Development of a Rapid and Inexpensive Monitoring Technique for Sulfide in Marsh Porewater

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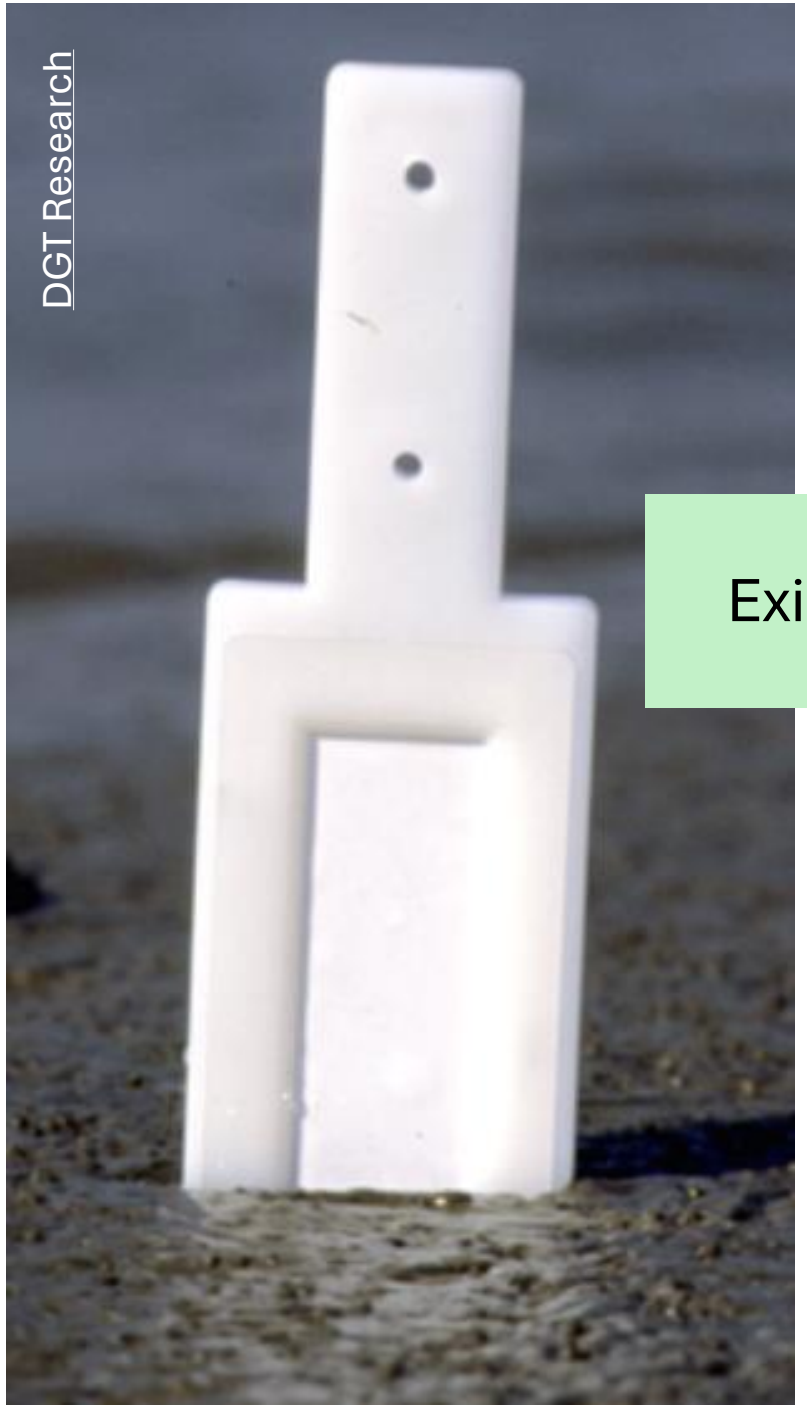
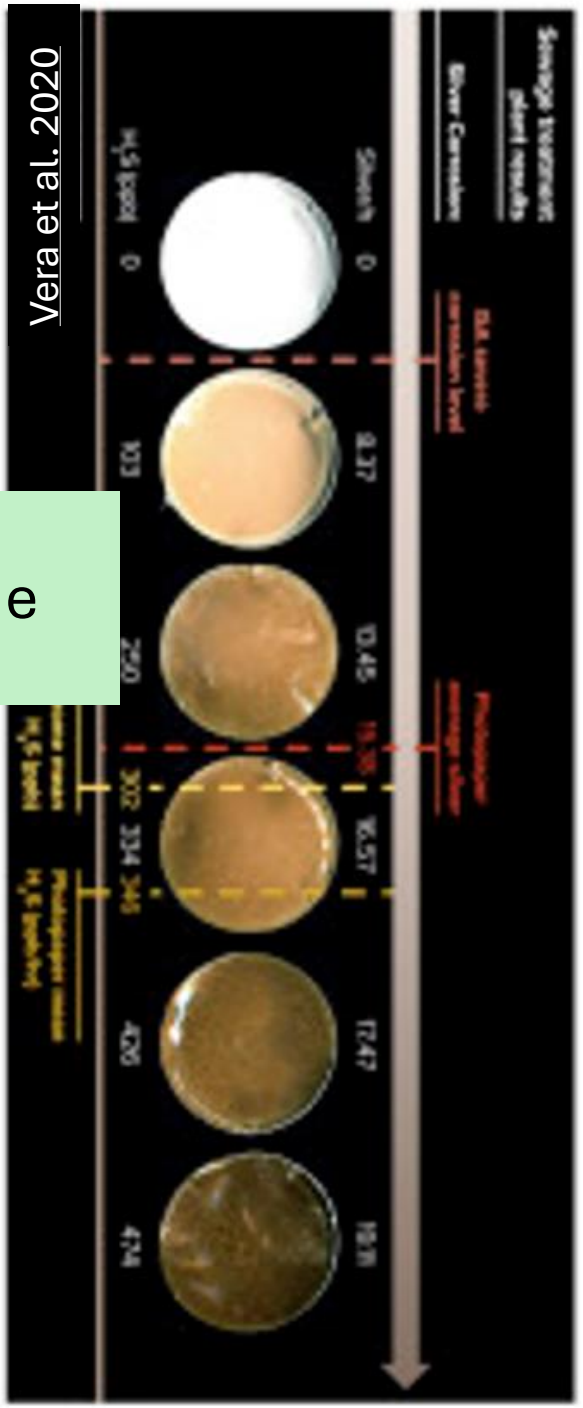
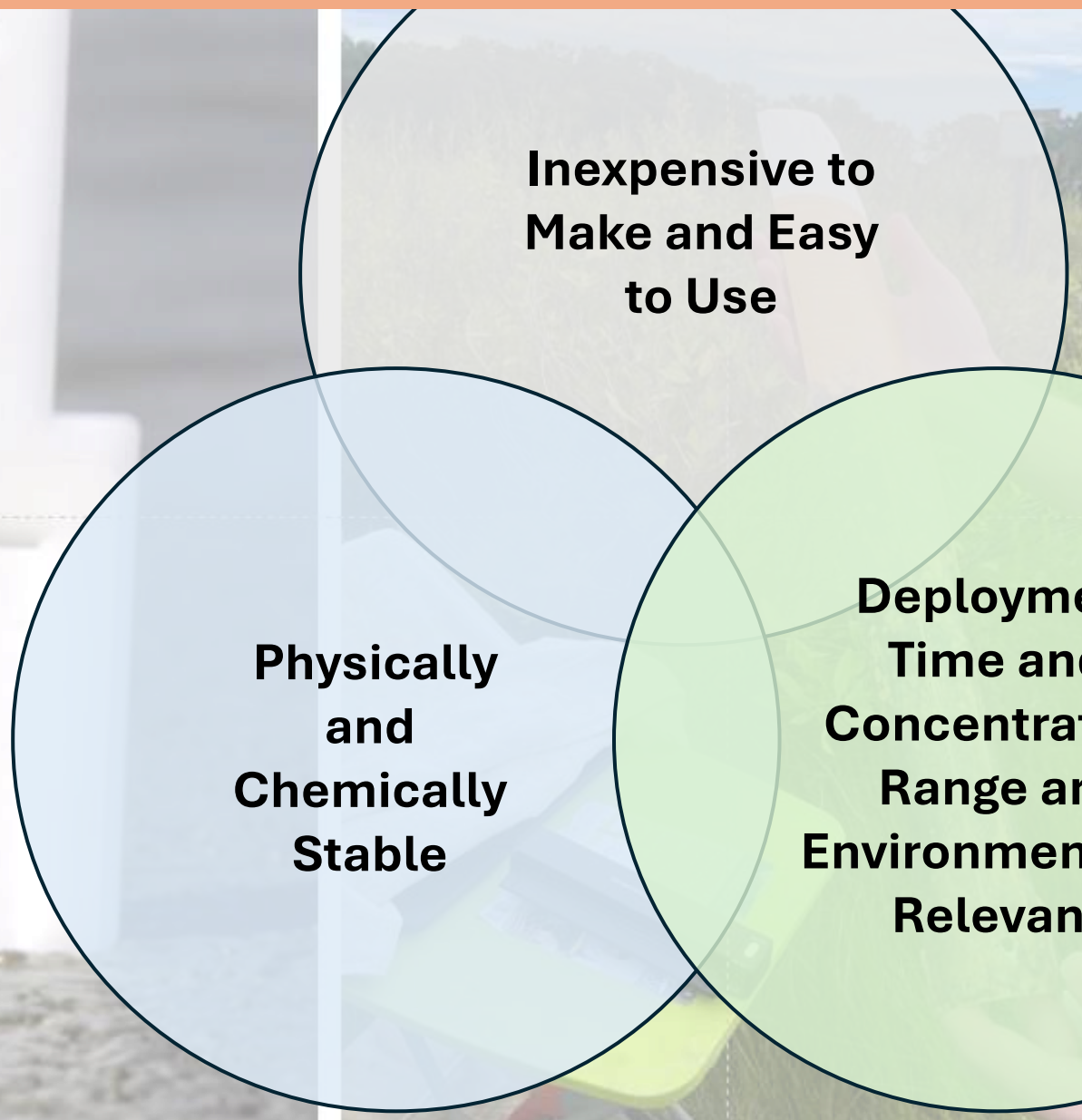


