

How much carbon is in the oceans? How much is in the atmosphere?

I,

Volume of all the oceans:

references:

Volume of all the oceans:	reference oc 1	1.3 billion cubic kilometers
Volume of all the oceans:		http://en.wikipedia.org/wiki/ocean
		1,300,000,000 cubic kilometers

II.

Density of the ocean waters

density range is	1,020 to 1,050 kg per cubic meter	reference oc2	http://en.wikipedia.org/wiki/seawater
average density=	1,035 kg per cubic meter		
1 cubic kilometer=	1,000,000,000 cubic meters		
1 cubic kilometer of seawater weighs=	1,035,000,000,000 kilograms		
1 cubic kilometer of seawater weighs=	1,035,000,000 metric tonnes		
1 cubic kilometer of seawater weighs=	1,035 million metric tonnes		

III

Types of dissolved inorganic carbon in the oceans:

A,	Bicarbonate, HCO ₃			
	concentration=	145 milligrams per kilogram	ref oc3 page 3	http://www.seafriends.org.nz/oceano/seawater.htm
	atomic weights=			
	Hydrogen	1		
	carbon	12		
	oxygen, 3 x 16=	<u>48</u>		
	molecular wt =	62		
	percent C=	19		
	concentration of carbon from bicarbonate in seawater=	28 milligrams per kilogram		

Carbon Dioxide , CO2
concentration=

85 mg/kg

(80 to 90 mg/kg)

ref:oc3 page 5

ibid

concentration of carbon in dissolved
CO2=

23 mg/kg

add carbon from CO2
pluse Bicarbonate=

51 milligram per kilogram

1 cubic kilometer
of seawater contains
this much carbon
from inorganic
carbon=

52,800,024,193,548 milligrams

1 cubic kilometer
of seawater contains
this much carbon
from inorganic
carbon=

52,800,024,194 grams

1 cubic kilometer
of seawater contains
this much carbon
from inorganic
carbon=

52,800,024 kilograms

1 cubic kilometer
of seawater contains
this much carbon
from inorganic
carbon=

52,800 metric tonnes

all of the seawater
in the world contains
this much carbon
from inorganic
carbon=

68,640,031,451,613 metric tonnes

[all of the seawater
in the world contains
this much carbon
from inorganic
carbon=](#)

[68,640 billion metric tonnes](#)

[all of the seawater
in the world contains
this much carbon
from inorganic
carbon=](#)

68,640,031 million metric tonnes

how much inorganic carbon is in the lakes and rivers of the world?
not much, compared to that in the oceans
97.2 percent of the water in the world is in the oceans

