
VESTA

Dr. Stephen Romaniello

Director of Geochemistry @ Vesta

- Marine biogeochemist and isotope geochemist (> 50 published peer-reviewed scientific papers).
- Formerly Gerald D. Sisk Associate Professor of Isotope Geochemistry at U. of Tennessee, Knoxville.
- Switched to Vesta full-time in 2021 during the pandemic. Adjunct appointment at Arizona State
- Responsible for scientific direction of Vesta, including R&D, fieldwork, modeling, MRV development, and reporting to state and federal authorities.

Vesta's Progress Since 2022

What have we been up to?

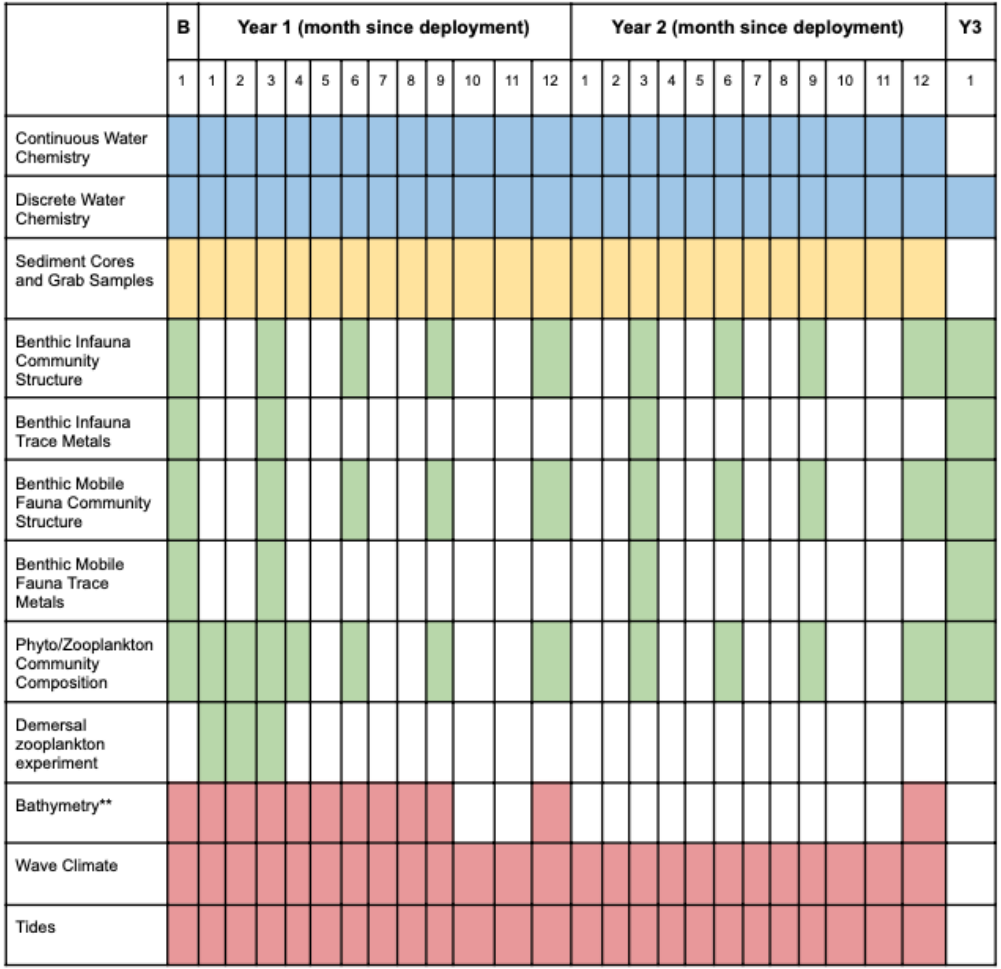
- **Pilots:** Conducted 3 pilot experiments
  - Southampton NY (beach, 600 tons)
  - Herring River, MA (salt marsh, 1 ton)
  - Duck, NC (offshore berm, 8000 tons)
    - First federally-permitted standalone OAE field trial in the US.
- **Lab Experiments:** Conducted more than a dozen ecotoxicology experiments.
- **Publications:** Published 5 papers (4 through peer review) with data and results for as many as 10 more papers in prep.
- **Funding:** Invested more than $20 million into marine OAE research and development.
  - Special thanks to major contributions from The Grantham Foundation
- **Innovative Model:** Partnered with Hourglass Climate to provide objective, independent monitoring and evaluation of our field pilots.
- **Collaborations:** Worked alongside at least 22 academic institutions, NGOs, federal agencies and commercial partners.