Existing Methods for Determination of Sulfide



Current Project Goal

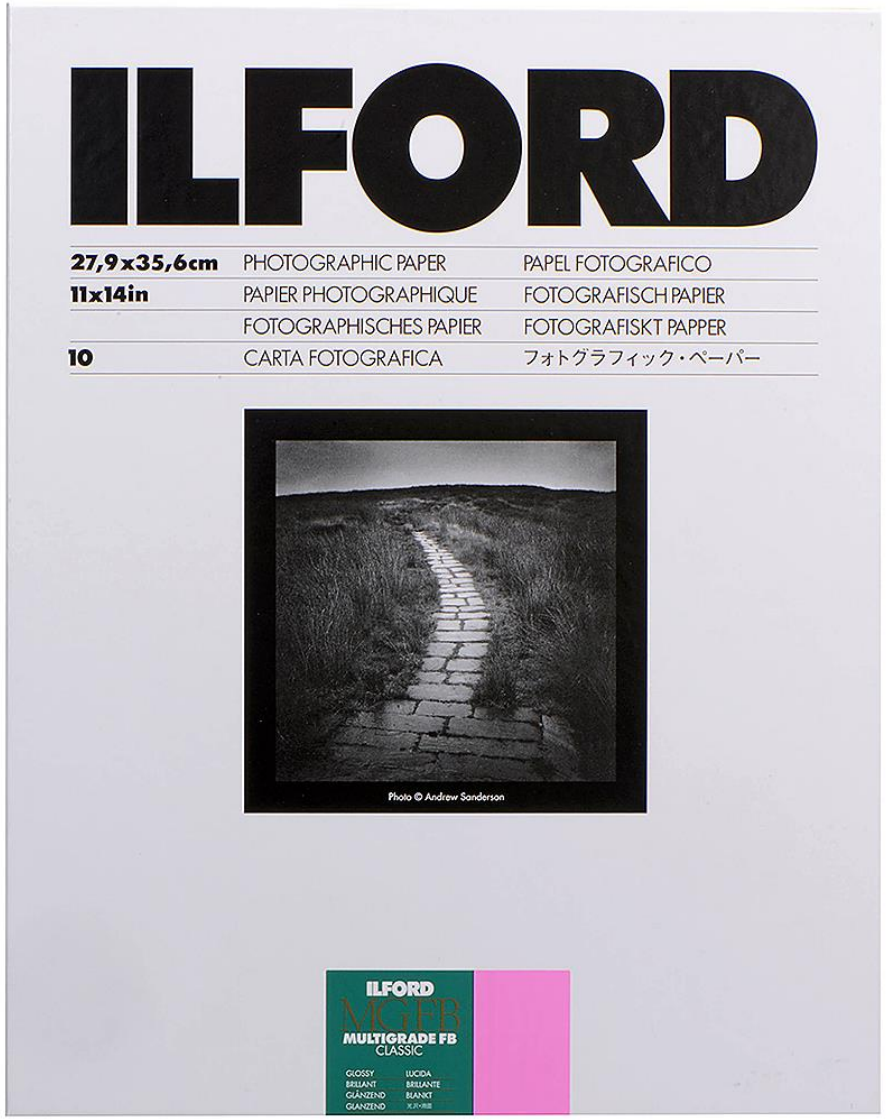


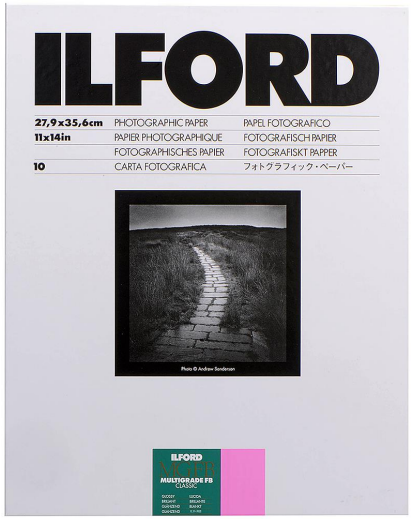
Photographic Paper

- ‘silver gelatin prints’
- If you’re a geochemist:
  - Ag-Halide $K_{sp} = 5 \times 10^{-13}$
  - Ag-S $K_{sp} = 5 \times 10^{-50}$

(meaning: how much should silver (Ag) want to react with sulfide if it’s present? Answer: a lot.)