reference oc4

c. Dissolved organic carbon in the oceans=

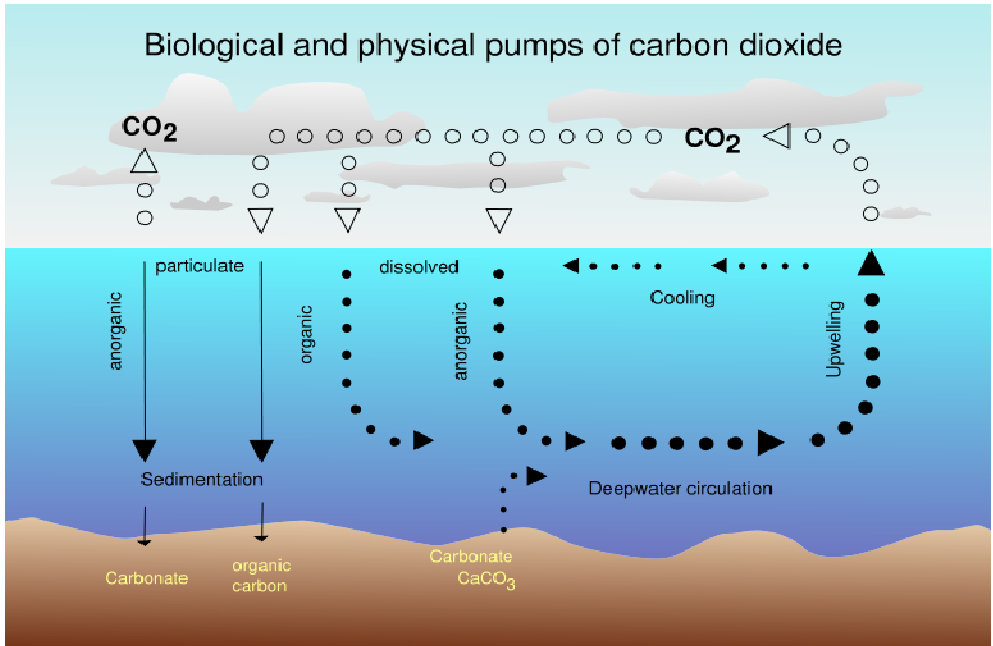
unknown quantity

oc3 page 6

ILLUSTRATION SEE REF OC4

OC4

http://en.wikipedia.org/wiki/File:CO2_pump_hg.svg



IV. Atmosphere, Troposphere

air is 390 parts per million by volume of CO2 ref a1
 1.79 parts per million by volume of methane ref a1

the volume of the troposphere = 5,000,000,000,000,000 cubic meters ref a2

the volume of the troposphere = 5,000,000,000,000 million cubic meters

the volume of CO2= 1,950,000,000,000,000 cubic meters

the volume of CO2= 1,950,000 cubic kilometers
 the volume of CO2= 1.95 million cubic kilometers

the mean temperature of the troposphere is 255 degrees kelvin ref a4
 also= -18 degrees celsius

when a gas is cooled down, its volume decreases
 using charles law, we can find what would be the volume at standard temperature

standard temp = 273 degrees kelvin or 0 degrees celsius

charles law
 $v_1/v_2 = T_2/T_1$

$v_1 =$ above volume of the CO2 in the atmosphere= 1.95 million cubic kilometers
 $v_2 =$ the volume of CO2 at STP= what we want to find out

$T_1 =$ mean temp of the troposphere= 255 degrees kelvin
 $T_2 =$ standard temp= 273 degrees kelvin

$$\frac{1.95}{v_2} = \frac{255}{273}$$

$v_2 =$ **2.09 million cubic kilometers of CO2 at standard temp**

this is the volume of the CO2 in the atmosphere if we warmed it up to standard temperature
 and now that we have this number, we can calculate how many moles of CO2 is in that volume, because,

at standard temperature and pressure, one mole of a gas occupies 22.4 liters

1 cubic kilometer= 1,000,000,000,000 liters

1 mole of a gas at STP= 22.4 liters

1 cubic kilometer= 44,642,857,143 moles of a gas at STP

1 cubic kilometer of CO2= 44,642,857,143 moles of CO2

1 mole of CO2 has this many grams of carbon= 12 grams of carbon

1 cubic kilometer of CO2 contains: 535,714,285,714 grams of carbon

535,714,286 kilograms of carbon

535,714 metric tonnes of carbon

2.09 cubic kilometer of CO2 contains: 1,118,382 metric tonnes of carbon

but we found 2.09 MILLION cubic kilometer of CO2
 so we have

1,118,382 million metric tonnes of carbon in the atmosphere

III. Add up the amount of inorganic carbon in the atmosphere and the oceans:

1,118,382 million metric tonnes of carbon in the atmosphere

68,640,031 million metric tons of inorganic carbon in the oceans

69,758,414 million metric tons of carbon in the oceans and the atmosphere

1,395,168 then add 2 percent for methane in the atmosphere and carbon in the lakes and rivers

71,153,582 million metric tons of carbon in the oceans, troposphere, lakes and rivers of the world

(daily, 25 million metric tons of carbon are emitted from the combustion of fossil fuels((see world carbon inventory april 2011)). Does this have an effect on atmospheric carbon?)

