LHS-2E and LSP-2: Novel 2mm Minus Lunar Regolith Simulants. K. Krol[1], P. Easter[2], A. Metke[3] [1] Space Resource Technologies (SRT) (532 S Econ Cir, Oviedo, FL, 32765, info@spaceresourcetech.com), [2] Exolith Lab (532 S Econ Cir, Oviedo, FL, 32765, parks.easter@ucf.edu), [3] Space Resource Technologies (SRT) (532 S Econ Cir, Oviedo, FL, 32765, anna.metke@spaceresourcetech.com).

Introduction: With the global focus on exploration and ISRU efforts aimed at the South Pole of the Moon the need for more accurate bulk engineering-grade Lunar Regolith Simulants is crucial. The majority of simulants developed and used have focused on replicating the <1mm size fraction of Lunar Regolith due in large part to the setting aside of >1cm samples [1] and sieve analysis typically being conducted with <1mm samples [2]. The actual percentage of regolith in the Lunar Highlands greater than 1mm is between 20-30% based on the samples returned from Apollo 16 [1].

Mineralogy plays a key role in geotechnical properties, specifically grain density, hardness, abrasivitiy, and particle shape [3]. Therefore it is important to not only simulate the size range, but also use mineralogically appropriate feedstocks to do so. The most widely used regolith simulant, NASA JSC-1A which has been broadly used to simulate the lunar surface since the 1990s [4] simulates the mineralogy of the Lunar Mare regions. However, the composition of the South Pole is generally expected to be Highlands-like and significantly more anorthosite rich unlike the basalt-rich Mare [5].

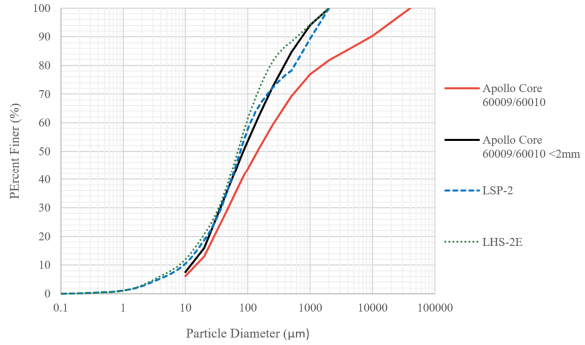

Figure 1: PSD of LHS-2E and LSP-2 compared to Apollo 60009/60010 [6]

In order to better simulate these properties we have developed an engineering-grade Highlands simulant LHS-2E which maintains the mineralogy of the LHS-1E simulant [7] while expanding the size range accordingly. In addition, we have also developed LSP-2 our first specifically Lunar South Pole simulant which contains a higher proportion of Anorthosite to better represent its presently known features as a distinct part of the Lunar Highlands [7].

Materials: In order to best simulate the mineralogy and bulk chemistry of the Lunar Highlands, simulants at SRT are blends of Greenspar anorthosite, Merriam Crater glass-rich basalt, Ilmenite, Olivine, and Bronzite [7]. Engineering grade (-E) simulants omit the added Ilmenite, Olivine and Bronzite which consist of approximately 1% of LHS by mass [7].

Processing: Emphasis in particle size reduction is placed on utilizing processes which minimize the rounding of particles. As a result, simulants at SRT are typically not ball milled or processed using a roller. Crushing techniques which involve percussive impacts like hamnmermilling are used instead and material is re-cycled through the system until passing a 2mm mesh screen. Individual constituents are then weighed and powder-blended by mass. Samples are taken from batches regularly to ensure consistency with reported spec sheet data using dry sieving, XRF, and XRD.

Availability and Use: SRT simulants are all readily available via the SRT website or by contacting us for a quote. So far about 250,000lbs (113.5 metric tonnes) of LHS-2E and LSP-2 combined have been manufactured and delivered to their recipients.

For small quantities of <100kg, usual Domestic lead time is approximately 5-7 business days while international lead time is 14 days. Please contact SRT to confirm most up to date lead time for bulk availability.

References: [1] Morris et al. (1983) *Handbook of Lunar Soils* pg. vii. [2] Carrier et al. (2005) *Geotechnical Properties of Lunar Soil* [3] Long-Fox et al. (2023) *Geomechanical Properties of Lunar Regolith Simulants LHS-1 and LMS-1* [4] Sibille et al. (2006) *Lunar regolith simulant materials: recommendations for standardization, production, and usage.*[5] McKay et al. (1991) *Lunar Sourcebook Ch. 7: The Lunar Regolith.* [6] Easter et al. (2024) *LHS-2E and LSP-2: Expanding Exolith Lab's Lunar Regolith Simulants to Particle Sizes >1mm* [7] Space Resource Technologies (2023) *Simulant Spec Sheet* https://spaceresourcetech.com/