



PROJECT VESTA



Olivine sand: A cost-effective carbon-removing material for coastal protection projects

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Olivine

Olivine is a common, naturally-occurring mineral.

Olivine (Mg_2SiO_4) is a silicate, just like quartz (SiO_2).

North Carolina contains **>200 Mt** of olivine. Also abundant in Washington state and elsewhere around the world.



Olivine Sand



Olivine can be milled to any grain size distribution.

Olivine sand meets NC State Sediment Criteria.

Olivine sand can be used in lieu of other upland sands or dredged material for coastal protection projects: *beach nourishment, nearshore placement, wetland restoration, etc.*

Content	Olivine sand	Allowable Limit [#]
Mean grain size	custom	n/a
Gravel	0%	native + 5%
Granular	0%	native + 10%
Silt	< 0.2%	native + 5%
Carbonate	0%	native + 15%

[#]As specified by 15A NCAC 7H.0312

Olivine Sand



When milled to sand-size, olivine is gray/green in color.

When mixed with native sand, there is no discernible change in color.



typical silicate beach sand



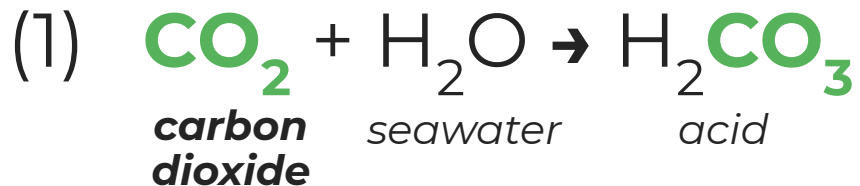
100% olivine sand

Carbon-removing, olivine sand



Like all sand, olivine sand slowly dissolves over decades to centuries in a natural process called **chemical weathering**.

Unlike other sand however, as olivine weathers, it removes **1 ton atmospheric CO₂ per ton olivine** and permanently stores it in the ocean.



Project Vesta



“Our mission is to remove excess carbon dioxide from the Earth’s atmosphere.

*By strategically moving olivine sand to coastlines, we can build nature-based **coastal protection projects** that simultaneously **mitigate climate change**.*

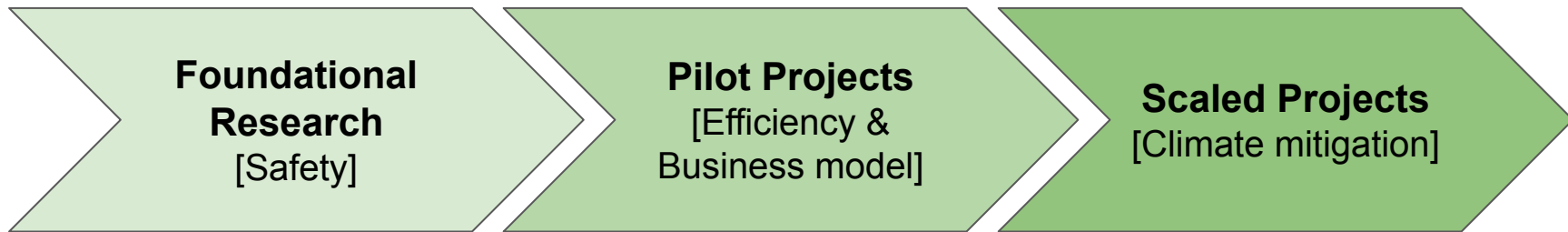
This is called Coastal Carbon Capture. ”

Objectives



- (1) Determine the environmental safety of olivine sand*
- (2) Determine the real-world efficiency of atmospheric carbon removal with olivine sand*
- (3) Demonstrate the business model for Coastal Carbon Capture*

Roadmap



Environmental Safety

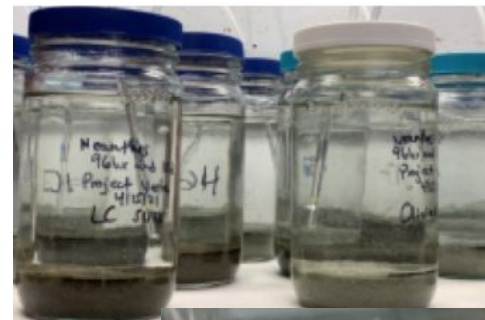


Ecotoxicological testing with Enthalpy Analytical

100% olivine sediment tests

No statistically significant difference between control and treatment groups

Polychaete (<i>Neanthes arenaceodentata</i>)	Control	Treatment (olivine)
96-hr mean % survival	100 ± 0.0	100 ± 0.0
10-day mean % survival	96 ± 8.9	100 ± 0.0
20-day mean % survival	100 ± 0.0	100 ± 0.0
20-day mean dry weight (mg/org) (i.e. growth)	18.5 ± 2.2	17.6 ± 3.2
Amphipod (two species)		
10-day mean % survival	99 ± 2.2	97 ± 4.5
10-day mean % survival	65 ± 18	56 ± 28



