CALIBRATION AND SEQUENCE DEVELOPMENT STATUS FOR THE SAMPLE ANALYSIS AT MARS INVESTIGATION ON THE MARS SCIENCE LABORATORY. P. R. Mahaffy[1] and the SAM Team, [1]NASA Goddard Space Flight Center, Code 699, Greenbelt, MD 20771 (Paul.R.Mahaffy@NASA.gov)

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TITLE: Calibration and Sequence Development Status for the Sample Analysis at Mars Investigation on the Mars Science Laboratory

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Abstract Body: Introduction: The measurement goals of the Sample Analysis at Mars (SAM) instrument suite on the "Curiosity" Rover of the Mars Science Laboratory (MSL) include chemical and isotopic analysis of organic and inorganic volatiles for both atmospheric and solid samples [1,2]. SAM directly supports the ambitious goals of the MSL mission to provide a quantitative assessment of habitability and preservation in Gale crater by means of a range of chemical and geological measurements [3]. The SAM FM combined calibration and environmental testing took place primarily in 2010 with a limited set of tests implemented after integration into the rover in January 2011. The scope of SAM FM testing was limited both to preserve SAM consumables such as life time of its electromechanical elements and to minimize the level of terrestrial contamination in the SAM instrument. A more comprehensive calibration of a SAM-like suite of instruments will be implemented in 2012 with calibration runs planned for the SAM testbed. The SAM Testbed is nearly identical to the SAM FM and operates in a ambient pressure chamber.

The SAM Instrument Suite: SAM's instruments are a Quadrupole Mass Spectrometer (QMS), a 6-column Gas Chromatograph (GC), and a 2-channel Tunable Laser Spectrometer (TLS). Gas Chromatography Mass Spectrometry is designed for identification of even trace organic compounds. The TLS [5] secures the C, H, and O isotopic composition in carbon dioxide, water, and methane. Sieved materials are delivered from the MSL sample acquisition and processing system to one of 68 cups of the Sample Manipulation System (SMS). 59 of these cups are fabricated from inert quartz. After sample delivery, a cup is inserted into one of 2 ovens for evolved gas analysis (EGA - ambient to >950oC) by the QMS and TLS. A portion of the gas released can be trapped and subsequently analyzed by GCMS. Nine sealed cups contain liquid solvents and chemical derivatization or thermochemolysis agents to extract and transform polar molecules such as amino acids, nucleobases, and carboxylic acids into compounds that are sufficiently volatile to transmit through the GC columns. The remaining 6 cups contain calibrants.

SAM FM Calibration Overview: The SAM FM calibration in the Mars chamber employed a variety of pure gases, gas mixtures, and solid materials. Isotope calibration runs for the TLS utilized 13C enriched CO2 standards and D enriched CH4. A variety of fluorocarbon compounds that spanned the entire mass range of the QMS as well as C3-C6 hydrocarbons were utilized for calibration of the GCMS. Solid samples consisting of a mixture of calcite, melanterite, and intert silica glass either doped or not with fluorocarbons were introduced into the SAM FM cups through the SAM inlet funnel/tube system.

Testbed Sequences Planned: The SAM toolkit of measurement sequences includes (A) atmospheric measurements either directly or with enrichment of trace species using getters and scrubbers, (B) EGA with QMS and TLS analysis (C) GCMS of gas produced in EGA to search for organic compounds, (D) derivatization and thermochemolysis processing followed by GCMS to extend the breadth of the organic analysis, and (E) compustion in oxygen of solid sampled material to convert refractory organic compounds into CO2 for TLS isotope analysis. While versions of experiments A, B, and C are presently loaded into SAM non-volatile memory and ready to run on Mars with minimal study on the testbed, experiments D and E will need to be optimized through use of the testbed before these sequences are transmitted to the rover for implementation by SAM.

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