FIELD SCIENCE ANALOG TESTING

1. Scope of Program

1.1 Programmatic Overview

NASA Analog Missions research addresses the need for integrated interdisciplinary field experiments as an integral part of preparation for planned human and robotic missions to the Moon and Mars. The focus of this program will be on engaging field scientists within NASA Exploration Systems Mission Directorate (ESMD) field campaigns to provide high fidelity field testing of hardware and operations to optimize future human scientific exploration of the Moon and Mars.

Funding provided in this program element is intended to enable researchers to participate in ongoing field campaigns including Desert Research and Technology Studies (D-RATS) and the Lunar Surface Operations-In-Situ Resource Utilization field test. The goal is to provide feedback and inputs to the design of hardware and operational procedures being developed for human planetary exploration.

This call represents a pilot program to test the feasibility and effectiveness of including trained field scientists supported by NASA's Science Mission Directorate (SMD) into ongoing ESMD-led analog field campaigns. Depending on the outcomes of this call, future calls may be issued through the MMAMA (Moon Mars Analog Mission Activities) ROSES element to support field scientists' participation in ESMD-led analog campaigns in future years.

1.2 Program Goals

A goal of this program is to test operations and systems for human lunar exploration to help optimize scientific investigations. NASA is in need of data to support surface science and operations scenarios as it moves forward in its architecture and requirements definition processes for human lunar exploration.

Proposers should plan to provide feedback to the ESMD analog teams regarding concepts of operations and hardware (including instrumentation) as NASA plans for future human lunar exploration. Only by considering how to accomplish high-fidelity science investigations can these components of exploration be satisfactorily tested to optimally aid with the planning and implementation of science investigations on other planetary surfaces. Work funded through this call will assist NASA with developing an improved understanding of numerous system-wide and operational challenges that must be addressed to enable the joint human-robotic exploration of planetary surfaces. Topics to be tested may include, but are not limited to, crew scheduling for IVA and EVA, decision-making protocols, traverse planning, sample handling, communications and data flow protocols to support science, navigation unique to science support, concepts for power distribution to support science, the use of robotic assistants, science backroom design and support for surface science activities.

NASA's scientific goals at the Moon follow closely those identified in the National Research Council Decadal Survey in Planetary Science[1] and in its report on the Scientific Context for the Exploration of the Moon[2]. Specifically, NASA seeks to support those investigations that will shed light on methodologies, techniques, instrumentation, or other aspects of the following scientific goals at the Moon including, but not limited to:

- Precise geochronology – sampling of impact melt sheets, lava flows, floors or ejecta of impact basins for detailed geochemical and isotopic analysis (either *in situ* or returned samples)
- Evolved gas and volatile analysis
    - Cryogenically and stratigraphically preserved sampling from regolith (on Earth, permafrost could be analogous)
    - Determining presence of refractory volatile-bearing species including water-bearing minerals, complex organics, and clathrates.
    - Determining elemental composition, especially hydrogen, for immediate surroundings of sampling sites.
    - Determining local stratigraphy for sample context;
- High-resolution geological and geochemical mapping – subsurface drilling and identification of unusual samples
- Geophysical analysis – crust, mantle, and core – sampling and high-resolution gravity measurements, installation of seismic and heat flow instrumentation
- Analysis of density, composition, and time variability of atmosphere – deployment of network of surface mass spectrometers to monitor migration of volatiles
- Analysis of dust – deployment of dedicated dust analysis packages. Sample collection to preserve dust particle size distributions and properties
- Other Earth Science, Astronomy, and Astrophysics goals that further our ability to conduct science from the Moon.

1.3 Eligibility

NASA will consider proposals from field scientists for participation in ESMD-led field campaigns.
General questions about this call should be directed to Dr. Jennifer Heldmann (NASA Headquarters), Jennifer.Heldmann@nasa.gov (202) 358-2302.