Environmental Safety



Ecotoxicological testing; ongoing studies

Olivine leachate tests: 5 concentration dilution series

- No Observed Effect Concentrations
- Point Estimates (e.g. EC_{25,50})
- Bioaccumulation

	Species	End-point(s)
Vertebrate	Inland Silverside (<i>Menidia beryllina</i>)	Survival and growth
Invertebrate	Mysid Shrimp (<i>Americamysis bahia</i>)	Survival and growth
Invertebrate	Mussel (<i>Mytilus galloprovincialis</i>)	Development and survival
Invertebrate	Sea Urchin (<i>Strongylocentrotus purpuratus</i>)	Fertilization
Invertebrate	Coral (<i>Acropora palmata</i>)	Survival, settlement
Plant	Seagrass (Mixed <i>Thalassia</i> , <i>Syringodium</i> , <i>Halodule</i>)	Survival, growth
Plant	Marine Diatom (<i>Skeletonema costatum</i>)	Cell density

Natural Analogs



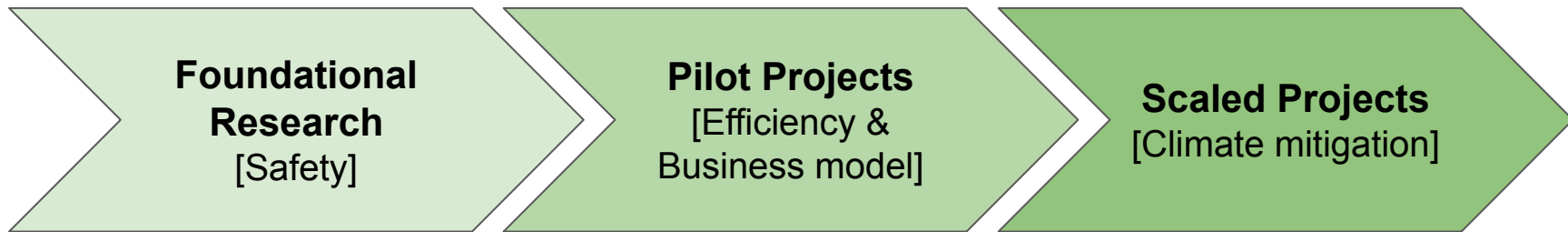
Olivine **naturally occurs in beach sands** around the world, from NYC to Iceland.

Studying Papakolea Beach, Hawaii as an end-member for high olivine content coastal environments (~30-40% *olivine sand*); comparison to nearby beaches

- carbon capture rate
- water chemistry
- ecological response



Roadmap



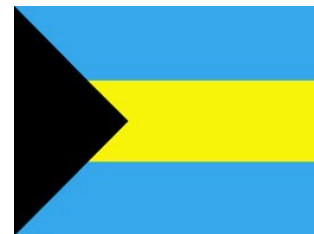
Field Pilots: International



Project Vesta is conducting a trial in the Caribbean and engaging with stakeholders and regulators about other pilots around the world.



Maharashtra, India



Grand Bahama,
The Bahamas

Field Pilots: National



Permit submitted in NY state - beach nourishment.

Permit prep in Duck, NC - nearshore berm.

- Berm reduces concerns around sand color and sea turtle nesting habitat.
- Pursuing research funding in partnership with Field Research Facility.
- Leverage technology and data from FRF.
- Working with local experts, Coastal Protection Engineering (CPE).



Partnerships



Great Lakes Announces Partnership with Project Vesta

September 29, 2021 16:05 ET | Source: [Great Lakes Dredge & Dock Corporation](#)

HOUSTON, Sept. 29, 2021 (GLOBE NEWSWIRE) -- Great Lakes Dredge & Dock Corporation ("Great Lakes") (NASDAQ: GLDD), the largest provider of dredging services in the United States announced today a first-of-its-kind partnership with Project Vesta, a clean technology pioneer developing a new way to use sand to remove excess carbon dioxide from the atmosphere.

