

EXPLORING THE MOON WITH THE SURFACE INVESTIGATION VIA LUNAR IMAGING AND COMPOSITIONAL ANALYSIS (SILICA) MISSION CONCEPT. S. Ray¹, R. D. Arevalo Jr.¹, A. Parsons², B. J. Farcy¹, M. Ayllon Unzueta² and the SILICA Team. ¹University of Maryland, College Park, MD, USA, ²NASA Goddard Space Flight Center, Greenbelt, MD, USA.

Introduction: The SILICA instrument suite is designed to address several outstanding questions including but not limited to the physical and chemical factors that govern lunar silicate differentiation, composition of the bulk silicate Moon (BSM), effects of space weathering on lunar surface material, and the organic inventory and resource potential of the Moon's (sub)surface. These objectives address community-driven high-priority science goals that have been enlisted in the *Artemis III Science Definition Team Report*, *NASA Science Strategy for the Moon*, *Planetary Science Decadal Survey*, and *Scientific Context for Exploration of the Moon* amongst other documents.

Payload Instrumentation: The SILICA instrument suite consists of the CRATER (Characterization of Regolith and Trace Economic Resources) and BECA (Bulk Elemental Composition Analyzer) subsystems.

CRATER subsystem. The CRATER subsystem comprises a multispectral camera (3M) and Laser Desorption Mass Spectrometer (LDMS) integrated to a lander. CRATER can provide 2D chemical images and 3D profiling of the regolith samples collected at the landing site.

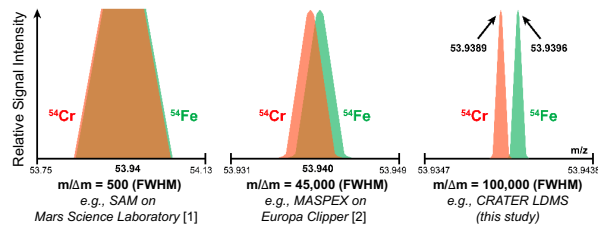


Figure 1. The orbitrap analyzer of the CRATER LDMS subsystem has a mass resolving power that exceeds that of mass spectrometers previously flown and/or developed for future spaceflight missions.

BECA subsystem. The BECA subsystem consists of a Gamma Ray Spectrometer (GRS) and Pulsed Neutron Generator (PNG) capable of acquiring bulk elemental composition of the target. Onboard a lunar rover, BECA can characterize the (sub)surface composition along a traverse that could potentially extend across at least two different lithologies.

The CRATER LDMS and BECA instruments have been matured through the NASA DALI program while the 3M multispectral camera has been developed with support from the Canadian Space Agency. The SILICA instrument suite is capable of (1) characterizing surface

materials by determining the modal mineralogy and bulk chemistry including refractory, moderately volatile, and heat-producing elemental abundances, (2) determining H-bearing phases and economic metals, and (3) constraining the organic molecule diversity to a define a life detection 'blank' for future astrobiology missions, thereby providing insights into the balance between exogenous infall, impact gardening, and molecular degradation on the lunar surface. In tandem, CRATER and BECA are capable of characterizing the lunar surface across a range (nm to m) of spatial scales. Although originally designed for the silicic Gruithuisen domes and the surrounding maria, the SILICA mission concept is extremely versatile. Consequently, several permutations and combinations of the instruments can be designed based on the science questions, weight and cost cap, and rover/lander capabilities. Thus, SILICA is a highly capable, versatile, low risk, high TRL (Technology Readiness Level) instrument suite that can be adapted to any region of the Moon.

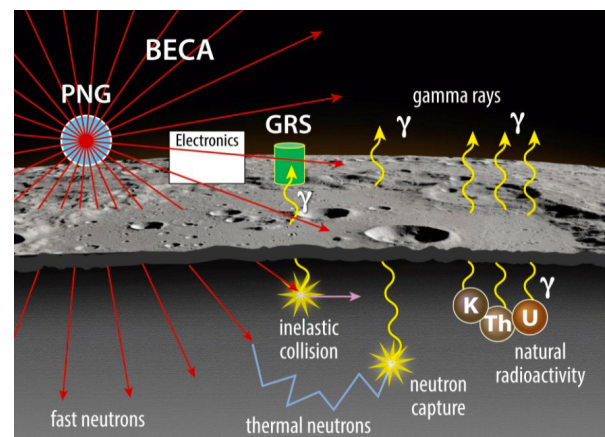


Figure 2. The BECA PNG source sends high-energy (fast) neutrons into the lunar surface, where they prompt the emission of gamma rays that are measured by the BECA GRS, enabling the determination of the bulk elemental composition of the target.

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References: [1] Mahaffy P. R. et al. (2012) *Space Science Reviews*, 170, 401–478. [2] Brockwell T. G. et al. (2016) *IEEE Aerospace Conference*, 5–12.