1.4 Types of Investigations Supported

[1] *New Frontiers in the Solar System: An Integrated Exploration Strategy*, National Academies Press, 2003 (http://www.nap.edu/catalog/10432.html)
[2] *The Scientific Context for the Exploration of the Moon*, National Academies Press, 2007 (http://www.nap.edu/catalog/11954.html)

Proposals are solicited under this program element for field scientists to participate in ESMD-led field campaigns in order to bring a scientific perspective to the analog activities and provide feedback regarding the variety of science investigations that can be accomplished within the constraints of an ESMD-led analog field campaign.

2. Programmatic Information

2.1 Special Requirements for Proposals

Proposers should submit a proposal not to exceed 3 pages. This proposal must include:
1) background information pertaining to previous field experience,
2) rationale for interest in participating in the ESMD analog field campaigns,
3) identification of field site of interest [Black Point Lava Flow (see Section 2.2.1) or Hawaii (see Section 2.2.2.)],
4) area(s) of scientific expertise with notional concepts for scientific field research that could be conducted at the analog site,
5) discussion of how field science investigations could be accomplished within the constraints of the ESMD-led field campaign,
6) acknowledgment that SMD funding is available to cover all travel expenses associated with the analog fieldwork but funding is not available to cover salary at this time.

Proposers should also indicate their availability during the scheduled field campaign dates (and dry runs as appropriate) and willingness to participate in analog planning activities.

In addition to the 3 page proposal, proposers should also include a CV (maximum of 2 pages) including a listing of relevant publications.

The full proposal submission should thus not exceed five pages (3 page proposal and 2 page CV).

Budget information will be determined in coordination with SMD after selections have been announced to cover researcher logistical expenses (see Section 2.3).

Individual scientists are allowed to submit only one proposal.

2.2 Analog Field Campaign Information

2.2.1 D-RATS (Desert Research and Technology Studies) at Black Point Lava Flow

Preparatory "dry run" test activities for assessing both hardware systems and operational procedures readiness will be conducted at the NASA Johnson Space Center PATS (Planetary Analog Test Site) or "rock yard" in Houston, TX, during the weeks of July 13-17, 2009 and August 10-14, 2009. The actual D-RATS remote analog field campaign will be conducted during the period of August 29 through September 17, 2009 at the Black Point Lava Flow (BPLF) test site location north of Flagstaff, AZ.

Small portable hand-held field rugged analytical scientific instruments for geologic sample analysis can be provided by proposers for field use and evaluation.

Selected participants may spend up to the indicated two-week period at the BPLF test site location provided that meaningful fieldwork activities are being conducted. Proposers are encouraged to coordinate proposed activities with the D-RATS Science Team under the leadership of Dr. Gary Lofgren (NASA-JSC, 281-483-5042 or Gary.E.Lofgren@nasa.gov).

Selected interested participants are also encouraged to plan to serve in a support role for staffing and/or advising real-time science "backroom" communications activities between Science Team operations and the ongoing activities being conducted by the astronaut/geology crewmembers in the Lunar Electric Rover (LER) vehicle during the extended 14-day traverse activities at the BPLF test site. Proposers can participate in backroom activities for a subset of the planned 14-day LER traverse.

Specific details regarding expectations for field work activities are still in the development stage and further information can be obtained by contacting the D-RATS Science Team lead, Dr. Gary Lofgren (NASA JSC) at 281-483-5042 or Gary.E.Lofgren@nasa.gov.

2.2.2. Lunar Surface Operations-In-Situ Resource Utilization field test

The International Lunar Surface Operations-In-Situ Resource Utilization (ISRU) analog field test will occur on the Big Island of Hawaii during the last week of January and first two weeks of February, 2010. Primary ISRU related activities associated with outpost resource prospecting and site characterization, oxygen extraction from regolith, and road/landing pad construction will occur around the Pu'u Hawahini craters on Mauna Kea (site used in Nov. 2008; ~9000 feet elevation near Onizuka Visitor Center). Field geology training for astronauts and space managers will occur at pre-selected sites across the Big Island (past field geology training exercises have included locations on Mauna Loa and the Volcano National Park near Kilauea). New field test locations on Mauna Kea (ex. Apollo Valley), Mauna Loa, Kilauea, or other interesting geological sites for training and instrument evaluation on the Big Island can be pre-selected and coordinated with the Pacific International Space Center for Exploration Systems (PISCES). A reconnaissance and final site selection trip will occur in November 2009 for all field test and geology training activities.

