Influence of soluble organic matter on *Cryptosporidium parvum* oocyst mobility in variable charge soils (USDA Grant# 2006-35102-17192)

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Coring of variable-charge soils
Del Monte Fields, Oahu, HI

Del Monte Fields, Oahu, HI

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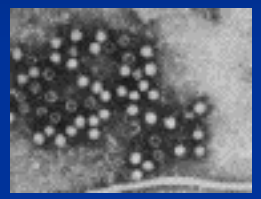
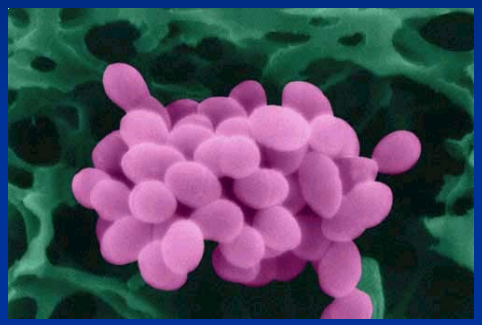
USGS science for a changing world

Problem: Transport of pathogens through soils

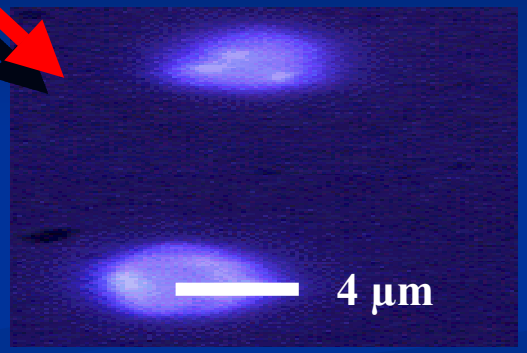
- Chlorine-resistant
- Low infective dose
- Ubiquitous
- Long-lived



Hepatitis Virus



Streptococcus



Cryptosporidium parvum oocysts

Virus 0.01-0.2 µm → Bacteria 0.1-3.0 µm → Protozoa 1.5-10 µm

Limitation: Information on oocyst transport through soils largely based upon work involving permanent-charge soils (PCS)

Objective: Better understanding of the ability of variable-charge soils (VCS) to remove oocysts under a range of conditions.

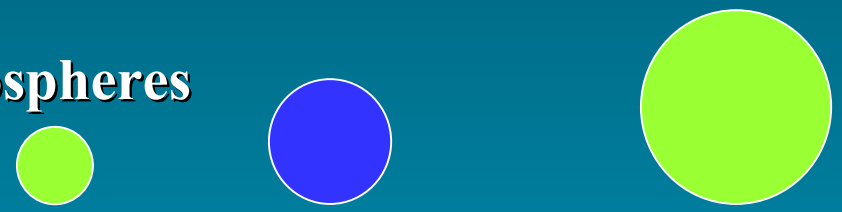
<u>Exploration:</u>

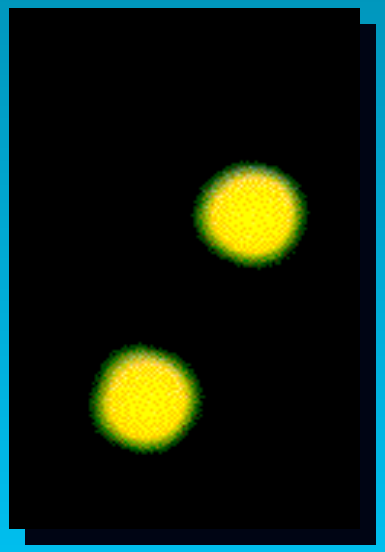
1. **Oocyst removal as a function of weathering & macropore structure.**
2. **Mechanisms governing oocyst-grain interactions.**
3. **Effect of organic matter on sorption & release.**
4. **Effect of sorbing clay particles on transport behavior**

