COMPOSITIONAL CHARACTERIZATION OF IRREGULAR MARE PATCHES VIA M³ AND DIVINER DATA ANALYSES. N. Piskurich¹, K. L. Donaldson Hanna¹, M. Martinot¹, and B.T. Greenhagen², ¹University of Central Florida, Orlando, FL (npiskuri@knights.ucf.edu), ²Johns Hopkins Applied Physics Laboratory, Laurel, MD.

Introduction: Irregular mare patches (IMPs) are small to mesoscale (~15 – 5000 m maximum length) hypothesized volcanic features on the lunar nearside located in host mare settings [1, 2, 3]. IMPs exhibit two morphologically distinct deposits: bulbous-shaped, smooth mounds with uniform texture and little to no blocks/boulders, and surrounding optically immature deposits with rough surface textures and a range of block densities [4, 5]. Recent morphologic Lunar Reconnaissance Orbiter Camera (LROC) observations and crater counting suggest that the IMPs may be recent features (~ 10 – 100 Ma) [4].

Initial geological characterization of the first IMP, Ina, in 1972 from Apollo 15 photographs has led to many hypothesized IMP formation mechanisms [e.g., 3, 6]. Proposed mechanisms include sublimation [3], small lava intrusions and caldera collapse [1], episodic outgassing and removal of surface regolith within the past 10 Ma [7], lava flow inflation [8], small basaltic eruptions within the past 100 Ma [4], pyroclastic eruptions [9], and lava lake processes and magmatic foam extrusions [10]. Here we characterize compositional trends in several IMPs that will allow us to better discriminate between IMP formation scenarios. Compositional characterization of IMPs will provide insight into the Moon’s thermal and magmatic evolution.

Methodology: Compositional characterization is performed for the largest IMPs: Sosigenes, Ina, Cauchy-5, Maskelyne, Nubium, and Ross-E-1. The compositional data for these IMPs are compared to surrounding terrains to investigate their similarities and differences. Moon Mineralogy Mapper (M³) Level 2 observations (~ 0.4 – 3 μm, 85 spectral channels, and ~ 140 – 280 m spatial resolution) were used to identify prominent absorption bands for the IMPs and the spectral parameters that best distinguish the IMPs from their surroundings. Because the IMPs’ spectra were consistent with pyroxenes, we applied the parabolas and two-part linear continuum algorithm [11] to the M³ spectra. A Savitzky-Golay filter was applied to smooth the spectra, and band center positions (a parameter indicative of mineralogical composition) were computed by fitting 4th order polynomials to the 1-μm and 2-μm regions. Geologic units of each IMP analyzed include smooth mounds, hummocky terrain, an averaged interior of each IMP, surrounding regolith, low albedo craters, and fresh, high albedo craters.

Multispectral thermal infrared observations from the Diviner Lunar Radiometer (~ 0.3 – 400 μm, 9 spectral channels, ~ 200 m spatial resolution) were used in conjunction with M³ spectral measurements. Diviner’s three channels near 8 μm (7.81, 8.28, and 8.55 μm) [12] were used to map the Christiansen feature (CF). Wavelength positions of the CF correlate to bulk silicate composition; common lunar rock-forming minerals (i.e., feldspar, pyroxene, olivine) show diagnostic CF positions [13].

Preliminary Results: For the M³ results, the hummocky terrain spectra of each IMP, except Maskelyne, exhibited the strongest ferrous absorption bands, likely due to their optical immaturity and blocky morphology, which is consistent with previous analyses [14, 15]. Interior IMP spectra and their surrounding geologic units showed band center positions consistent with high-Ca pyroxenes (HCP) (i.e., spectra with absorption bands near 1 and 2 μm due to the occupancy of Fe²⁺ and/or Ca²⁺ in the M1 and M2 crystallographic sites) [16-18]. Four of the IMPs exhibited absorptions in the 1.5 – 1.8 μm region in addition to the 2-μm region, suggesting that IMPs may be composed of a combination of glassy deposits and basaltic materials (e.g., HCP). For the Diviner results, analyses of standard CF maps for the four largest IMPs indicate that IMP interiors show shorter CF wavelength positions than their surrounding terrains, which could be related to differences in composition, maturity or blockiness.

Future Work: We intend to aggregate a global catalog of M³ and Diviner spectra for the IMPs that are spatially resolvable by these instruments. We will compile our results with visible and near-infrared laboratory spectra obtained from the RELAB database to further constrain IMP compositions.