MODELING TOOL FOR LUNAR MINING OPTIMIZATION AND RESOURCE PROCESSING BASED ON GEOLOGICAL CONTEXTS. L. Sibille[1], S. Saydam[2], C. Tapia Cortez[2], [1]Southeastern Universities Research Association (SURA), Swamp Works, Exploration & Research Technologies, Mail Code LASSO-013, NASA Kennedy Space Center, FL 32899; email: Laurent.Sibille-1@nasa.gov, [2]School of Minerals and Energy Resources Engineering, UNSW-Australia, Sydney, NSW 2052 Australia; email: s.saydam@unsw.edu.au

Introduction: In their assessment of the first Landing Site / Exploration Zone Workshop for Human Missions to the Surface of Mars in Houston, TX, organizers representing NASA's Science Mission Directorate and Human Exploration Operation Mission Directorate identified the need for a better understanding of the potential resources (reserves) and of the major factors impacting feasibility assessments for extraction on Mars. The participating teams also lacked the tools to analyze the multi-dimensional data sets describing the environmental and geological knowledge of the targeted region and the capabilities of mining and extraction systems.

Today the renewed interest in understanding how access to lunar resources may help pave the path to a cis-lunar economic future forces us to face the same questions: what are the true technical capabilities of the ISRU technologies under development when they face the geological and environmental contexts of the lunar surface? What are the highest priority technology gaps and geological knowledge gaps that impact economic viability of lunar resources exploitation?

ISRU models developed over the years have been particularly valuable in describing the inputs and outputs of regolith processing systems using data collected in field operations by NASA-led teams [1]. At this time, many models often oversimplify the mining and processing systems and do not fully exploit integrated system-level models widely utilized in the terrestrial minerals industry [2]. Other models resort to using overly simplistic descriptions of the geology while high-level economic models of space resource utilization ignore the resource context altogether and use simple parametric scaling laws to describe higher production rates. Altogether, the data output of these tools comes with a high degree of uncertainty.

The work presented here is an effort to augment NASA's current set of modeling tools with a novel comprehensive mining and materials processing model that integrates the specific geology of the targeted resource, integrating the expertise and best practices of terrestrial mining industries with the knowledge of expert space technologists in ISRU. Results of this work will deliver comparative results on the operations and technologies best suited for a particular resource deposit on a planetary body of choice, based on planetary science data describing the resource.

Space Resources Utilization Simulator: In mining projects, including both terrestrial and off-Earth, there are many variables obtained from diverse sources that interrelated each other. During the planning stage of an operation, if these variables used inappropriately, the consequence could lead technically an unfeasible mine. To avoid this, interactive visual platforms have largely been used in mining industry to facilitate the large amount of data. The main advantage to using these platforms is that their capacity to read and write data from diverse sources and database, and combine all data inputs and settings in a single model for a better mine plan.

Despite geographical and geological differences, most mining operations involve similar tasks that make up a generic model of mining. That model is generally called 'block model' which consists of the following tasks: deposit definition (resource/reserve modeling); breaking, extraction and transport of ore and disposal of waste material; processing of ore to yield valuable product and waste tailings; disposal of waste tailings, and transport and sale/use of product. Off-Earth Mining will also have similar tasks; however, the proposed model must identify the required modifications, particularly related to economic value.

This presentation will describe the capabilities of the simulation tool and a case of optimized mining scenario within a geological context.

References:

[1] Sanders, G.B. et al. (2015) *AIAA SPACE 2015 Conference and Exposition, AIAA SPACE Forum, (AIAA 2015-4458)* [2] Haldar, S.K. (2012). *Mineral exploration: principles and applications*. Newnes.