South Australian clay HAB mitigation trials

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Position: Principal Marine Scientist

Acknowledgement of Country

We acknowledge the Kaurna people of the Adelaide Plains as the traditional custodians of this Country on which we meet and pay our respects to their elders past and present.

We appreciate their traditional knowledge, care of, and spiritual connection to the air, land and sea.

We thank them for their ongoing stewardship and ways of seeing, thinking and being as part of Country.

Alongside Aboriginal nations, we strive to protect and grow the health of our beautiful state.

Artwork by Ngarrindjeri artist Jordan Lovegrove.

Background

Clay has been used to mitigate HABs

- Not species specific
- Acts as a flocculant
- Surface charge plays a key role
- Unmodified clay has negative surface charge
- Algae also have negative surface charge

= repel

Huge volumes required

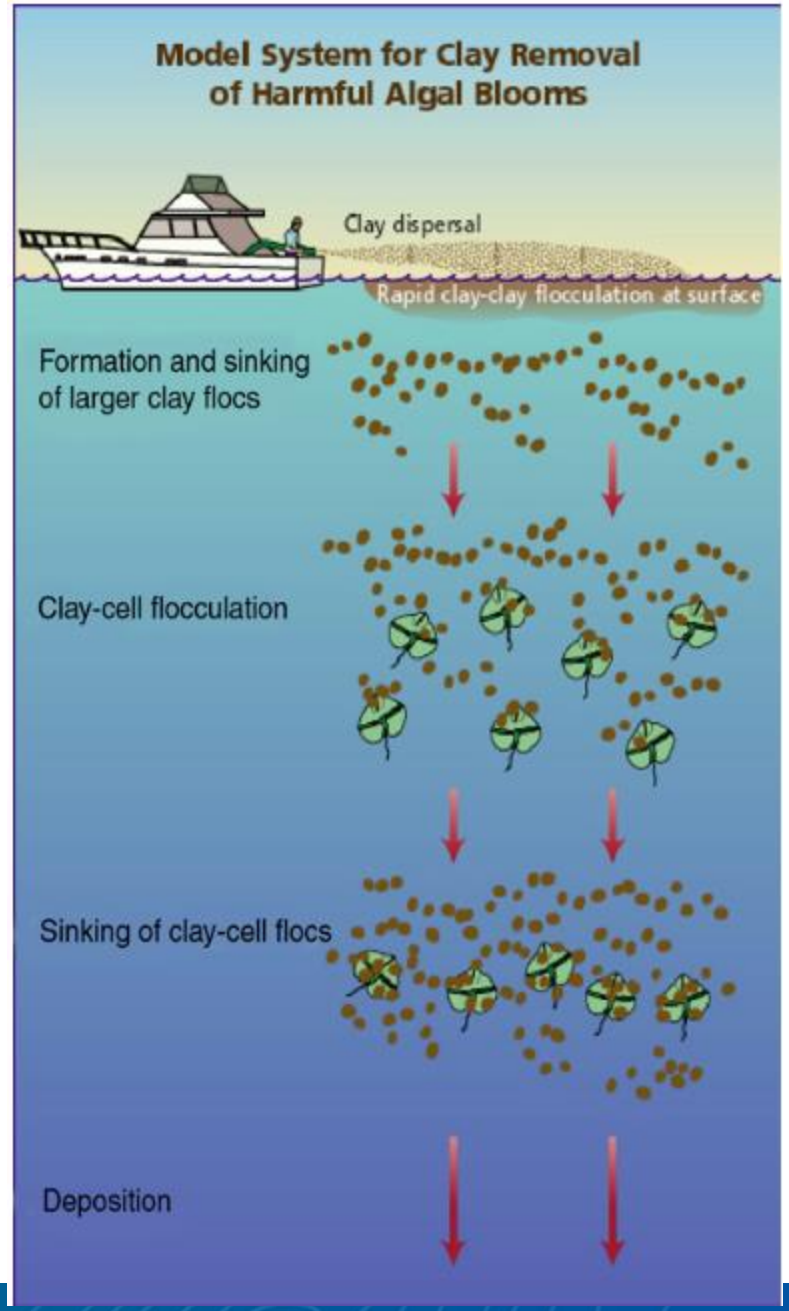


Image : WHOI

Timeline

- Late 1980's first documented use for HAB mitigation in Japan
- Mid 1990's Korean Loess used to mitigate *Margalefidinium polykrikoides* blooms in South Korea with positive impacts on local fisheries
- Late 1990's Korea develops early warning systems and clay dispersal strategies for routine use
- 2000's China uses clay to mitigate HABs on a large scale particularly for aquaculture protection
- Development of modified clays
