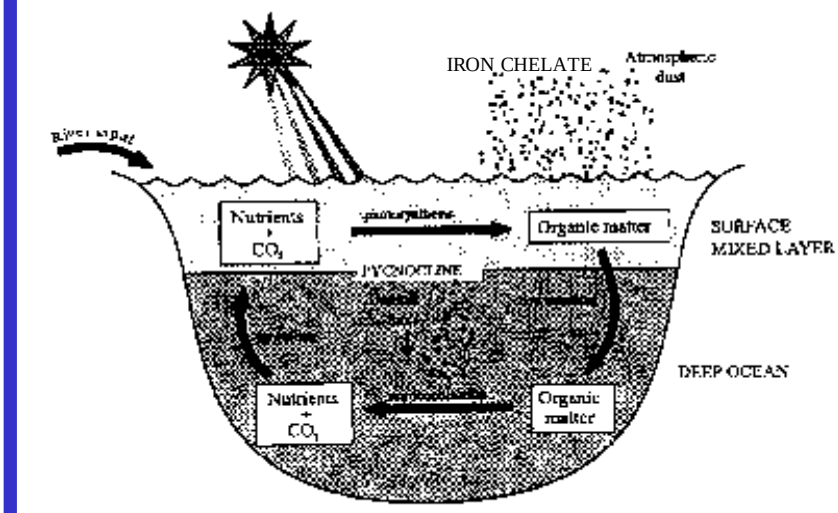
3.3.2 OCEAN SEQUESTRATION – IRON FERTILIZATION

Technology Description



CONCEPT OF IRON FERTILIZATON

It is hypothesized that the rate of carbon dioxide fixation by microscopic plants called phytoplankton that live in the surface waters of the oceans may be limited by the availability of iron. In particular, field experiments in high nutrient, low chlorophyll (a measure of plant biomass) ocean waters such as the Southern Ocean and the Equatorial Pacific have shown that addition of iron increased the rate of removal of carbon dioxide through the process of photosynthesis. The carbon dioxide has thus been incorporated into plant biomass (phytoplankton), some of which will sink to deeper waters (export) where it may be sequestered for a period of time. Industry has developed a strong interest in using iron fertilization as a potentially low cost technology to offset carbon dioxide emissions. Many fundamental questions, however, remain as to the long-term effectiveness and potential environmental consequences of this carbon sequestration strategy.

System Concepts

- Iron chelate "fertilizer" is mixed into the ocean via vessel propellers. The release stimulates phytoplankton bloom.
- The phytoplankton bloom increases the rate of carbon fixation or photosynthesis, thus reducing the levels of carbon dioxide dissolved in the surface waters, which increases the uptake of atmospheric CO_2 by those surface waters (the CO_2 gradient gets bigger, so the flux into the ocean should increase). Having converted carbon dioxide to plant biomass, some of the phytoplankton will sink to deeper waters where the carbon will be sequestered.

Representative Technologies

- Technologies will be borrowed extensively from the unit operations of the maritime industry and existing instrumentation systems.

Technology Status/Applications

- Three previous research demonstrations have been performed. The Southern Ocean Iron Fertilization Experiment (SOFEX) occurred in January-February 2002. This research, which was cofunded by the National Science Foundation and the Department of Energy, aimed to quantify carbon export – that is, how much carbon sinks to deeper waters, after fertilization with iron. The major goal was to quantify the extent of export production of carbon.

Current Research, Development, and Demonstration

RD&D Goals

- Determine whether iron-induced phytoplankton blooms result in the vertical flux (transport) of carbon from the surface waters (export production) to the deep waters.

RD&D Challenges

- Determine the overall short-term environmental consequences of release of iron as iron chelate.
- Determine the long-term consequences of iron enrichment on the surface water community, midwater community, and ocean processes.
- Determine the best proxy for carbon.

- Quantify the efficiency of the long-term storage of carbon.

RD&D Activities

- Continue data reduction from SOFEX cruise.
- Determine magnitude of carbon export from surface layer from SOFEX.
- Prepare for proposal selection from current solicitation.

Recent Progress

- Previous cruises of research vessels IRONEX I and II, and SOIREE, confirmed the stimulation of phytoplankton bloom by the addition of iron chelate.
- Measurements of vertical profiles of carbon indicated that some of the additional phytoplankton contributed to the stream of sinking organic carbon.