First Case Study: Hawaiian VCS

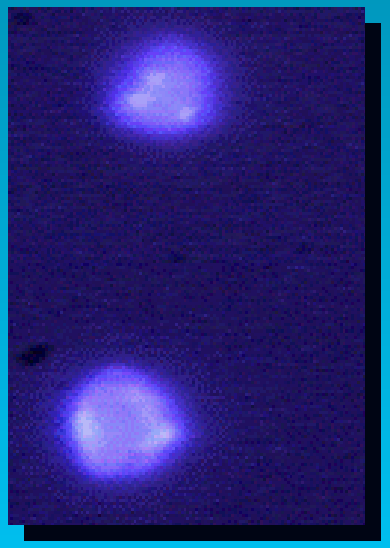
- Highly aggregated
- Highly weathered (fluctuating redox)
- Low organic carbon content (1-1.5%)
- Metal oxides on grain surfaces (10-18 % total Fe Content)
- Unknown ability to remove or attenuate *C. parvum* oocysts (Note: VCS problems documented in Brazil, Georgia, Tennesee)

Preliminary study: Use carboxylated fluorescent microspheres as abiotic surrogates for oocysts?





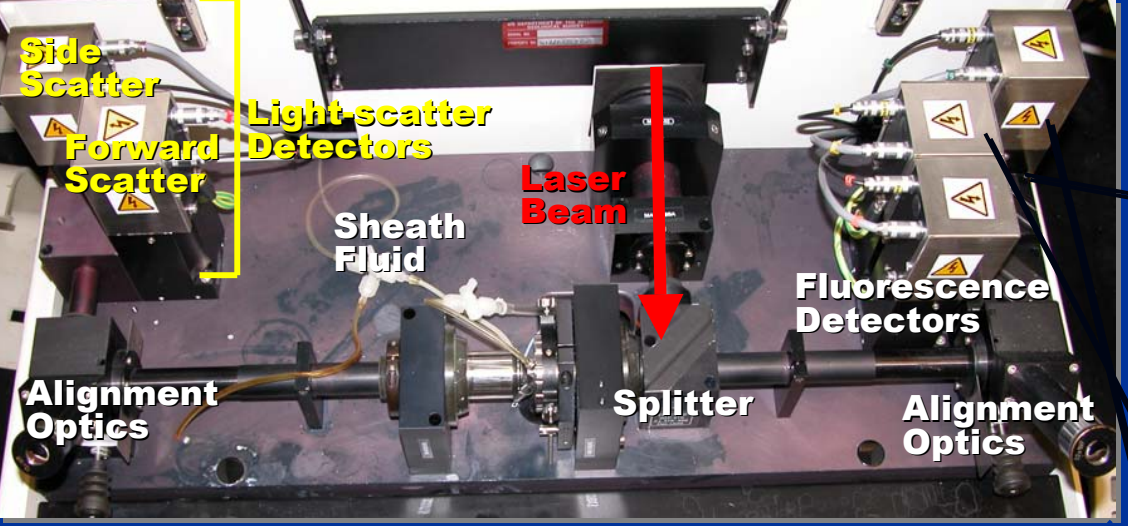
microspheres



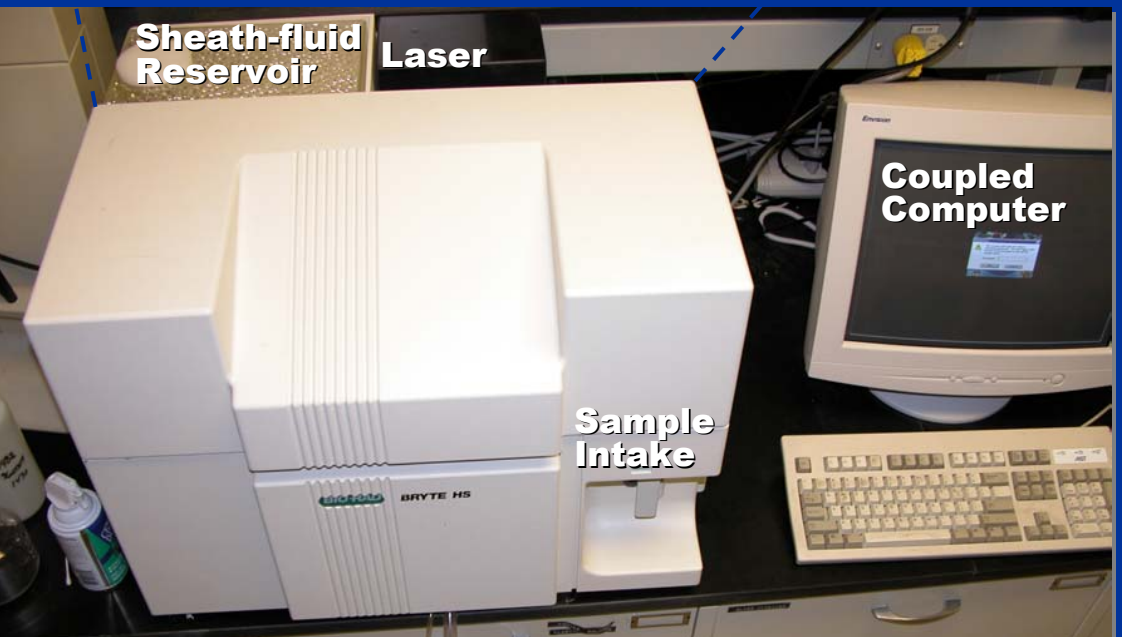
C. Parvum oocysts

Considerations:

- Size
- Aspect ratio
- Buoyant density
- Surface charge
- Attachment behavior



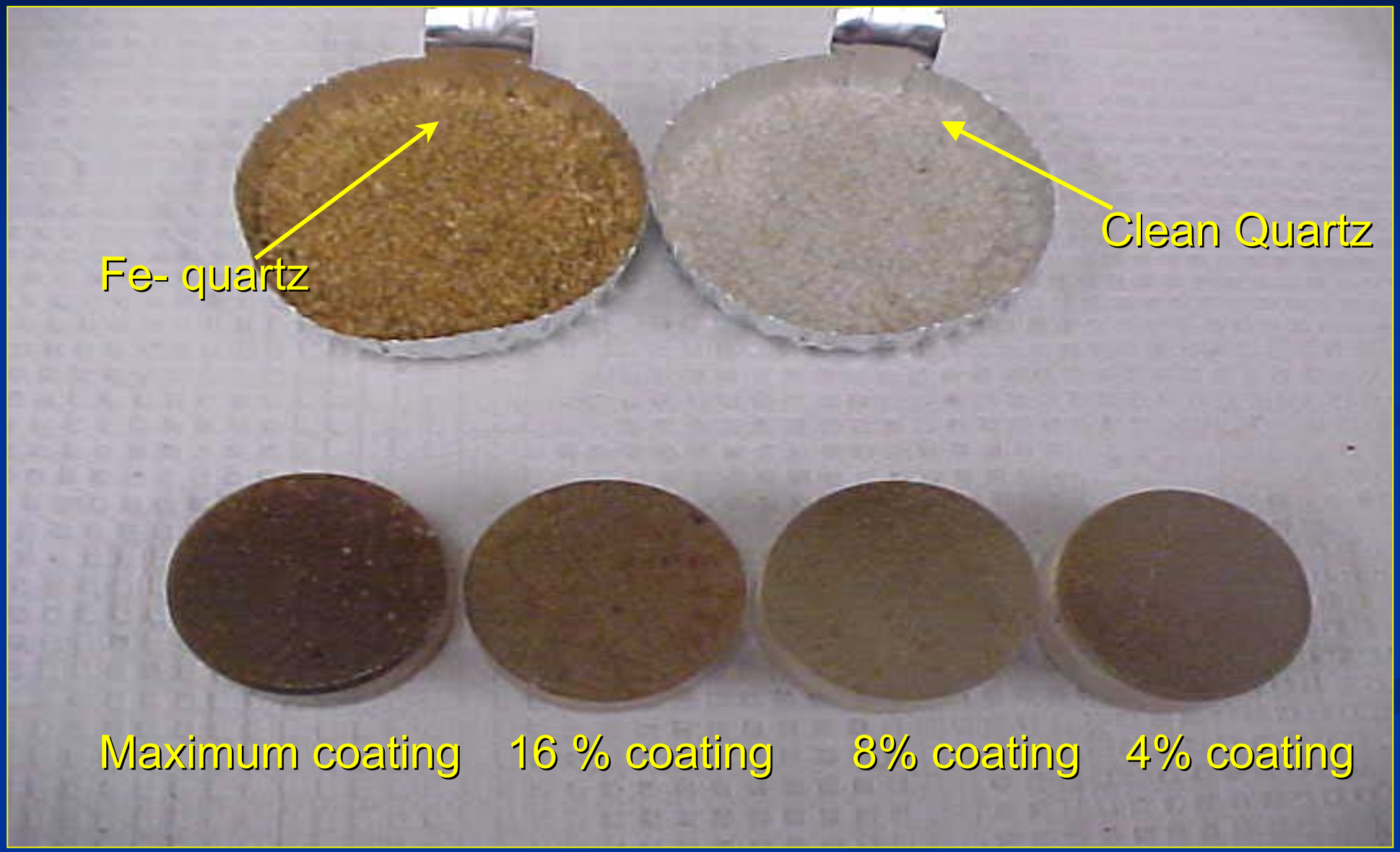
FLOW CYTOMETER, USGS, Boulder (Differential quantification of poly-disperse microsphere and oocysts)