- 2000-2010s laboratory and mesocosm trials in Europe and US
- 2010s further development of modified clay technology
- 2020's research and trials in US (some regulatory hurdles)
- Widespread operational use of clay (un / modified) only in Asia.

Modified clay

- Most well developed modified clay is modified with poly aluminium chloride (PAC)
- Various formulations but MCII is used throughout China.
- MCII has a positive surface charge attracting negatively charged particles.
- Acts as a coagulant and flocculant = significantly more efficient
- Unmodified clay ~400 t / km^2 vs MCII 4-10 t / km^2

EPA role

EPA was tasked to triage proposals to mitigate HABs

- MCII was proposed for use and warranted further work
- Any material used to kill algae can be considered an algicide and requires APVMA approval
- Addition of clay into waters is prohibited by the *Environment Protection (Water Quality) Policy 2015* and would require an exemption for use
- APVMA provided an emergency permit restricted to use by the Taskforce
- EPA recommended progressing to lab scale testing

Clay application trial

EPA was tasked to triage proposals to mitigate HABs

- Tested three clay formulations (PAC)MCII, SA Kaolin and Landscaping clay (kaolin)

- Used field collected Karenia sp.
- Required testing over two phases
- Tests ran for 24 hours

What was tested

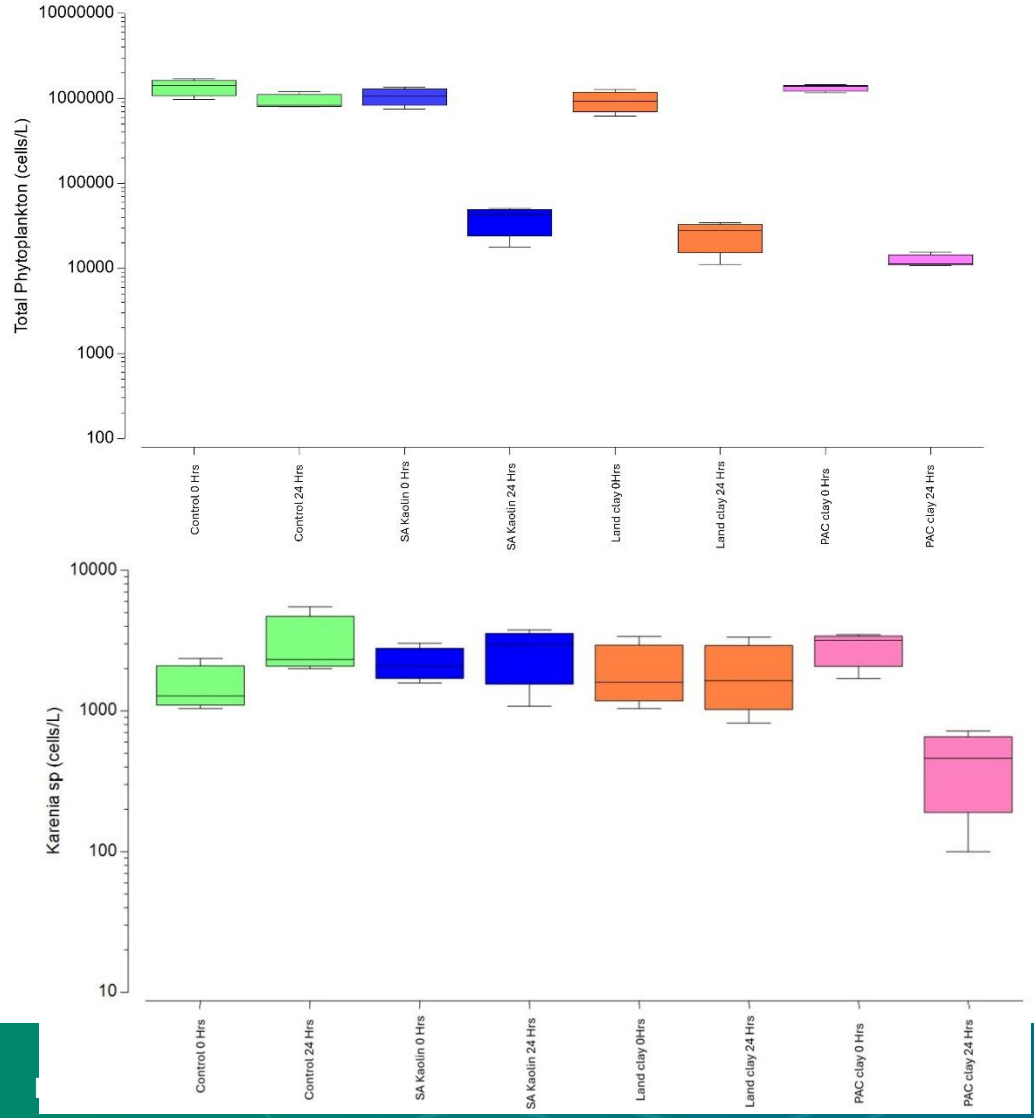
Tested phytoplankton removal (inc. Karenia sp.)

