VARIATION IN EVAPORATION RATES OF LIQUID MEDIA AT LOW PRESSURE. R. L. Mickol[1], J. M. González-Medina[1,2], and T. A. Kral[1,3] [1]Arkansas Center for Space and Planetary Sciences, 202 Old Museum Building, University of Arkansas, Fayetteville, Arkansas, 72701, USA, [rmickol@uark.edu], [2]Dept. of Chemical Engineering, University of Puerto Rico, Mayagüez, Puerto Rico, 00681, USA, [3]Dept. of Biological Sciences, SCEN 632, University of Arkansas, Fayetteville, Arkansas, 72701, USA.

Introduction: The discovery of methane in the martian atmosphere in 2004 [1] has fueled the study of methanogens as a possible biological source of the gas. Methanogens are anaerobic microorganisms that produce methane and exist in a wide variety of environments on Earth, making them a prime candidate for life on Mars.

One obstacle hindering microorganism growth on Mars is the low surface pressure. The surface pressure on Mars reaches as low as 6 mbar, compared to the average of 1 bar on Earth. We have previously illustrated the survival of desiccated cells at low pressure [2], but our current goal is active growth under martian conditions. Early experiments indicate high rates of evaporation at low pressure (J. M. González-Medina et al., LPSC XLIV, this conference). The evaporation of the medium limits the growth of the methanogens by reducing the amount of available nutrients. The relatively fast evaporation rate also limits the amount of time that the organisms can spend, and perhaps adapt, under the low pressure conditions.

In this study, we aimed to reduce the rate of evaporation by the addition of agar to the liquid medium.

Methods: Agar in concentrations from 0% to 0.5% was added to our liquid medium in an attempt to limit the evaporation rate of the medium due to the low-pressure environment.

Methanogen growth medium was prepared following the procedure of Kendrick and Kral [3]. Ten milliliters of the medium was added to each of twenty test tubes. Zero percent agar, 0.1% agar, 0.25% agar and 0.5% agar were added to each of five tubes of medium. A sterile solution of 2.5% sodium sulfide was added to the medium following sterilization via autoclave. Syringe needles were inserted into the stoppers of the tubes, and the tubes were placed into the Pegasus Planetary Simulation Chamber [2].

The chamber was evacuated to 30 mbar, filled with 80% H_2/ 20% CO_2 gas to 500 mbar, and evacuated again to 130 mbar. This cycle was repeated three times to remove atmospheric oxygen. The pressure of the chamber at the end of three cycles was 200 mbar.

The chamber was maintained at room temperature and 240 mbar for 18 days. Following removal of the tubes from the chamber, the height of the medium within each test tube was measured and compared against the original height of the medium before the experiment began.

Results: The concentration of agar had no effect on the average decrease in height of the medium before and after exposure to low pressure. Tubes with 0% agar averaged a decrease in medium height of 2.5 +/- 0.5 mm, tubes with 0.25% agar experienced a decrease in medium height of 2.5 +/- 0.71 mm and tubes with 0.5% agar had a decrease in medium height of 2.5 +/- 0.87 mm. Tubes with 0.1% agar averaged a decrease in medium height of 1.83 +/- 0.29 mm (Fig. 1).

Interestingly, replicates located deeper within the chamber experienced greater evaporation, while also displaying greater evaporation with increased agar concentration (Fig. 1). Replicates with 0% agar experienced a decrease in medium height of 3.8 +/- 1.1 mm. Tubes with 0.1% agar, 0.25% agar and 0.50% agar had decreases in medium height of 4.0 +/- 0.0 mm, 5.3 +/- 0.4 mm, and 7.0 +/- 2.1 mm, respectively.

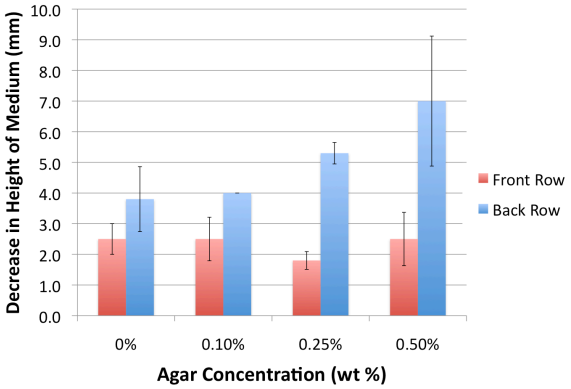

Figure 1. Average decrease in height of medium (in mm) between front row and back row of tubes, per agar concentration, after 18 days at 240 mbar. Error bars illustrate one standard deviation.

Discussion and Conclusion: Our results from this experiment indicate that the addition of agar to our liquid medium does not significantly reduce the rate of evaporation of the medium at low pressure. However, our replicate tubes, located deeper within the chamber, illustrated an increased rate of evaporation as well as a relationship between the concentration of agar added and the amount of evaporation.

In comparison with our previous experiment, however, there appears to be a large discrepancy between evaporation rates within the chamber (Fig. 2) (J. M.

González-Medina et al., LPSC XLIV, this conference). It is difficult to directly compare these results with our earlier experiment due to differences in pressure and experiment length. Our next step is to repeat the experiment, with solely liquid medium and with medium-agar mixtures, for the same length of time and at the same pressure, to be able to more accurately compare the results. Additionally, we will analyze evaporation at various depths within our chamber in order to better understand the mechanisms contributing to high evaporation rates at low pressure.

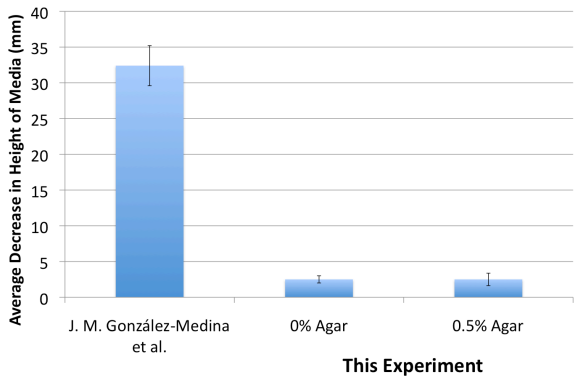

Figure 2. Comparison between previous experiment of J. M. González-Medina et al. (LPSC XLIV, this conference) and this experiment. Image shows average decrease in height of media (in mm) for previous experiment and two agar concentrations from this experiment. Error bars indicate one standard deviation.

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References: [1] Krasnopolsky, V. A., et al. (2004) *Icarus*, 172, 537–547. [2] Kral T. A. et al. (2011) *Planetary and Space Science*, 59, 264-270. [3] Kendrick, M.G. and Kral, T.A. (2006) *Astrobiology*, 6, 546–551.