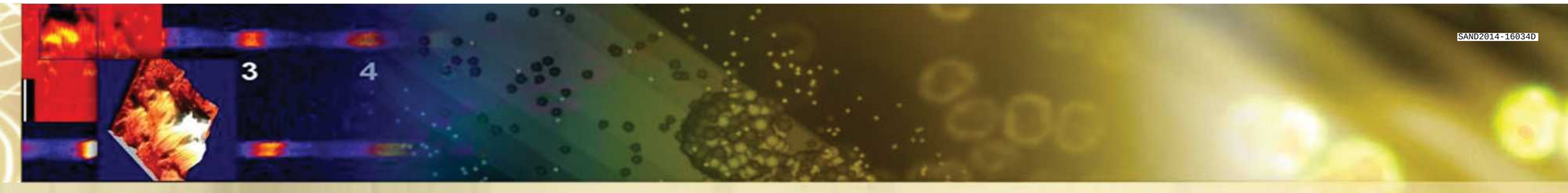
SANDIA BIOSCIENCE



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Nutrient Recycling for Sustained Algal Production

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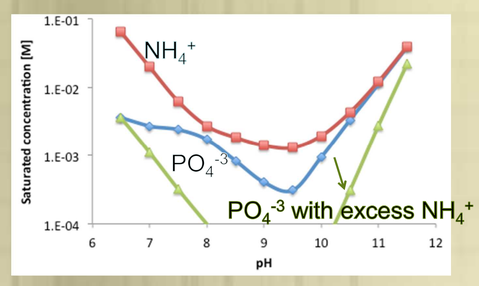
Project Goals

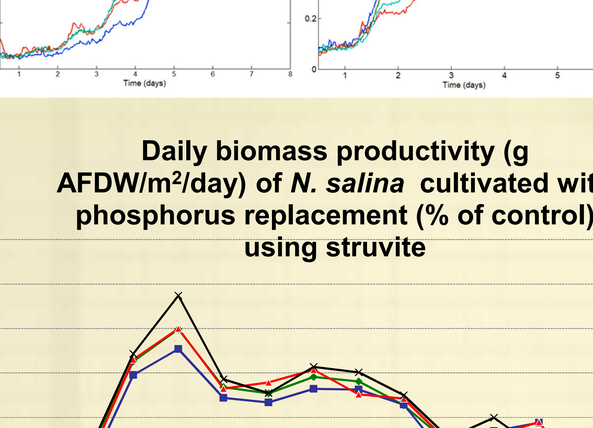
Nutrients are needed for biological productivity, not fuel.
- N: amino acids (incl. chlorophyll)
- P: nucleic acids, phospholipids, ATP.

Our work:
- Develop and evaluate processes for nutrient recycling.
  - Two steps:
    - Convert organic N and P to inorganic forms.
    - Separate nutrients from energy products & return to culture.
    - **Chemical form of nutrients not important; must be bioavailable**

Target struvite ($MgNH_4PO_4$) as <u>convenient,</u> transportable, fungible nutrient
- Recovers 1:1 N:P
- Precipitates at accessible concentrations.
  - Experience in waste water treatment industry.
- Involves Mg readily available in seawater
- (and inexpensive otherwise).
- Alternates include Ca and Mg phosphates.

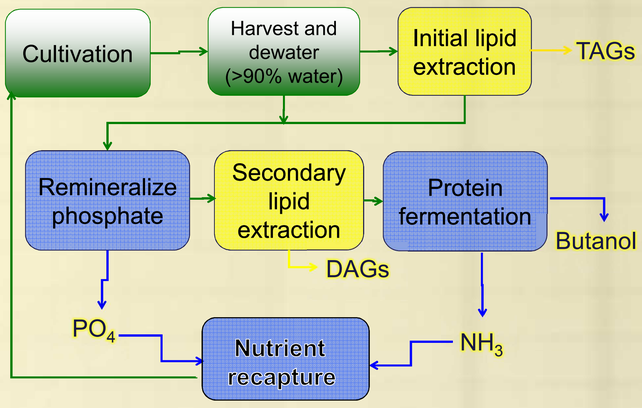


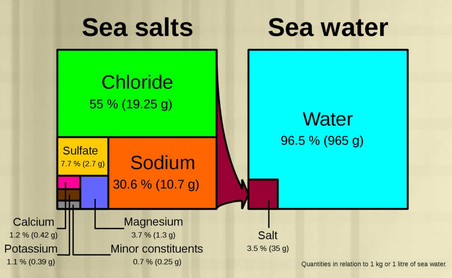
Repeated algal growth and recycle of PO_4^{3-}



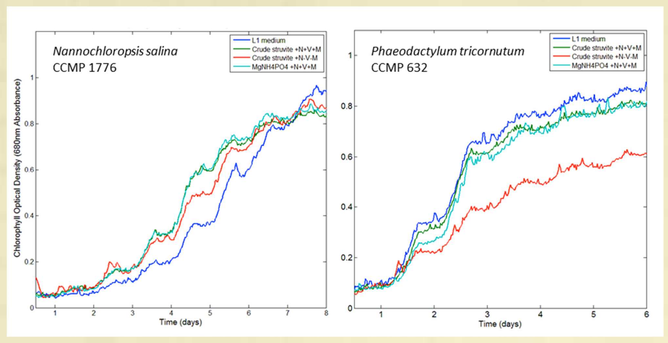
- Algal cultures were harvested by centrifugation and algal biomass was disrupted by osmotic shock.
- Phosphate was remineralized by incubation at pH 6, 37° c for 20 hrs.
- Soluble phophate was returned to culture without further treatment.