Hardware associated with excavation, area/road construction, and oxygen extraction from regolith will be provided by both NASA and the Canadian Space Agency (CSA). A ground penetrating radar, a 1 meter core sample drill, a cone penetrometer, and a Mossbauer spectrometer are also currently planned as a minimum instrument suite for surface and subsurface physical and mineral characterization.

For instruments used to help characterize the physical and mineral content of the location for site characterization, site selection, and excavation planning, field science activities should occur in the first 5 to 10 days of the field test activity. Science instrument operations can continue to occur throughout the 3 weeks of field testing to increase the fidelity of the 3-D terrain and mineral/resource mapping activity. Science instrument operations can also be performed at field geology training sites at the conclusion of the initial field geology training effort.

Internet and satellite communications from Hawaii to the continental US will be provided by the CSA. Participants are invited to support science data fusion and on-site data fusion before transmission back to the Payload Tele-Operation Control (PTOC) center at the CSA Headquarters. An equivalent NASA control center may be established for this field test at a TBD location.

Field work will occur primarily at the Pu'u Hawahini craters on Mauna Kea throughout the 3 weeks of the field test. Short duration (1 to 2 day) field trips to other locations on the Big Island are possible with advanced planning and should correlate to sites selected for the field geology training effort.

Specific details regarding expectations for field work activities are still in the development stage and further information can be obtained by contacting the Lunar Surface Operations-In-Situ Resource Utilization field test lead, Jerry Sanders (NASA JSC) at 281-483-9066 or Gerald.B.Sanders@nasa.gov.

2.3 Availability of Funding

This program element is supported and managed by the Planetary Sciences Division within the NASA Science Mission Directorate. Funding is available to support field scientist logistics expenses associated with participation in the analog field campaign(s), including both the dry run activities and the field campaigns themselves. Specifically, NASA will cover all travel expenses including airfare, ground transportation, and per diem for the field campaigns. Travel budgets will be worked by SMD with selected investigators after the selection announcement.

2.4 Evaluation of Proposals

Due to the expedited nature of this call, all proposals will be evaluated internally by NASA personnel in both the Science Mission Directorate and Exploration Systems Mission Directorate with expertise in analog field campaigns. Team leads for D-RATS and the Hawaii field tests will also participate in the review process.

2.5 Future Solicitations

Depending on the outcomes of this season's field campaigns, future calls may be issued through the MMAMA (Moon Mars Analog Mission Activities) ROSES element to explicitly include field scientist participation in ESMD-led field campaigns. In

MMAMA calls funding will be available to cover researcher time as well as travel and other associated expenses. One objective of NASA's Science Mission Directorate is to provide a mechanism for science to play an integral role in the development of requirements for human exploration through this and other opportunities.

2.6 Selection of Proposals

NASA Headquarters aims to make selections within two weeks of proposal submission such that awardees may be integrated into the ESMD analog field campaign teams in a timely manner.

2.7 Awards

Approximately 3-4 awards will be selected. Awards will be for up to one year in duration.

3. Summary of Key Information

Expected program budget for new awards	~40K
Number of new awards pending adequate proposals of merit	3-4
Maximum duration of awards	1 year
Due date for proposals	May 11, 2009
Detailed instructions for the preparation of proposals	See details contained within this call.
Page limit for entire submission	5pp
Submission medium	Electronic proposal submission is required; no hard copy is permitted. Email submissions in one PDF file attachment to Dr. Jennifer Heldmann at Jennifer.Heldmann@nasa.gov.

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