The Photocatalytic Reactions of Desert Varnish

By: Lacie Johnson

Working Under Carrick Eggleston

Outline

- What are Photocatalytic Semi Conductive Minerals?
- What is Desert Varnish?
- The process of Electron Hole Pairs.
- Experiment Results
- Implications

What are Photocatalytic Minerals?

- These are semi conductive minerals, that react with light energy and go through different redox reactions in the aqueous solution in the environment.
- They do this through a process that is known as Electron Hole Pairs
- Where can these be found?
  - Proven: Hematite and Pyrite
  - Researching: Desert Varnish

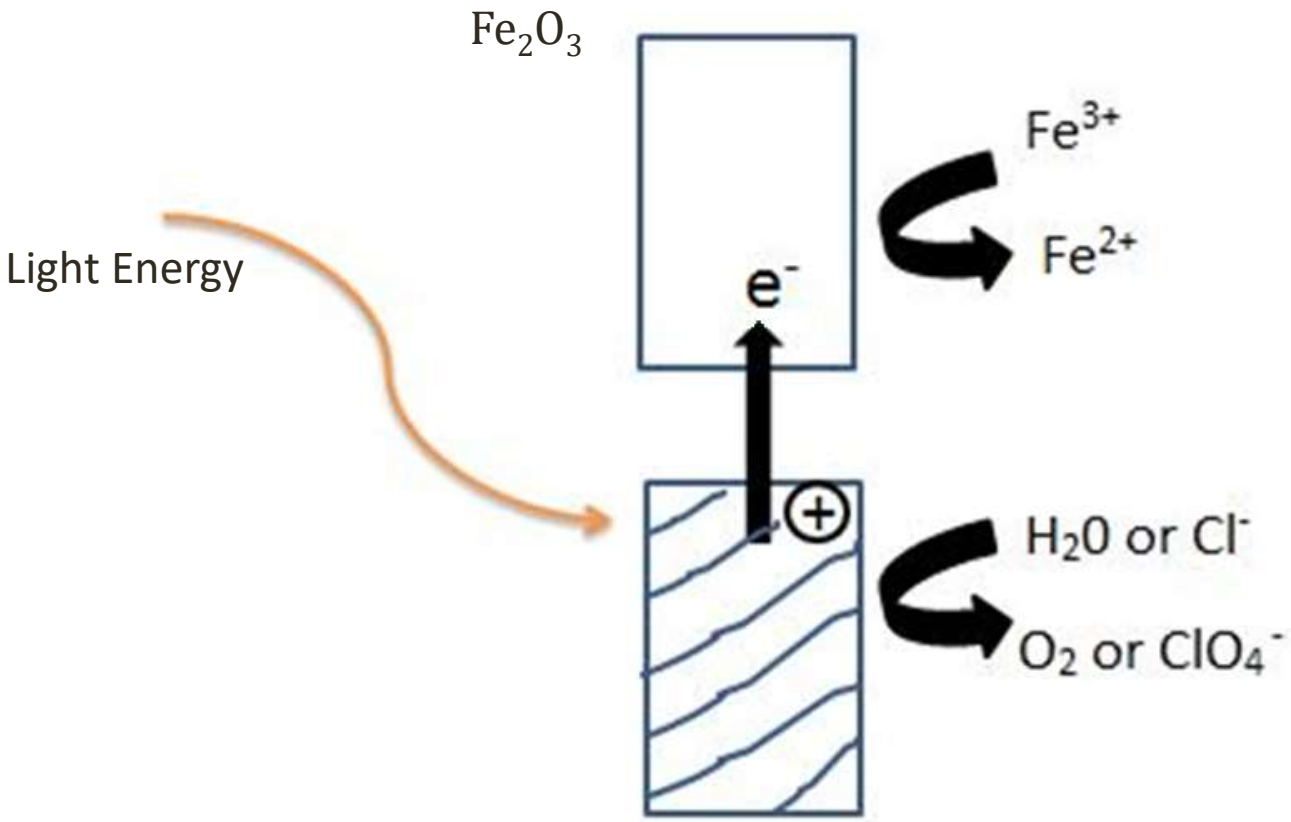
What is Desert Varnish?

