

# A Chance to Sequester Carbon Dioxide into Thermohaline Currents

2nd CONFERENCE ON CARBON SEQUESTRATION

(Alexandria, VA)

section: ocean dynamics

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The ocean is the natural sink of most of the CO<sub>2</sub>.

Dissolution of natural CO<sub>2</sub> affects the 1st 100 m (330 ft) of the ocean surface.

Increased CO<sub>2</sub> content in the air leads to increased solubility (Henry's Law).

Increased solubility reduces the pH value of the 1st 100 m to unwanted values.

# The solution:

Use of the total ocean water for hiding the CO<sub>2</sub>

The word „hiding“ implies to find the CO<sub>2</sub> later.

In some hundred years:

- (1) most of the fossile energy has gone.
- (2) the ecosystem has reached its peak conversion of CO<sub>2</sub> into oxygen.
- (3) the CO<sub>2</sub> concentration is falling - causing the same problems as the increase.

The change of the CO<sub>2</sub> concentration is the problem not the absolute value!

# Thermodynamics

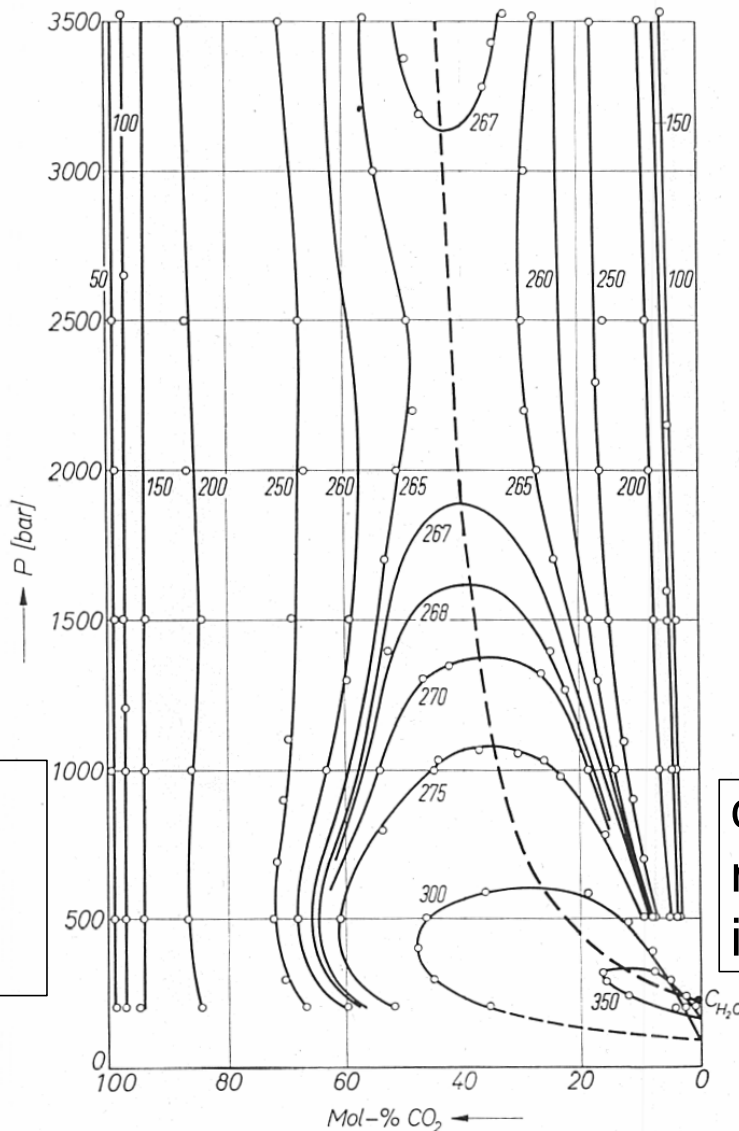
No reliable data available!

