

Reactive Oxygen Species Generation by Lunar Simulants

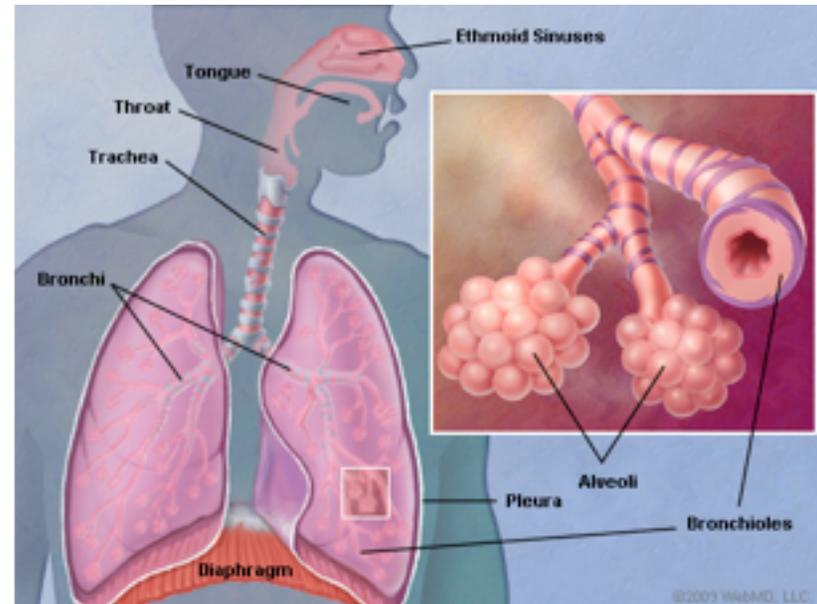
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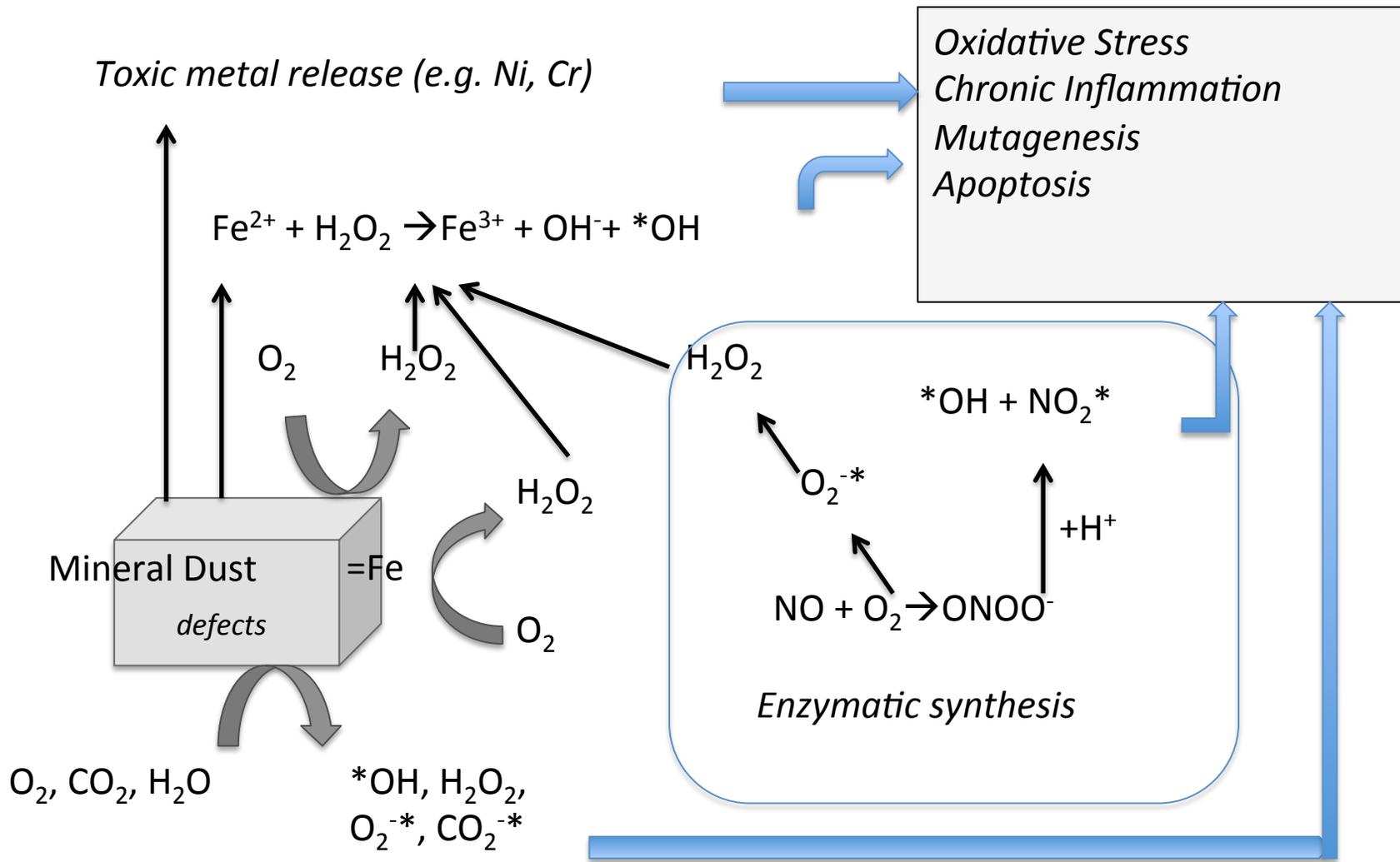
Figure 1. Harrison Schmitt exploring the Moon in 1972. Note the dust on his space suit. (Credit: NASA)

