Lipids and hydrocarbons are organic compounds of great interest for future NASA missions to the Moon, Mars and Icy Moons. They are important for understanding the geochemical and astrobiological histories of planetary bodies. Lipids are essential for life as we know it and are likely required for putative extraterrestrial organisms. These robust organics can also be synthesized abiotically and survive for long periods of geological time (e.g. billions of years). They also contain origin-diagnostic molecular features (i.e., number of carbon atoms, chain length, branch points) that indicate whether they were formed via biotic or abiotic processes. Laboratory characterization techniques are well established, but are laborious, operator dependent, previously precluding in situ analysis. We have developed a TRL-4 fluidic system that integrates lab proven techniques for lipid analysis while minimizing reagent volumes and concentrating organics for analysis, thereby increasing signal by orders of magnitude. This system will enable organic surveys by extracting and concentrating lipids from approximately 25 cc of regolith, rock, and/or ice using a fluidic and microfluidic sample processor made of materials compatible with non-aqueous organic solvents required for extraction (Fig. 1). ExCALiBR can be deployed on a lander, process a drilled or scooped sample, extract lipids, then purify the analyte to send it to downstream analytical instrumentation.

**Lunar Science Objectives:** While the terrestrial record of the chemistry that preceded life’s origin has been largely erased by geologic processes, a repository of life’s “original organics,” many delivered during the late heavy bombardment (LHB), is believed to exist in topographically low regions at the lunar poles. Recent studies suggest that rapid burial by ejecta material during the LHB and subsequent lava flows from lunar volcanism could have preserved them since deposition/synthesis, as they were protected from radiation, and sustained cold temperatures would enhance long-term preservation. Although organics were not identified in samples returned from the Apollo missions LCROSS found evidence of organic building blocks in the lunar ejecta plume from a permanently shadowed crater. Thus, returning to volatile-rich regions to perform in-situ analysis will enhance knowledge of the Moon’s chemical makeup and may also advance our understanding of terrestrial life’s chemical origins. It is possible that organic compounds could be trapped with other volatiles in accessible near-surface cryogenic regions. Given the linked formation of the Moon and Earth 4.5 billion years ago, characterizing lunar lipids will improve our understanding of organics potentially available on early prebiotic Earth. Additionally, such material could provide an “abiotic control” for future life-detection missions by improving our understanding of lipid distribution in a non-biological planetary environment in absence of the terrestrial contamination.