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TITLE: The Search for Nitrates on Mars by the Sample Analysis at Mars (SAM) instrument

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ABSTRACT BODY: Planetary models suggest that nitrogen was abundant in the early Martian atmosphere as N₂ but it was lost by sputtering and photochemical loss to space, impact erosion, and chemical oxidation to nitrates. A nitrogen cycle may exist on Mars where nitrates, produced early in Mars' history, may have been later decomposed back into N₂ by the current impact flux.

Nitrates are a fundamental source of nitrogen for terrestrial microorganisms, and they have evolved metabolic pathways to perform both oxidation and reduction to drive a complete biological nitrogen cycle. Therefore, the characterization of nitrogen in Martian soils is important to assess habitability of the Martian environment, particularly with respect to the presence of nitrates. The only previous mission that was designed to search for soil nitrates was the Phoenix mission but N-containing species were not detected by TEGA or the MECA WCL. Nitrates have been tentatively identified in Nakhla meteorites, and if nitrogen was oxidized on Mars, this has important implications for the habitability potential of Mars. Here we report the results from the Sample Analysis at Mars (SAM) instrument suite aboard the Curiosity rover during the first year of surface operations in Gale Crater. Samples from the Rocknest aeolian deposit and sedimentary rocks (John Klein) were heated to ~835°C under helium flow and the evolved gases were analyzed by MS and GC-MS. Two and possibly three peaks may be associated with the release of m/z 30 at temperatures ranging from 180°C to 500°C. M/z 30 has been tentatively identified as NO; other plausible contributions include CH₂O and an isotopologue of CO, ¹²C¹⁸O. NO, CH₂O, and CO may be reaction products of reagents (MTBSTFA/DMF) carried from Earth for the wet chemical derivatization experiments with SAM and/or derived from indigenous soil nitrogenated organics. Laboratory analyses indicate that it is also possible that <550°C evolved

NO is produced via reaction of HCl with nitrates arising from the decomposition of perchlorates. All sources of m/z 30 whether it be martian or terrestrial will be considered and their implications for Mars will be discussed.

KEYWORDS: 5200 PLANETARY SCIENCES: ASTROBIOLOGY, 6225 PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS Mars, 0406 BIOGEOSCIENCES Astrobiology and extraterrestrial materials, 0469 BIOGEOSCIENCES Nitrogen cycling.

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