AN ANALOGUE MISSION IN SUPPORT OF MOONRISE AND OTHER SAMPLE RETURN MISSIONS TO THE SOUTH POLE–AITKEN BASIN. G. R. Osinski[1], I. Antonenko[1], T. Barfoot[2], N. Ghafoor[3], B. L. Jolliff[4], and P. Sylvester[5]. [1]Centre for Planetary Science and Exploration & Canadian Lunar Research Network, University of Western Ontario, London, ON, Canada (gosinski@uwo.ca), [2]Institute for Aerospace Studies, Univerisity of Toronto, Toronto, ON, Canada, [3]MDA Space Robotics, Brampton, ON, Canada, [4]Dept. Earth & Planetary Science, Washington University, MO, USA, [5]Dept. of Earth Sciences, Memorial University, St. John's, NL, Canada.

Introduction: The return of samples from the South Pole–Aitken (SPA) basin on the Moon is a high priority target for Canadian, U.S., and international scientific communities [1]. Analysis of materials from this oldest and deepest of the lunar basins is fundamental for addressing questions such as the bombardment history of the inner solar system, the role of large basins in modifying planetary surfaces, and the differentiation of planetary bodies.

A New Frontiers Phase A concept study, called MoonRise, is designed specifically to address these questions (http://moonrise.jpl.nasa.gov/). Using a robotic lander, this mission proposes to collect materials from the Moon's South Pole-Aitken basin and return them to Earth for analysis.

In order to prepare and train for such a mission, and for future potential robotic and human sample return missions in general, we plan to carry out a series of analogue missions on the Earth that will be used to develop and test procedures and techniques.

Analogue Mission Overview: This analogue mission, which is being funded by the Canadian Space Agency, will consider two scenarios:

1) A robotic sample return mission to SPA.
2) A robotic precursor mission to SPA with a follow-on 7-day human sortie mission.

Scenario 1. Robotic sample return is widely accepted as a priority for lunar science. The first scenario, therefore, will consider a purely robotic mission, such as the proposed MoonRise concept mission. MoonRise, lead by PI Brad Jolliff from Washington University and a technical team from the Jet Propulsion Laboratory, consists of a lander that will set down in the SPA, deploy a robotic arm and collect regolith samples that will be returned to Earth for analysis.

Scenario 2. The ultimate goal of lunar exploration, however, includes astronauts. Scenario 2 considers a robotic precursor mission to SPA that is followed, approximately 6 months later, by a human sortie mission. The precursor mission would involve robotic surveying and prospecting of Sites of Interest (SOIs) in preparation for human field geology operations.

Analogue Sites: Through an advanced site selection process, two locations were identified as targets for this analogue mission; the Mistastin impact structure, Canada, and the Ries impact structure, Germany.

Impact craters are the dominant feature on the Moon, and lunar sampling missions will naturally strive to navigate these ubiquitous structures and use them as probes to lunar stratigraphy. For this reason, impact structures have been selected as the target sites. The SPA basin is located in the lunar highlands, which consists predominantly of anorthosite. The Mistastin impact structure is one of few terrestrial impact sites that contain significant amounts of anorthosite. Feldspars are also a significant component of the impact melt-bearing breccias of the Ries impact.

Other factors that affected site selection included 1) a lack of vegetation, required to conduct lunar-like deployments, 2) accessibility, and 3) preservation of impact structures, required to adequately model lunar crater topography.

Analogue Mission Objectives: This mission has a number of purely scientific objectives, relating to the understanding of impact chronology, shock processes, impact ejecta, and the resource potential of impact craters. However, most pertinent to lunar mission preparation are the operational objectives.

It is no longer sufficient to simply "grab" a sample of the lunar soil for study. Contemporary questions in lunar studies require that specific samples of melt, ejecta, or bedrock be targeted and collected. One of the main goals of this analogue mission is to develop mapping, analysis, selection, and sampling, protocols for identifying and collecting specified target materials. This will require a detailed set of decision-making processes for outcrop mapping, site targeting, microimaging, sample selection, and sample acquisition.

Today's robotic technologies are also far more advanced than what was available during the Apollo era. Therefore, it is important to re-evaluate which operational strategies are appropriate for robotic vs. human activities. This comprises the final objective for this mission, to evaluate the optimal combination of robot and/or human workers for each task, be it astronaut only, astronauts with robotic assistants, or unmanned robotic surrogates. Analogue missions such as this are also important for highlighting the technological developments that are needed to enable a sustainable lunar and solar system exploration program.

References: [1] NRC 2007. *The Scientific Context for the Exploration of the Moon*. Washington D.C.: The National Academies Press. 107.