Monitoring



Chemical, geological, morphological, and ecological

Baseline (+6 mo.) & post-olivine deployment monitoring (~2 yr)

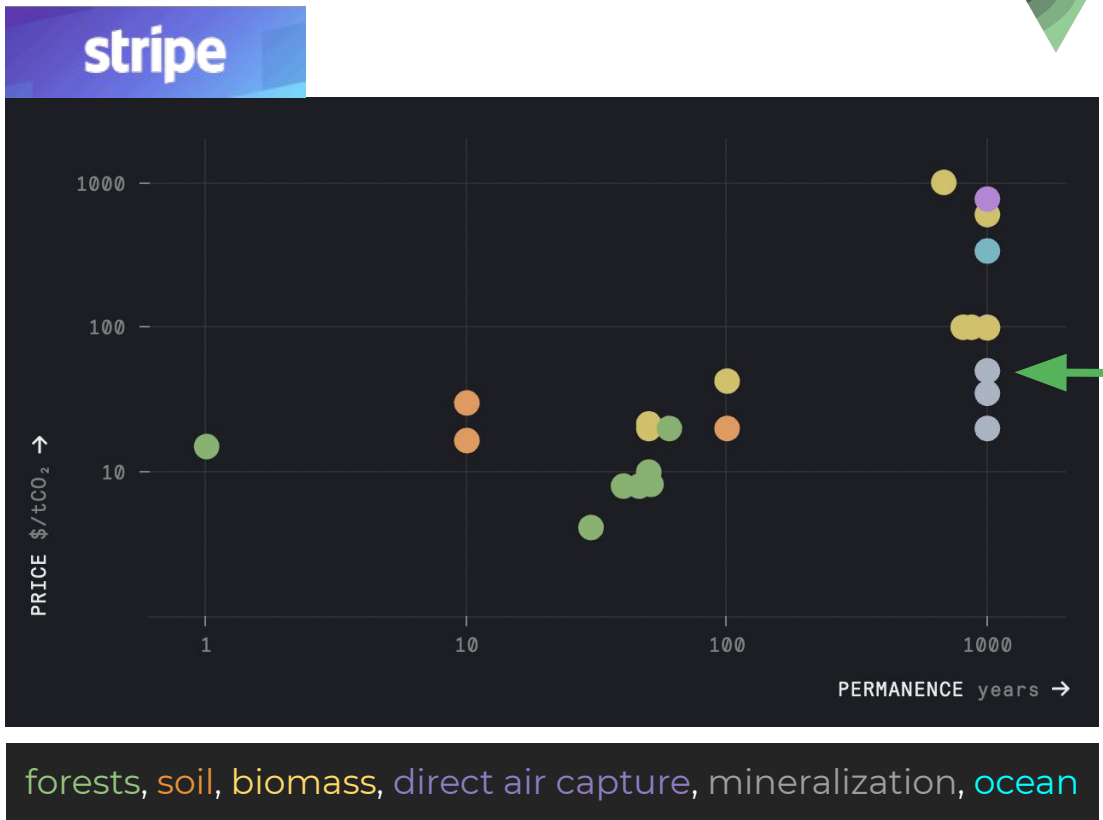
Waters	Sediments	Geomorphology	Ecology
<ul style="list-style-type: none">• pH, temp, salinity• major & trace metals• alkalinity, DIC, pCO_2• nutrients• DOC• Dissolved oxygen• Total suspended solids	<ul style="list-style-type: none">• Grain size• Mineralogy• Organic content	<ul style="list-style-type: none">• Lateral transport• Vertical sorting	<ul style="list-style-type: none">• Species abundance• Species distribution• Ecotox• Sand temp, moisture

Economics

In the carbon credit market, the price/ton CO₂ ranges from \$10 - 1000.

Vesta sold carbon credits to Stripe for \$75/ton CO₂, making Coastal Carbon Capture one of the cheapest, permanent, technologies.

