TERRESTRIAL ANALOGS FOR LUNAR SCIENCE AND EXPLORATION: A SYSTEMATIC APPROACH. Pascal Lee[1,2,3], Andrew Abercromby[4], Stephen Braham[2], Matt Deans[1], Terrence Fong[1], Brian Glass[1], Stephen J. Hoffman[4], Christopher P. McKay[1], Jonathan Nelson[2], Marcelo Vasquez[5], and Nicholas Wilkinson[2]. [1]NASA Ames Research Center (MS 245-3, Moffett Field, CA 94035-1000, USA, pascal.lee@marsinstitute.net), [2]Mars Institute, [3]SETI Institute, [4]NASA Johnson Space Center, [5]National Space Biomedical Research Institute.

Summary: The planning of a range of future human activities on the Moon requires the use of terrestrial analogs to help these activities be as safe, productive, and cost-effective as possible. We discuss key features of a systematic approach to selecting terrestrial analogs for lunar exploration operations planning.

Introduction: A *terrestrial analog for a planetary body* may be defined as *an environment, feature, process, or activity on Earth, outdoors or indoors, representating, or relevant to, one or more aspects of an environment, feature, process, or activity on that planetary body* [1].

Terrestrial analogs for the Moon are needed to serve all four fundamental *functions* of analogs: to help i) learn, ii) test, iii) train, and iv) engage [2]. While the overarching goals of analog campaigns are to help retire risk, maximize productivity, and minimize program costs, they are also key to engaging the public, students, local experts, and international partners.

Selecting Lunar Analog Sites: Key factors to be considered in the evaluation and selection of any analog are: 1) aspect(s) of interest, 2) application(s), 3) function(s), 4) fidelity, 5) cost-effectiveness [3, 4]. While no place on Earth offers a high fidelity analog to all aspects of the lunar surface environment – in particular, there is no single all-encompassing high fidelity "science analog" for the Moon -, a number of sites can be found that may be considered adequately representative or relevant to the Moon for the purpose of planning specific lunar surface science *operations* and more generally lunar *exploration operations.* As planning for human exploration operations on the Moon advances, it is anticipated that in addition to day to day small scale testing of specific system elements on site (in a "moonyard") or in the field, larger-scale, integrated analog campaigns will increasingly be needed to bring together episodically in an operationally challenging and relevant field setting, major system elements ready for integrated testing and validation.

The factors to be considered in the selection of an analog site for integrated exploration operations work go beyond the inherent scientific or terrain attributes of the location. Ease of access (which includes the logistics of transportation, the preexistence of local infrastructure, land access permits required, etc.) is critical. The main source of cost in any analog field campaign generally lies in deployment logistics, in particular in transportation. Maximum advantage should be taken of any preexisting field infrastructure with proven and affordable means of access. An ideal systematic approach to selecting lunar analog sites is a compromise between reusing whenever possible known field sites with established scientific and operational relevance, infrastrcture and access conditions, and preserving the option to access new sites as needed. An optimal balance therefore lies in: 1) identifying a limited number, N_{ss}, of "Strategic Sites" where substantial field infrastructure remains available permanently and site access is both reliable and cost-effective; *and* 2) having the cability (a set of deployable assets) to flexibly access an open number, N_{TS}, of "Tactical Sites" for short-term and more targeted deployments as needed. Different approaches to minimizing N_{ss} while maximizing N_{TS} can be adopted, but the process should include broad-based consultation with the lunar science and exploration communities to ensure that the full range of lunar science and exploration requirements are captured.

2008 Integrated Lunar Analog Campaign Sites

Three analog sites were selected in 2008 to host NASA Constellation Project field campaigns requiring substantial integration and field infrastructure:

1) Moses Lake Sand Dunes, Moses Lake, WA (Jun)
2) Haughton-Mars Project, Devon Island, Arctic (Aug)
3) Black Point Lava Flow, Flagstaff, AZ (Oct).

Each one of these sites was selected in consideration of a specific set of functions to be fulfilled. Our presentation will offer details on how these sites served the needs of their respective campaigns, and lessons learned for future integrated analog campaign efforts.

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