THE DISTRIBUTION AND ORIGIN OF LUNAR LIGHT PLAINS AROUND ORIENTALE BASIN. H. M. Meyer[1], B. W. Denevi[1], A. K. Boyd[2], and M. S. Robinson[2], [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, USA, [2]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85281, USA.

Background: Lunar light plains are relatively flat, smooth to gently rolling deposits that occur in crater floors and other topographic lows in the lunar highlands, with albedo values comparable to surrounding highland terrain [e.g., 1,2]. Once interpreted to be the product of highland volcanism, Apollo 16 samples from the light plains of the Cayley formation [3] led to the interpretation that most light plains form from the deposition of fluidized basin ejecta [e.g., 1]. Conflicting relative age estimates suggest these light plains are ejecta from the Orientale and Imbrium basins [5], or from a larger number of impact events combined with possible volcanic eruptions [2,4]. Here we examine the distribution, variability, and origin of light plains associated with the Orientale basin using data from the Lunar Reconnaissance Orbiter Camera (LROC).

Methods: To determine the distribution of the light plains, a study area extending from the rim of the Orientale basin ~2200 km to the north-northwest was defined that includes ~2.7 million km^2 (Fig. 1). The light plains within this area were mapped using a global mosaic from the LROC Wide Angle Camera (WAC) [6] at a pixel scale of 100 m and a map of the standard deviation of slope as an indication of roughness, derived from the Global Lunar DTM (GLD100) [7] (Fig. 1). The plains were mapped at a scale of 1:300,000 (150 m/pixel), and were compared to the results from an automated classification based on WAC multispectral images and the GLD100 [8].

To determine how the light plains are distributed as a function of distance from the Orientale basin rim, the study area was divided into eleven ~200 km-wide bins. The first bin is dominated by the Hevelius Formation [2], the main blanket of textured ejecta, which continues into portions of the second and third bin. The area of light plains within each bin were normalized to the total bin area to yield the percentage of light plains per bin.

Results: *Comparisons with previous work:* The light plains mapped in this work compare favorably with the automated classification of Boyd et al. [8]. Differences occur primarily in regions of high frequency topographic variation. The manually mapped light plains were also compared to a geologic map of the region from Scott et al. [2] (Fig. 3). The plains material of Scott et al., interpreted to be ejecta from Orientale, shock-melted rock, and volcanic deposits, corresponds to the light plains mapped in this work. However, we

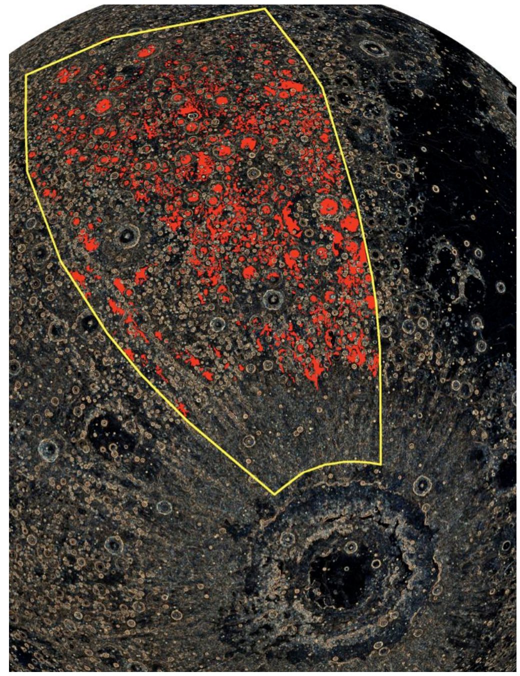

Fig. 1. Mapped light plains (red) are shown within our study area (yellow outline) to the northwest of Orientale. The basemap is a composite of 1000-m roughness displayed in red, 667-m roughness in green, and 337-m roughness in blue. The orthographic projection is centered at 10°N, 250°E.

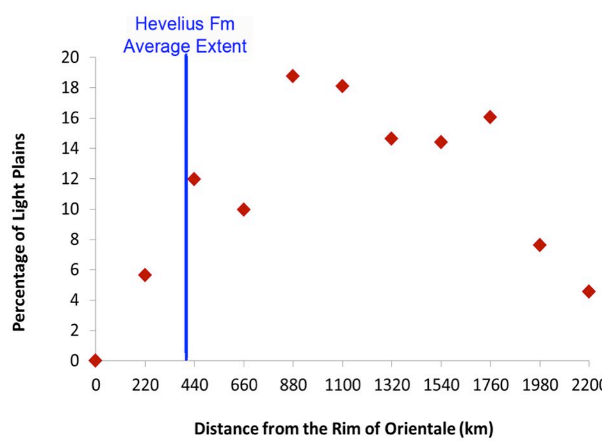

Fig. 2. The distribution of light plains with increasing radial distance from Orientale. The Hevelius Formation average extent corresponds to the Inner Facies of the Hevelius Formation [2]. The Inner Facies extends ~420 km from the rim of Orientale (Fig. 1).

find that many areas previously mapped as terra material are better classified as plains material (Fig. 3). For example, in the area shown in Fig. 3, the plains by Scott et al. comprise 11% of the terrain, vs. 19% for those mapped in this study. This difference is likely due to the availability of higher resolution images and the new topographic model.

