Carbon Sequestration Science
EVIDENCE THAT OOLITIC ARAGONITE (CaCO₃) IS PRECIPITATED IN THE WHITINGS:
1. Calcite and aragonite crystal size, shape, and Geochemistry (Loreau, 1982; Milliman et al., 1993).
2. The intimate association of carbonate crystals and cyanobacteria cells (Robbins et al., 1997).
3. Cell counts along transects of Whitings, where concentrations of planktonic cyanobacteria are double and as much as 10 times higher inside than outside Whitings (Robbins et al., 1996 Thompson et al. 1997).
4. The amino acid content of the organic fraction of the Whitings (Robbins and Blackwelder, 1992).

Cyanobacteria Biosequestration of Carbon

Light Reactions

Photosynthesis

Calvin Cycle

Rubisco: CO₂ to Organics

Fixing CO₂ to CaCO₃

Releasing & Gassing off Oxygen

pH increase

High alkalinity/High Ca

High solubility of CO₂ in water available

Birds Eye Diagram: Calvin Cycle

Sugar, Amino Acids And other Organic Compounds.

Carbon Sink CO₂ Fluxes from Air to Water

“The Ocean” H₂O

CaCO₃

O₂

NADPH

ATP

NADP⁺ ADP + Pi
Interpretation of ASTM D6866 - 11 Standard Test Methods for Determining the Bio based Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis

ASTM Method 6866 is a standard analytical test that is used to determine the exact percentage of a solid liquid or gas that is derived from renewable sources. The test utilizes C14 analysis to determine the age of the carbon in the material. C14 is a weakly radioactive isotope of carbon formed when solar radiation causes some of the carbon in atmospheric CO2 to change from C12 to C14. When the CO2 is taken up and no longer exposed to the atmosphere the C14 will decay back to C12. The rate of this decay is: 50% of the C14 will decay back to C12 every 5700 years (5000 year half-life). ASTM D6866 analysis measures the C14 content in a sample to determine ratio of carbon of recent origin to the total carbon in the sample. According to Glen Norton of the USDA testing Laboratory at Iowa State University (Co-Author of ASTM 6866), carbon of recent origin is defined as material containing carbon fixed in the last 3-5 years.

The results of the test are presented as % bio-based content. This terminology is used because up until the analysis conducted on oolitic aragonite from Ocean Cay, the only sources of carbon fixation analyzed by this program are plant based materials. The samples analyzed by the USDA testing lab indicated that 62% of the carbon in the sample was fixed in the last 3 to 5 years.

The result indicates that the oolitic aragonite shoals at Ocean Cay are receiving new material and are a renewable resource.
Carbon Sequestration
5,700 tons of Carbon/year

Air: Sea Carbon (CO$_2$) Gas Fluxes in Whitings (Photosynthesis)
17,000 km$^2$ of Whitings area/yr = a CO$_2$ sequestration of $3.5 \times 10^{-6}$ g carbon m$^{-2}$ s$^{-1}$
Average Tons of Carbon (CO$_2$) sequestered to Organic Compounds via Photosynthesis
Monthly: 1.6 tons of CO$_2$ uptake
Annual: 19.2 tons of CO$_2$ uptake

Carbon (CO$_2$) Calcification in Whitings (Mineralize CO$_2$ to recalcitrant carbonates)
13-76 km$^2$ of Whitings area/day/3m depth = a CO$_2$ sequest of $4.2 \times 10^{-3}$ g carbon m$^{-3}$ hr$^{-1}$
Average Tons of Carbon (CO$_2$) sequestered to Inorganic Compounds via Mineralization
Monthly: 473 tons of CO$_2$ uptake
Annual: 5,682 tons of CO$_2$ uptake

Robbins, Yates; 2001; “Direct Measurement of CO2 Fluxes in Marine Whitings”

Carbon -12 isotopes - lighter
Carbon -13 isotopes - heavier
Oshenite® | renewable performance mineral

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