COORDINATED MINI-RF AND LROC OBSERVATIONS OF THE LUNAR SURFACE. S. J. Lawrence[1,2], M. Mechtley[1], P. Spudis[3], B. Bussey[4], M. S. Robinson[1]. [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ [2] sjlawren@asu.edu [3]Lunar and Planetary Institute, University Space Resources Association, Houston, TX [4]Applied Physics Laboratory, the Johns Hopkins University, Laurel, MD

Introduction: Mini-RF is a lightweight Synthetic Aperture Radar (SAR) instrument aboard the Lunar Reconnaissance Orbiter (LRO), and the Lunar Reconnaissance Orbiter Camera (LROC) is the LRO's imaging system [1]. The Mini-RF and LROC Science Teams have begun a comprehensive program to systematically compare overlapping LROC NAC and WAC images to Mini-RF non-polar datasets. Combining the ultraviolet/visible LROC data with the Mini-RF radar data will yield important new insights about the size and distribution of surface and subsurface blocks, the albedo, bulk density, structure, and composition of the regolith, and the nature of lunar pyroclastic deposits [2]. In this study, we discuss some of our preliminary results from directly comparing LROC NAC images to Mini-RF data.

Methods: *Mini-RF* uses a hybrid polarimetric architecture to measure the lunar surface backscatter characteristics. It transmits a left circular polarized signal, but receives coherently H and V linear polarizations. The resulting data are sufficient to calculate the Stokes parameters for the lunar surface images as well as daughter products such as the classical Circular-Polarization-Ratio (CPR). Mini-RF can acquire data in one of two radar bands, S or X (12 vs 4 cm) and has two resolution modes: Baseline (150 m) and Zoom (15 m).

LROC consists of three instruments: a Wide Angle Camera (WAC), which provides 7-band synoptic multispectral imagery in ultraviolet and visible wavelengths, and two Narrow Angle Cameras (NACs) to provide high-resolution (0.5 to 2.0 m/pixel) images of key targets on the lunar surface [5]. The two NAC s are mounted side-by-side on the spacecraft, yielding a combined swath of 5km x 25 km on the lunar surface from the nominal 50-km LRO mapping orbit. LRO may also be physically rolled off-nadir in order to collect an extremely limited number of geometric stereo observations [6].

For this investigation, Mini-RF S-Band zoom-mode H- and V- linearly polarized data and overlapping LROC NAC frames were mosaicked, coprojected, and directly compared to provide new insights about the lunar surface.

Results: Our initial investigation has focused on two areas where the Mini-RF and LROC NAC datasets coincide, Riccioli CA crater and the Reiner Gamma formation.

Riccioli CA: Riccoli CA is a 14-km diameter impact crater northeast of Riccioli crater on the limb of the Moon. Fig 1 shows a subset of the Mini-RF frame covering an area several kilometers south of Riccioli CA; Fig. 2 shows a mosaic of two LROC NAC frames of the same region. The high-sun LROC image is sensitive to the albedo (and thus, to some extent, the composition) of the surface. The Mini-RF swath is sensitive to surface and subsurface roughness. Differences between the images, especially the bright (rough) areas in the western part of the Mini-RF image, show that Mini-RF is sensitive to surface properties that may not be readily apparent in LROC NAC imagery.

Reiner Gamma: Reiner Gamma, the distinctive albedo swirl, has long been a subject of interest for lunar geologists [7-9]. As one of the Project Constellation design reference sites for prospective future human lunar exploration, Reiner Gamma is a high-priority target for the LROC Science Team [10]. Mini-RF has acquired a SAR strip that covers part of the Reiner Gamma formation, which is the first time that an orbital S-band radar system has imaged the region with optimal viewing geometry. Comparisons between the Mini-RF and LROC data show that the swirl is easily discernable in the visible-light LROC image, but is only weakly visible in the Mini-RF S-band data. The Mini-RF is sensitive to backscattered energy; this indicates that swirls are weak back scatterers.

Future work: Comparisons between Mini-RF and LROC data will continue throughout the LRO mission. The Mini-RF and LROC science teams have identified numerous areas of where planned or collected observations will overlap, including the Orientale basin, the Aristarchus region, and the Sulpicius Gallus regional dark mantling deposit, and our study will expand to include these and other lunar regions.