Metals (total and soluble) in waters and sediment (phase 2)

Toxicity tests (RTgill-W1 cell line) and rotifer (*Brachionus sp.)*

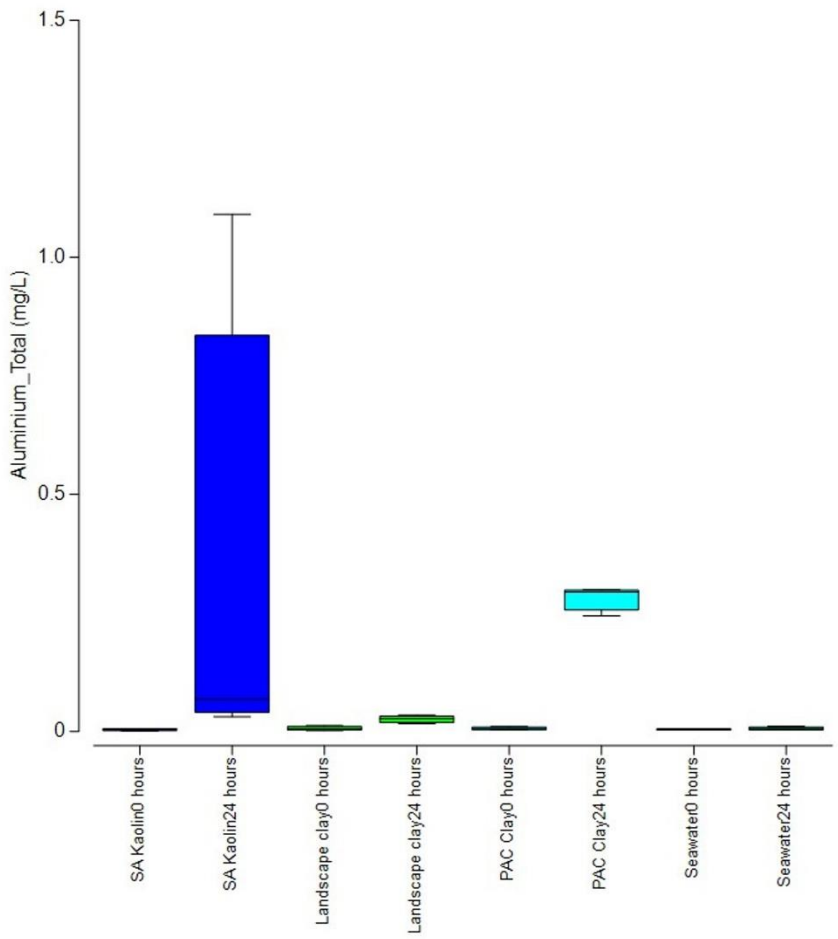
Brevetoxins (ELISA)