Distribution of Plains: The light plains constitute 12% of our mapped study area, and the distribution of light plains is found to vary with increasing radial distance from Orientale (Fig. 2). The first and second bins are dominated by the Hevelius formation; the relatively small fraction of plains in the fourth bin (~600-800 km) is likely due in part to the presence of two large, post-Orientale impact craters. The highest percentage of light plains occur within bins 5-9 (~800-1800 km from Orientale), with ~14-19% plains per bin area. Beyond ~1800 km from the rim there is a distinct dropoff in plains density to ~8% in the tenth bin (~1800-2000 km) and ~5% in the eleventh bin (~2000-2200 km). There is a moderately higher concentration of plains in the eastern side of the study area than in the west (Fig. 1). In some cases this difference appears to be due to the presence of large impact craters and crater chains.

Morphologic Variation: Consistent with previous work [2], the Hevelius Formation displays both gradational and sharp embayment relationships with the light plains, including distinct lobes and flow-like features within the Hevelius Formation that overlie light plains. The texture varies over the defined area, but the variations do not appear to correlate directly with distance from the basin rim. In some cases, the plains appear thicker and rougher, and in others, thinner and smoother.

Discussion: We are currently extending the study area to the west to further characterize the differences in light plains distribution and morphology. The light plains appear to extend farther to the north than our present study area, but the marked decrease in density of mapped light plains beyond ~1800 km from Orientale's rim is consistent with the majority of plains having formed as ejecta from the Orientale impact event. Further mapping as well as relative age dating will help elucidate whether the difference in the eastern and western distributions is due to the influence of ejecta from Imbrium to the east, or from heterogeneities within Orientale deposits. Crater size-frequency distributions of selected regions of plains will also help to evaluate whether light plains form from numerous discrete impact events or can be related to only the largest and youngest basin-forming events. The relationship between the light plains and basins, the size of the area affected by a single basin, and the implications for the origin of the plains will be applied to other planetary bodies, like Mercury, which have plains deposits of uncertain origins.

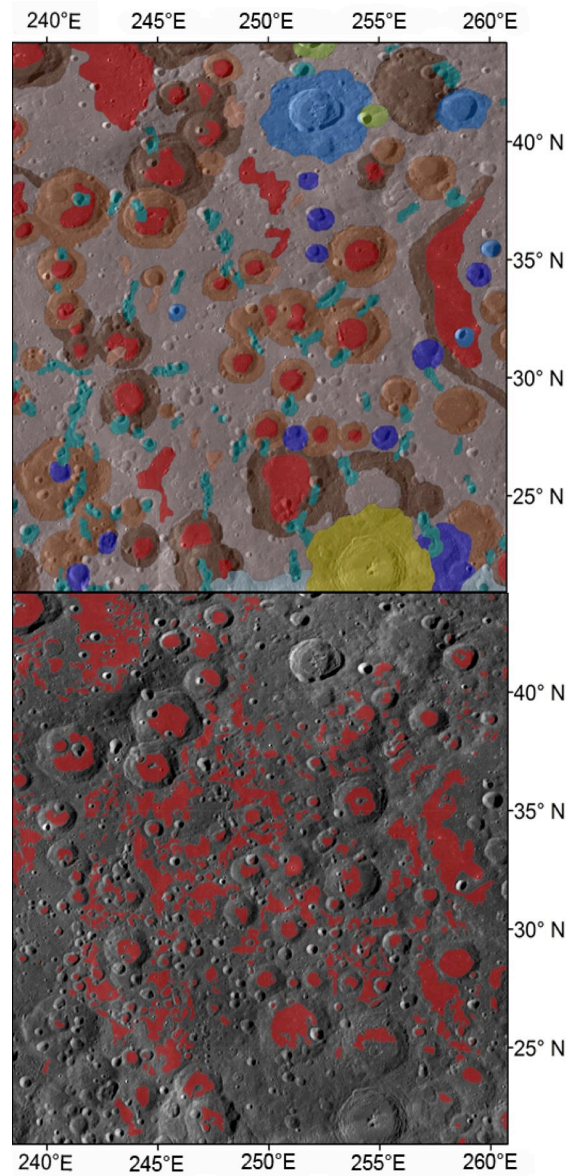

Fig. 3. A portion of our study area shown as mapped both by Scott et al. [2] (top) and in this work (bottom). The plains material (red) of Scott et al. generally correspond to regions mapped as light plains (red) in this work. Additional areas previously mapped as terra material (tan) are classified here as light plains.

References: [1] Eggleton R. E. and Schaber G. G. (1972) *NASA Apollo 16 Prelim. Sci. Rep.*, 29-7–29-16. [2] Scott et al. (1977) Geologic Map of the West Side of the Moon, *USGS*, Denver, CO. [3] Young J. W. (1972) *NASA Apollo 16 Prelim. Sci. Rep.,* 5-1–5-6. [4] Neukum G. (1977) *The Moon 17,* 383-393. [5] Boyce J. M. et al. (1974) *Proc. Fifth Lunar Sci. Conf.,* 11-23. [6] Robinson M. S. et al. (2010) *Space Sci. Rev. 150*, 81-124. [7] Scholten F. et al. (2011), *JGR, 117*, doi:10.1029/2011JE003926. [8] Boyd A. K. et al. (2012) *AGU Fall Mtg*, P23C-1947.