# Tödheide and Franck

T: 50 - 350°C

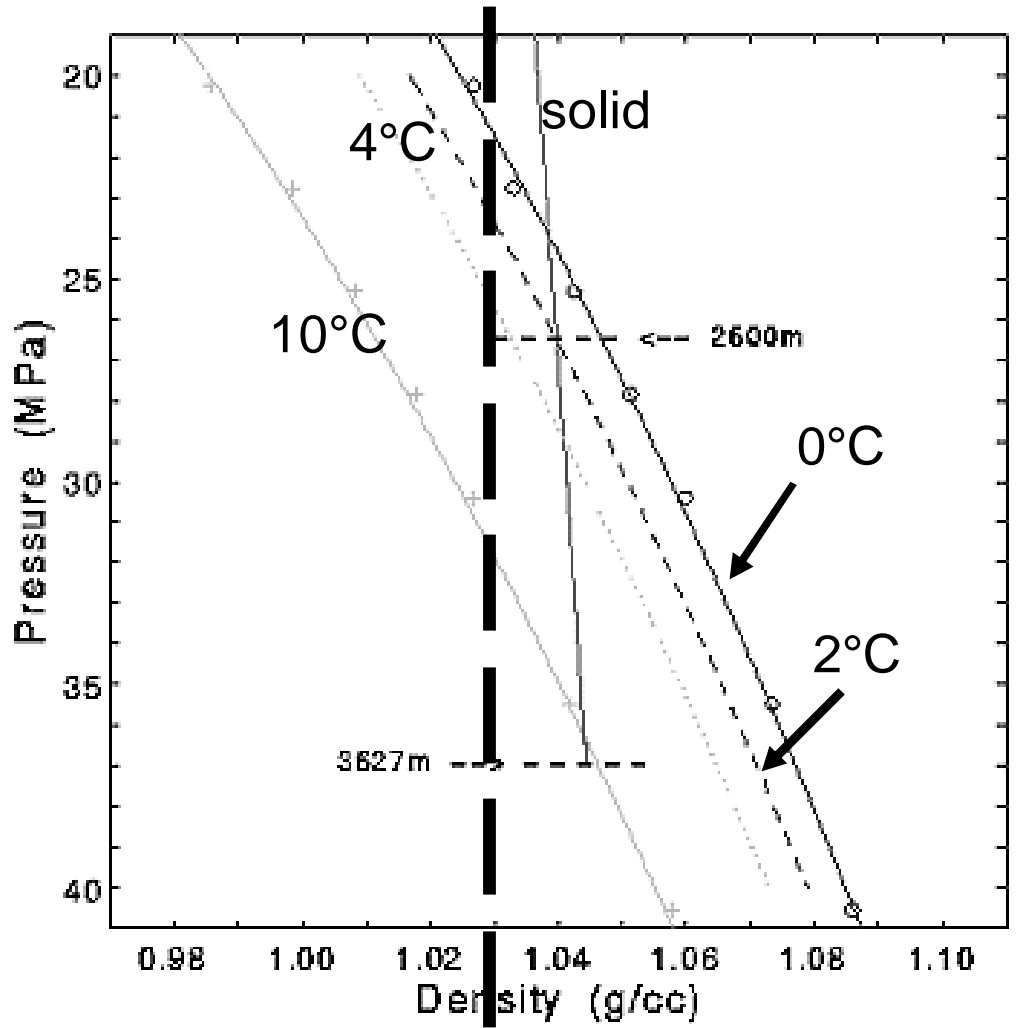
P: 200 - 3500 bar

analytical method



less  
water in  
CO<sub>2</sub>

ca. 5  
mol% CO<sub>2</sub>  
in water



Approximate density of sea water

(partly taken from Brewer, Science 1999)

## Deep sea

CO<sub>2</sub> is a liquid or a solid (gas hydrate as a function of pressure and temperature).