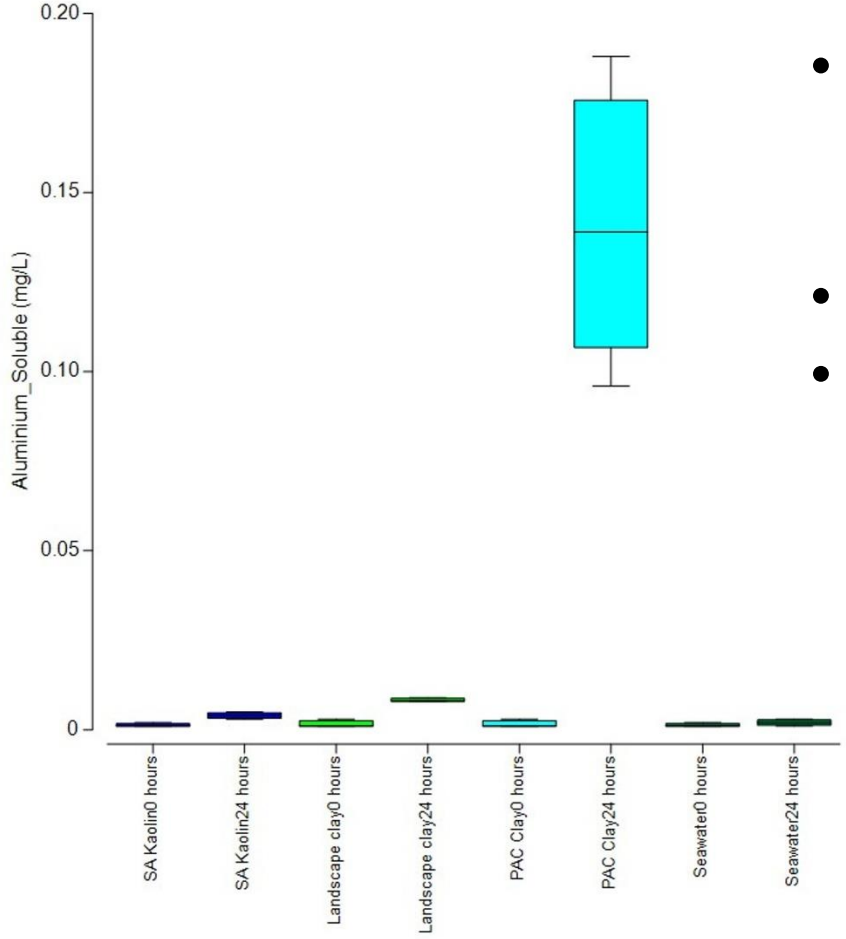
Phytoplankton removal



- All clay treatments reduced phytoplankton with removal efficiencies 96.5 – 99.1%
- Only PAC clay reduced Karenia sp.
- However limitations in using field collected Karenia.

