The nitrate/perchlorate ratio of martian surface materials: Implications for the nitrogen cycle on Mars

JENNIFER C. STERN[1], BRAD SUTTER[2], W. ANDREW JACKSON[3], RAFAEL NAVARRO-GONZALEZ[4], CHRISTOPHER P. MCKAY[5], DOUGLAS W. MING[6], PAUL R. MAHAFFY[1]

[1]NASA Goddard Space Flight Center, Greenbelt, MD 20771

[2]Jacobs/NASA Johnson Space Center, Houston, TX 77058

[3]Texas Tech University, Lubbock, TX 79409

[4]Universidad Nacional Autónoma de México, 04510 Mexico D.F., Mexico

[5]NASA Ames Research Center, Moffett Field, CA 94035

[6]NASA Johnson Space Center, Houston, TX 77058

Nitrate was recently detected (≤0.1%w/w) in both unconsolidated aeolian drift sediments and ancient sedimentary rocks in Gale Crater on Mars at [1]. The detection of nitrate suggests that fixed N on Mars may not only have a broad spatial distribution, but also that N fixation mechanisms may have existed both in the past and present. The key questions are whether a nitrogen cycle ever developed on Mars, and if one continues to operate today. Either case would require a mechanism to recycle fixed N back into the atmosphere, a chemical equivalent of biological denitrification on Earth.

Terrestrial Mars analogs, Mars meteorites, and other solar system materials can help establish a context for interpreting *in situ* nitrate measurements on Mars. In this study we compare the relative abundance of nitrates to oxychlorine salts on Mars and in hyper-arid terrestrial Mars analogs. On Earth, these species are well correlated in environments dominated by atmospheric nitrate deposition, and deviations from this correlation can suggest other processes. In addition, nitrate/perchlorate ratios on Earth can be indicative of biological activity. The nitrate/perchlorate ratio on Mars is < 1, significantly lower than anywhere on Earth (nitrate/perchlorate > 10^3) or in Mars meteorites [2,3]. Using terrestrial analogs as a guide, we examine possible mechanisms and their timing for creating and altering the nitrate and perchlorate reservoirs on the Martian surface.

[1] Stern et al. (2015) PNAS 112(14)4245-4250. [2] Jackson et al. (2015) GCA 164:502-522. [3] Kounaves et al. (2014) *Icarus* 229:206-213.