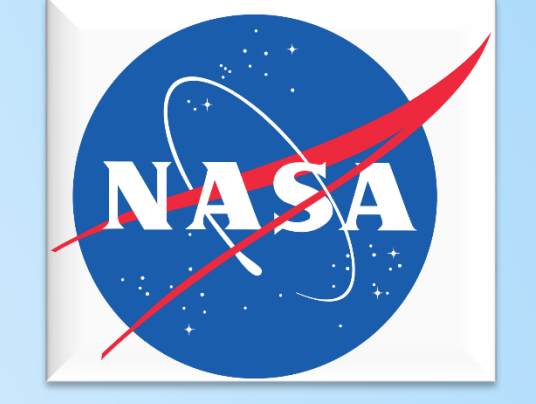




Chloroamino Acids as a Chemical Explanation for Viking Labeled Release Soil Activity on Mars



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Background

Martian soil experiments

- The Viking Labeled Release (LR) life detection experiment added organic nutrients in solution to martian soil and monitored CO₂ evolution. The origin of the CO₂ (g) released in the LR experiments on Mars is still being debated.
- In 2008, the Phoenix mission discovered perchlorate in martian soil
- Perchlorate degrades to other active chlorine species when exposed to martian surface radiation conditions (Quinn et al. 2013)

Active chlorine present in martian soil can explain the LR results (Quinn et al. 2013)

- Chloroamino acids form when amino acids are exposed to hypochlorite
- Chloroamino acid decomposition releases CO₂ (Hand et al. 1983)
- D-alanine, L-alanine and glycine were three of the 7 substances used in the LR experiments

Objective: Compare the decomposition kinetics of chloroalanine under Viking LR temperature conditions to mission data sets.

Methods

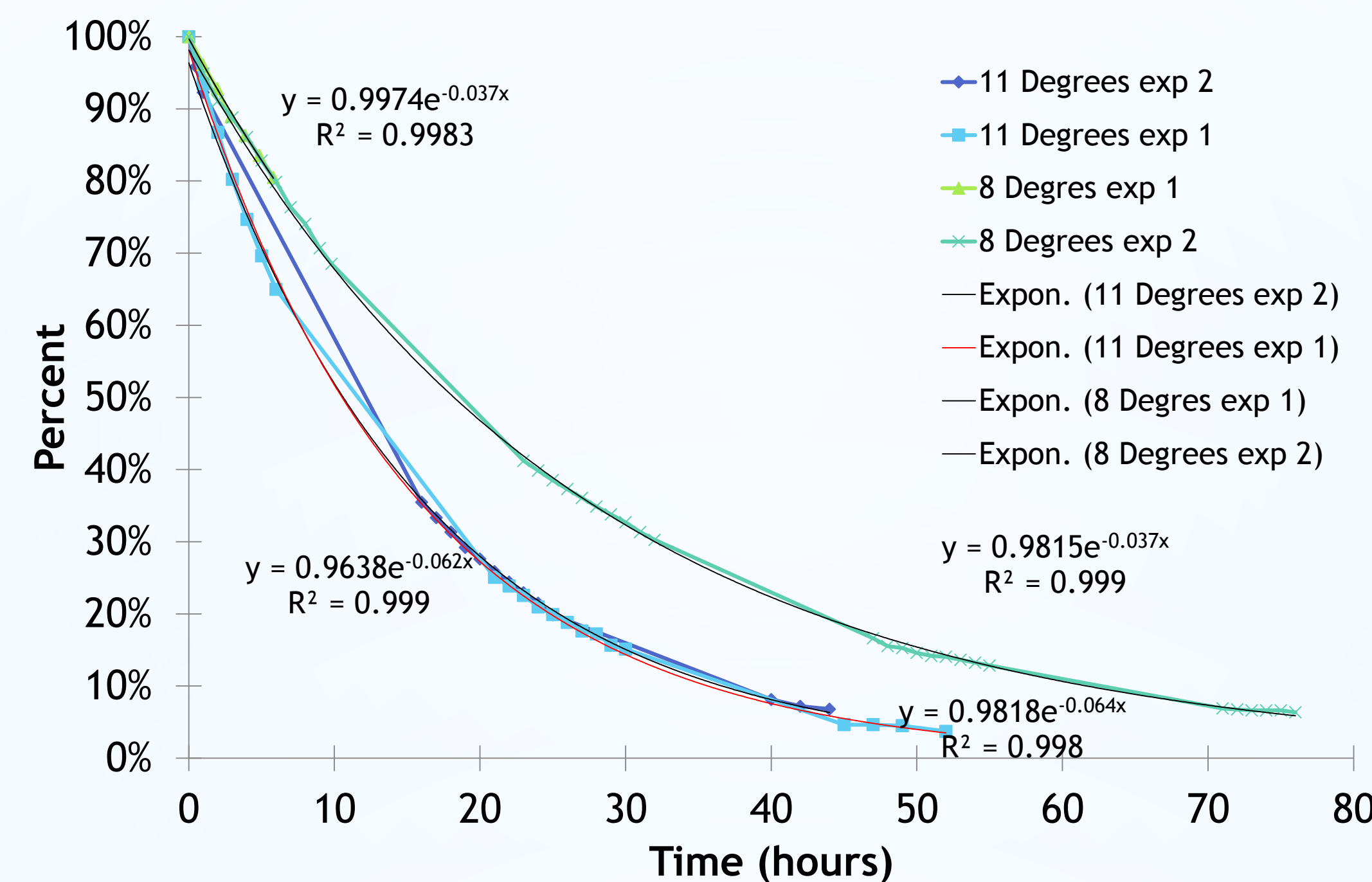
- A 5 mM solution of hypochlorite was prepared using a ground sample of calcium hypochlorite - Ca(ClO)₂
- Hypochlorite concentration determined using UV spectroscopy, 350 L mol⁻¹ cm⁻¹ at 290 nm as the molar attenuation coefficient
- 5 mM solution of DL-alanine was created, solution kept at Viking experiment test cell temperatures
- The amino acid was mixed with hypochlorite solution in a 3:2 ratio
- Decomposition of the chloroalanine measured using UV spectroscopy with a shuttered UV light source. Rate constants from the data
- Rate constants and experiment temperatures were then used to make an Arrhenius plot