Waters



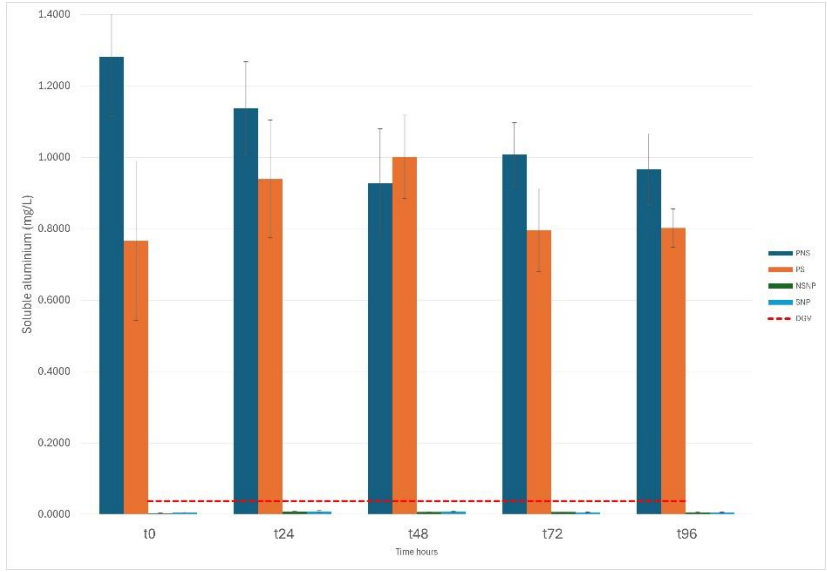


- PAC clay increase soluble aluminium in waters
- ~ 3 x higher than DGV
- Factors can mediate toxicity including pH and potential for sediment interactions in the field