The lung: Our largest Interface with the Environment



WebMd

When exposed to particulate matter, our immune system responds by making hydrogen peroxide or bleach, which reacts with some minerals to form radicals. Radical damage proteins, DNA, and stress cells. Recalcitrant particles can lead to chronic inflammation. Body may respond by encapsulating particles with tissue, which diminishes lung function



Simulating Materials on Airless Planetary Bodies

Factors Contributing to Mineral Reactivity

Composition

Mechanical
Stress

Dehydro-
xylation

Space
Weathering

Research Strategy

Simulants
Synthetics
Major
Minerals

Grinding

Heating
(Vacuum)

H⁻ beam, UV/
IR Laser (BNL)

Goal to prepare well-characterized materials for reactivity, biopersistence and exposure studies.

Health Sciences Studies

Impact on Human Explorers over Time

Oxidative
Stress
Inflammation

Cell Damage/
Death

Genotoxicity

Fibrosis

ROS in
mineral
dispersion

ROS/RNS in
A549
epithelial cells

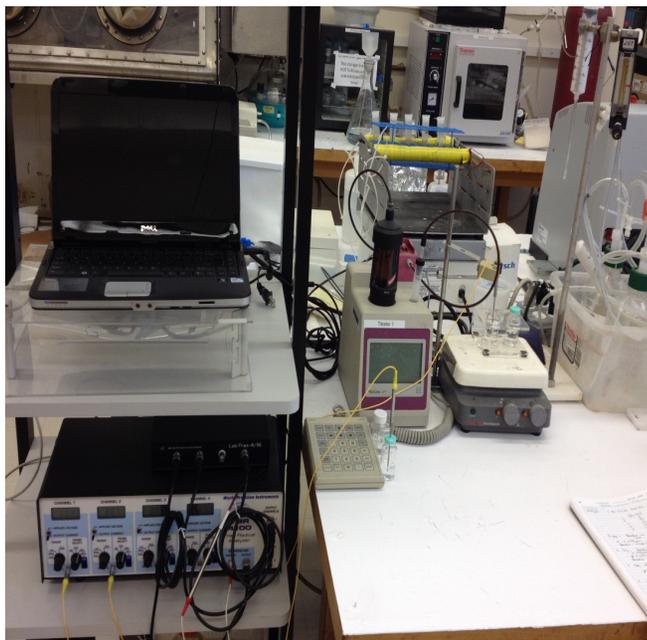
Protein
damage
in epithelial
cells and lung
tissue
(mouse)

DNA damage/
Inhibition
DNA Repair

Animal study
(outside
scope)

