LUNACHEM: AN INSTRUMENT TO ENABLE SUSTAINED HUMAN LUNAR EXPLORATION. J. C. Rask[1], E. Tranfield[1], C. G. McCrossin[1], D. J. Loftus[1]. [1]Space Biosciences Division, NASA Ames Research Center, Moffett Field, CA 94035 (jon.c.rask@nasa.gov)

Introduction: As NASA prepares for sustainable exploration of the Moon, a clear understanding of the chemistry of lunar dust is required for extended duration lunar surface operations. All aspects of the unique environment of the Moon—micrometeorite bombardment, UV light exposure, solar wind radiation, solar particle event radiation and galactic cosmic radiation—influence the mineralogy of the Moon, and are believed to impart a high degree of chemical reactivity to lunar dust. While the basic structure and composition of lunar dust is well known, little is known about its in situ chemical reactivity, which could have significant implications for astronaut health and in situ resource utilization. Ground based studies of lunar dust chemical reactivity are currently underway [1] [2].

Payload Description: We propose LunaChem as an instrument that can be delivered to the Moon to measure the in situ chemical reactivity of lunar dust [3]. While the current design of LunaChem is notional, certain key capabilities are required, including sample acquisition from the lunar surface, partitioning of the sample into uniform aliquots to perform multiple analyses, in order to determine the peak chemical reactivity and decay of chemical reactivity once the lunar dust is brought into a habitat like atmosphere. Within this general framework, an instrument weighing 5 kg with average power consumption of less than 20 W is envisioned. These features make it an ideal payload for small lunar landers that support early science objectives and early exploration technology demonstrations. While LunaChem was originally conceived as an instrument for robotic precursor missions [4], we believe that LunaChem could also be carried by astronauts on crewed missions, so that analysis of lunar soils could be performed more broadly as an ongoing part of exploration activities. The core capabilities of LunaChem could be expanded by adding functionality as identified with input from the lunar science community.

Implications and Synergies: LunaChem aligns with high priority initiatives within the Lunar Exploration Roadmap, enables and supports the goal of collaborative expansion of science and exploration, and will be a key step to engaging commercial activity if flown aboard a commercial launch provider. Science results from LunaChem will validate Earth-based assessment of lunar dust toxicity [5]. Perhaps more importantly, LunaChem would support the establishment and implementation of comprehensive outpost site-selection criteria and processes.

References:

[1] W. Wallace, L. Taylor, B. Cooper, D. McKay, B. Chen, A. Jeevarajan, 2009. Lunar dust and lunar simulant activation and monitoring. Meteoritics & planetary science 44, no. 7, p. 961-970.

[2] E. Tranfield, E., J. C. Rask, W. T. Wallace, C. McCrossin, K. Kuhlman, D. Loftus, 2009. Chemical activation of lunar dust specimens and simulants, NASA Lunar Science Institute conference, abstract no. 74. http://lunarscience2009.arc.nasa.gov/node/74

[3] E. Tranfield, J. C. Rask, C. McCrossin, W.T. Wallace, K. R. Kuhlman, L. Taylor, A. S. Jeevarajan, R. Kerschmann, D. J. Loftus, 2008. Chemical reactivity of lunar dust relevant to humans. Joint Annual Meeting of LEAG-ICEUM-SR, abstract no. 4110.

[4] E. Tranfield, J. C. Rask, W.T. Wallace, K. R. Kuhlman, A. S. Jeevarajan, R. Kerschmann, D. J. Loftus, 2008. Chemical Reactivity of Lunar Dust as it Pertains to Biological Systems, 8th European Workshop on Astrobiology, European Astrobiology Network Association (EANA).

[5] E. Tranfield, J. C. Rask, L. Franzi, C. McCrossin, M. Corcoran, D. Loftus, 2009. Estimation of the toxic effect of irradiated lunar dust specimens, NASA Lunar Science Institute conference, abstract no. 76. http://lunarscience2009.arc.nasa.gov/node/76