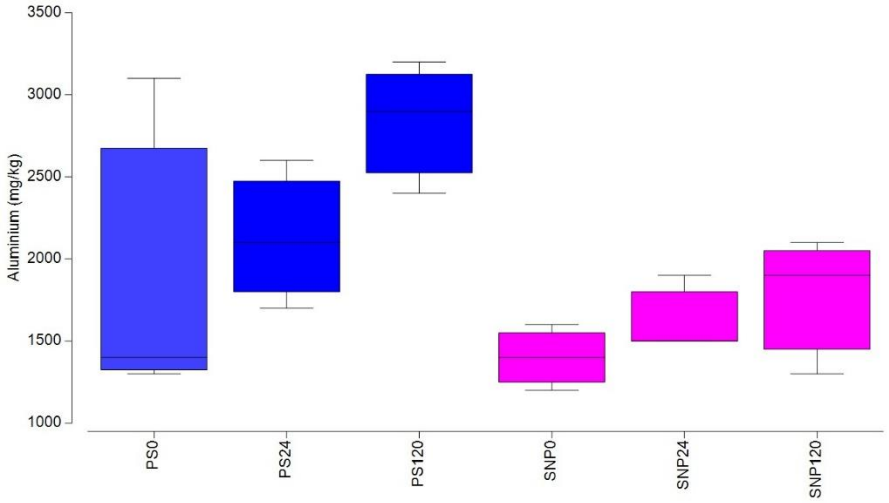
Sediments

Addition of PAC clay lowered pH so second test was undertaken over 120 hours

- Included pH buffer
- Addition of sediment



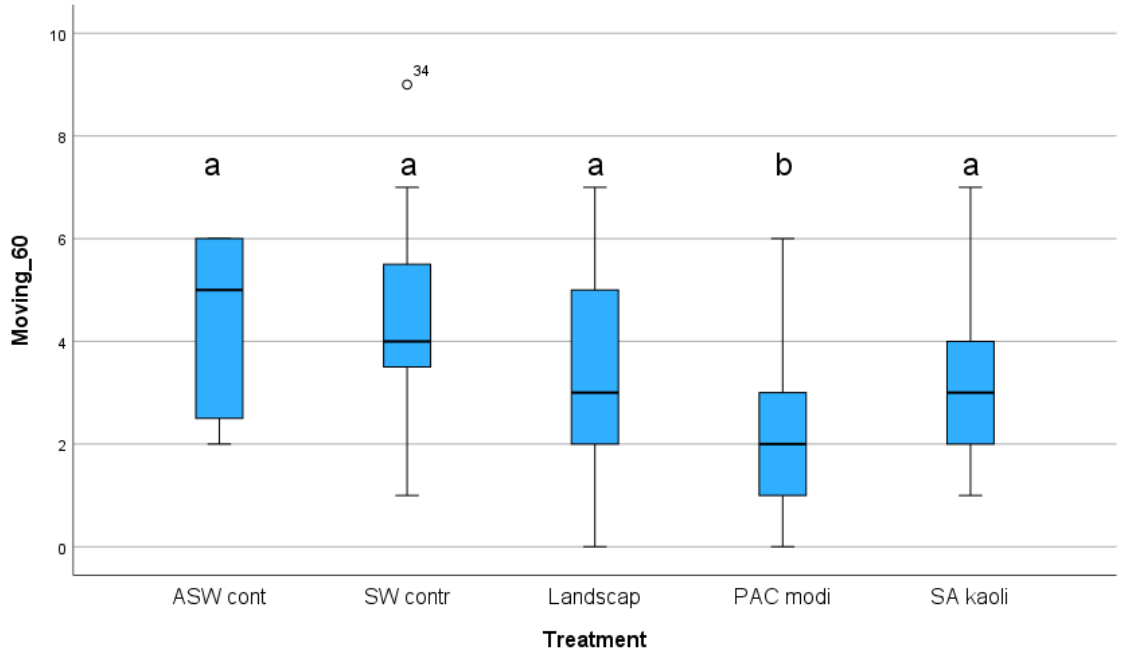
- pH buffering had no effect
- Inclusion of sediment had minor effect
- Sediment accumulated aluminium from PAC clay treatment (p=0.033)

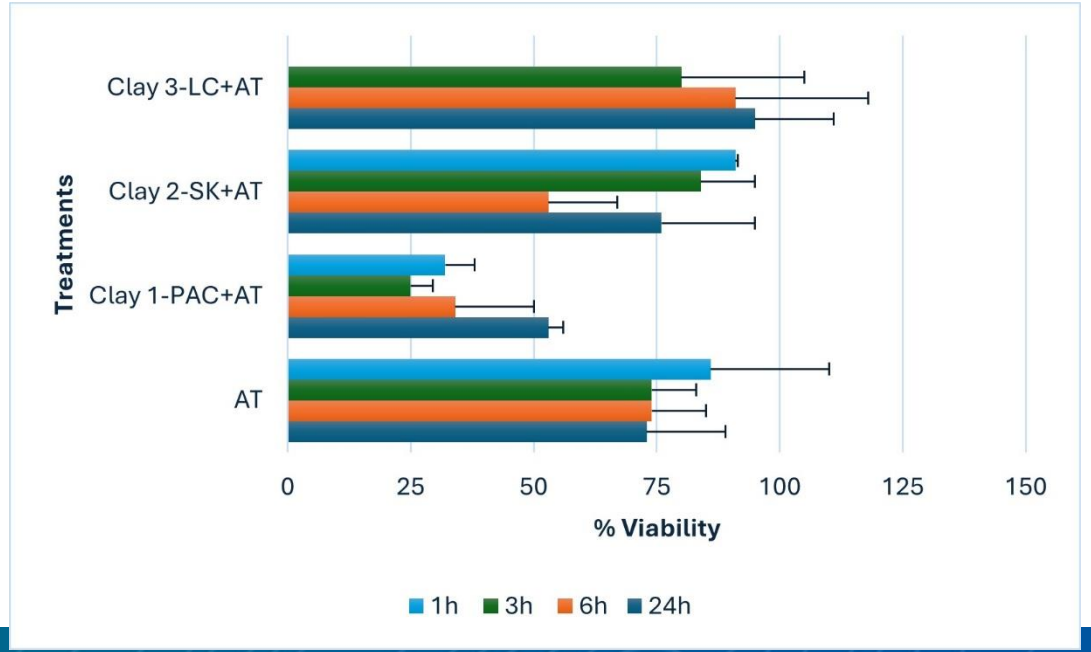


Toxicity

Rotifer test showed toxicity compared to all other treatments. Other treatments showed no effect