Research Team

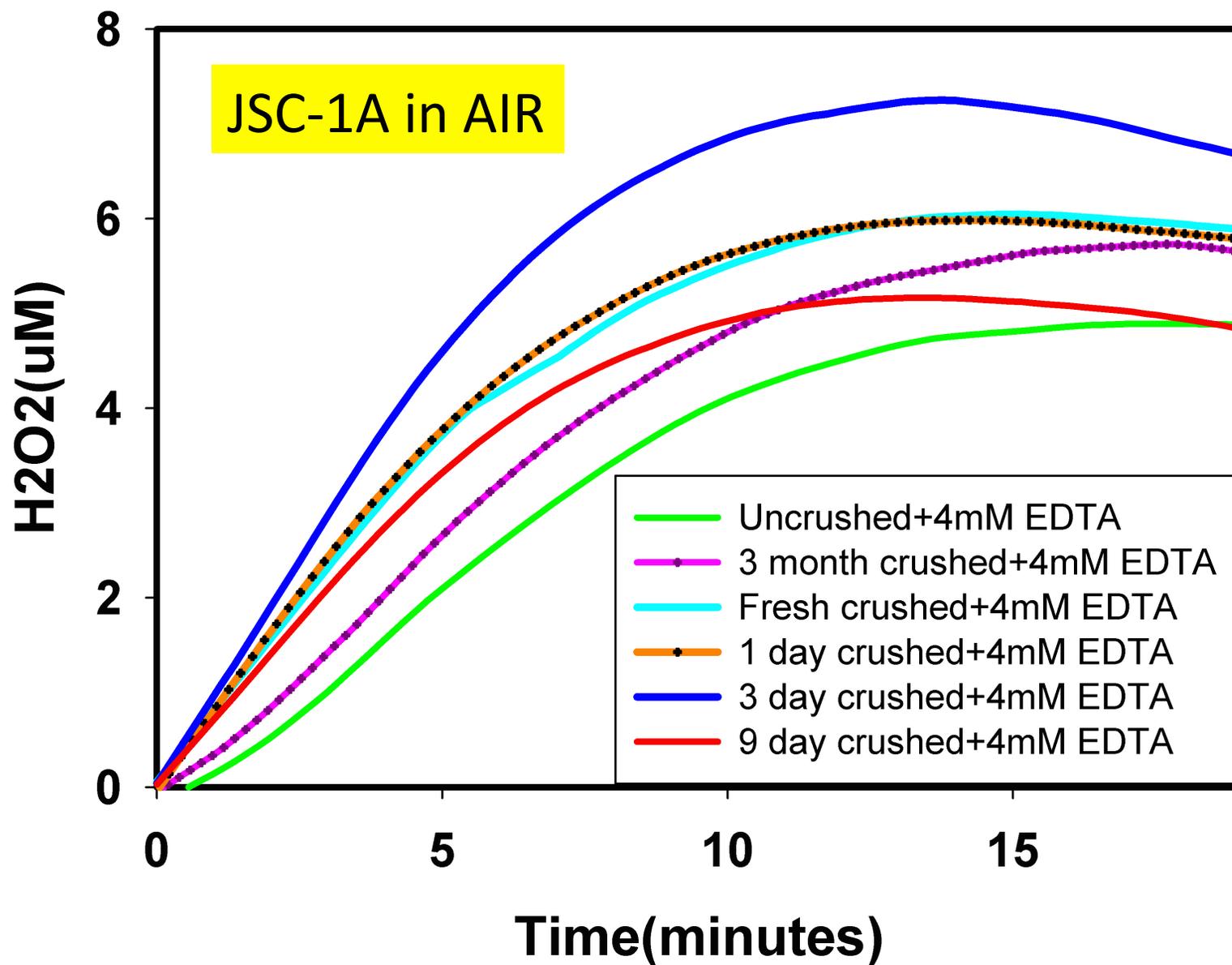
- Systematically study the generation of ROS in simulants dispersions in water (and simulated lung fluid) (Schoonen lab)
- Systematically study influence of alteration on olivine (poster Sara Port, Hurowitz lab)
- Study effect of exposure to simulants in mice lung tissue (poster Jillian Nissen, Tsirka lab)
- Study genotoxicity of simulants (poster Rachel Caston, Demple lab)



