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The Acid Ocean

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Abstract:

Today carbon dioxide CO_2 concentrations in the atmosphere are increasing as a direct results of human activities such as deforestation and the burning of fossil fuels. Over the past 150 years, CO_2 concentrations in the atmosphere have increased by as much as 30 percent (from 280 to 370ppm). The effect of CO_2 on the PH chemistry of seawater and aquatic organisms and ecosystems.

The pH drops as a result of absorbing excess CO_2 from the atmosphere. As fact that the oceans are becoming more acidic.

Key words: Carbon dioxide-salinity -Acid ocean – pH

Introduction:

The acid ocean

Carbon dioxide in the ocean and atmosphere carbon dioxide (CO_2)is considered a trace gas in the atmosphere because it is much less abundant than oxygen or nitrogen. However, this trace gas plays a vital role in sustaining life on earth and in controlling the earth's climate by trapping heat in the atmosphere.

The oceans play an important role in regulating the amount of CO_2 in the atmosphere because CO_2 can move quickly into and out of the oceans. Once in the oceans, the CO_2 no longer traps heat. CO_2 also moves quickly between the atmosphere and the land biosphere (material that is or was

living on land). Of the three places where carbon is stored-atmosphere, oceans, and land biosphere –approximately 93 percent of the CO_2 is found in the oceans. The atmosphere, at about 75 pentagrams of carbon (pentagram p_g is 10^{15} grams), has the smallest amount of carbon.

Balances in Carbon Dioxide levels:-

Marine plants and animals plays a role in the uptake and release of carbon dioxide in the ocean. Plants, primarily phytoplankton but also macrophytes such as this sea wead, take up carbon dioxide and release oxygen, which oxygen dependent animals need to survive.

280 parts per million (PPM) by volume for at least 1.000 years prior to the industrial era.

Atmospheric concentrations of CO_2 were constant because the carbon being removed from the atmosphere in some places exactly matched the CO_2 being added to the atmosphere in other places.

CO_2 concentration in the atmosphere are increasing as a direct result of human activities such as deforestation and the burning of fossil fuels.

Over the past 150 years CO_2 concentrations in the atmosphere have increased by as much as 30 percent (from 280 to 370ppm). The CO_2 that remains in the atmosphere acts as a green house gas, absorbing long-wavelength radiation (heat) in the atmosphere.

Natural ocean carbon cycle:

The oceans contain about 50 times more CO_2 than the atmosphere and 19 times more than the land biosphere. Most of the CO_2 that diffuses into the oceans reacts with the water t form carbonic acid.

The oceans are mixed much more slowly than the atmosphere so there are large horizontal and vertical changes n CO_2 concentration in general, tropical water release CO_2 to the atmosphere, whereas high-latitude oceans take up CO_2 from

the atmosphere. CO_2 also about 10 percent higher in the deep ocean than at the surface.

Sea water:

Sea water in the world's oceans has a salinity of about 3.5% and t average density of sea water at the ocean surface is 1.025m/ml. sea water is denser than fresh water or pure water (density 1.0gm/ml at 4C). The freezing point of sea water decrease as salt concentration increases.

The most saline open sea is the Red Sea, where high rates of evaporation, low precipitation and river inflow. The density of surface sea water ranges from about 1.020 to 1.029 $kg.m^{-3}$, depending on the temperature and salinity. Sea water pH is limited to the range 7.5 to 8.4.

The speed of sound in sea water is about 1.500 metres/second and varies with water temperature and salinity.

Temperature distribution in the Ocean:

The average incoming energy from the sun at the earth's surface is about four times higher at the equator than at the poles. Heat is then transferred from low to high latitude by winds in the atmosphere and by currents in the ocean.

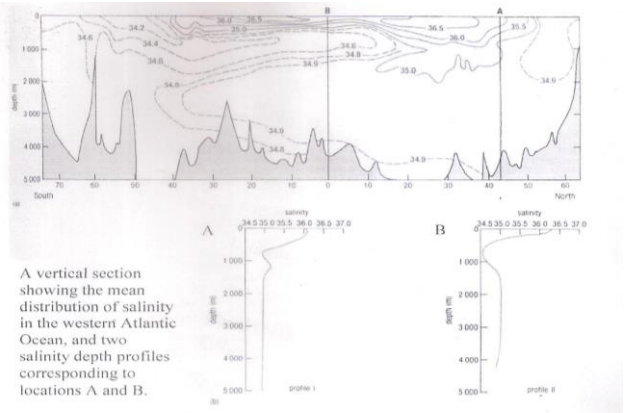
The geothermal heat flay from the interior of the earth is generally in significant except in the vicinity of hydrothermal vents at spreading ridges and in relatively stagnant location like the abyssal northern north pacific and black sea(man, et al. 1991).

Between about 200m and 1000 depth, the temperature declines rapidly throughout much of the ocean. This region of steep temperature gradient is known as the permanent thermocline, beneath which, from about 1000m to the ocean hoor, there is virtually no seasonal variation and the temperatures are around 2C.

Salinity distribution in the ocean:-

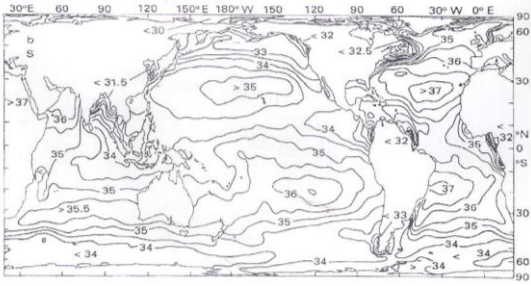
The salinity of surface sea water is controlled primarily by the balance between evaporation and precipitation. As a result the highest salinity is found about 20 to 30 north and south salinity is important due to:

1- Salinity, along with temperature, determines the density of water, and hence its vertical flow patterns in thermotaline circulation.
2- Salinity records physical processes affecting a water mass when it was last at the surface.
   a. Precipitation /evaporation-salts excluded from vapour.
   b. Freezing /thawing – salts excluded from ice.
3- Salinity can be used as a conservative (unchanging) tracer for determining the origin and mixing of water types.