Acknowledgements



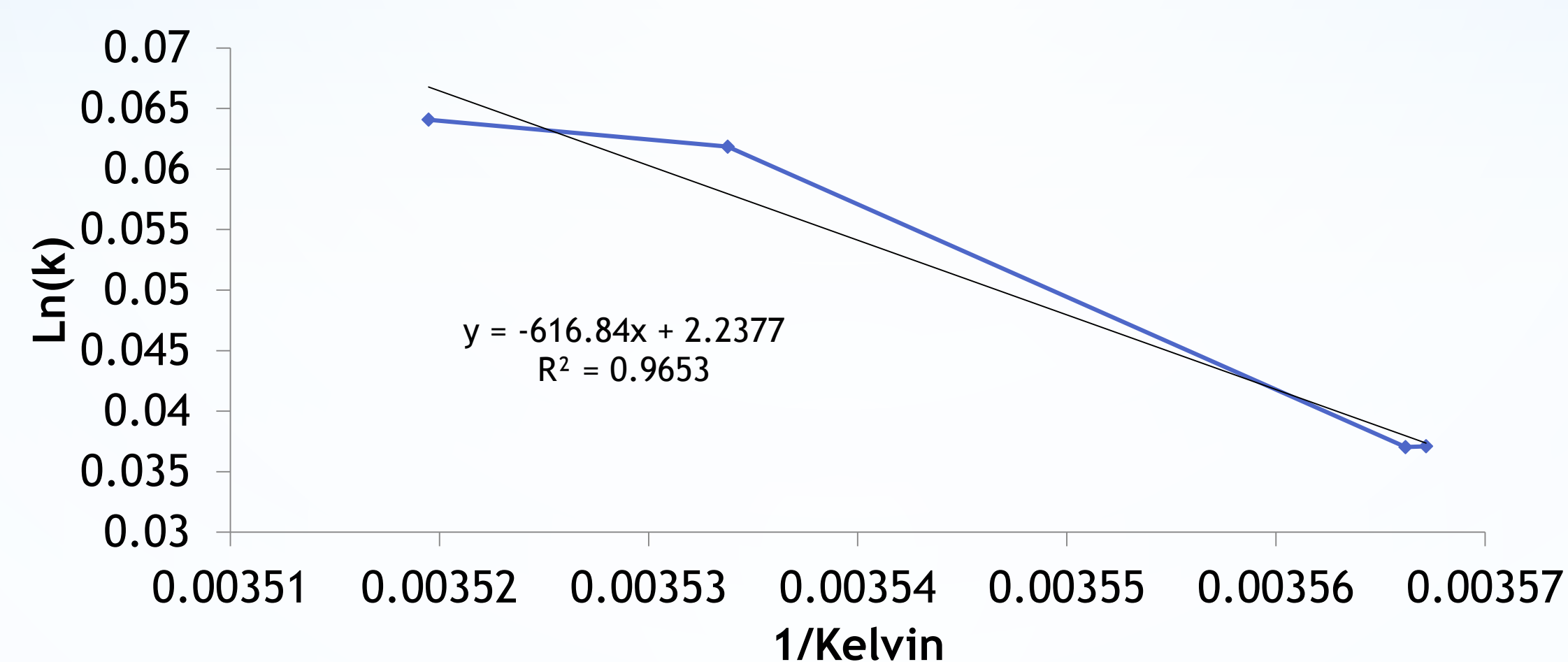
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Results



	Average Temp	Slope	R ²
Experiment 1	7.183	-0.0371	0.99828
Experiment 2	7.260	-0.03703	0.998976
Experiment 3	10.983	-0.06407	0.997983
Experiment 4	9.959	-0.06394	0.999905

Arrhenius Plot - Chloroalanine



Discussion

- In each case the decomposition of chlorinated alanine followed first order kinetics
- Using an Arrhenius plot, the measured rates allow the determination of decomposition rates at temperatures other than those tested.
- The computed values for A and the energy of activation are 9.57 1/hr and 5.18 kJ/(mol*K), respectively.
- With these data it is possible to determine the contribution of chloroalanine decomposition to the results of the Viking mission LR experiments.
- This is incomplete, however, as there would also be chloroglycine formation, and chloroglycine decomposition data at LR experiment temperatures are not available at this time.
- When this information is available, the decomposition rates of both chloroalanine and chloroglycine can be computed, and compared to the rates of CO₂ (g) released in the Viking LR experiment.

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