Hawai‘i Institute of Geophysics and Planetology, 1680 East-West Road, POST 504, Honolulu, HI 96822 (gillis@higp.hawaii.edu).

**Introduction:** The Clementine Mission acquired nearly global data with a near infrared (NIR) camera, which included 6 wavelengths of data (1.1, 1.25, 1.5, 2.0, 2.6, and 2.7 μm). The Herculean task of calibrating the NIR data is nearly complete. The data are of sufficient quality to allow first order scientific examination. A full description of the data calibration techniques and error analysis are provided in other papers presented at this conference [1,2].

**Data & Methods:** Clementine collected 11 band multispectral data (0.415, 0.75, 0.9, 0.95, 1.0, 1.1, 1.25, 1.5, 2.0, 2.6, and 2.7 μm) at 100-200 spatial resolution for most of the lunar surface [3]. The US Geological Survey produced a global mosaic sampled at 500-m/pixel for six of these wavelengths from between 1.1 and 2.7 μm [2,4]. From this mosaic we produced a 1 km resolution simple cylindrical mosaic for all longitudes, and latitudes between 70° north and south. For the purpose of searching for the presence of water bearing phases in the regolith, the 2.7 μm data were normalized by the 2.6 and 2.0 μm. This calculation yielded two ratio images in which we could search for an absorption due to the presence of water-bearing minerals.

**Results & Discussion:** The 2.7 μm band provides a new useful data set for characterizing the Moon. This wavelength is sensitive to the presence of water and hydroxyl components; thus, allowing the search for the hydrated mineral phases. Thus allowing the search for the remnants of comets that may have hit the Moon and have left their mark in the lunar regolith in the form of clay minerals. Detecting the presence of a 2.7 μm absorption is critical for search for cometary impacts, and revealing whether comets may have brought water to the Moon, and has fall into could traps at the lunar poles.

An exhaustive search for a 2.7 μm absorption was undertaken but no convincing signs of water or clay minerals were detected in both the 2.7/2.6 and 2.7/2.0 band ratios. Areas of highest interest were Reiner gamma and other spiral locations, and young impacts into both highland and mare terrains. It has been purported that the formation of Reiner gamma and other swirl materials were the result of the interaction of a comets coma with the lunar surface [5]. The absence of water in the swirl material suggests that these features are primarily the result of surface maturity [6, 7].

The unexpected range in spectral reflectance values at 2.7 μm is greater than at the shorter wavelengths, allowing mare units to be easily recognized. Flow units of various compositions become readily detectable. The 2.7 μm image makes the task of mapping mare basalt units, which typically have similar reflectance and low relief, much easier. These data may also help with understanding how factors other than ilmenite content in the maria affect UVVIS color [8].

And last, the 2.7 μm data allow easier separation of maturity and compositional differences. Different than the 0.750 μm where differences in reflectance are dominated by differences in maturity (the affect of maturity is even more pronounced at 415 μm), variations in color at 2.7 μm constitute differences in compositions. Hence, crater rays observed at this wavelength are almost solely due to compositional variations and represent less well maturity variations.

Color variations at 2.7 μm allow easy discrimination and mapping of basalt flows in Oceanus Procellarum. Illustrated in Fig. 1 the variation in color between the Clementine 0.415 μm band and the 2.7 μm band is much greater for the latter. These data provide a better mapping tool than the any individual wavelength of data and is similar to 415/750 image ratio (Fig. 1). The 2.7 μm data, however, offer an improvement of the ratio images because they also contain topographic information that a ratio image and individual bands at shorter wavelength do not. The 2.7 μm band is at the cusp between reflectance and emittance; thus, data at this wavelength contains information about topography because sun-facing slopes are warmer and emit more thermal energy than shaded slopes. These data will add new information for not available in previous mare mapping studies [e.g., 9].

**Conclusions:** At this time we find no evidence for water-bearing minerals on the lunar surface. Perhaps as the NIR calibration is refined and its resolution is increased to 100 m/pixel clay minerals may be found in small young impact craters.

The single 2.7 μm band seems useful for discriminating mineralogic differences in basalt flows in the maria. These data also provide valuable topographic information of the Moon’s surface.


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Figure 1. Clementine A) 0.75 m\(^2\), B) 2.7 m\(^2\), and C) 0.415/0.75 ratio image centered on Mare Imbrium (MI). Also visible in this image is Oceanus Procellarum (OP), Mare Frigoris (MF), Mare Serenitatis (MS), Mare Tranquillitatis (MT), Mare Insularum (Mins), Mare Vaporum (MV), Sinus Aestuum (SA), Aristarchus (A) and Copernicus (C). The projection is from 0° to 70°N and from 70°W to 30°N.

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