- Could we use photo paper as an inexpensive, rapid, and stable alternative to other methods of porewater sulfide determination?

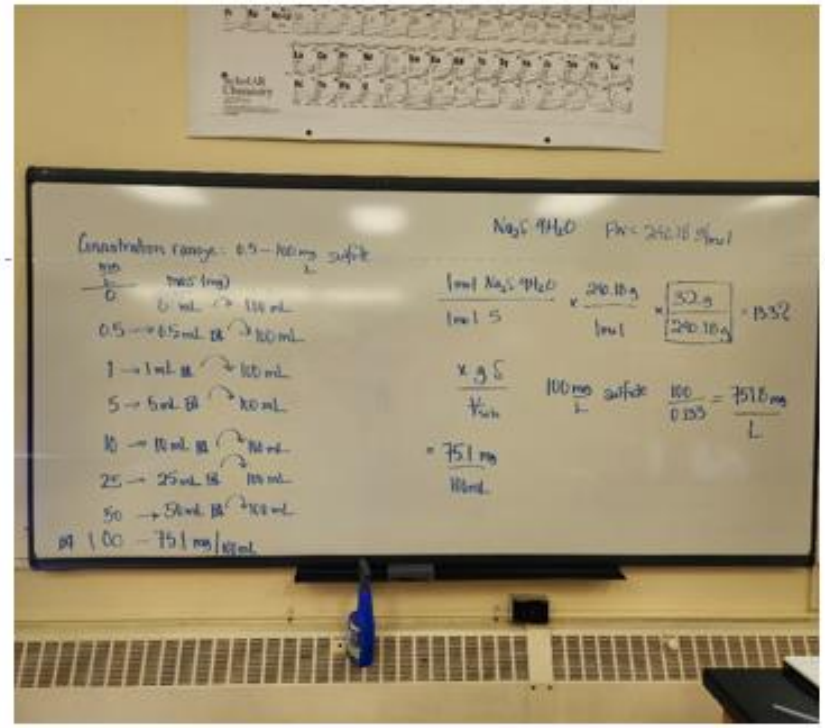




So:

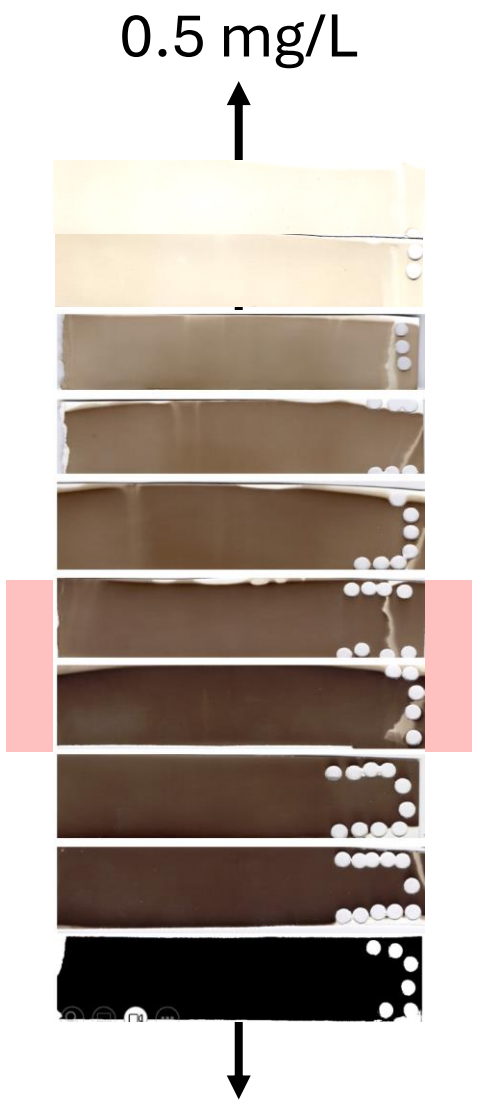
- $25 for 10 sheets (= 110 strips)
- $20 for a gallon of fixer
- $10 for 60 craft sticks
- tape of some sort
- headlamp with red light
- (custodial stockroom or other dark room for field prep)

Now take it to the lab



- Uptake and reaction of photopaper with sulfide is a kinetic process so deployment duration is a *f*(free sulfide present)
- Strategy is to test for deployment duration in a specific environment, confirm color intensity coverage and then create standards for that same deployment duration

