The role of clay minerals in the preservation of Martian organics, Implications for Curiosity Rover on Mars

Slavka Andrejkovičová[1], Amy McAdam[2], Jennifer Stern[2], Jennifer Eigenbrode[2], Christine Knudson[2,3], Fernando Rocha[1], Paul Mahaffy[2]

In an early Earth scenario, clay minerals are considered to provide one of the most likely substrates where organic matter could have been concentrated and possibly transformed by abiogenic catalytic reactions to polymeric organic networks that were the forerunners of biopolymers. This supports suggestions that clay minerals may have had an important sequestering and possibly catalytic role in the organic chemical evolution in the early Solar System. During its traverse in the Gale crater, the Curiosity rover detected a diversity of clay minerals at different locations. Ancient organic molecules have been recently discovered in situ by the Curiosity rover in the Martian regolith despite the current harsh conditions of the surface of Mars. Among the many types of organic compounds of fundamental importance for life, it is amino acids that have attracted the most attention because they are the building blocks of proteins. Amino acid adsorption on smectite is relevant to prebiotic processes involving possible catalytic reactions in the early Solar System, as implied by the clay-organic correlation found in meteorites, and the generation and modification of organic components essential for the origin of life. Therefore, this project addresses the unexplored question if amino acids could be preserved on Mars by clay minerals. Curiosity carries onboard SAM instrument, specifically designed to detect organic materials in Martian soils. The oven in SAM heats the sample up to 860 °C and outcome from this instrument are masses of evolved gases. Laboratory synthesized glycine-intercalated clay mineral (nontronite) was analyzed by laboratory SAM-like instrument and CO_2 (m/z 44) evolution from this analog sample was compared with CO2 evolution from Martian samples. The preliminary results show that CO2 evolution from glycine-nontronite between 300-500 °C is consistent with CO_2 evolution in Martian sample Mojave (MJ).

1 – Geosciences Department & Geobiotec, University of Aveiro
2 – NASA Goddard Space Flight Center, Greenbelt, MD, 20771 USA
3 – CRESST, University of Maryland College Park, College Park, MD, 20742 USA

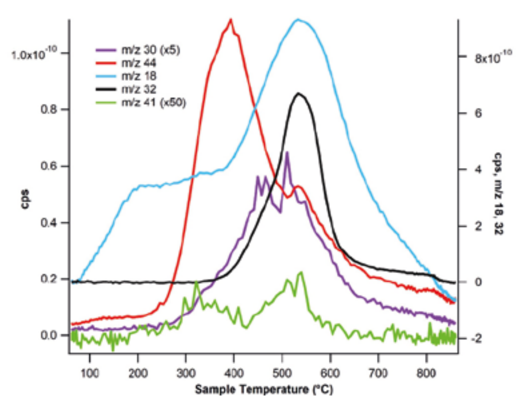

FIGURE 1
CO_2 evolution (m/z 44) from Glycine-nontronite Mars analog

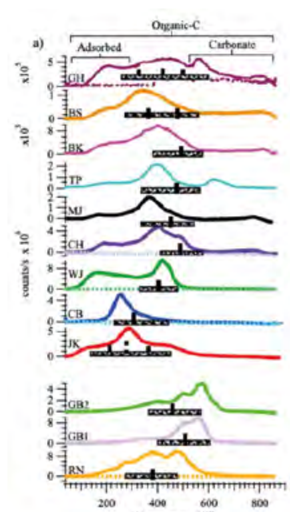

FIGURE 2
CO_2 evolutions from several Martian samples