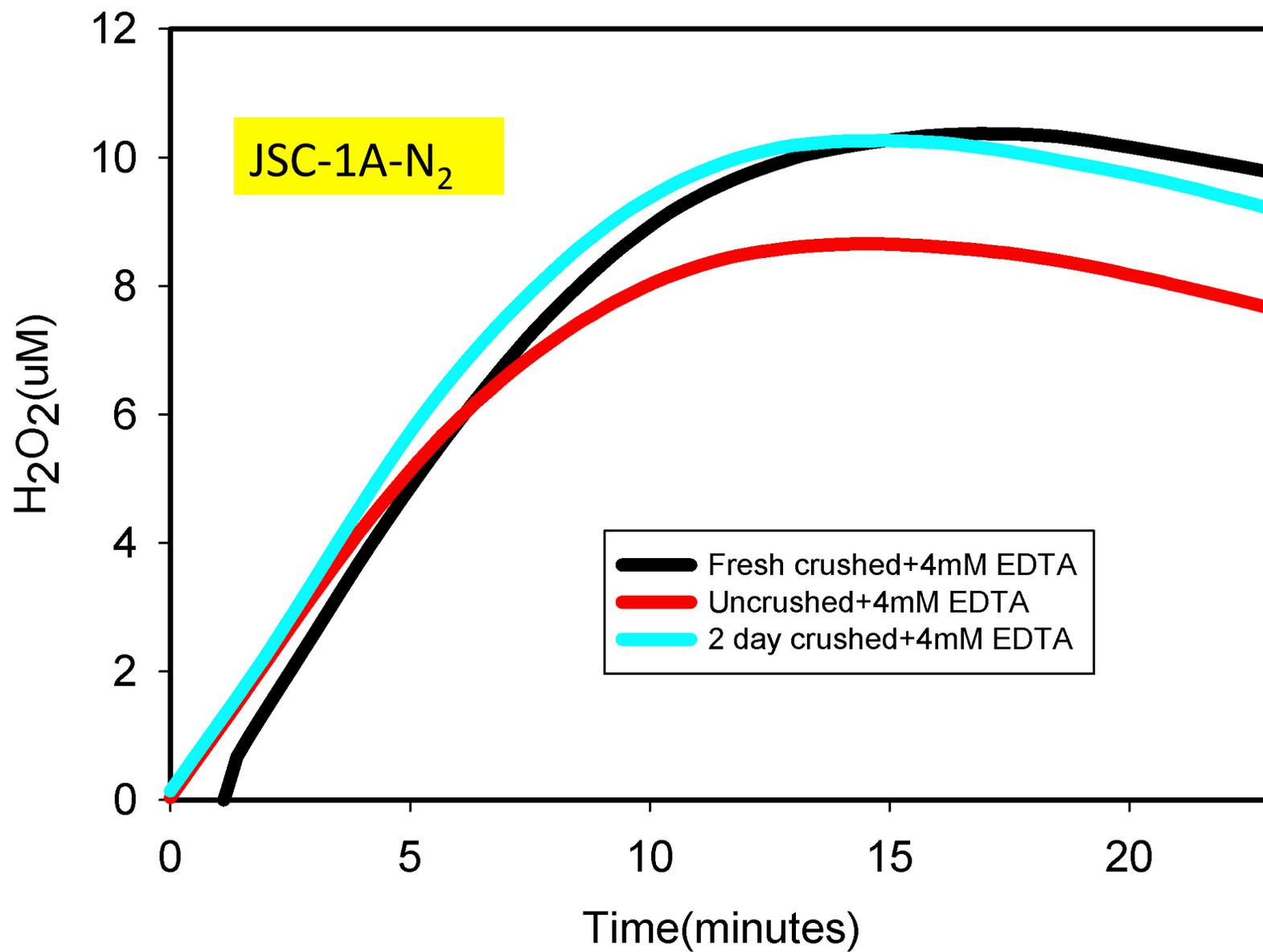
H₂O₂ generation

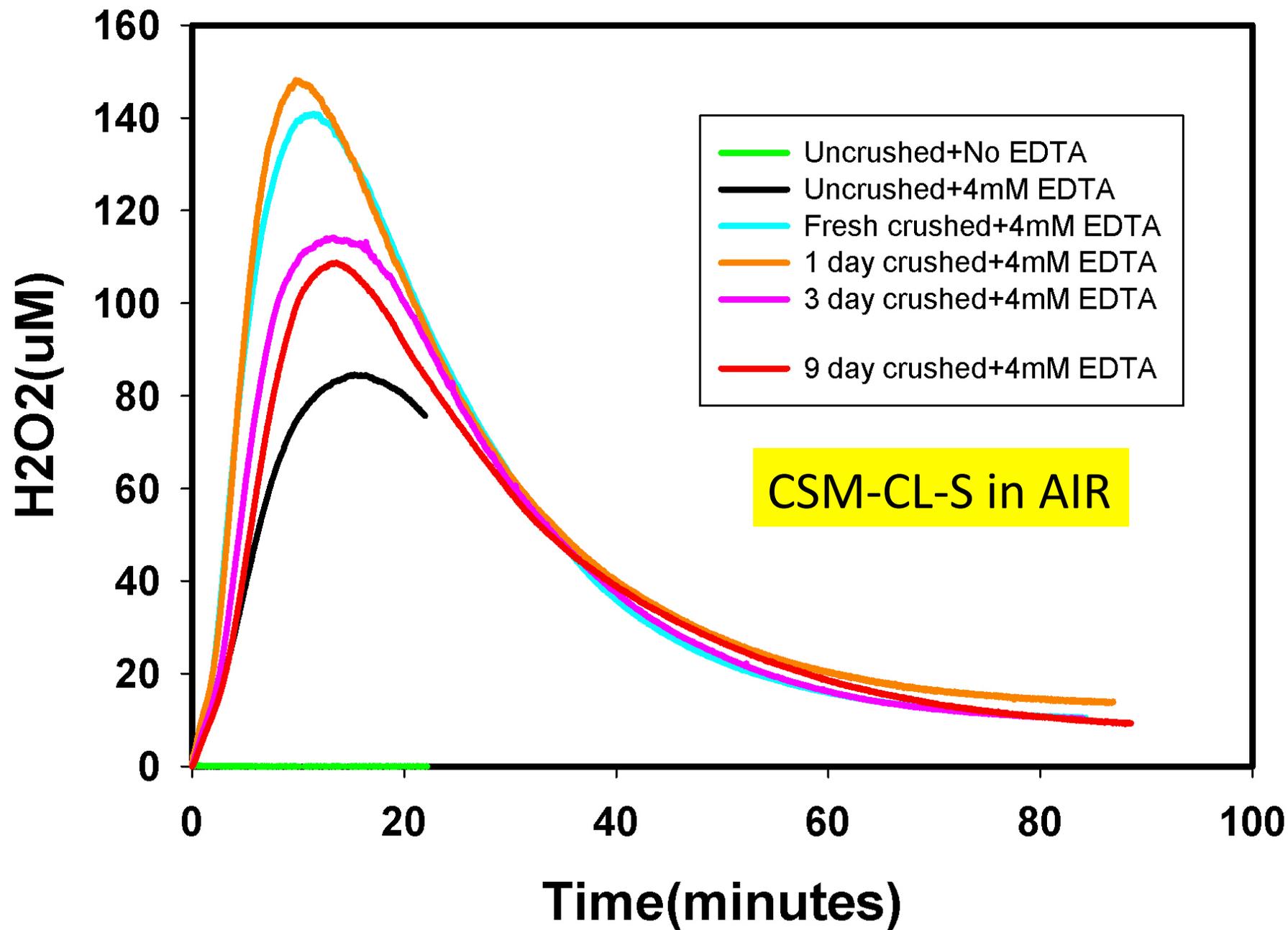
- Simulants dispersed in water with or without EDTA
- EDTA used to inhibit Fenton Reaction
- H₂O₂ measured continuously
- Materials crushed by hand for 10 minutes in air or under N₂ in glovebag