5-min deployments



Old Pond Marsh, Hancock ME

Old Pond Pool

Old Pond Runnel

Northern Bay, Penobscot ME

N. Bay Pool

N. Bay Platform

Mill Creek Marsh Pool, Penobscot ME

Marsh Pool Blank

04.02.25

06.16.25

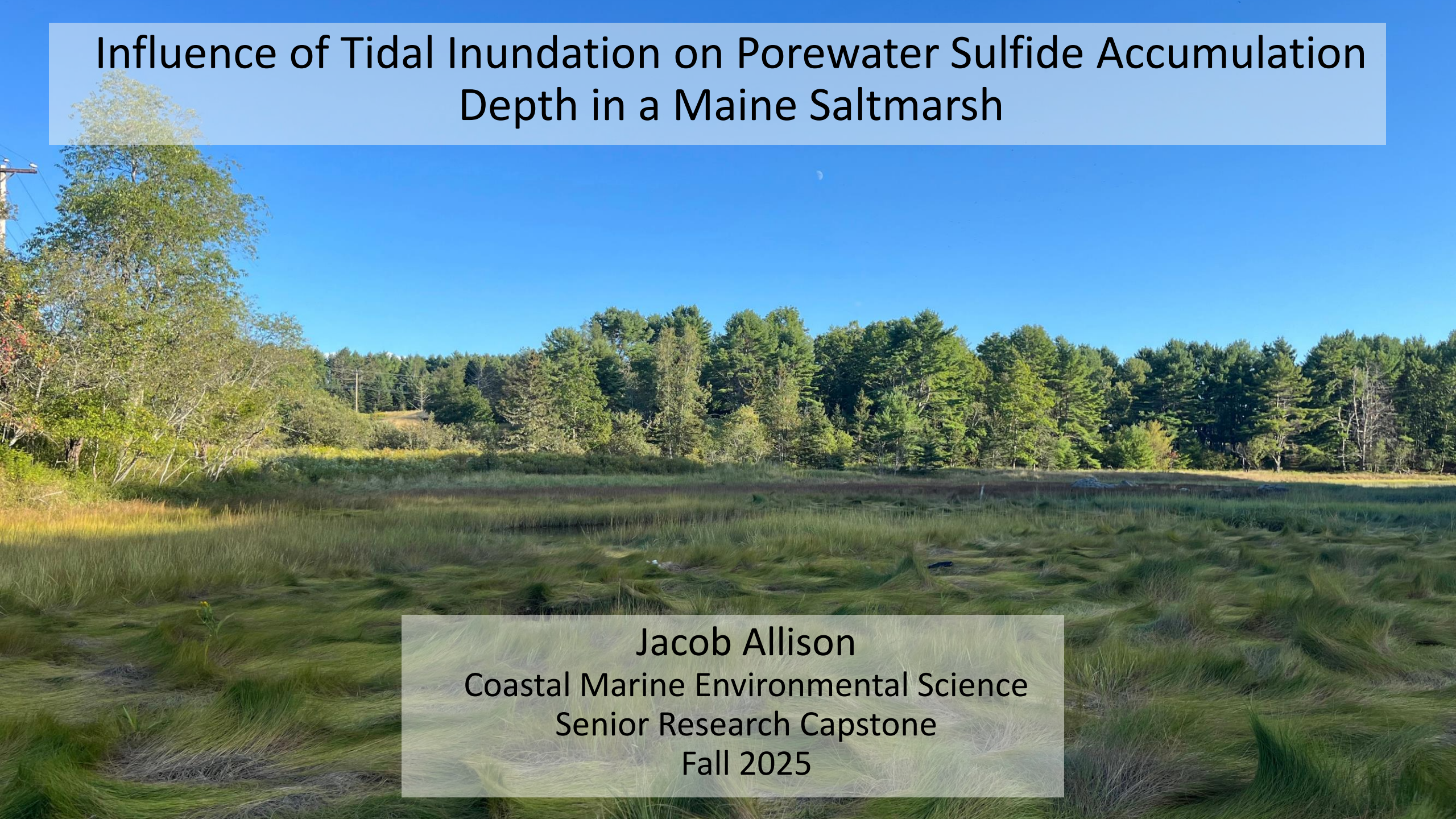
08.01.25

King Tide: August 24/25

08.26.25

09.16.25

Influence of Tidal Inundation on Porewater Sulfide Accumulation Depth in a Maine Saltmarsh



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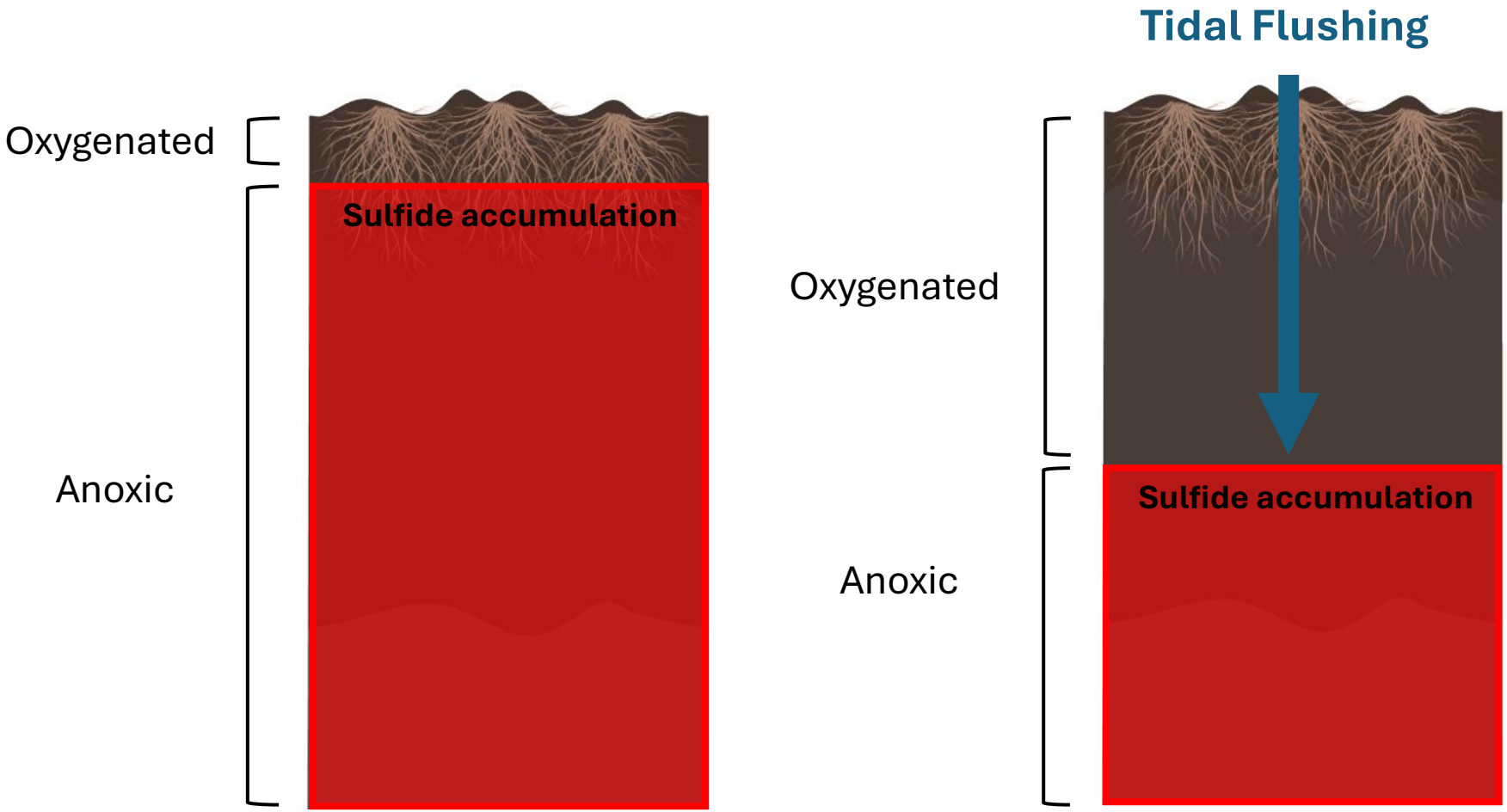
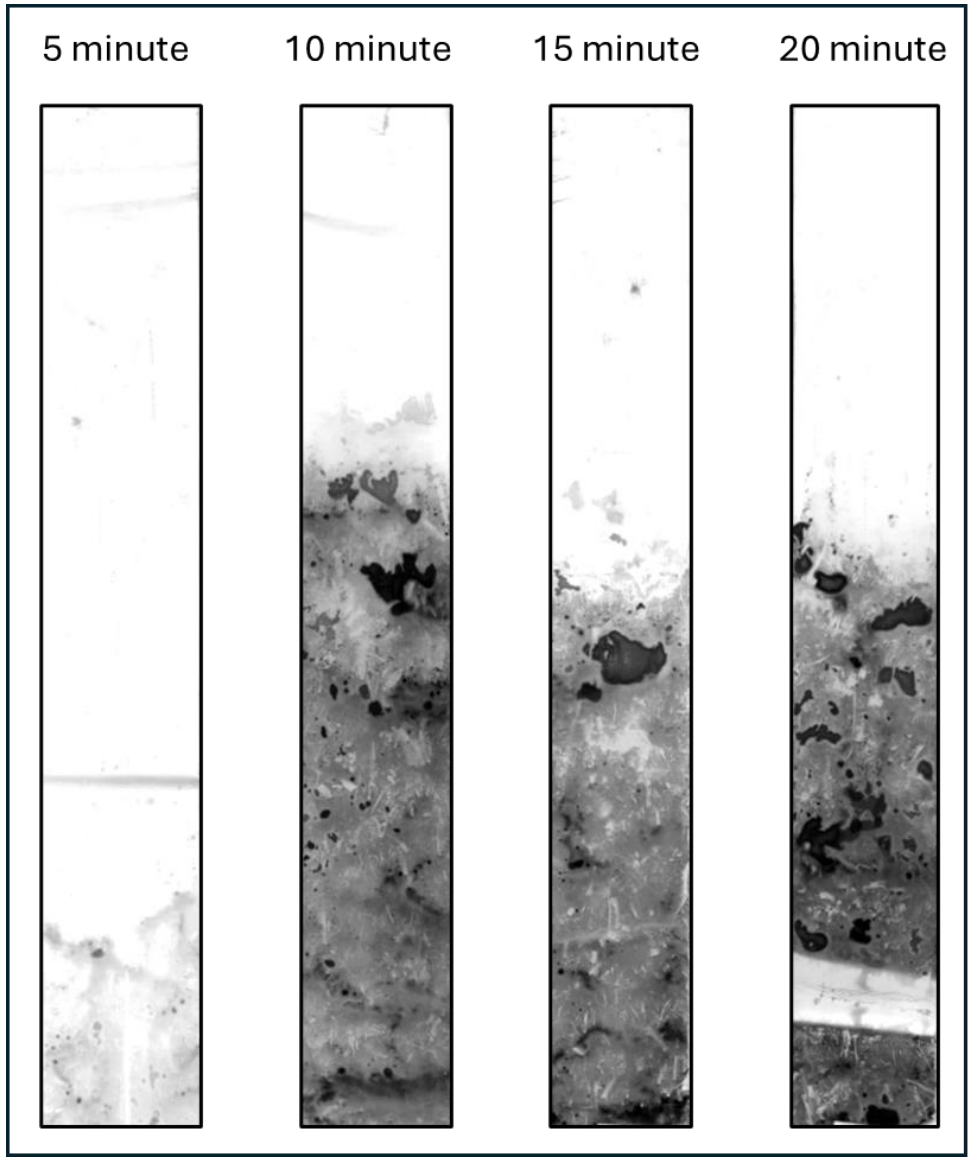
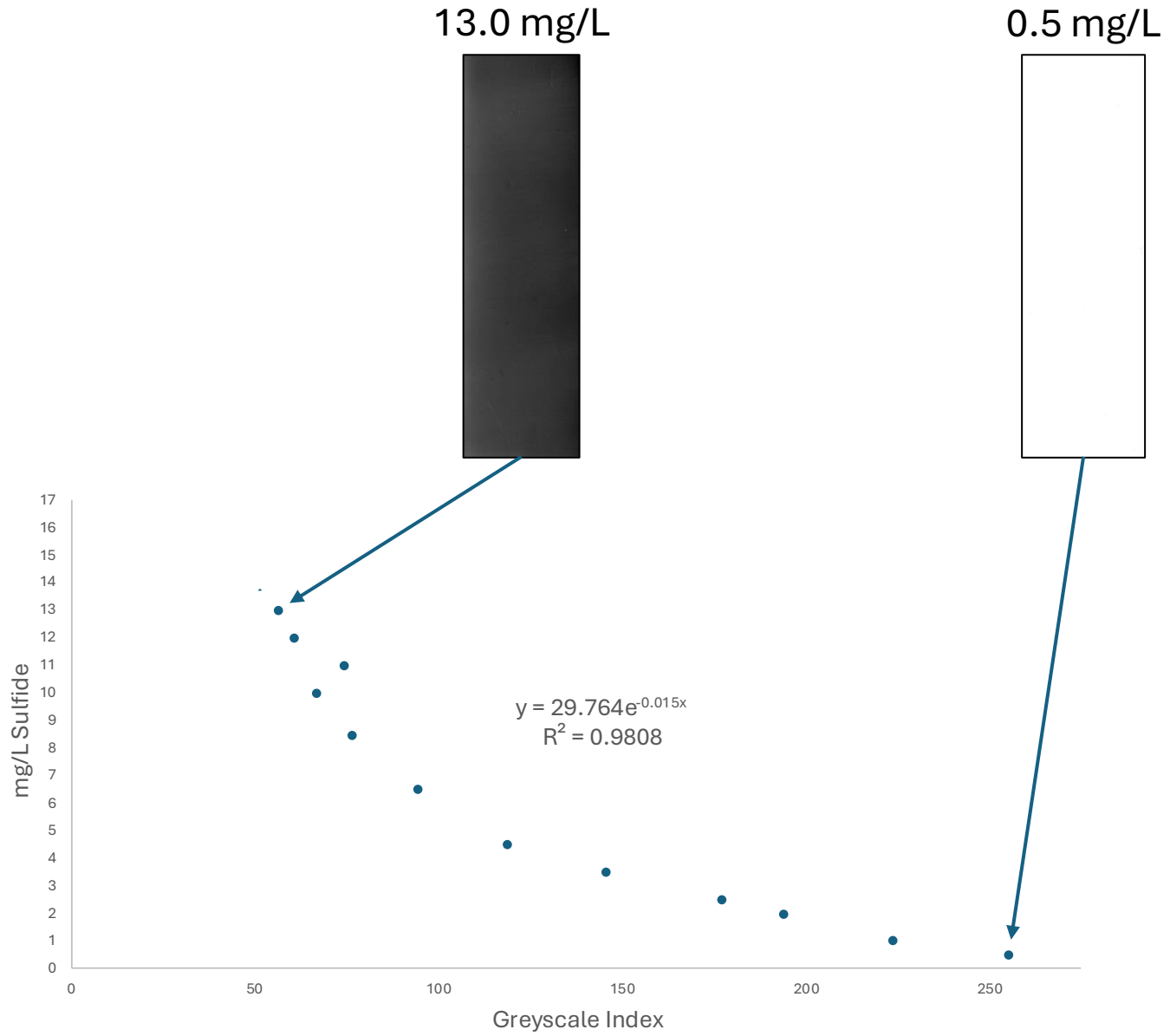
Hypothesis

