COMPOSITIONAL COMPLEXITIES OBSERVED FOR THE CRATER LANGRENUS. J. L. Cohen and C. M. Pieters, Department of Geological Sciences, Brown University, Providence, RI 02912, Jessica_Cohen@brown.edu

Introduction: The crater Langrenus is one of seven craters on the Moon that has been previously identified as containing troctolite within the central peaks using Clementine UVVIS 5-band spectra [1]. This crater is now being examined in order to understand the relationships between these olivine-rich materials, other mafic-bearing assemblages, and the surrounding areas. Preliminary results have revealed the presence of a diverse suite of rock types. Although other mafic minerals are observed in the wall and rim, troctolite appears to be present only in the central peaks.

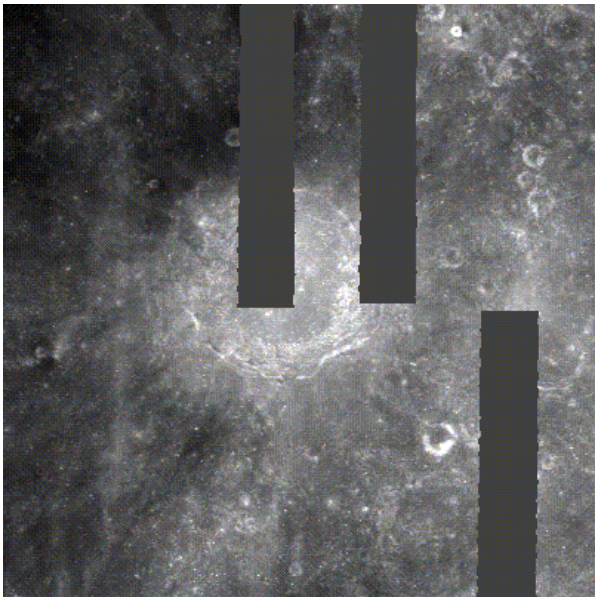

Figure 1a. 750 nm (albedo) image of the crater Langrenus and the surrounding areas. Image is centered at approximately -8.5°, 61.0°.

The Crater Langrenus: The crater Langrenus is located at the very eastern edge of the nearside of the Moon. It is approximately 125 km in diameter and is likely to be Eratosthenian in age [3, 4]. It is centered at approximately -8.5°, 61.0°, and lies just to the east of Mare Fecunditatis [3, 4]. It is surrounded to the west by maria and to the east by highlands. This can be seen in the albedo image of the area presented in figure 1a. The prominent compositional boundary can be readily identified in figure 1b, an approximate indication of ferrous band strength (a ratio image of the 750 nm band divided by the 1000 nm band). Using this ratio, more mafic minerals (basalts) appear relatively bright, while the Fe-poor highlands appear dark.

Within Langrenus, three provinces have been identified using a combination of Clementine images and the geologic map prepared by Hodges [4]: terraces, interior plains, and central peaks. The terraces include the outermost third of the crater, identifiable in figure 1b by bright rings at slope breaks. The interior plains appear to be relatively more smooth and less compositionally diverse. The central peaks are quite distinct from the rest of the crater. Hodges [4] suggests a maximum relief of approximately 2000 meters above the crater floor, as well as a boulder-rich texture. In geologic maps previously constructed of this area, little compositional data or description was known.

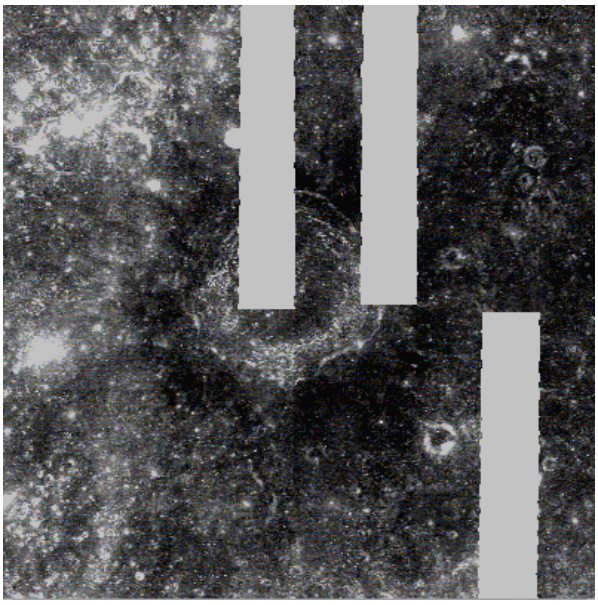

Figure 1b. Same as figure 1a, shown instead as a ratio image of the 750 nm band divided by the 1000 nm band.

Data Acquisition and Processing: For this study, two types of Clementine data were utilized. The images seen in figures 1a and 1b are sections of the 1 km Lunar Mosaic processed and distributed by the USGS [5]. Strips of this image are blank due to the fact that the 950 nm band was not acquired for certain orbits (most notably the 278 revolution which contains the central peaks). Images presented in figures 2 and 3 are examples of individually processed and calibrated Clementine frames. Figure 2 is a 750 nm full resolution (albedo) image of an area containing the north rim and interior plains of Langrenus. Figure 3 is the same area displayed with a standard Galileo color composite (R = 750/415, G = 750/950, B = 415/750). This frame is from revolution 145. The locations of 5-color spectra extracted from these data (discussed below) are indicated.