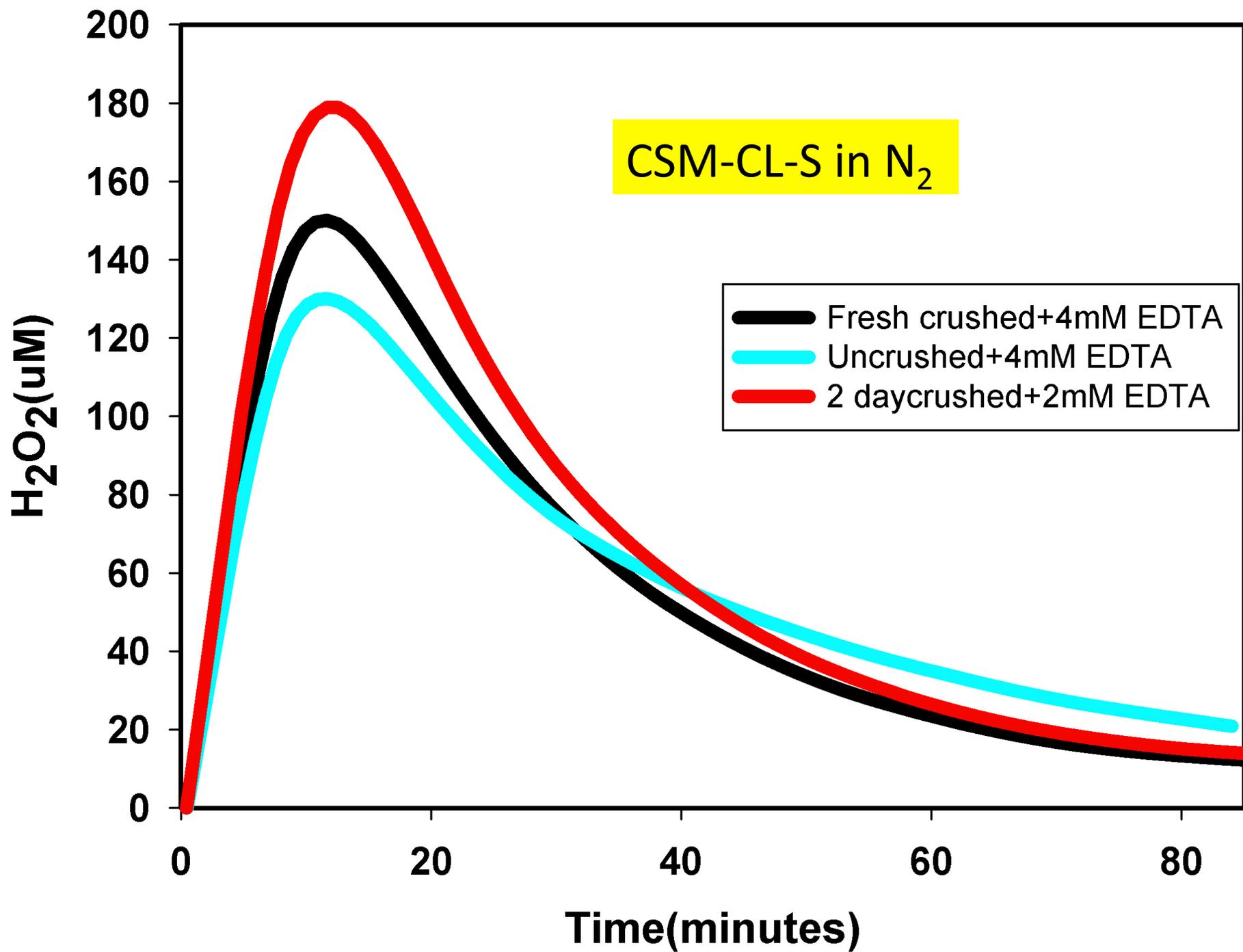




JSC-1A







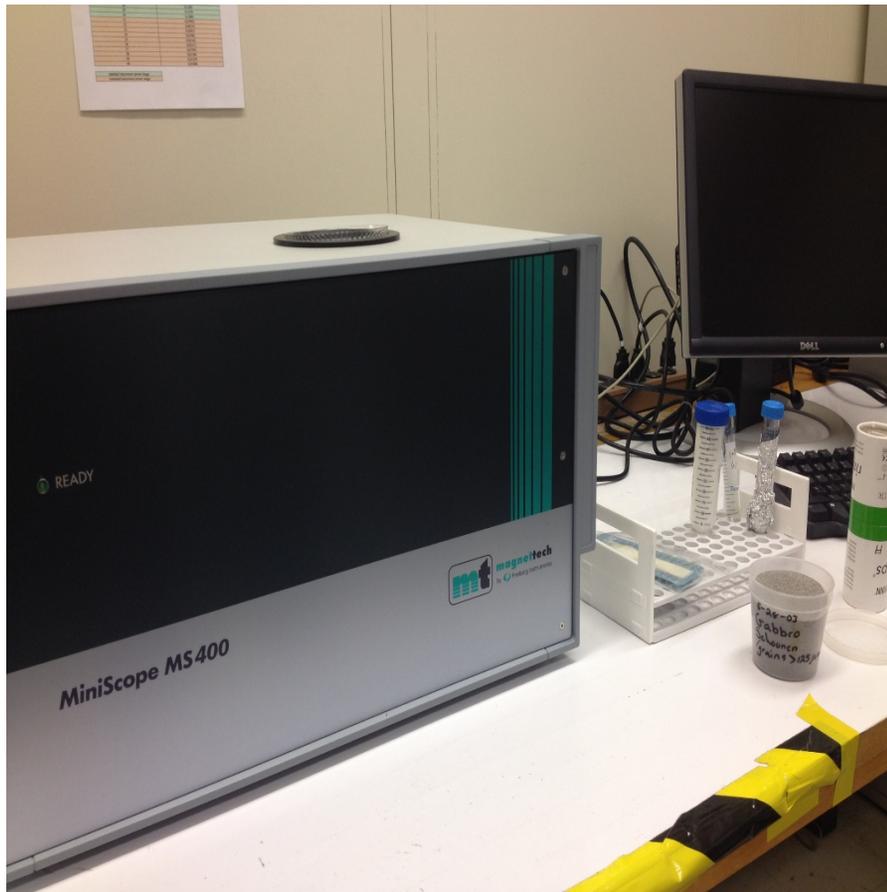
Summary Results H₂O₂ 10 minute hand grinding