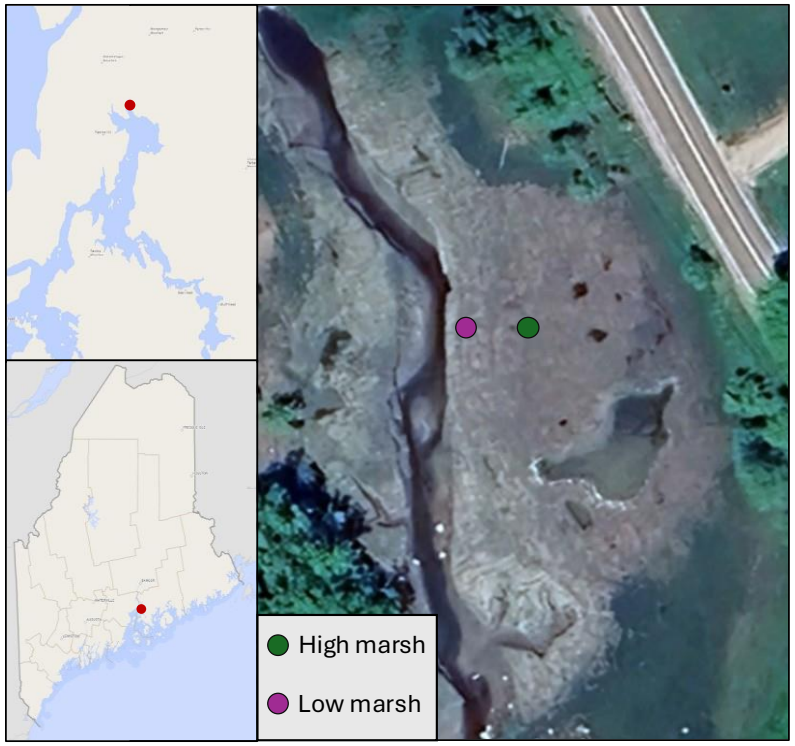
Tidal flushing prevents sulfide from accumulating to toxic levels in the root zone of saltmarsh plants



