POSSIBLE BIOLOGICAL ORIGIN OF THE CARBONATES IN THE MARTIAN REGOLITH. M. V. Tarasashvili[1] (mariam.tarasashvili@ens.tsu.edu.ge) and N. D. Aleksidze[1] (aleksidze.nugzar@yahoo.com); [1]Javakhishvili Tbilisi State University; 1, Chavchavadze Ave., 0179 Tbilisi, Georgia.

Introduction: Carbonates are products of the aqueous processes and may hold important clues about the history of liquid water on the surface of Mars. Calcium carbonate has been identified in the Martian regolith around the Phoenix landing site, amount of which is most consistent with the formation in the past by the interaction of atmospheric carbon dioxide with liquid water films on particle surfaces [1]. Outcrops rich in magnesium-iron carbonates has been identified in the *Gusev* crater [2]; Magnesium carbonate is present in the *Nili Fossae* region. Here, data show that magnesium carbonate is closely associated with both phyllosilicate-bearing and olivine-rich rock units [3].

Although Martian carbonates are less likely to be of biological origin, ability of cyanobacteria to precipitate carbonate compounds has been reported for long by various authors [4, 5, 6]; many have experimented with the survival of cyanobacteria in arid deserts and anoxic atmospheres, in order to investigate their physiological and biochemical adaptation mechanisms within Mars-like conditions. Studies have demonstrated that tough species of cyanobacteria occupy endolithic niches of the driest deserts, surviving within basalt, chalk and gypsum crusts [7, 8]. Thus, based on the results, it seems reasonable to hypothesize that at least some amount of carbonaceous deposits in Martial regolith could be linked to the metabolism of the extant Martian life. The experiment supporting this hypothesis is described here.

Materials and Methods: Cyanobacterial species have been obtained from icy volcanic springs containing high concentrations of Iron and Sulfur compounds. 10ml of the culture drops ($1 \cdot 10^4/cm^3$ cells) have been added to 25ml quartz test tubes containing 50g of AMG - artificial Martian ground [9]. Samples have been placed inside the MCSC - Mars Climate Simulation Chamber [10, 11] and stored for 14 months.

For the qualitative analysis of carbonate anions (CO_3^{2-}), simple titration method has been used: 10g of bioremediated AMG has been suspended in 25ml of distilled water. After adding 2 drops of phenolphthalein, a typical titration assay has been performed. To determine exactly which carbonate salts have been accumulated, titration assays were performed for the various ions as well.

Results: Initial AMG samples contained many species of cyanobacteria. Practically all have survived after the exposure to the MCSC conditions for 14 months. Survival strategies included stages of 1. Intensified sublimation of water; 2. Colonial distribution on the surface or/and underground; 3. Production of heterocysts; and 4. Substance (antioxidant) accumulation. Intensive production of white carbonaceous deposits has been observed between 6-11 months after inoculation (Fig. 1).

Fig.1. *(Left) Intensive water sublimation takes place soon after inoculation, cyanobacteria colonize superficial layers of AMG; (Right) After 8 months - Colonially distributed cyanobacteria and Carbonaceous deposits are visible.*

Analysis revealed the presence of various carbonates, such as Calcite and Magnesite formations and Magnesium-Iron carbonates. A small amount of Calcium sulfate (gypsum) was also present. The extreme level of carbonates lately results in the extinction of cyanobacteria in the closed environment, however, continuous cultures are potentially self-sustained.

Conclusions: Experiments have shown that carbonates found in the Martian ground could have a biological origin. Although in MCSC samples have been intensively ventilated with CO_2, vigorous photosynthesis kept test-tube environments oxygenated, thus contributing to the survival of the obligate aerobic species, as well as the formation of the minerals. In parallel to the carbonate deposition, accumulation of Nitrogen in the AMG also takes place, thus pointing out that these two processes could be cross-linked.

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