- Deployed in May -June 2024
- 8,300 metric tons of olivine, 500 meters offshore in 7 meters of water as a nearshore berm
- Collaborators: US Army Corps of Engineers, Hourglass Climate, Coastal Studies Institute
- First Standalone US mCDR permits
- ~$12M, ~ $7M for MRV and eMRV

Monitoring Plan

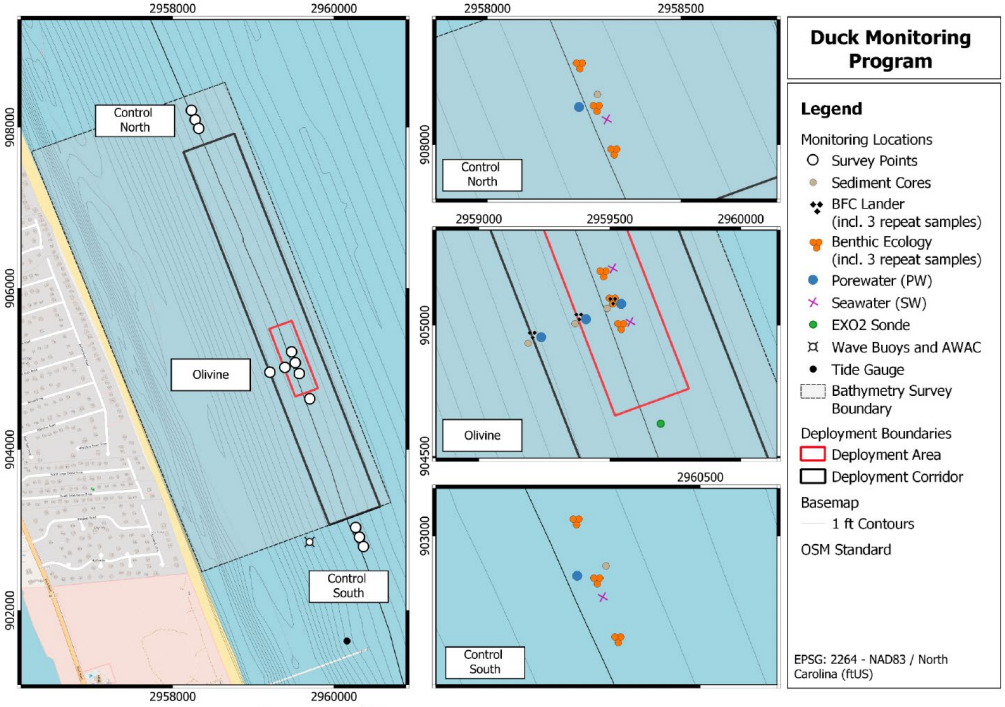
> 2 years of independent monitoring

- Major monitoring categories include water quality, ecology, and sediment transport for assessing ecological impact and carbon removal
- Monitoring plan also included side-scan sonar, protected species observer, and turbidity monitoring during deployment
- Annual reporting to state and federal agencies
- Multiple, independent monitoring collaborators
- Full monitoring plan is publicly available. Email steve@vesta.earth.



Ecological monitoring program

BACI design for monitoring geochemical, sedimentological, and ecological parameters



- Initial monitoring for megafauna and turbidity during placement of material
- Regular sediment cores + water column and porewater sampling conducted with sondes, Niskins surveys and custom hardware
- Focus on species diversity and abundance with additional monitoring for ecotoxicological impacts from trace metal concentration and bioaccumulation
- Methods include collection of benthic infauna and trawl surveys for mobile fauna

