LANDING SITE OPTIONS FOR SHORT-DURATION EVA HUMAN EXPLORATION AND SAMPLE RETURN OPPORTUNITIES. David A. Kring[1], [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).

Introduction: An NRC (2007) report [1] outlined the scientific concepts and goals for future robotic and human exploration. Those goals were further evaluated in a global assessment of all locations on the lunar surface where they could be addressed [2]. That latter study also led to several general conclusions: Schrödinger basin on the lunar farside, within the South Pole-Aitken basin, is the location where the largest range of objectives can be addressed; Amundsen basin may be a better target than Shackleton crater for studies of polar volatiles; most of the NRC (2007) objectives can be addressed within the South Pole-Aitken basin; but to truly resolve all of the NRC (2007) objectives, global access to the Moon is required. Based on my own field and sample analytical experience, including lunar mission simulations, it is clear that the best results will be obtained with trained crew on the lunar surface rather than with robotic assets alone.

Resources [1] and [2] provide a foundation for assessing potential landing sites for short duration missions akin to the H missions of Apollo (*e.g.*, deployment of ALSEP and two EVAs) that are limited to the equatorial nearside of the Moon. In general, the recent global landing site study of [2] highlighted areas of complex geology where a large number of objectives can be addressed during a single mission. That type of landing site, however, is best explored with a longer duration stay with a significant mobility asset like the LRV or LER. For precisely landed H-style missions of short duration, limited EVAs, and no mobility asset, relatively simple geologic sites will usually be preferred. At those locations, a relatively small number of collected samples may provide the data needed to unambiguously resolve a site-specific question that may, if carefully selected, have global implications.

Examples include: (1) A mission to the eastern margin of the **Orientale basin** where samples of impact melt could be collected to determine the end of the basin-forming epoch on the Moon; potentially, in the same area, crew could collect samples of the lunar crust uplifted from depth to test models of lunar differentiation and models of impact basin formation. (2) Missions to older basins, such as **Nubium** (middle pre-Nectarian), **Smythii** (slightly younger), and **Nectaris** to determine the magnitude and duration of the lunar cataclysm. Those sites will require detailed studies to identify locations where suitable age-reset basin samples can be collected with a high probability of success; potentially, samples of the mare in those basins could be collected too. (3) A mission to the **Rima Bode** vent to collect volcanic pyroclastic debris to further test models of the thermal and magmatic evolution of the Moon; and (4), for similar reasons, a mission to **Oceanus Procellarum**, within **Flamsteed**, to collect some of the Moon's youngest mare samples. (5) Missions to **Theophilus** and **Eratosthenes** craters to sample age-reset material to constrain the impact flux during the Eratosthenian. (6) Missions to **Kepler**, **Aristarchus**, **Copernicus**, and **Tycho** craters to assess the Copernican impact flux and better calibrate the crater density chronometer. (7) A second mission to the Aristarchus region to sample volcanic units, including those associated with the dramatic **Vallis Schröteri** to further assess the thermal and magmatic evolution of the Moon. This is not an exhaustive list of potential targets, but represents the range of geologic terrains that are suitable for H-type missions. Dozens of additional sites can be extracted from [2].

Landing sites could also be selected to highlight engineering issues related to future exploration. For example, while landing on a relatively dark albedo melt-bearing pool just beyond the north rim of Tycho to collect a sample to determine its age, one could also collect samples from the adjacent clastic ejecta unit with a much brighter albedo. That second type of sample would further enhance our assessment of the Tycho impact event, while also providing the material needed to measure differences in regolith production on two completely different types of surfaces [3].

Conclusions: Missions involving a crew of two that are limited to 1½ to 2 days on the surface, two short-duration EVAs, without a mobility asset such as an LRV or LER, should target geologically simple sites where there is a high probability that a specific question will be answered with the samples available. It is also important to note, however, that significant geologic training will be needed for crew to identify and collect the correct samples. Moreover, scientifically robust missions will also require a well-trained science operations team that can work with the crews during both the training phases and during EVAs.

References: [1] NRC (2007) *The Scientific Context for Exploration of the Moon*. [2] Kring D. A. and Durda D. D. (eds.) (2012) *A Global Lunar Landing Site Study to Provide the Scientific Context for Exploration of the Moon*, LPI Contrib. No. 1694. [3] Przepiórka A. et al. (2012) *LPS XLIII,* Abstract #1387.