The marsh platform had significantly lower sulfide concentrations compared to marsh pools which required a new set of standards

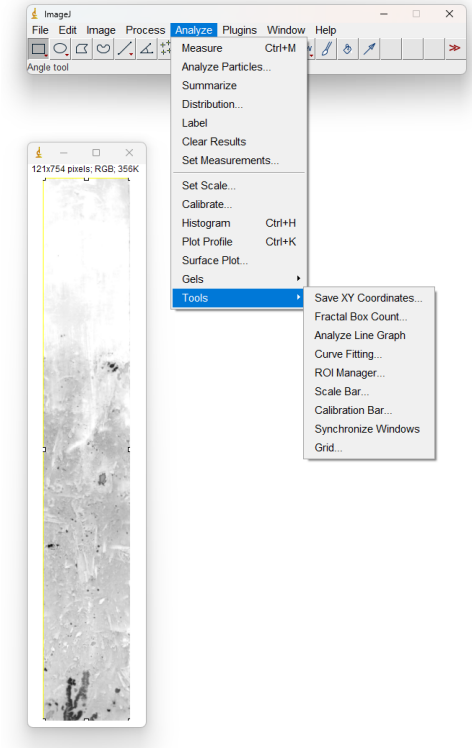






Test strip deployment

- Mill Creek Marsh (Penobscot, Maine)
- Two sampling locations
  - High marsh (*S. patens*)
  - Low marsh (*S. alterniflora*)
- Sampling occurred before, during and twice after inundation
- Samples were taken in triplicate



X	Y	Red	Green	Blue
0	0	255	255	255
1	0	255	255	255
2	0	254	254	254
3	0	252	252	252
4	0	251	251	251
5	0	251	251	251
6	0	249	249	249
7	0	250	250	250
8	0	251	251	251
9	0	252	252	252
10	0	251	251	251
11	0	252	252	252
12	0	253	253	253
13	0	253	253	253
14	0	254	254	254
15	0	255	255	255
16	0	254	254	254
17	0	252	252	252
18	0	251	251	251
19	0	251	251	251
20	0	250	250	250
21	0	249	249	249
22	0	249	249	249
23	0	248	248	248
24	0	248	248	248
25	0	249	249	249
26	0	249	249	249
27	0	248	248	248
28	0	246	246	246
29	0	246	246	246
30	0	245	245	245

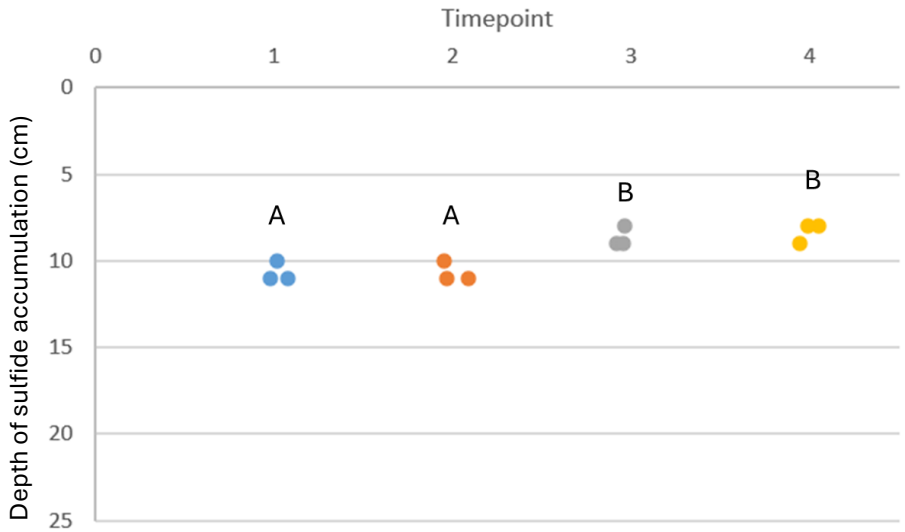
Depth (cm)	Percent Change
0	
1	0.03%
2	0.02%
3	-0.02%
4	0.01%
5	-0.03%
6	-0.16%
7	-0.88%
8	-0.40%
9	-2.67%
10	-9.51%
11	-16.42%
12	-20.41%
13	-23.74%
14	-32.35%
15	-28.75%
16	-33.29%
17	-35.91%
18	-36.37%
19	-40.33%
20	-39.65%

Data processing:

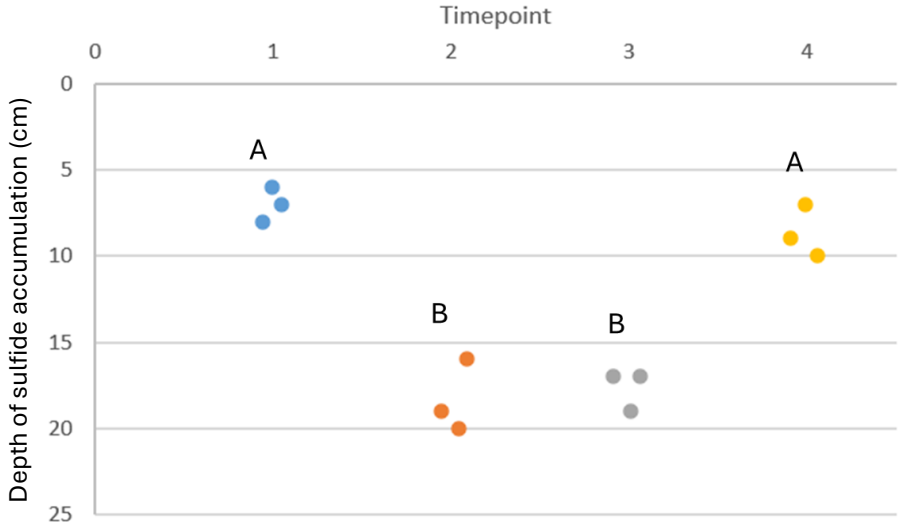
- Scan test strips (800 DPI)
- Crop individual strips
- Use ImageJ to save XY coordinates and intensity of each pixel
- Divide data into 1 cm depth increments
- “Sulfide accumulation depth” is the point at which there is a cumulative intensity change of 5.0%
- Repeat for each test strip