*We provide **free** olivine sand to coastal protection projects, financed through carbon credit sales.*



Source: (carbon)plan

MRV



Measurement, **R**eporting, and **V**erification: *Vesta's bread and butter*

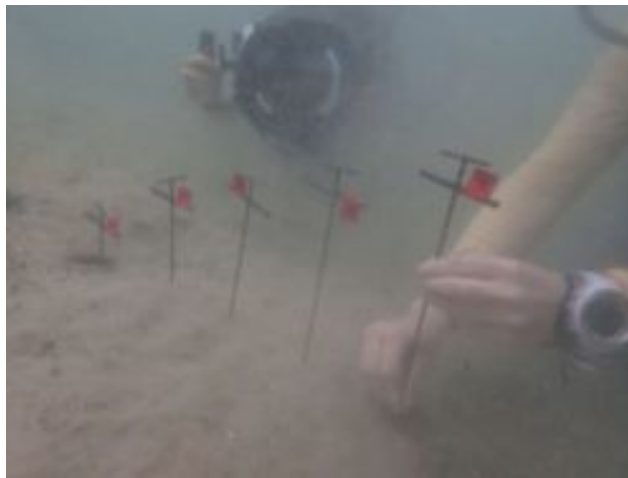
To sell carbon credits on large-scale, international markets, MRV is required.

Measurement: Data and information on the carbon capture.

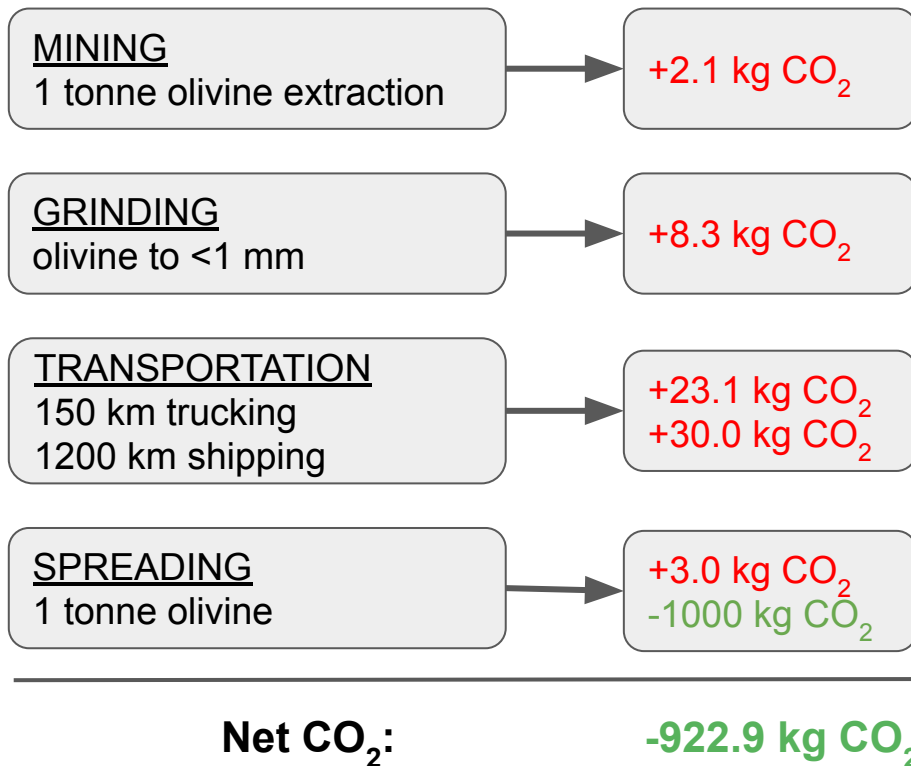
Reporting: Compiled data into standardized formats

Verification: Third party assessment of data to insure accuracy and reliability.

Project Vesta is developing the techniques and technologies required for Coastal Carbon Capture MRV.



Incorporating Emissions



Every project differs, but Coastal Carbon Capture **sequesters ~5-20x more CO₂ than it emits**, with higher efficiency numbers at scale.

Impact



37 million cu yd of sand is placed annually in the U.S. (Elko et al. 2021)

This represents an immense, *existing* opportunity to have coastal protection, climate adaptation projects also serve as climate mitigation.

Through carbon credit sales, olivine sand can also open financing doors to **new or under resourced** coastal protection projects. Coastal communities will benefit, as will industry partners.

Through Coastal Carbon Capture, coastal communities and states can have a global environmental impact and meet their own **sustainability goals**.

Thank You



And please get in touch! We are always seeking **new partnerships.**

Questions?



Project Vesta – accelerating
the Earth's natural weathering
process to help reverse
climate change.

www.projectvesta.org