Proposed Closed Nutrient Cycle for Algal production

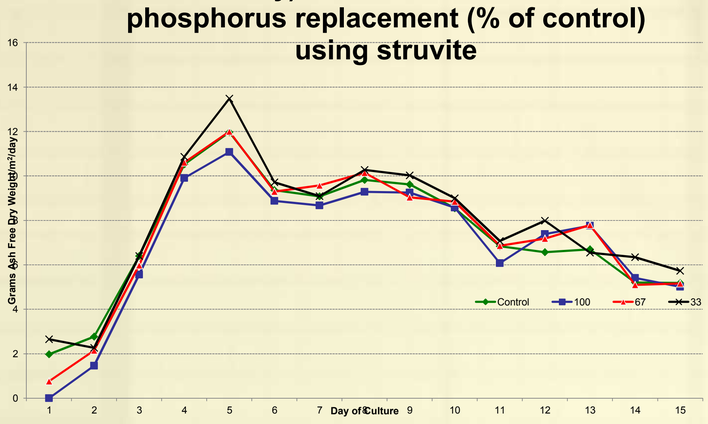




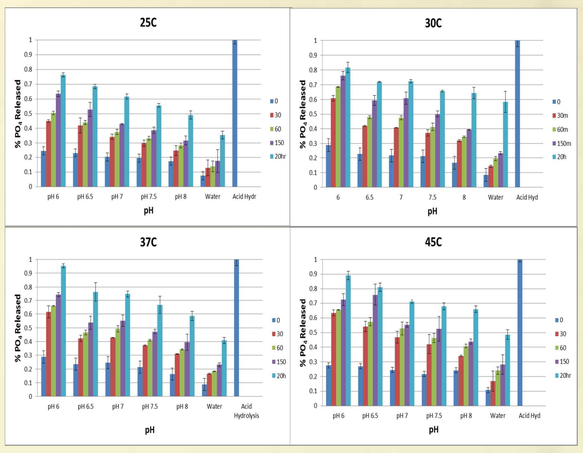
Gowth of *N. salina* & *P. tricornutum* on struvite



Reagent grade and crude struvite from wastewater treatment was used to replace total phosphate in laboratory cultures, of *N. salina* and *P. tricornutum* (top) and up to 100% phosphate in open raceway ponds of *N. salina* (bottom).



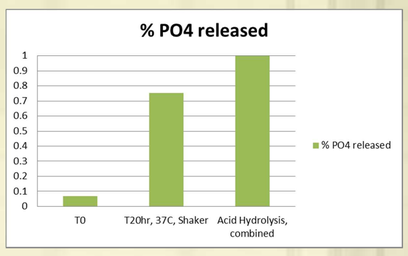
Rapid emineralization of PO_4^{3-} in *N. salina* biomass

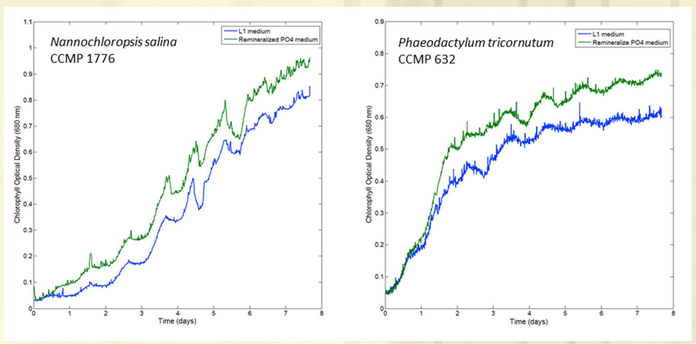


- Disrupted but nondenatured biomass was incubated at a range of pH and temperatures.
- Samples were withdrawn at the times indicated and soluble phosphate was determined.
- Levels of soluble phosphate were compared to an acid hydrolysis of the algal biomass.

Regrowth of algae on remineralised PO_4^{3-}

- ~50 gm of 20% solids. *p. salina*
- Diluted to 2% solids pH 6.5, 37° , 20hrs
- Liberated phosphate used to replace total phosphate in algal culture
- <u>Growth of *P. tricornutum* and *N. salina* on soluble liberated phosphate</u>





Summary

- Phosphate can be remineralized, in soluble form, from non denatured *N. salina* biomass by enyzmatic digest or mild pH treatment
- Soluble, remineralized phosphate can provide 100% of phosphate required for growth of *N. salina* or *P. tricornutum.*
- Crude struvite can provide 100% of phosphate and large fraction of nitrogen for the growth for the growth of *N. salina* and *P. tricornutum* at laboratory scale
- Crude struvite can provide 100% of phosphate and large fraction of nitrogen for the growth for the growth of *N. salina* in pilot scale outdoor raceways.