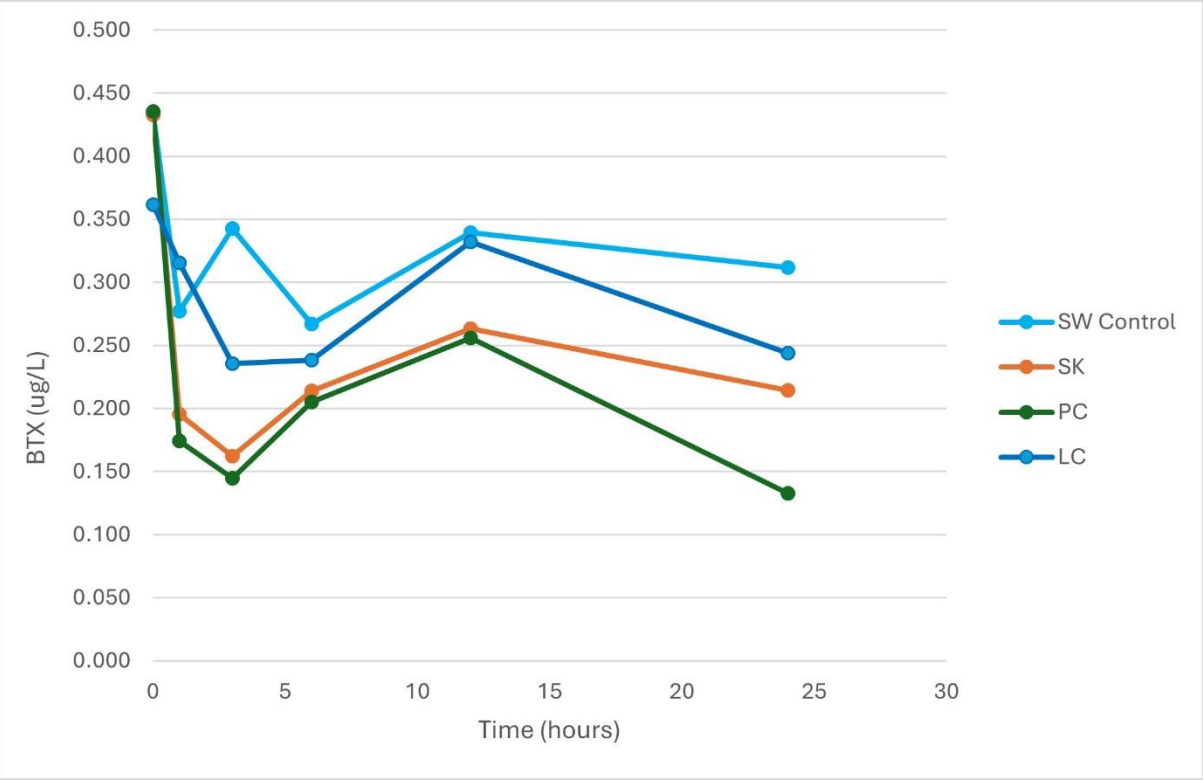
RT gill W1showed toxicity due to PAC clay treatment





Brevetoxins

A reduction in BTX was observed but not as a result of the clay treatment (p = 0.089)



Conclusions

- PAC clay was the most effective formulation for reducing HAB abundance

However

- Significant non target toxicity observed
- Potential for long term sediment effects
- No effect on brevetoxins

- The EPA recommended it is not pursued further. Decision is consistent with US and most European decisions on MCII

Acknowledgements

Involved:

EPA - Clive Jenkins, Matt Nelson, Natan Noel, Kingsley Griffin, Mollie Owens

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UTAS - Andreas Seger

WHOI – Don Anderson

Thank you

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