MINI-RF PSR OBSERVATIONS: WATER ICE OR ROCKS? Wenzhe Fa, and Yuzhen Cai, Institute of Remote Sensing and Geographical Information System, Peking University, Beijing 100871, China (wzfa@pku.edu.cn).

Introduction: Potential water ice in the permanently shadowed regions (PSRs) over the lunar poles is regarded as one of the most valuable resources in the solar system, and it also contains information concerning significant questions about the Moon [1]. Radar is regarded as an effective tool for detecting water ice, because under certain conditions, ice deposits produce a unique backscatter signature. Recently, NASA' and India's Miniature Radio Frequency (Mini-RF) radars found a class of anomalous craters with high circular polarization ratio (CPR) only in their interior regions, but not exterior to their rims. Most of these craters are located in the permanently shadowed regions, and their CPR characteristics are different from those of fresh craters. Based on the correlation with Lunar Prospector neutron data and thermal conditions, these anomalous craters were interpreted as potential sites for water ice deposits [2, 3].

New Results: We conducted an exhaustive search in the LRO Mini-RF CPR images and found 84 and 34 anomalous craters over the north and south polar regions (Fig. 1) [4]. In addition, we also found a large number of anomalous craters over the non-polar regions, where water ice cannot exist. A recent study showed that, for anomalous craters, CPR varies with position relative to the crater center [5].

Using a quantative radar scattering model [6], we found that surface slope, roughness, dielectric permittivity, and regolith thickness cannot explain the elevated CPR in the interior of anomalous craters. Examinations in high-resolution optical images from Lunar Reconnaissance Orbiter Camera (LROC) show that there are abundant surface rocks within the interior region of anomalous craters, whereas no rocks outside of their crater rims (Fig. 2).

To study the effect of surface rocks, a two-component (single scattering from a rock-free surface and double scattering from rocks) mixed model is proposed to simulate lunar surface CPR. From this model, CPR difference between the interior and exterior regions of a crater correlates directly with the difference in rock abundance. Results for 8 typical craters showed that there is a strong correlation between CPR difference and the difference in rock abundance, which matches well with model prediction (Fig. 3). This indicates that surface rocks are the key factor for the elevated CPR in the interior of anomalous craters, instead of ice deposits as pointed out in previous studies [2, 3].

Conclusions and Future Work: The enhanced CPRs in the interior of anomalous craters are most probably caused by meter-scale rocks either perched on the lunar surface or buried in the regolith, suggesting that ice deposits, if present, are not the only physical agent causing the enhanced CPR. Future study is required to verify whether polar anomalous craters are overabundant or not. If so, does this represent the signature of water ice?

References: [1] Watson K. et al. (1961) *JGR, 66,* 1598–1600. [2] Spudis P. D. et al. (2010) *GRL, 37,* L06204. [3] Spudis P. D. et al. (2013) *JGR, 118,* 2016–2029. [4] Fa W. and Y. Cai (2013) *JGR*, *118*, 1582–1608. [5] Eke et al. (2014) *Icarus, 241*, 66–78. [6] Fa W. et al. (2011) *JGR*, *116*, E03005.

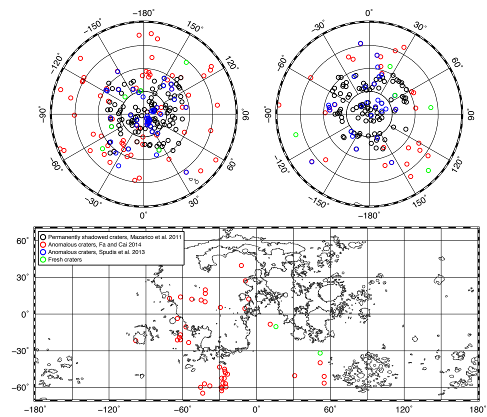

Figure 1. Distribution of permanently shadowed craters, anomalous craters, and fresh craters over the lunar surface.

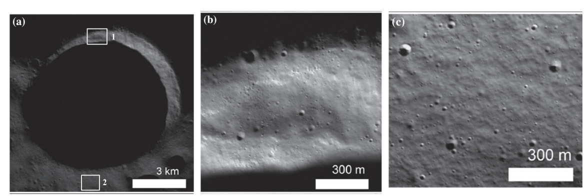

Figure 2. (a) A LROC NAC mosaic for Hermite B. (b) A LROC image showing a rocky region (box 1) in the northern crater wall. (c) A LROC image for a rock free region in the south of outer wall (box 2).

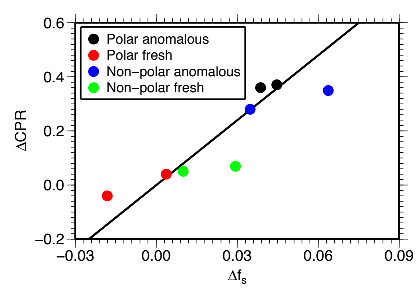

Figure 3. CPR difference between the interior and exterior regions versus the difference in rock abundance from model prediction (black line) and observations (dots).