Ebullition-related Considerations During a Sediment Site Feasibility Study

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INTRODUCTION

WHAT IS EBULLITION AND WHY DOES IT MATTER?

Ebullition in natural systems is the production of gases by microbiological activity.

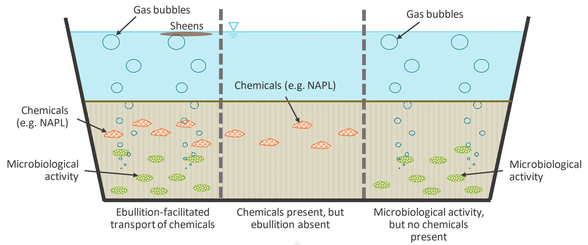
Gas production at depth could encounter and mobilize fines and chemicals (e.g., nonaqueous phase liquid [NAPL], Hg) as it travels up through the sediment column to the water surface in the form of bubbles.

KEY FEASIBILITY STUDY CONSIDERATIONS

A	Conceptual model (CM): ebullition-related
B	Nature and depth of ongoing microbiological processes
C	System response to changes in water column pressure
D	Managing methane buildup and capping viability
E	Development of practical remedial targets
F	Evaluation of potential remedial technologies that can address ebullition

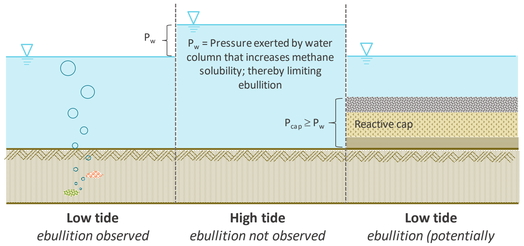
EVALUATING DEPTH OF EBULLITION OCCURRENCE THROUGH DATA COLLECTION AT VARIOUS DEPTH INTERVALS

A. CONCEPTUAL MODEL (CM)



Information on potential configurations within sediment.
Focus is on locations with both microbiological activity and chemicals present.

C. SYSTEM RESPONSE TO CHANGES IN WATER COLUMN PRESSURE



Capping as a potential remedial technology

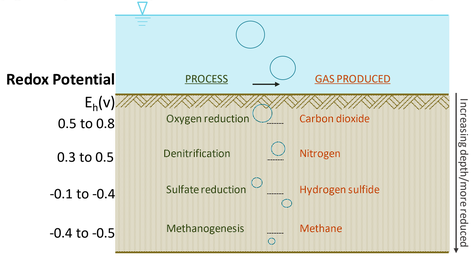
D. METHANE MANAGEMENT AND CAPPING VIABILITY

✓ Methane-consuming microorganisms and diffusion could prevent methane buildup

✓ Cap weight increases methane solubility and sediment strength and enhances cap viability

B. NATURE AND DEPTH OF ONGOING MICROBIOLOGICAL PROCESSES

Identify gases present in pore water at various sediment depths

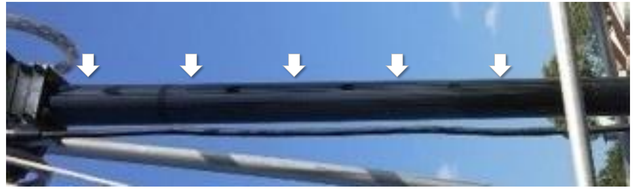


Gas-generating microbiological process occur in a well-established hierarchy

At depth, conditions are most anaerobic and methane is the primary gas produced

Methane is produced and consumed by methanogens and methanotrophs, respectively

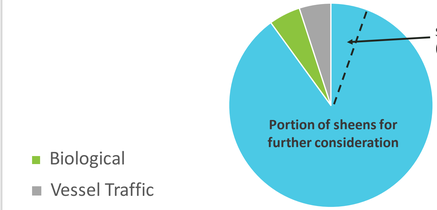
Measure sediment redox potential and identify gases present at intervals ( ) along sediment column



Isolate and identify depth of methanogens presence using appropriate techniques (e.g. fluorogenic probes to identify types of enzyme activities being expressed)

EVALUATION OF POTENTIAL REMEDIAL STRATEGIES

E. DEVELOPMENT OF PRACTICAL REMEDIAL TARGETS



F. POTENTIAL REMEDIAL TECHNOLOGIES THAT ADDRESS EBULLITION

ONGOING NATURAL PROCESSES

- Ebullition declines over time as nutrients are utilized and eventually exhausted
- Diminishing ebullition in older, deeper sediment is expected

CAPPING

- Cap pressure (like high tide) increases methane solubility resulting in decreased ebullition
- Reactive cap materials can attenuate ebullition-induced chemical flux

IN SITU TREATMENT

- Disrupt anaerobic microbial activity using in situ solidification, biocides, or oxidants

REMOVAL

- Target sediment depth to which active ebullition is occurring in contaminated layers

CONCLUSIONS

1. Ebullition results from microbiological activity
2. Need to establish levels of undesirable and controllable sheens
3. Identify depth at which ebullition is occurring in sediments
4. Focus on areas not targeted for removal and where chemicals will remain
5. Select and implement appropriate strategy to address ebullition-facilitated transport of chemicals