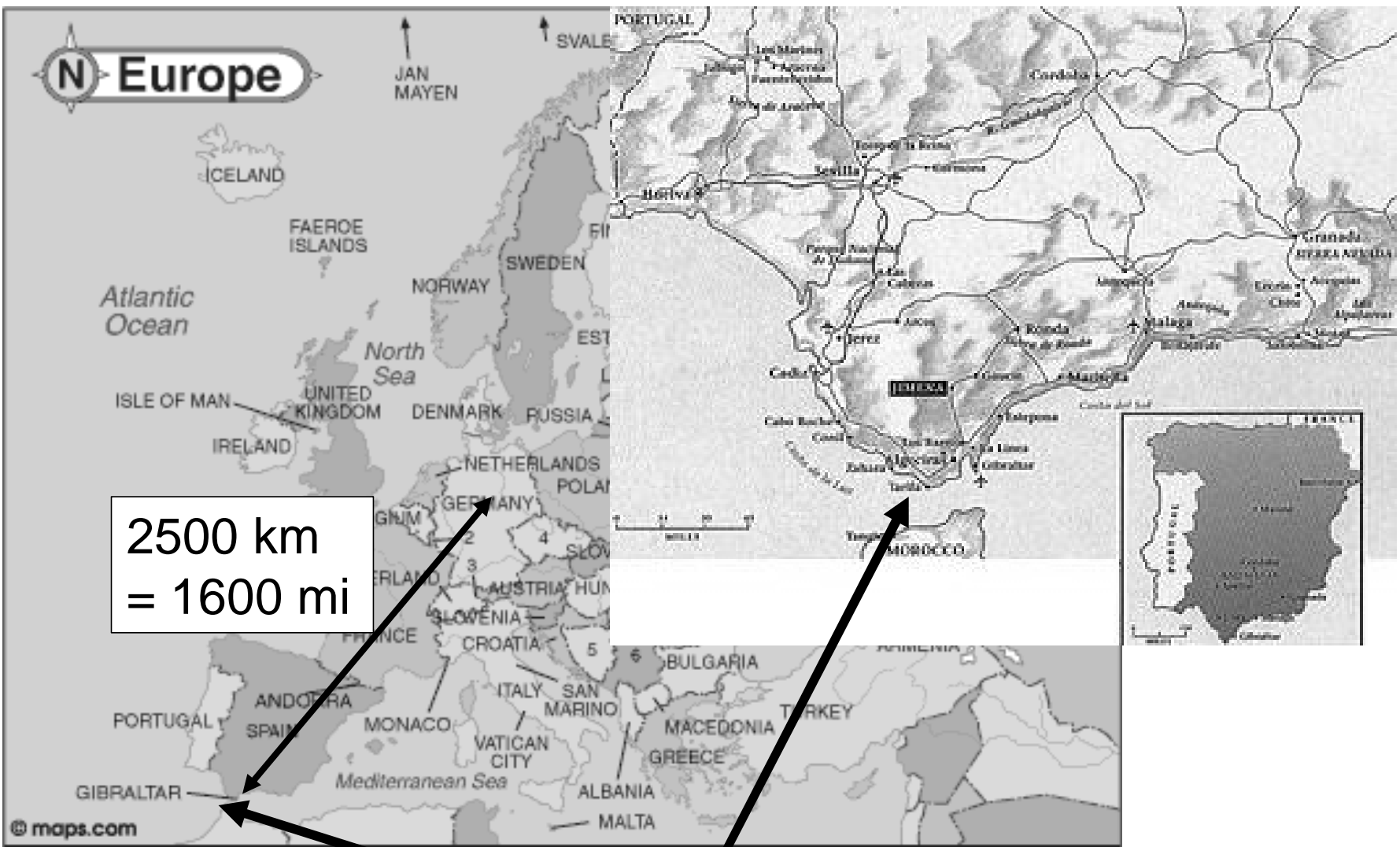
At a certain pressure the CO<sub>2</sub>-phase is denser than the water phase.

**Flat zones + thermohaline zone** (Tarifa, Spain) [Marchetti]  
(**Mediterranean Outflow Water**)

CO<sub>2</sub> is dissolved in water in one phase.

Residence time 300-500 years.