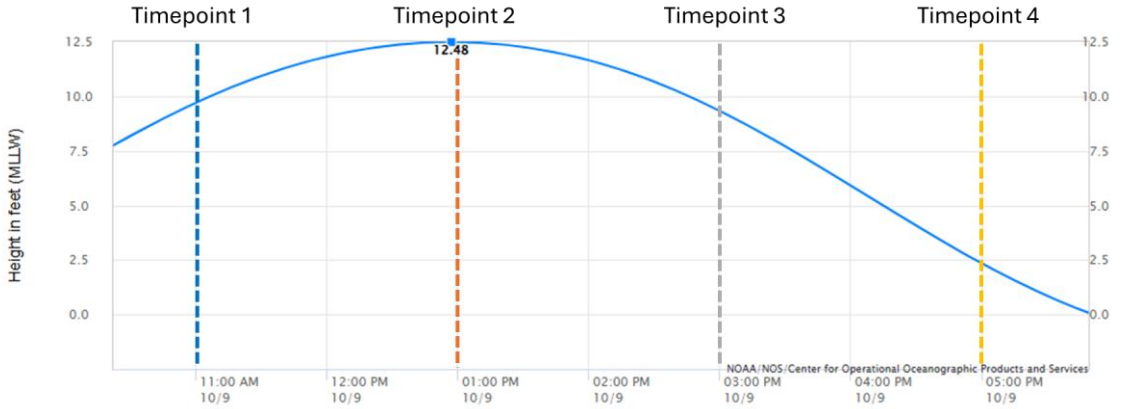
Tidal inundation caused a statistically significant shift in the sulfide accumulation depth in the high marsh and low marsh during a “king tide”