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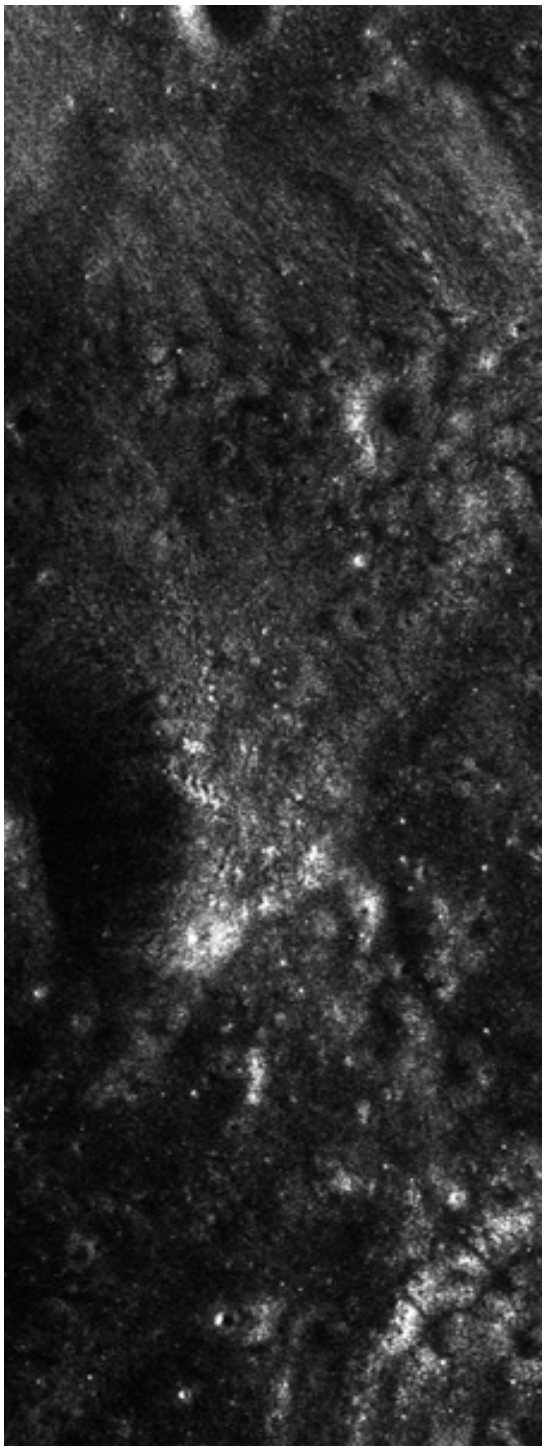

Figure 1. Mini-RF S-band H-polarization return of the lunar highlands several kilometers south of the Riccioli C/CA impact structure [NASA/GSFC/JHUAPL].

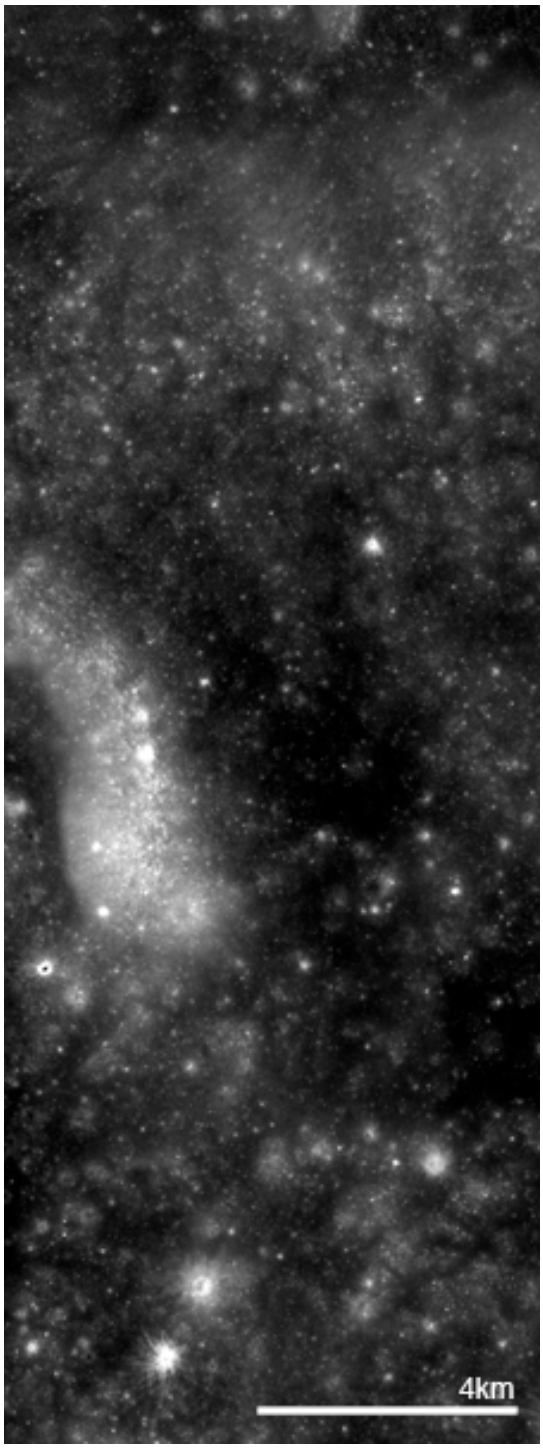

Figure 2. Subset of LROC NAC frame M107358008, showing the same area as Figure 1. Image was acquired at an incidence angle of 20.5 degrees [NASA/GSFC/ASU].