Coastal Studies Institute
A Multi-Institutional Research Partnership

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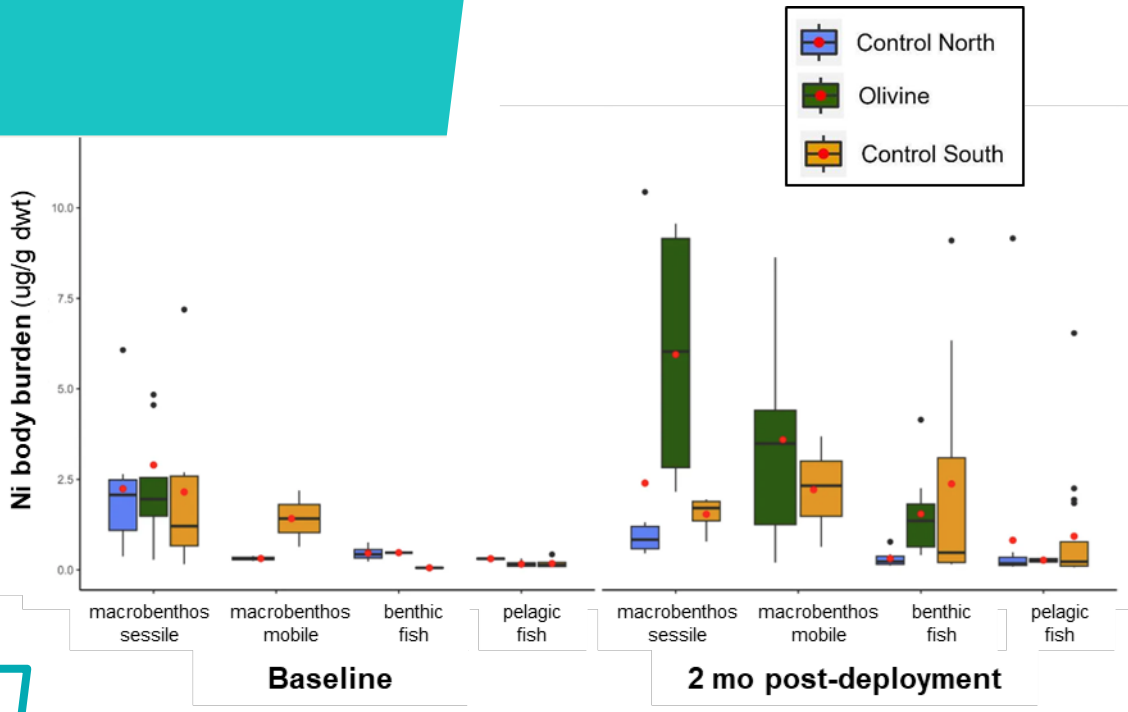
Monitoring results at a glance

Ecology

- Ecology results to date show low, but detectable, nickel concentrations increases but no evidence of ecological impact.
- Full species recovery for abundance and diversity after 2 months
- No uptake of other trace metals; potential evidence of Ni biodilution



Ecological safety will be driven by olivine concentrations. Need to evaluate thresholds and engineer deployments on a site-by-site basis.

Independent data collection and analysis by "Jankowska et al, 2024, AGU Fall Meeting"

HOURGLASS CLIMATE

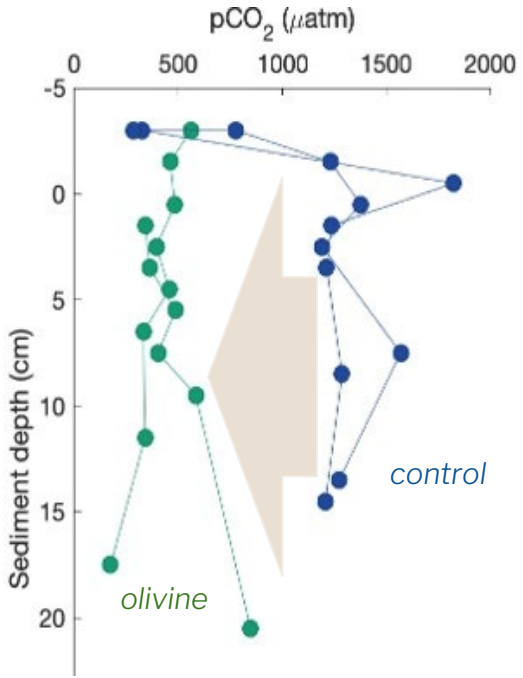
Monitoring results at a glance

Carbon removal

- Olivine is dissolving and geochemical parameters suggest carbon removal is occurring at the site
- 3 weeks post placement data indicated carbon removal via carbonate mineral formation
- 9 weeks post placement, data suggests carbon removal possibly driven by alkalinity generation
- Treatment site sustained higher pH (0.3 units) over 7 months

Carbon-removal effectiveness will be driven by olivine concentrations. Need to engineer deployments on a site-by-site basis.

CO_2 concentrations in olivine area compared with control area



Independent data collection and analysis by

HOURGLASS CLIMATE

What's next for Vesta?

Plans going forward

- **Publications:** Results of field pilots in peer-reviewed journals and public reports expected to be published in the near future.
  - In the meantime we would be happy to all share the results with NASEM or discuss with other outside third parties. Please reach out to steve@vesta.earth.

- **Partnerships and Governance:** Over the next 18-24 months, Vesta plans to continue our strategy of research through deployment. We are currently focused on:
  - Engaging with coastal construction partners;
  - Establishing independent oversight to guide and govern our research efforts (stay tuned!)

- **OAE Field Development:** We would be delighted to assist in NASEM's process however we can be useful. Recalling Antonius' comments from the June meeting, we are particularly hopeful that NASEM can help develop standards and expectations to guide a safe and responsible scaling pathway from the lab, to small-scale field pilot experiments, and eventually to initial commercial deployments.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