Excit'n (nm)

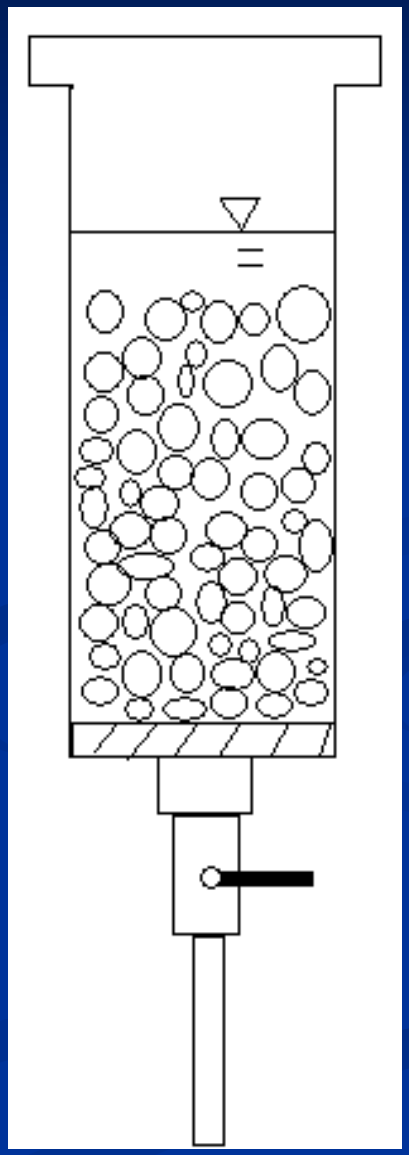
430
440
450
460
470
480
490
500
510
520
530
540
550
560
570
580
590
600
610

