DEMONSTRATION OF MINERAL PREDICTIVE MAPPING ON THE LUNAR SURFACE. J. A. Coyan[1], L. P. Keszthelyi[2], [1]jcoyan@usgs.gov, Geological Survey, Geology, Minerals, Energy, Geophysics Science Center, 904 West Riverside Avenue, Suite 202, Spokane WA 99201. [2]U.S. Geological Survey, Astrogeology Science Center, Flagstaff, AZ.

Introduction: The Artemis Program has set a priority to return humans to the moon and then the surface of Mars [1]. Bringing resources from Earth to facilitate solar system exploration is too costly. As such, it will be imperative to utilize in-situ resources. Water ice signatures have been detected, in abundance, at the lunar poles in the permanently shadowed regions (PSRs) from both remote sensing methods and from direct measurement by the LCROSS mission [2]. However, limitations in remote sensing has complicated the process of making estimates of the amount of water-ice present, the areal distribution, the form, the thickness, and the quality. It has also made for a lack of consensus in making predictions of the amount and distribution of water resources available on the moon [2, 3, 4, 5]. NASA's near term plan is to send the VIPER rover to the lunar polar regions to prospect for volatiles [1]. An important question remains though, 'Where to direct the rover? Ice stability maps are useful for permissive areas; however, incorporation of all remotely sensed data either in their current form or as evidence layers can inform other prospective areas.

Mineral Predictive Mapping: In the hierarchy of data analytics, without a rich dataset to serve as training data for data-driven approaches such as neural networks, random forests, or weights of evidence due to the lack of direct measurement, it is necessary to turn to knowledge-driven, data-analytical techniques such as Fuzzy-Set Theory. Thanks to the Lunar Reconnaissance Orbiter [5] and international missions, there is a rich remote sensed dataset available for the moon, however without direct sampling in the polar regions, Fuzzy Logic is the preferred method for creating predictive maps for these regions. Fuzzy Logic is a method of mapping that allows for partial membership into a category vs a binary categorization.

Terrestrial mineral resource assessments rely heavily on deposit models that quantify mappable criteria. Mappable criteria is defined by process-based understanding of differentiation, concentration, migration, deposition, and trap methods and geometry. Once these criteria are defined, where, how deep, the form, quality, and quantity of volatiles can be characterized to guide exploration and prospecting. We present here a demonstration of Mineral Predictive Mapping for the Lunar South Pole. The methods presented here will produce steadily more reliable results as more information is obtain, especially in situ observations.

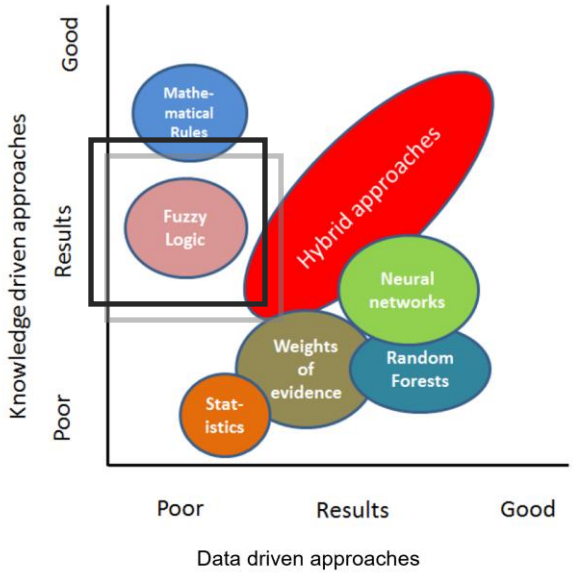

Figure 1. Relevance of knowledge vs data-driven approaches (modified from [6]).

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