Develop a carbonic anhydrase-based enzymatic approach for sustainable CO$_2$ sequestration in seawater.

Motivation
- Investigate the feasibility of carbonic anhydrases for overcoming the slow CO$_2$ and water combination in seawater
- Explore the potential of seawater in sequestering CO$_2$

Project Description
- Screen and identify carbonic anhydrase isomers that retain high activity under high-salinity conditions
- Determine the optimal conditions for carbonic anhydrase-mediated carbonate precipitation in seawater
- Improve carbonic anhydrase efficacy in seawater by modifying the enzyme microenvironment

Context
- The slow combination of CO$_2$ and water prevents sequestering CO$_2$ in seawater far from cost-viable
- Current processes require alkalifying seawater
- We will minimize the environmental impact and reduce the cost of seawater CO$_2$ sequestration using carbonic anhydrase to overcome the slow kinetics of CO$_2$ hydration

Project Deliverables
- A carbonic anhydrase isomer that efficiently converts CO$_2$ to carbonates in seawater
- An optimal condition of carbonic anhydrase-mediated CO$_2$ sequestration in seawater
- A bionanoreactor that encapsulates carbonic anhydrase for enhanced CO$_2$ sequestration
- Two journal articles and several conference presentations
- Preliminary data for standard NSF grant applications

Potential Impact
- Lead to a new potential gigaton-scale CO$_2$ sequestration strategy that will make significant contributions to reaching net-zero CO$_2$ emissions and alleviating global warming
- Provoke the expansion of current carbon anhydrase applications to more environmental matrices such as soil and surface water bodies, which will provide a suite of solutions for sequestering CO$_2$

References and/or Acknowledgements