GEOPHYSICAL CHARACTERIZATION OPPORTUNITIES IN SCHRÖDINGER IMPACT BASIN USING KAGUYA LUNAR RADAR SOUNDER AND LUNAR RECONNAISSANCE ORBITER. S. P. S. Gulick[1,2,3], C. Grima[1,3], C. Gerekos[1], and G. Kramer[4] [1]Institute for Geophysics, Jackson School of Geoscience, University of Texas at Austin, 10100 Burnet Rd Bldg ROC, Austin, TX 78758; sean@ig.utexas.edu, [2]Department of Geological Sciences, Jackson School of Geosciences, University of Texas at Austin, Austin, TX 78712, [3]Center for Planetary Systems Habitability, University of Texas at Austin, Austin, TX 78712, [4]Planetary Sciences Institute, Tucson, AZ

Introduction: Impact cratering drives upwards motion of crustal or mantle materials, affects physical properties of target rocks, and mobilizes fluids [1]. Large impact basins can generate global deposits, store deeply sourced rocks in peak rings, and be the site of post-impact hydrothermal and volcanic processes [2-3]. Impact basin floors can be geologically complex due to a mixture of impact melts, impactoclastic products, and later modifications, such as volcanic events and faulting [4-5]. Subsurface imaging can assess these structural and depositional processes thereby enabling greater insights from surface mapping, especially where insights into physical properties of surficial geologic units can be quantified and assessed.

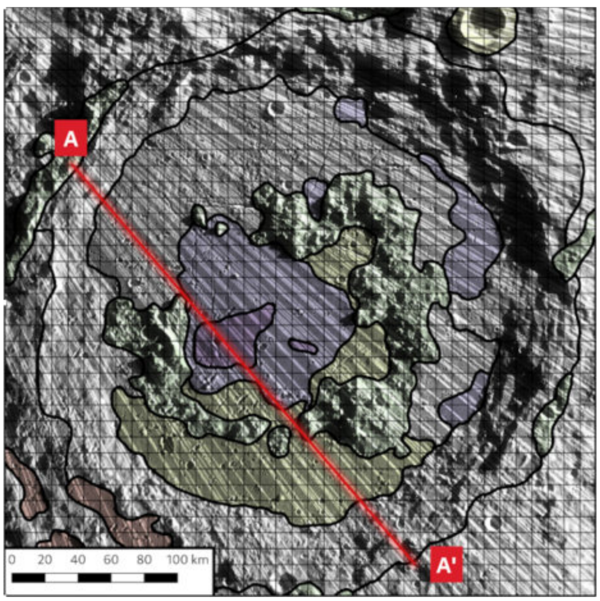

Figure 1. White lines depict available LRS ground tracks over a LRO WAC mosaic of the Schrödinger basin. Geologic units [6] are overlapped as indicative landmarks. A grid of 10x10 km^2 illustrates the relative resolution of our first application strategy for the RSR. A-A' is radargram and cluttergram shown in Fig. 2.

Recent geophysical imaging and scientific drilling of the well-preserved Chicxulub impact basin on Earth has strongly supported the geologic implications of hydrocode models of impact formation wherein peak rings are formed from dynamic collapse of over-heightened central uplifts and represent sites likely to exhibit outcrops of deep crustal rocks for future sampling. Physical properties of the drilled lithologies proved fundamentally altered by impact yielding low densities and high porosities, a result consistent with GRAIL findings of a broadly porous lunar crust.

Here, we assess the potential to merge new radar products and analysis of the JAXA Kaguya Lunar Radar Sounder (LRS) with data from the Kaguya Terrain Camera (TC), NASA Moon Mineral Mapper (M3), Lunar Reconnaissance Orbiter (LRO) Wide Angle Camera (WAC) and Lunar Orbiter Laser Altimeter (LOLA), and GRAIL to explore geologic diversity, depositional processes, subsurface structure, and identify potential resources and geohazards of the Schrödinger impact basin.

Methodological Improvements: With a 5 MHz central frequency, JAXA LRS can image the subsurface to 100s of m [7]. This proved effective in regions of flat topography, where subsurface reflections caused by differences in electrical permittivity were imaged, but challenging in regions surrounded by greater topography causing surface clutters to mislead the identification of subsurface returns. LRS with its polar orbit results in dense coverage within the South Pole Aitken region including over the Schrödinger impact basin which will host a landing site for the PRISMS deployments by CLIPS in 2025. Here, we conduct first step radar simulations to discriminate internal reflectors from surface clutters (Fig. 2 top) which allow for identification of true subsurface returns when interpreted in parallel with coincident radargrams [8].

Preliminary Results: A preliminary interpretation of the example profile (Fig. 2 bottom) suggest the ability to recognize the following geologic features within the impact basin: 1) an asymmetric terrace zone that is visible beneath the crater fill near the rim, 2) potential melt-rich impact breccia (suevite) distal from the peak ring, 3) the peak ring top and potentially base in some locations, 4) melt rock of either impact or volcanic origin within and to the outside of the peak ring, and 5) some additional subsurface reflections that may represent collapse breccia. In this interpretation, we were guided by subsurface images of terrestrial craters, e.g. Chicxulub [9], and used reflectivity and geometry to argue for presence of melt rock versus exposed peak ring material. The most suspect interpretations are base of peak ring however a comparison with the cluttergram (Fig. 2 middle) does not show the continuity of reflections, where interpreted on the radargram.