High Marsh

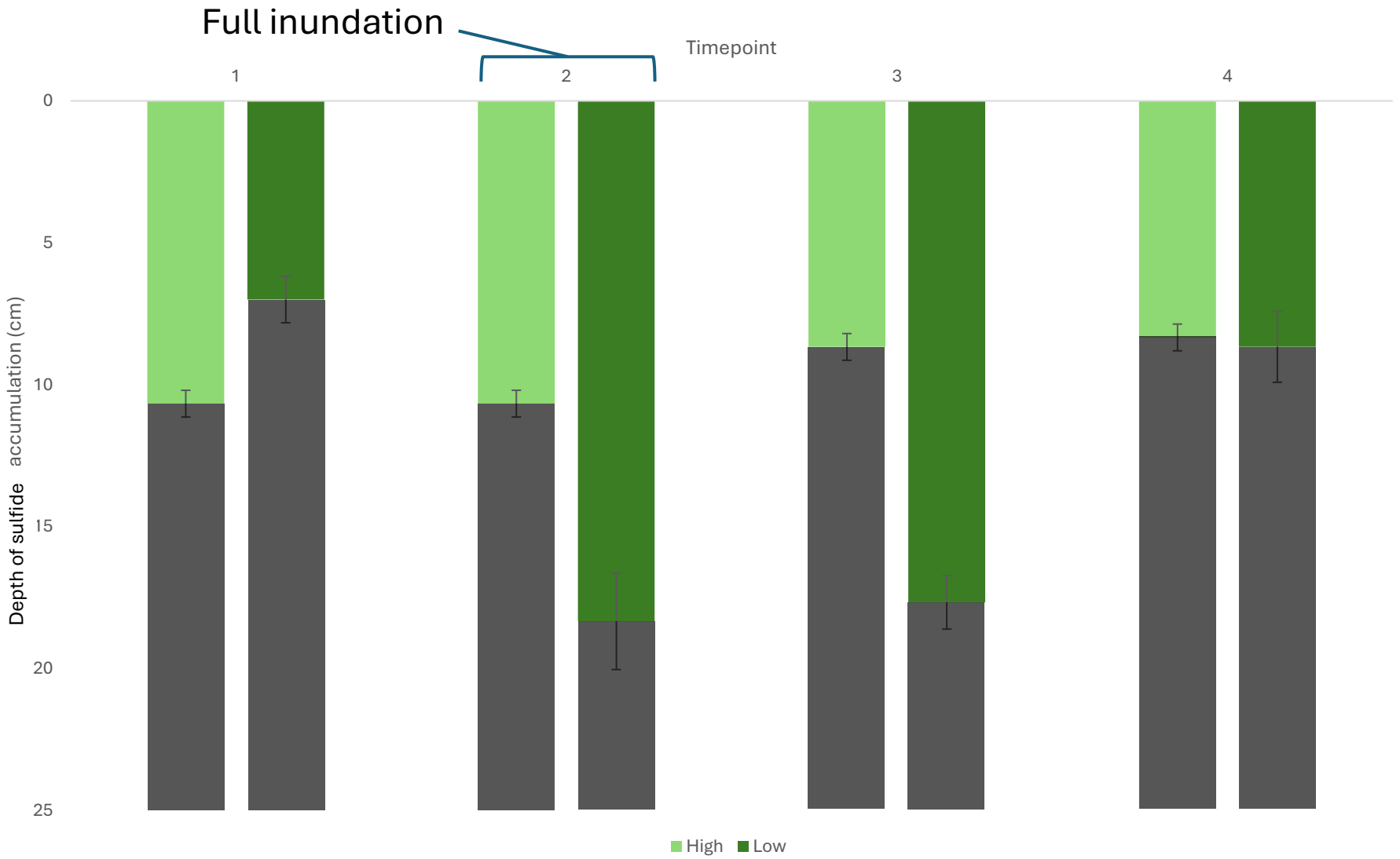


Low Marsh



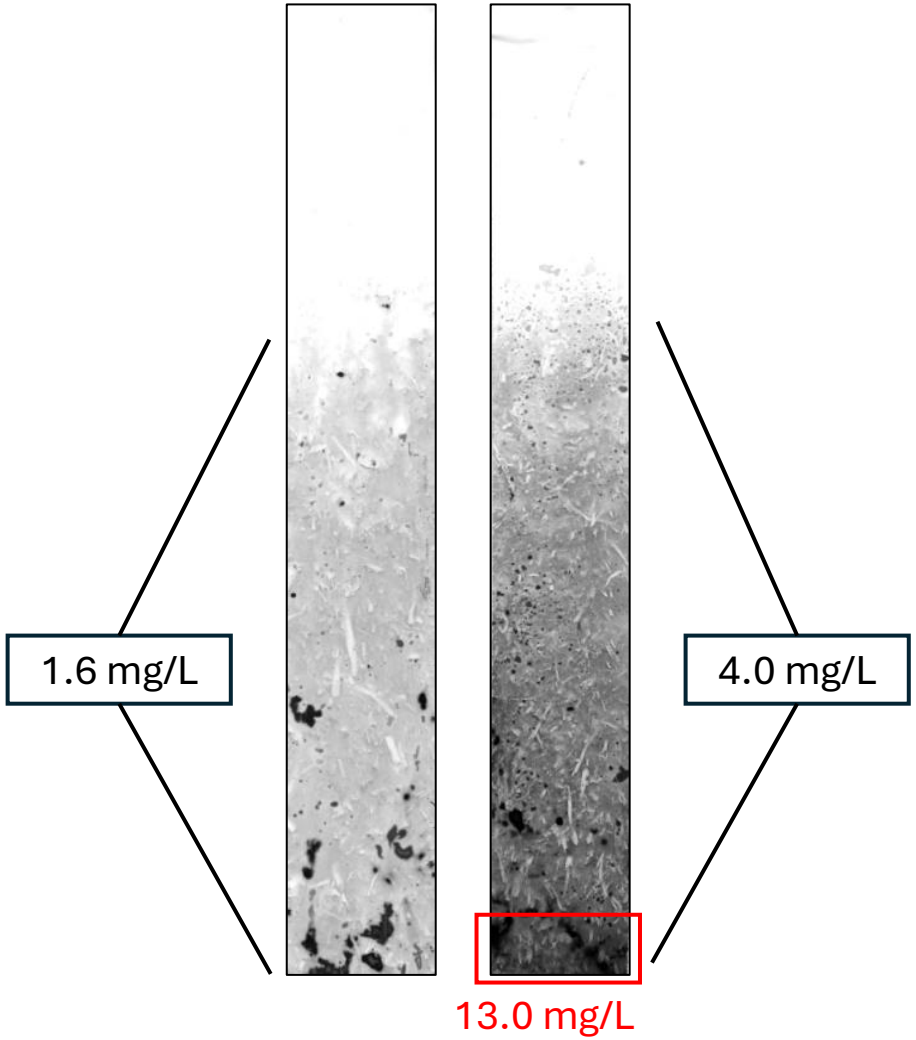


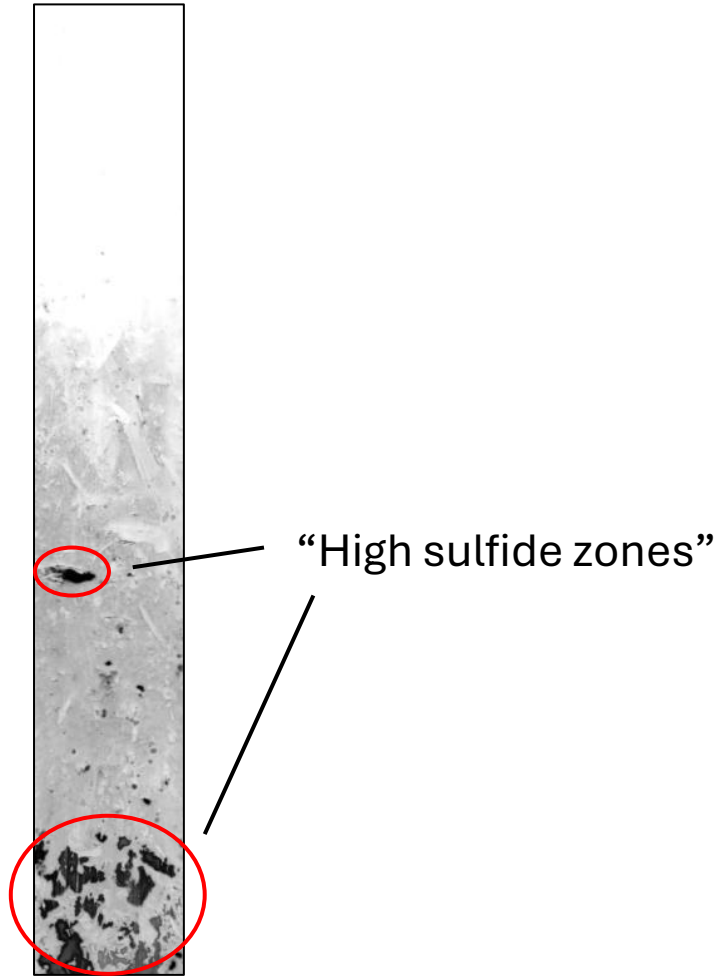
Hypothesis: Tidal flushing prevents sulfide from accumulating to toxic levels in the root zone of plants



Low marsh:
Yes!

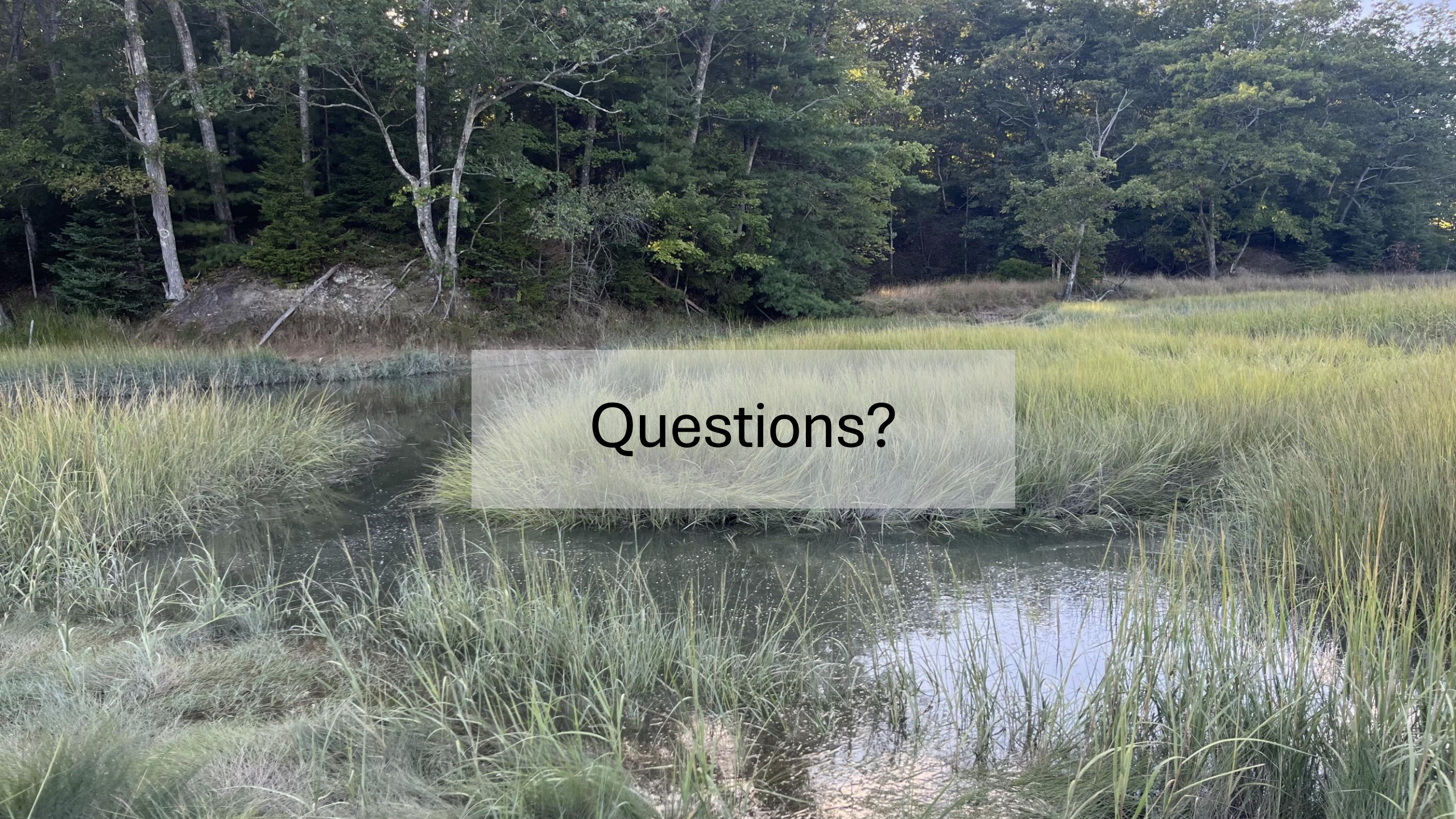
High marsh:
Unclear?





Next steps

- Integrate sulfide accumulation depth data with sulfide concentration data that have not yet been analyzed
- High sulfide zones? An area for future study


Questions?