A vertical section showing the mean distribution of salinity in the western Atlantic Ocean, and two salinity depth profiles corresponding to locations A and B.

Salinity distribution in surface waters (isohaline surfaces)



About one-third of the Co_2 emitted each year is quickly absorbed by the ocean.

In the long run some 85% of all of mankind's Co_2 emissions will be absorbed by gas exchange across the air-sea interface. The annual rate of uptake is controlled by ocean mixing now " disposed" of about 530 billion tons of fossil fuel Co_2 in the oceans, and the rate of invasion now exceeds one million tons of Co_2 per hour i.e 24 million tons per day.

- Study from NOAA program (national oceanic and Atmospheric administration) also obtained from same program.

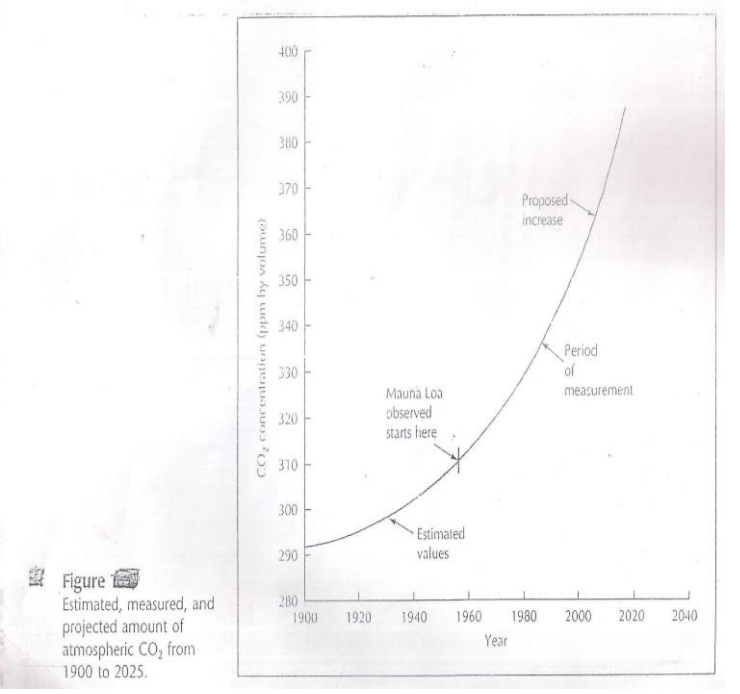


Figure
Estimated, measured, and projected amount of atmospheric CO_2 from 1900 to 2025.

Global Co_2 budget (giga tones of carbon dioxide per year).

Period	Fossil fuel cement	Atmospheric growth	Land-use change	Land sink	Ocean sink
1990-2000	6.4 $\pm$ 0.4	3.1 $\pm$ 0.1	1.6 $\pm$ 0.7	2.6 $\pm$ 0.9	2.2 $\pm$ 0.4
2000-2008	7.7 $\pm$ 0.5	4.1 $\pm$ 0.1	1.4 $\pm$ 0.7	2.7 $\pm$ 1.0	2.3 $\pm$ 0.5

We are thereby acidifying the ocean and fundamentally changing the remarkably delicate geochemical balance.

The ocean pH change will persist for thousands for years. Because the fossil fuel Co_2 rise is faster than natural Co_2 increase in the past, the ocean will be acidified to a much greater extent than has occurred naturally. (Caldeira and Wiket 2003).

Most of the carbon in sea water is in the form of HCO_3, while the concentration of Co_3^2 and dissolved Co_2 are one and two orders of magnitude lower, respectively. The equilibrium reaction for Co_2 chemistry in sea water that most cogently captures its behavior is $Co_2 + Co_3^2 + H_2O = 2\ HCO_3$

A state in which the ocean's pH drops as a result of absorbing excess Co_2 from the atmosphere. The belief by many scientists is that the more Co_2 pumped into the air, the more Co_2 absorbed into the oceans, and the lower the PH. Yet the process and degree of acidification is not a simple formula, a region's pH can fickles 0.24 units in a 24 – our cycle and 1.5 units over the course of a year. And levels can fluctuate from one year to the next. Despite these fickles, however, one characteristic is abundantly clear. The pH levels are plummeting- and faster than expected.

Ocean pH levels are affected by many factors, such as the availability of sunlight, the temperature of the water, the amount of phytoplankton, and of course, atmospheric Co_2 concentrations. I believe that the ocean pH may drop 0.2 units over the next few years, and some believe that the average pH has already fallen 0.1 units over the past century.

Then pH levels drop, numerous marine species feel the effects, particularly calcifying organisms – such as coral, system, and mussel whose shells dissolve in acidic water. At the same time, other species, like the acorn barnacle or fleshing algae, thrive I these waters, disrupting the natural eco-system even further.

Conclusion:

In fact, the study reveals that grow more acidic, so after a long period in the year 2250 oceans expected to be acidic, so there will be very weak atmospheric circulation, no rainfall expected precipitation will not happen, so it will be death.

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Workshop co-sponsored by the center for ocean solutions (with senior staff in attendance from the national oceanic and atmospheric administration (NOAA).