

# Assessing the Dynamics of Microbial Sulfate and Perchlorate Reduction in Environments Relevant to Mars

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## Introduction

- Investigating bioweathering strategies for perchlorate and sulfate concentrations in Martian regolith to form soil for plant growth and other applications
- Goal is to quantify and understand how sulfate concentrations and microbial sulfate reduction influence microbial perchlorate reduction.
- By examining the interaction between sulfate and perchlorate reduction processes, the study aims to generate crucial knowledge for Martian regolith biotransformation to support a mission to Mars.

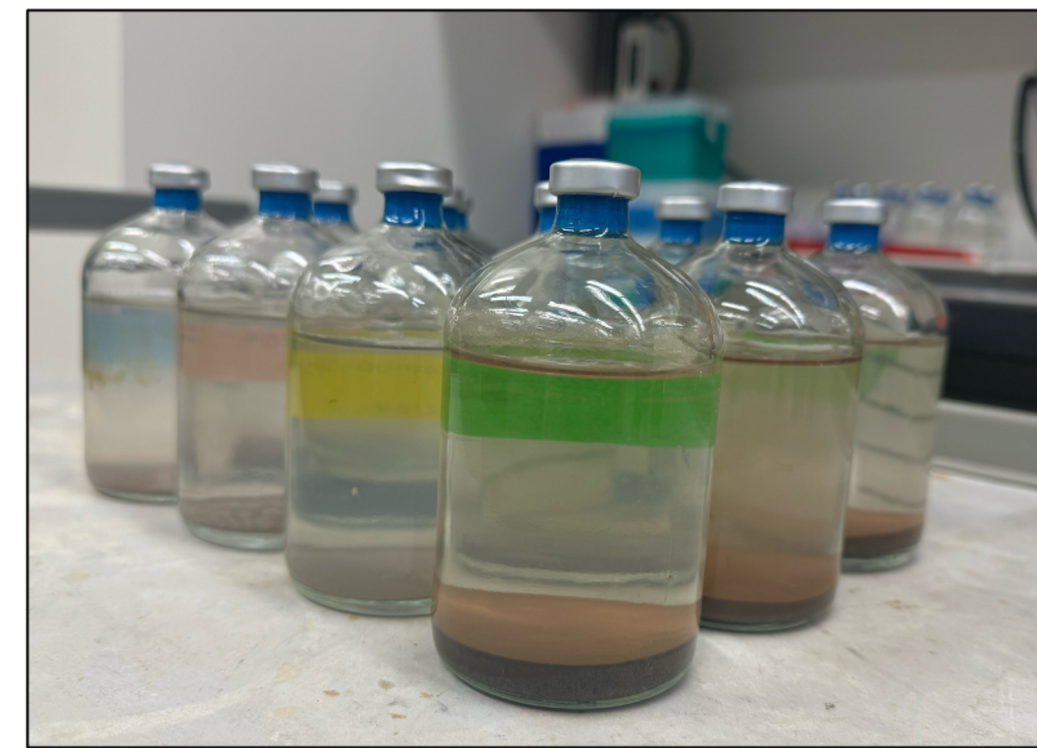
## Methodology

- Conditions studied:

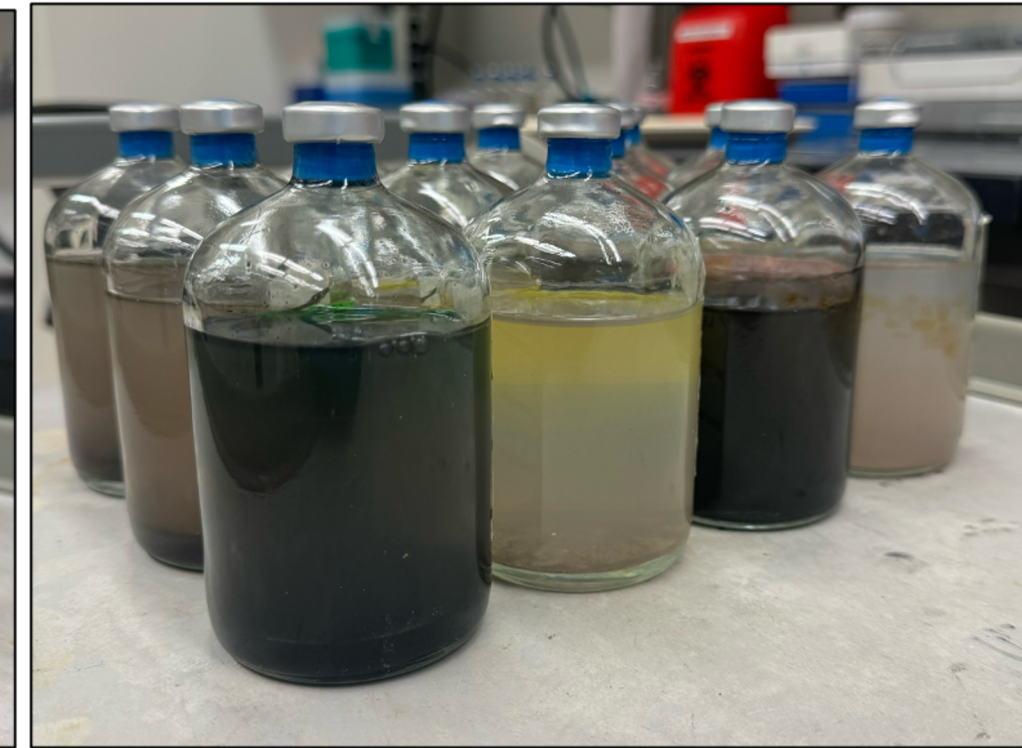
Condition Label	Inoculum Added	Total Liquid Added	Sodium acetate 1.5 M Added	Perchlorate 1 M stock	Sulfate concentration 1 M stock	Sulfide 0.2M stock	Incubation Conditions
Sulfate	5 mL	200 mL	20 mM	—	7.04 mM	—	30 °C
Perchlorate	5 mL	200 mL	15 mM	8.17 mM	—	—	30 °C
Combo + Sulfide	5 mL	200 mL	35 mM	8.17 mM	7.04 mM	1 mM	30 °C
Leached Regolith Combo	5 mL	200 mL	35 mM	8.17 mM	7.04 mM	—	30 °C