Preliminary study: Model granular media with iron – coated quartz



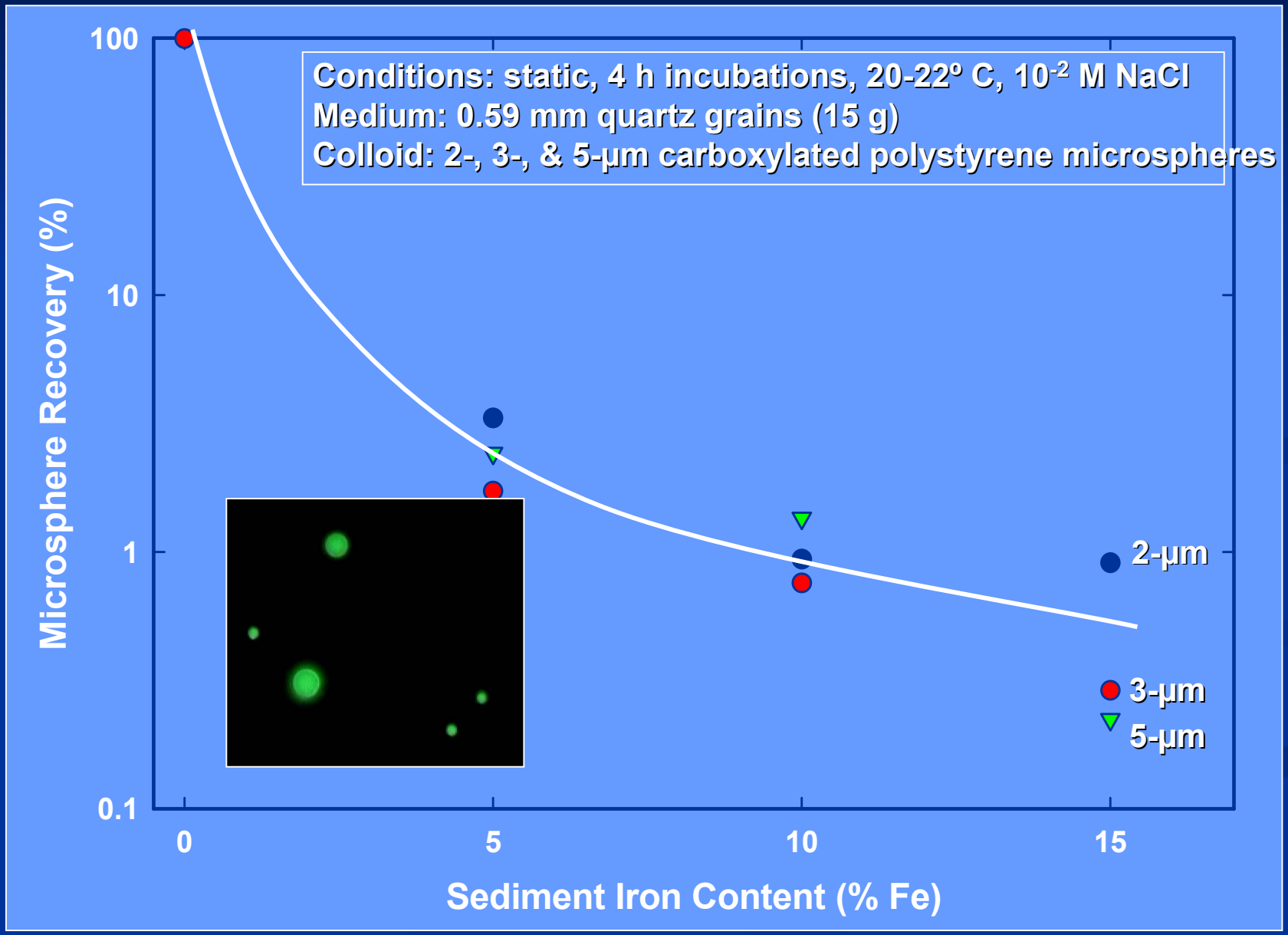
Static Columns (Sorption Studies)

- 3-5 replicates per condition
- 10-15 g of granular media per vial
- constant temperature
- static conditions