- It is a dark manganese - and iron – oxide rich coating that can be up to 100 µm thick.
- Since the 1980's it is thought to be made from Biological processes of non-phototrophic microorganisms such as cyanobacteria.

Our Hypothesis

- Desert varnish is formed by the photocatalytic properties of semiconducting minerals that occur in the varnish reacting with the aqueous solution in the environment.
- Photocatalysis creates the cations (Fe^{2+} and $Mn^{2+)}$ that are used to stimulate and support the growth of non-phototrophic microorganisms.
- Through the process known as Electron Hole Pairs

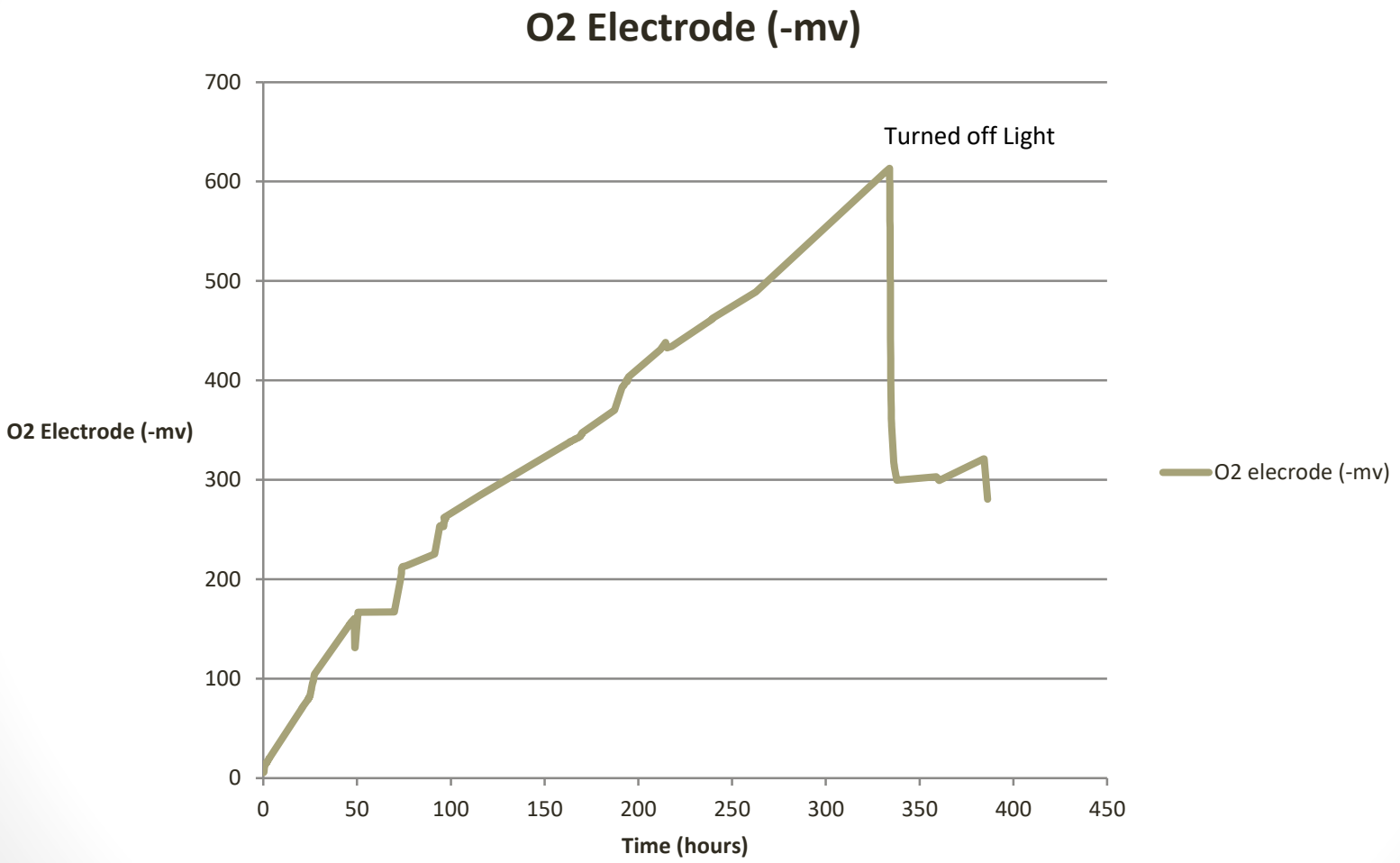
Electron Hole Pairs



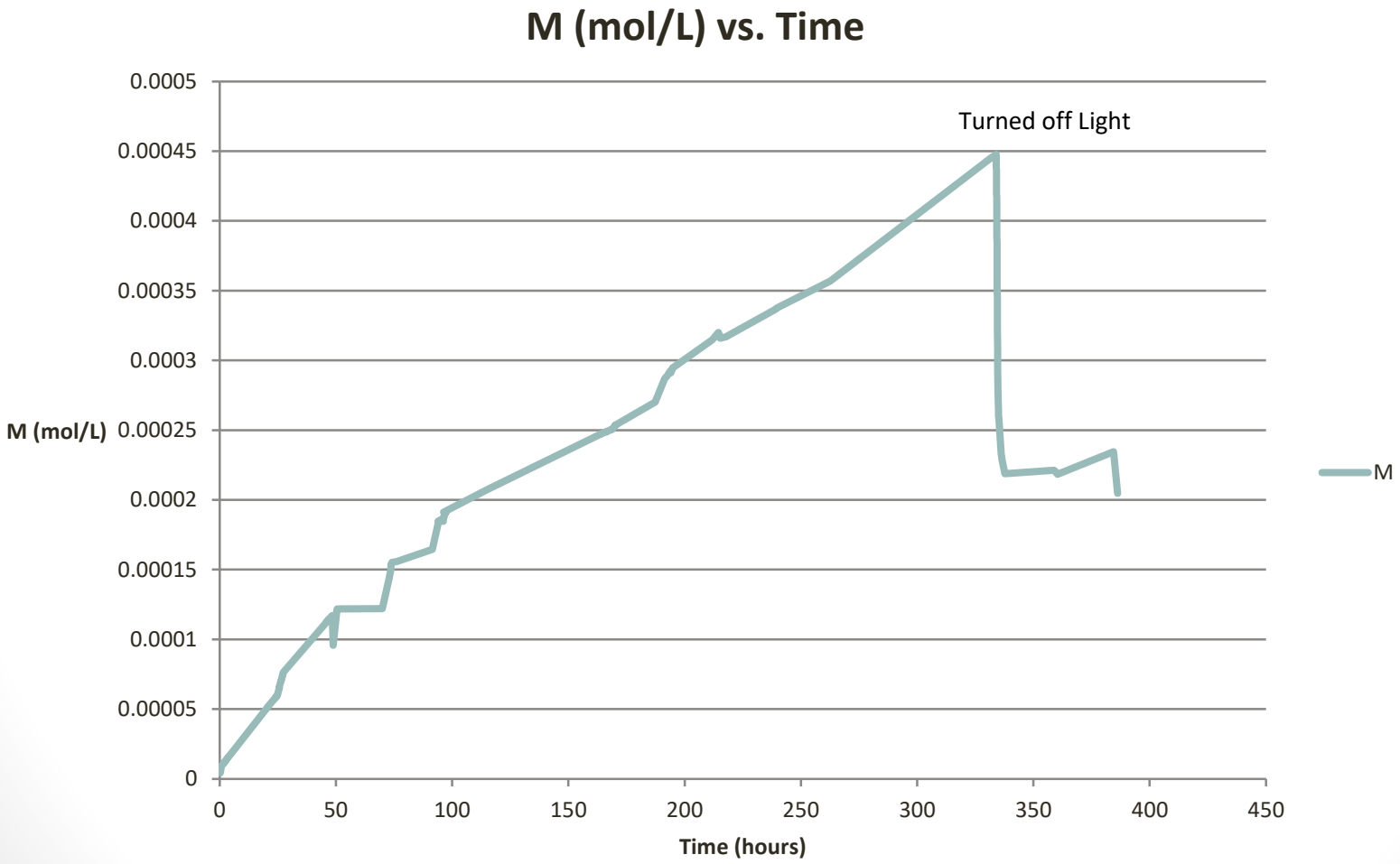
Experiment

- Creating an anaerobic environment
- Placing 10 mM KCl into a air tight container with a piece of desert varnish
- Using a Xenon light source to illuminate the desert varnish in solution
- Using a dissolved free O_2 microelectrode to measure the amount of oxygen being produced in the system