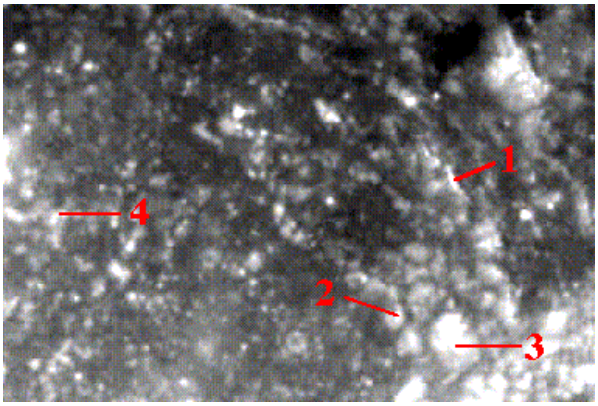

Figure 2. 750 nm (albedo) image of the north rim and interior plains of Langrenus. Numbers indicate the locations from which spectra were acquired.

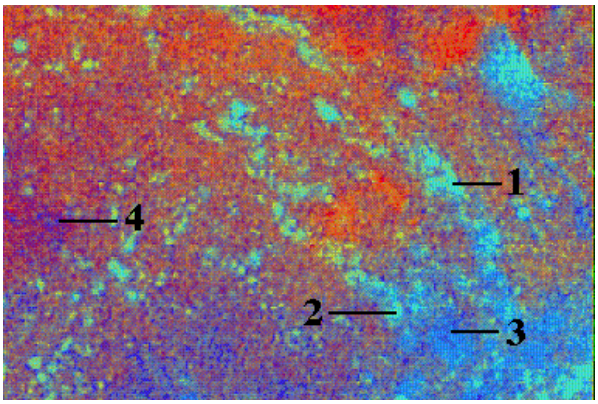

Figure 3. Standard Galileo color composite of the same area is shown in figure 2. Mafic rocks appear turquoise, while more anorthositic rocks appear deep blue. Reds and oranges include well developed soils as well as impact melt.

Compositional Relationships: Examples of 5-color reflectance spectra for various Langrenus lithologies are displayed in figure 4. Spectra were collected from the north rim and interior plains of Langrenus and include both mafic and anorthositic rock types. In addition, 2 spectra (1 mafic, 1 anorthositic) are included from a Clementine image of the central peaks of Langrenus (labeled "cp"). This image was part of the central peak survey by Tompkins [6].

Examination of the Clementine images along with the 5-color spectra for individual units (figure 4) indicate that the crater Langrenus is compositionally quite complex. Mafic-rich localities (e.g., areas 1, 2, cp - mafic) can be identified adjacent to more iron-poor anorthositic areas (e.g., areas 3, 4, cp - anorthositic). Of the mafic localities, only those within the central peaks [7] have thus far been clearly identified as olivine-rich troctolite. The other mafic signatures appear to be more pyroxene-rich. It is not yet known whether the pyroxene-rich compositions seen in the crater interior and rim are related to the neighboring mare or to deep-seated highland lithologies.

All of the spectra displayed in figure 4 were collected from high albedo which are relatively fresh surfaces, having experienced little space weathering. The distribution of anorthositic versus mafic material within the crater appears to be almost random (with the exception of troctolite), especially within the rim. For example, there appears to be no correlation between distance from the central peaks and the distribution of mafic, but pyroxene-rich, materials. Further detailed mapping around the rim and ejecta of Langrenus may reveal important patterns that relate to the original stratigraphy of this mare-highland boundary.

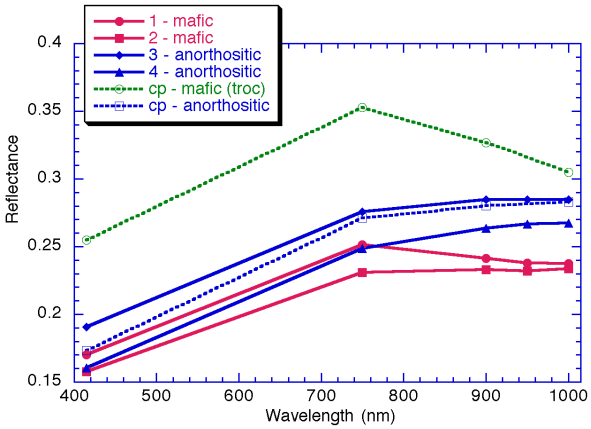

Figure 4. Examples of 5-color spectra acquired for Langrenus. The numbered spectra were collected from the images displayed in figures 2 and 3. Spectra labeled "cp" were taken from the central peak image, analyzed by Tompkins [6].

Summary: Preliminary analysis of spectral units within the crater Langrenus has revealed a very complex and compositionally diverse area. Detailed assessment of the relationship between rock types is expected to provide a more comprehensive understanding of the local stratigraphy and the source region of the central peak troctolites.

References: [1] Pieters, C. M., S. Tompkins (1999a) LPSC30 ab#1286; [2] Pieters, C. .M. , S. Tompkins (1999b) *JGR* 104, 21935; [3] Wilhelms, D. E., J. F. McCauley (1971) *Map I-703* USGS; [4] Hodges, CA (1973) *Map 1-739* USGS; [5] Clementine 1-km Lunar Mosaic, USGS; [6] Tompkins, S. (1997) Ph.D., Brown Univ.**;** [7] Tompkins, S., C. M. Pieters (1999) *MPS* 34, 24.