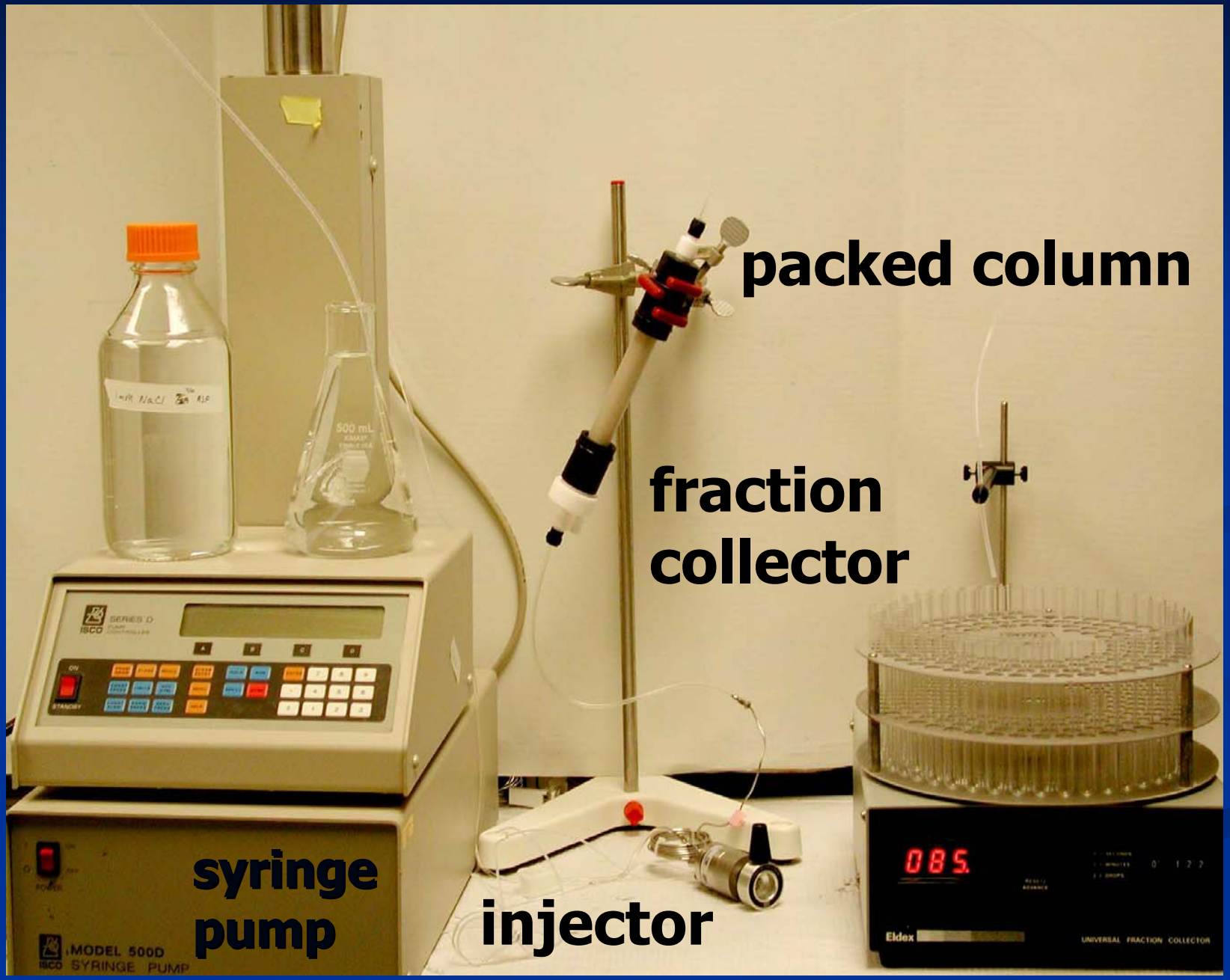
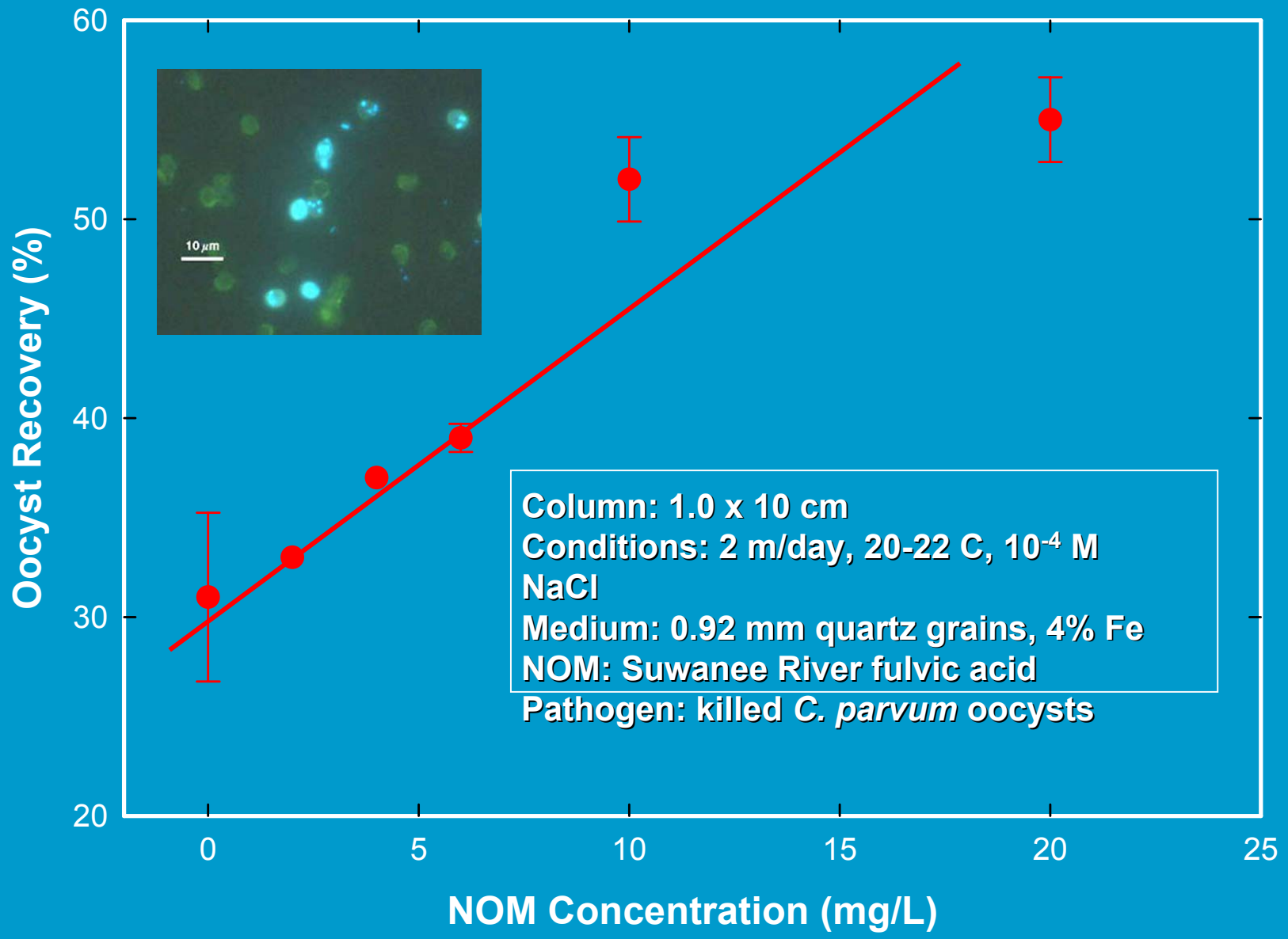


Attachment of oocyst-size microspheres in static sand columns

(Data: A. Mohanram and D. Metge)



Flow-Through Column Setup



Effect of organic matter on oocyst transport in Fe-coated sand columns (Ref: Abudalo, Ryan, Harvey, Metge, in preparation)