25 out of 1,210,764=

0.000035 percent

IV. Video map of CO2 from fossil fuels in the US

Vulcan Project from Purdue University

<http://www.youtube.com/watch?v=eJpj8UUMTaI>

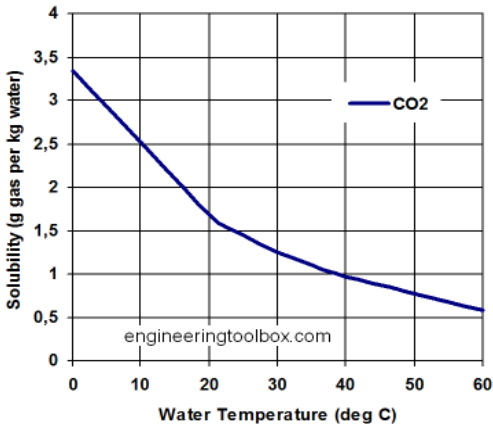
can you think of anything they left out?

V. The Exosphere

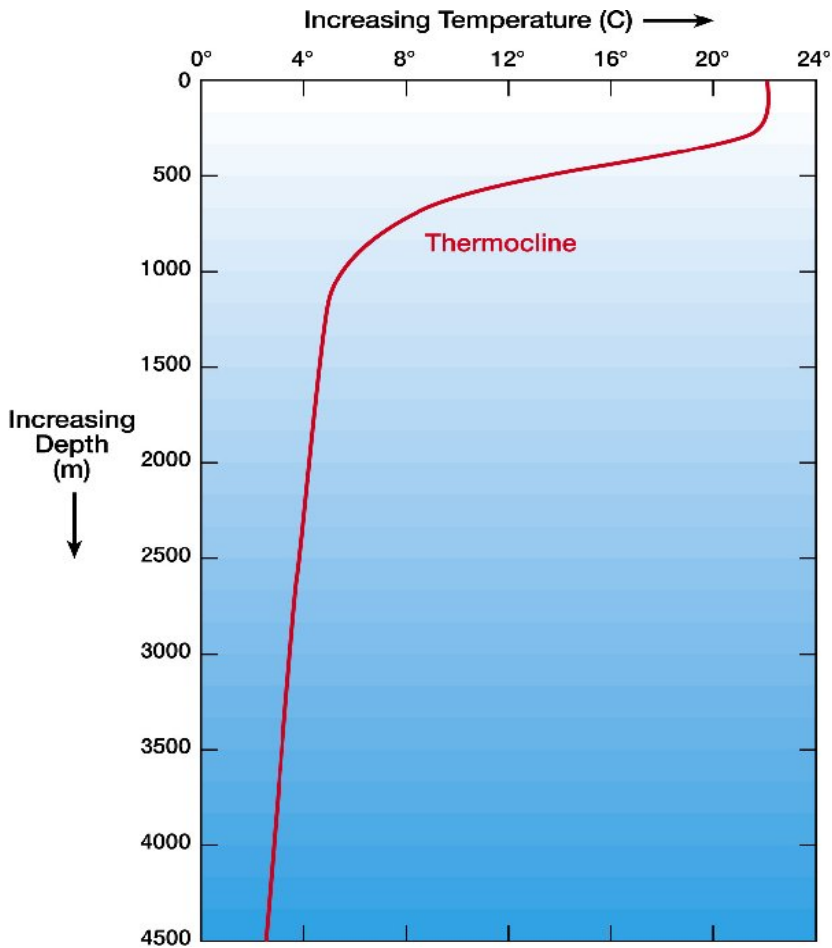
[Very high up, the Earth's atmosphere becomes very thin. The region where atoms and molecules escape into space is referred to as the exosphere. The exosphere is on top of the thermosphere.](#)

VI.

graph showing co2 solubility changes in h2o v temp



from ref oc5



from ref oc6