Future Work: Leveraging the reflectivity of the LRS surface-return to investigate decametric surface properties for insights into depositional processes has never been carried forward. Our future work will apply the Radar Statistical Reconnaissance (RSR) technique (see Fig. 1 for resolution) to differentiate the scattering/incoherent component of the LRS surface returns from the coherent portions of the signal, and use our radar simulations to assess the contribution of roughness scattering to the surface reflectometry [10].

Resultant profiles and maps, which are sensitive to the subsurface geology, can be jointly analyzed with image, spectral, and topographic data, and GRAIL high-resolution products, to: 1) conduct a next stage interpretation of the Schrödinger impact basin stratigraphy, 2) search for impact-generated but shallow buried features such as the non-exposed portions of the terrace zone and peak ring structures, 3) explore the thickness/physical properties of impact deposits and post-impact volcanic units, and 4) examine cross-cutting structural features (scarps and grabens) for potential origin and hazard.

With these new data products and geologic interpretations, the Payloads and Research Investigations on the Surface of the Moon (PRISM) teams will have crucial information about the geology of future landing site(s) in Schrödinger basin, where the Farside Seismic Suite (FSS) and Lunar Interior Temperature and Materials Suite (LITMS) are planned for 2024-2025 deployment. Seismic structure and electrical properties from these suites represent a calibration opportunity for using radar data within Schrödinger basin and lunar targets more generally, for which this proposal represents critical groundwork in radar processing, clutter simulation, statistical analysis, and multi-sensor integrated geologic mapping.

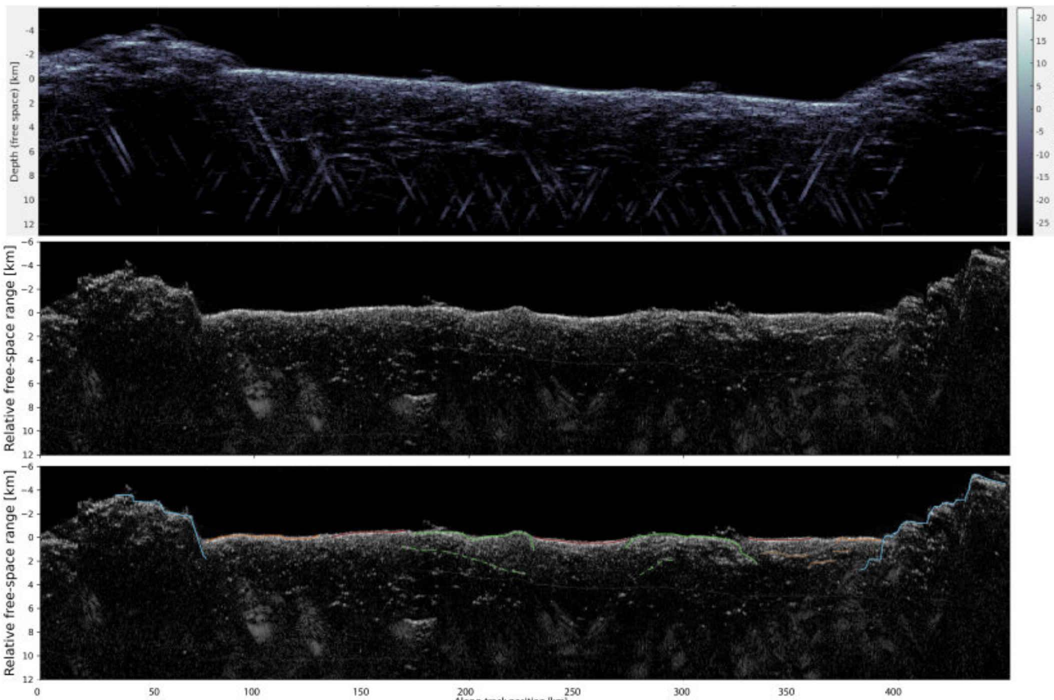

Figure 2. Radargrams and clutter analysis for the LRS profile A-A' in Figure 1. Top panel is a cluttergram using range compressed, unfocussed SAR processing. Middle panel is the nearly coincident SAR10 km data product from the LRS. Lower panel is a preliminary interpretation where blue is top of terrace zone, green is peak ring, red is melt rock, orange melt-rich breccia, and brown possible blocks within collapse breccia.

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References: [1] Melosh (1989) *Icgp*. [2] Morgan J et al. (2016) *Science 354*, 878-882. [3] Kring D et al. (2016) *Nat Comm, 7*, 1-10. [4] Gulick S et al. (2019) *PNAS 116*, 19342-19351. [5] Kramer et al. (2013) *Icarus 223, 131-148.* [6] Shankar B. et al. (2013) *Can J Earth Sci, 50*, 44-63. [7] Ono T. et al. (2010) *Spc Sci Rev,* 154, 145-192. [8] Gerekos C. et al (2018), *TGRS* 56(12) 7388-7404. [9] Christeson et al. (2021) *JGR*, 126, e2021JE006938. [10] Grima et al., (2022) this conference.