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LUNAR SOUTH POLE GEOLOGY: PREPARING FOR A SEVENTH LUNAR LANDING. David A. Kring[1,2], [1]Center for Lunar Science and Exploration, Lunar and Planetary Institute, Universities Space Research Association, 3600 Bay Area Blvd., Houston TX 77058 (kring@lpi.usra.edu), [2]NASA Solar System Exploration Research Virtual Institute.

Introduction: The lunar south polar region is a heavily impact-cratered terrain with dramatic topography, long shadows, deep shadows (including permanently shadowed regions (PSRs)), and, in stark contrast, a few, small, near-constantly illuminated areas (e.g., [1]). The south pole is located on impact ejecta covering the rim of a 4.2 km-deep, 21 km-diameter Shackleton crater (Fig. 1). The crater hosts one of the regions PSRs, although reflected light subtly illuminates its interior. The crater's age is between ~1.1 and 3.6 Ga [2,3]. The age is important. If the age is >3.5 Ga, then the crater may have been an important trap for volatiles vented by volcanic mare eruptions [4]. It also would have been a trap for volatiles released by the Schrödinger volcanic vent, the largest indigenous source of volatiles in the south polar region [5]. That age also implies older polar craters (de Gerlache, Haworth, Shoemaker, and Faustini) were important traps for those indigenous volatiles. On the other hand, if the age of Shackleton crater is ≤3 Ga, then it would have only been a significant trap for transported solar wind and volatiles from impacting bodies.

Traverses: Ice-bearing deposits are not likely on the rim of Shackleton and nearby illuminated prominences (although crew can peer into the very deep PSR of Shackleton). Potentially volatile-rich regions exist within tens of km and can be accessed with small pressurized rovers (SPRs) to address ISRU and NRC (2007) science questions (e.g., [6]). An example traverse for crew in SPRs is illustrated in Fig. 1 [7]. Those and similar regions can also be explored with SPRs driven tele-robotically from Houston between crew landings [7]. Tele-robotic transfer of SPRs to a second landing site for crew, followed by crew traverses in those vehicles in the vicinity of the Malapert massif, Cabeus crater, and Leibnitz β massif, is a concept developed during the Constellation Program [8] and explored with a 28-day-long mission simulation [9,10]. If crew do not have mobility and are limited to EVA in the immediate vicinity of a South Pole lander, they will need to focus on other science and exploration objectives.

Samples: If crew are limited to the rim of Shackleton Crater (e.g., as in [11]), then most of the samples available to them will be Shackleton ejecta. Potentially, that will include Shackleton impact melts, from which an age can be ascertained. The regolith may also contain impact melt from SPA and other pre-Nectarian and

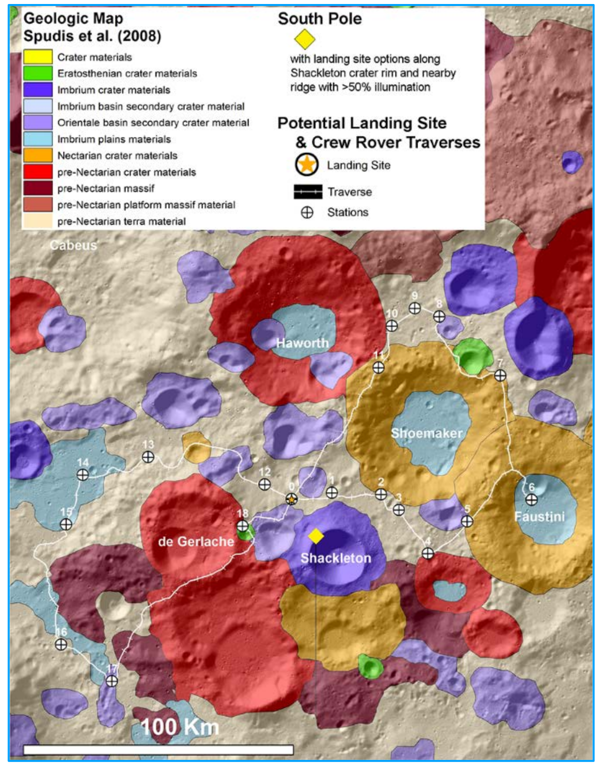

Figure 1. Geologic map with south pole landing site, suitable for both crew and rover-facilitated traverses, plus a second landing site with rover-facilitated traverses of PSRs. Modified after Spudis et al. (2008) and Allender et al. (2019).

Nectarian-age impacts, plus fragments of the original highland crust, with components from the lunar magma ocean and later intrusives, plus cryptomare from SPA. Boulders are currently being mapped [12] that may provide additional geologic context for those lithologies. In all cases, the samples will provide an opportunity to study polar regolith processes.

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