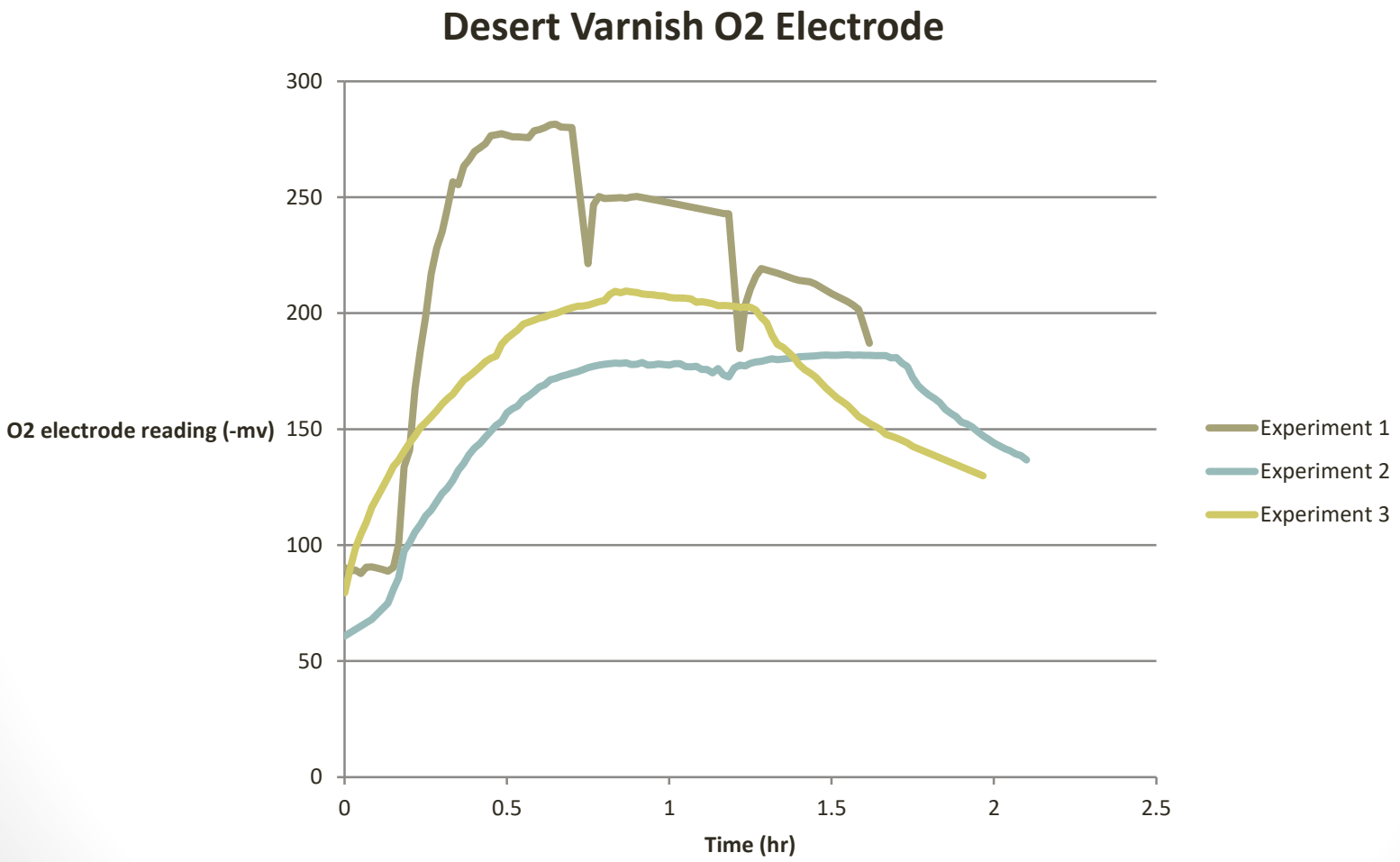
Hematite and Pyrite



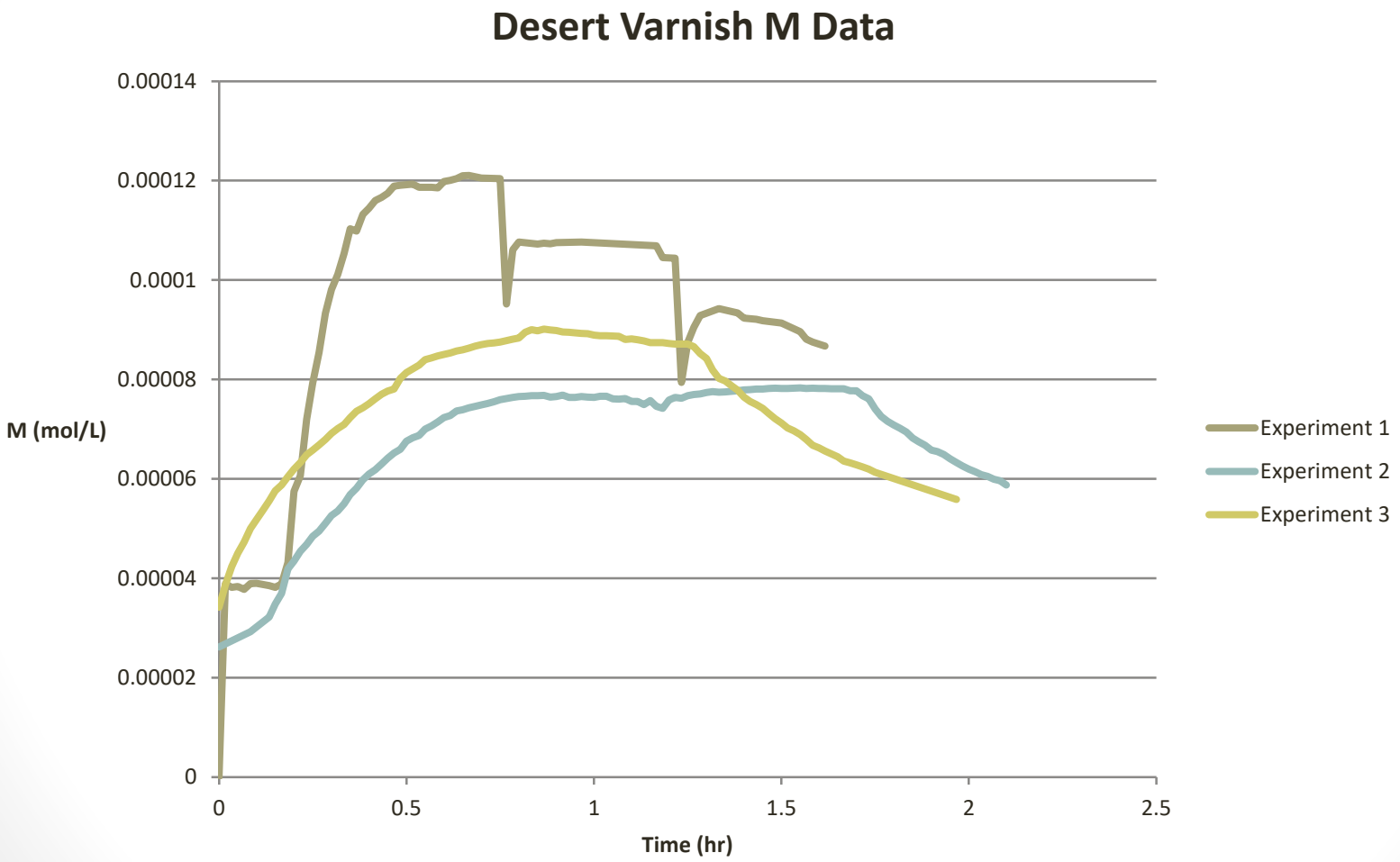
Hematite and Pyrite



Experiments & Results



Experiments & Results



Implications

- Because we are creating free O_2 gas within the system containing a piece of desert varnish and 10 mM KCl we can show that the Electron Hole Pair process is occurring.
- NASA is currently using a similar process in experiments for creating a viable oxygen source on the Moon.
- If we can study this process we can possibly create solar cells from these photocatalytic semi-conducting minerals.
- There are possibilities that these reaction may also be happening on Mars which has an abundance manganese - and iron – oxide rich coatings and perchlorate.

References

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