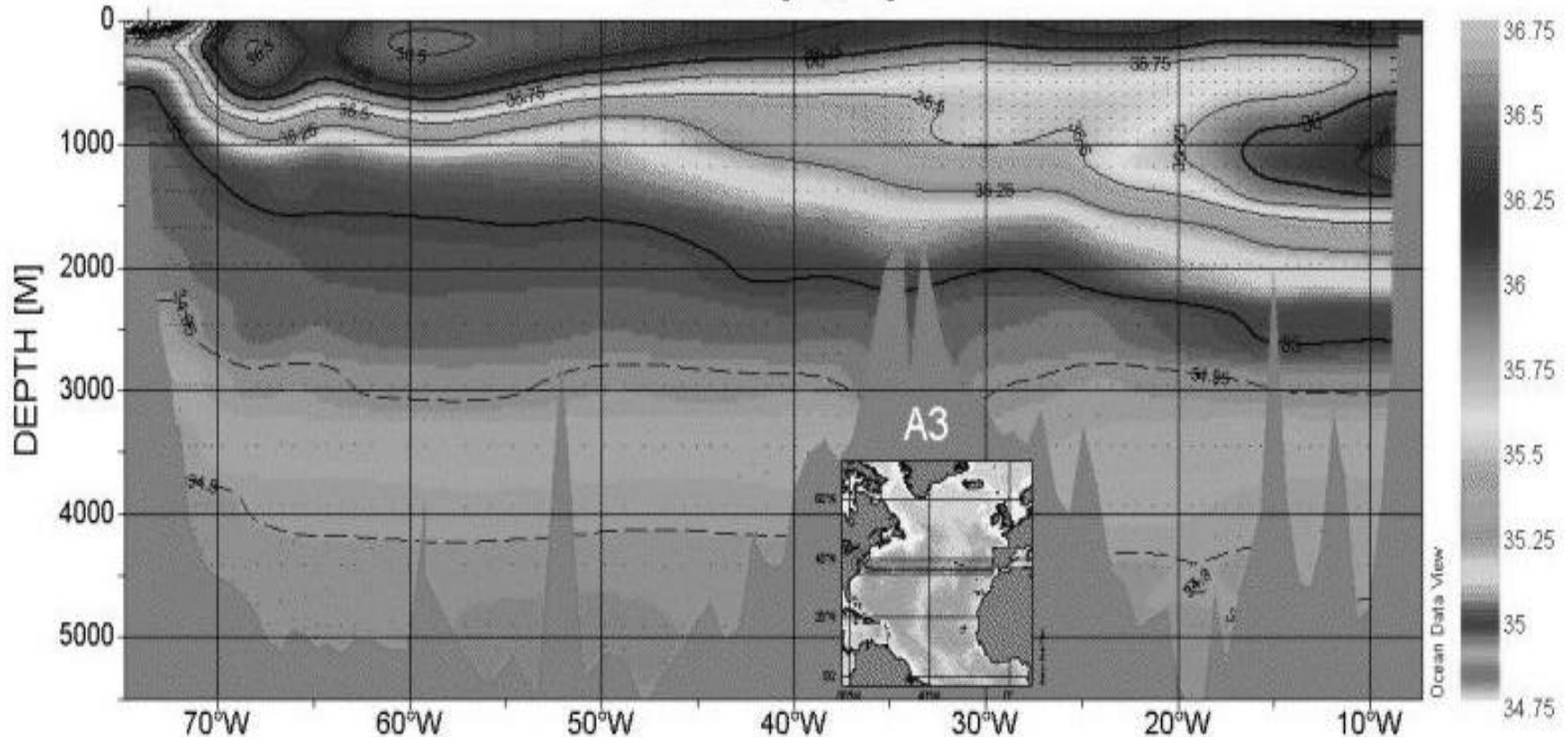
2500 km  
= 1600 mi

Tarifa, Spain

Injection point

Carbonsq  
May 6, 03

## SALINITY [PSS78]



Deep water profile of the salinity at latitude 36°N of the North Atlantic: (*Schlitzer, R., Electronic Atlas of WOCE Hydrographic and Tracer Data Now Available, Eos Trans. AGU, 81(5), 45, 2000*)

Residence time of dissolved CO<sub>2</sub> in the deep water depends on the density.

The density of the water phase can be tuned by the CO<sub>2</sub> solubility (higher CO<sub>2</sub> solubility increases (!) the density).

The outflow of 0,61 Sv (10<sup>6</sup>m<sup>3</sup>/s) [British OCCAM global ocean model] enables the total German CO<sub>2</sub> production to dissolve in 144 minutes

= actual solubility is far away from thermodynamical saturation

= no pH change.

The dissolution process can be performed onshore and the distance to the thermohaline current is small.

No gas hydrate formation.

This proposal is

- standard in terms of technology
- requires less equipment and all onshore

## Problems

- no lobby for sequestration in Germany
- no economical solution for the separation of CO<sub>2</sub> in the power plant
- no reliable thermodynamic data
- the future of the dissolved CO<sub>2</sub> must be predicted
- no real ocean experiments possible

Dr.Voelker, FU Berlin

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the travel



If you want to build a ship, don't drum up people together in order to assign them tasks and work, but rather teach them to long for the endless immensity of the sea.

*Antoine de Saint Exupéry*

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The end.