Simulant	Olivine	Plag.	Pyroxene	Glass	Air (max)	N ₂ (Max)
JSC-1A	12	38	19	27	7.0	10
JSC-1A- Aggl	12	38	19	27	3.5	4.5
OB-1	6	44	3	43	43	120
NU- LTH-2M	6	52	16	24	2.4	3.5
NU- LTH-2M Aggl	6	52	16	24	9.0	10
CSM-CL-S	8	40	4	44	150	180

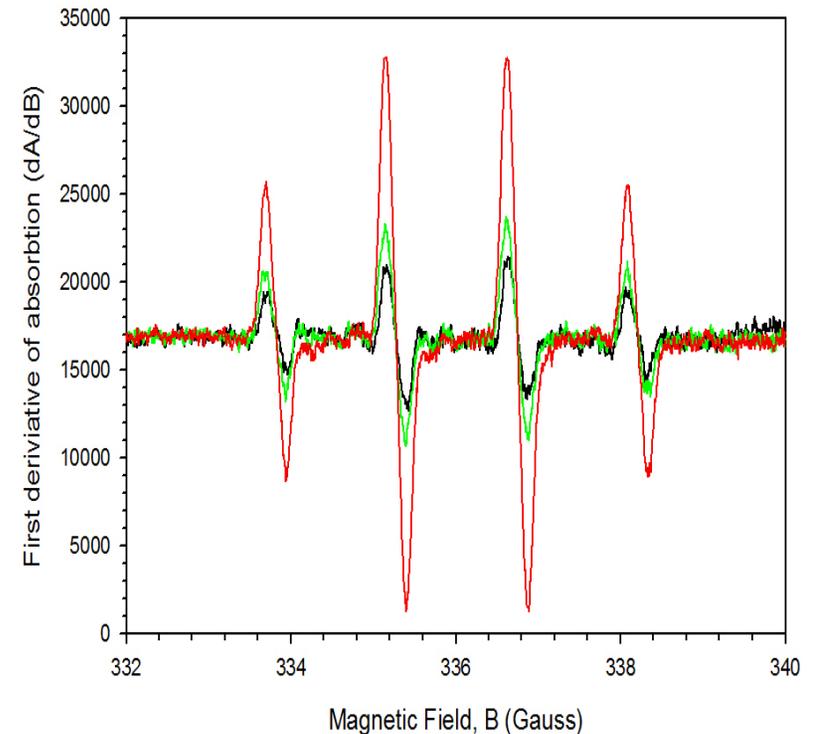
Samples provided by Doug Rickman, In Situ Resource Utilization (ISRU),
NASA_Marshall Space Flight Center

- OB-1 and CSM-CL-S produce by far most H₂O₂ (higher glass content).
- Agglutinitic glass does not appear to significantly change H₂O₂ formation.
- N₂ environment enhances H₂O₂ formation, preserves reactivity.

Next Step OH Radical Formation (ESR)



RIS⁴E Institute's Magnetech MiniScope MS400 Electron Paramagnetic Resonance (EPR) Spectrometer



— DMPO (control)
— DMPO incubated with JSC-1A
— DMPO incubated with freshly crushed JSC-1A

Successful EPR measurement of OH-radical spin trap spectra through exposure to lunar regolith simulant JSC-1A

Thanks to Collaborators



h

Lunar - NWA 4734