\*Combo = Perchlorate & Sulfate

- 2 mL liquid samples taken daily for the first week and then every two days until day 21
- Ion Chromatography (IC) analysis performed to quantify perchlorate and sulfate reduction
- Total Organic Carbon (TOC) analysis performed on leached regolith
- Redox Potential measurements taken to evaluate oxidative or reductive environments within the bottles

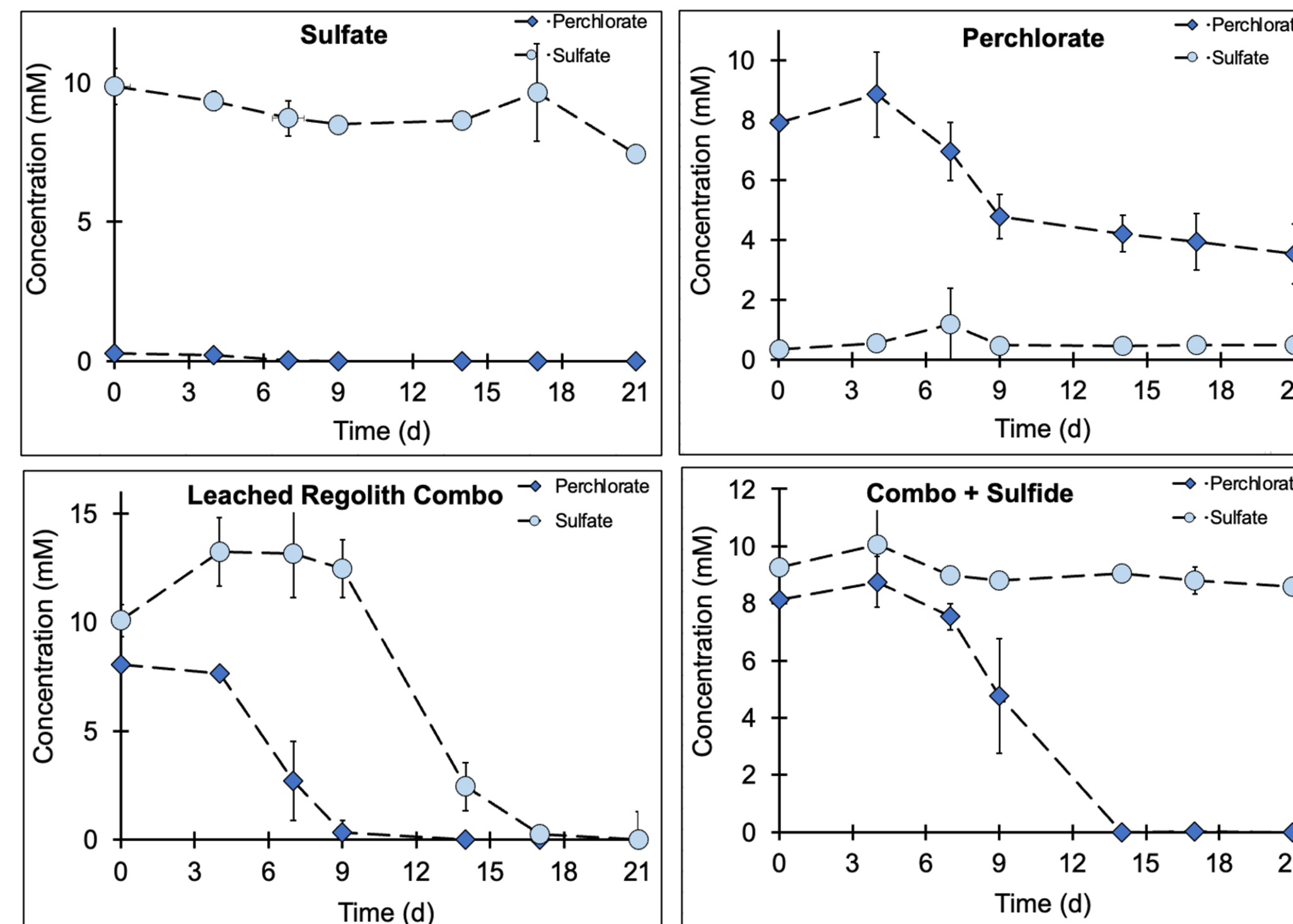


Bottles at t=0

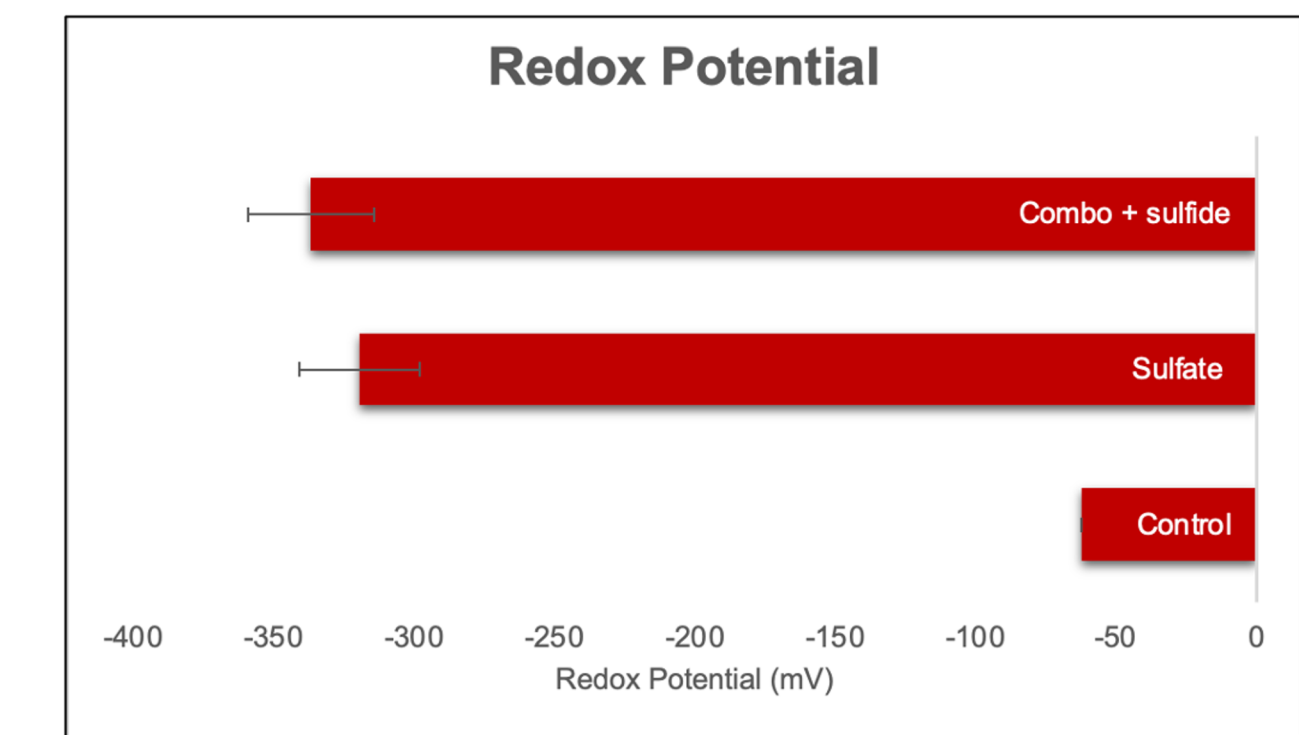


Bottles at t=21

## Ion Chromatography Results



## Redox Potential Results



\*Control = Anaerobic Media

## TOC Results

Condition Label	Triplicate #	Milligrams Carbon	% Carbon	Average % Carbon
Regolith before microbial activity	1	0.539	0.270	0.259
	2	0.559	0.264	
	3	0.493	0.246	
Regolith after microbial activity	1	2.480	1.221	1.308
	2	2.651	1.289	
	3	2.850	1.414	

## Conclusions

- Sulfate concentrations of 1 g/L were not inhibitory to perchlorate reduction in either combo conditions.
- Condition with leached regolith performed the best at both perchlorate and sulfate reduction.
- Microbial activity significantly increased TOC, a requirement for soil and plant growth.