IDENTIFICATION OF NEW SCIENCE TARGETS BASED ON MAPPING (1:10,000) OF ARTEMIS III AOI 001 & 004 ON THE SHACKLETON-DE GERLACHE RIDGE. H. Bernhardt[1] and M. S. Robinson[1], [1]School of Earth and Space Exploration, Arizona State University, Tempe, USA (h.bernhardt@asu.edu).

Introduction: For future crewed and robotic landings on the Moon (e.g., Artemis III and VIPER, [1,2]), the Shackleton-de Gerlache ridge (SDR) at the lunar South Pole has been identified as a potential landing site due to the unique proximity of permanently shadowed regions (PSRs) to peaks of extended Sun visibility (>80% between 2024 and 2026 [3,4]). Based on our 442 km^2, 1:10,000 geomorphic mapping of Artemis AoIs 001 & 004, we propose new, science-focused traverses.

Methodology: Mapping was conducted in ArcMap at 1:8000 using a 5 meter/pixel digital elevation model based on the Lunar Orbiter Laser Altimeter (LDEM), an averaged, 1 m/px mosaic of Lunar Reconnaissance Orbiter Camera Narrow Angle Camera, and a seven-band color mosaic (152 m/px) of LROC Wide-Angle Camera images. Unit characterization was based on texture, roughness, physiographic context, and slope. Apparent brightness was not used as a parameter due to the difficult illumination conditions. Shadowed areas were mapped as extrapolations from adjacent units based on LDEM-derived surface roughness.

Results: We mapped 10 morphologic units, the most extensive of which is the moderately sloped surface (a weak expression of “elephant hide texture” [5]) at 166 km^2, i.e., ~36% of the mapping area. Most contacts are gradual and did not reveal any stratigraphic hierarchy. At our mapping scale, almost all morphologic signatures are related to impact events, i.e., actual craters smaller than ~100 m as well as slope processes (different intensities of elephant hide texture) controlled by topography formed by larger impacts. We differentiate between seven classes of crater rims based on their degradation state and therefore likely relative age. Meters-scale blocks occur solitary (Fig. 1, squares), around fresh craters (Fig. 1, triangles), as well as on four decameter-scale knobs (unit *k*). Previously mapped boundaries of the Shackleton ejecta [6-8] could not be confirmed and lack any visible signature in the analyzed datasets.

Traverses: We devised three sequential traverses, “Safe”, “Extended”, and “Increased risk”, accepting slopes of 10°, 15°, and 16°and lengths of 3.64 km, 11.92 km, and 11.43 km (Fig. 1, shown as single red, dashed line). The three traverses would visit four, eleven, and nine blocks/blocky craters/blocky knobs, respectively, and pass through seven of our map units. Aside from shallow slopes, almost the entire “Safe” traverse would benefit from relatively good Sun and Earth visibilities ≥50% on the 2024-2026 timeframe [3]. The “Extended” traverse drops to <30% Sun visibility over a ~3.5 km long section and passes by a potential high yield science target – a blocky knob, which we interpret as degraded Shackleton ejecta block and therefore suggest to have a higher likelihood than any block along the preceding traverse to yield significant insights into Shackleton’s age, the regional crustal lithology including possible SPA signatures, as well as regolith deposition rates. Timing any traverse to pass through this section during optimal illumination conditions (Sun at azimuth of ~140°W) and using a relay satellite for Earth communication could increase the feasibility of traversing this section. The “Extended” traverse ends at the intersection of the SDR and Shackleton’s rim at a location that would offer a direct line of sight onto the crater floor as well as several dozen, up to ~8 m wide blocks, of which at least five are on sufficiently shallow slopes to be accessed. The “Increased risk” traverse would proceed on Shackleton’s rim to reach a ~180 m wide, blocky crater with residual ejecta blanket. The traverse would end on a highly degraded crater’s smooth, level floor, which might potentially be a Shackleton impact melt pond.

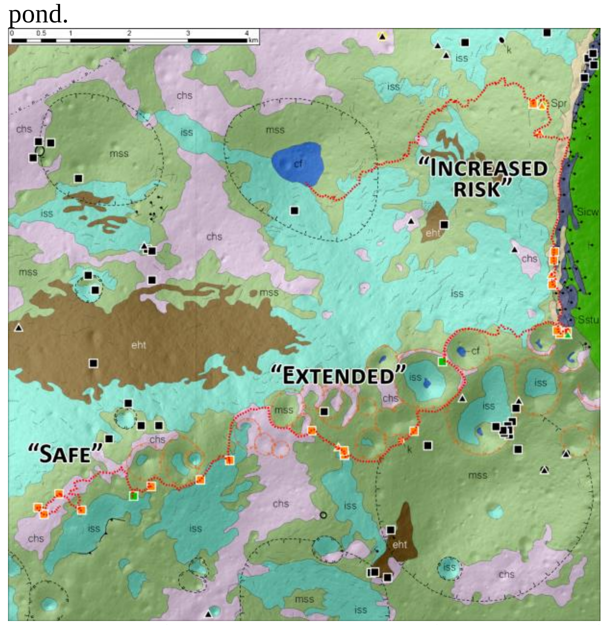

Figure 1: Excerpt of our geomorphic map (1:10,000) of Artemis III Areas of Interest 001 and 004 (Shackleton’s crater rim is on the right edge of the image). Dashed, red line is the three sequential traverses discussed in the text. Squares and triangles are blocks and blocky craters, respectively (orange: visited; green: approached; black: not visited or approached).

References: [1] Artemis III Report (2020), Retrieved from https://www.nasa.gov/sites/default/files/atoms/files/artemis-iii-science-definition-report-12042020c.pdf; [2] Colaprete et al. (2020), LPSC#2241; [3] Barker et al. (2020), PSS, https://doi.org/10.1016/j.pss.2020.105119; [4] Gawronska et al. (2020), Adv. In Sp. Res., 66(6), 1247–1264; [5] Zharkova et al. (2020), Icarus, 351(March), 113945; [6] Krasilnikov and Ivanov (2018), Moscow Solar System Symposium#358); [6] Spudis et al. (2008), GRL, 35(14), 1–5; [8] Halim et al. (2021), Icarus, 354, 113992.