Annekatrin Löffler, Bernd Schneider, Jacek Beldowski, Hildegard Kubsch

PART I:

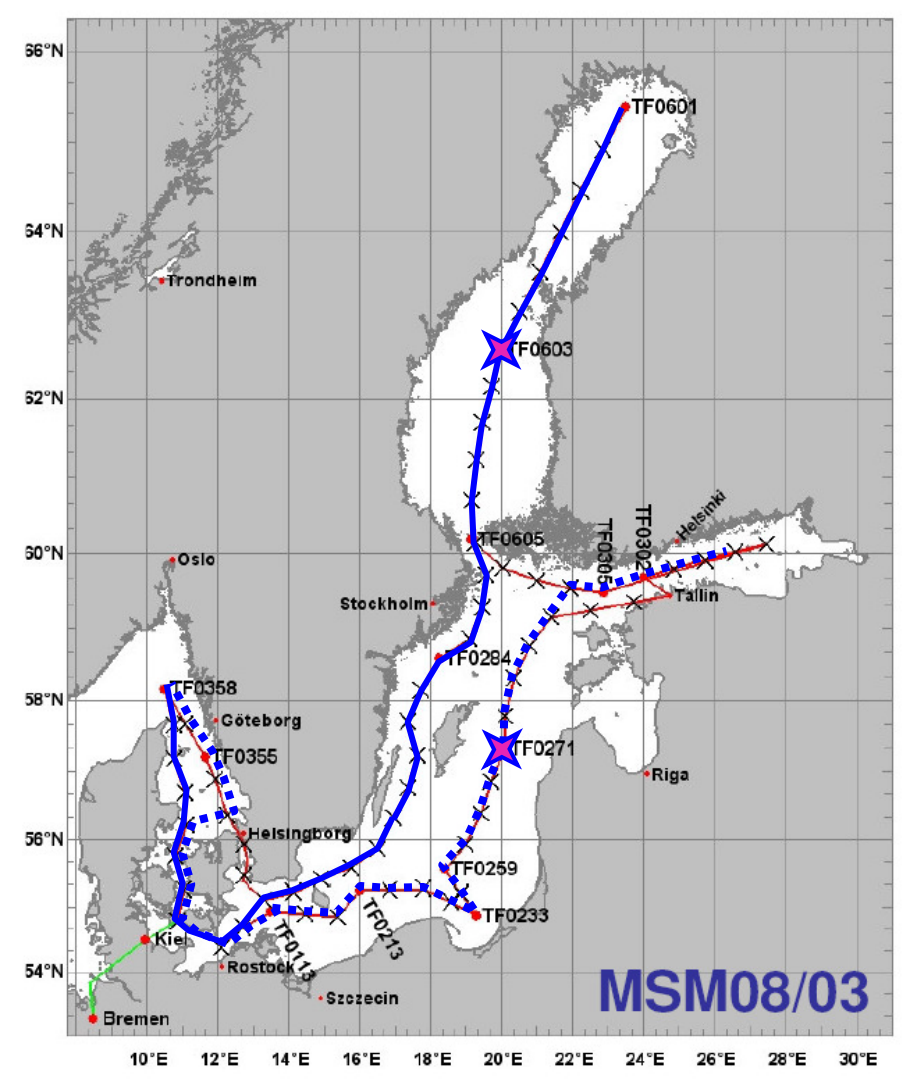
- **Distribution of total dissolved inorganic carbon (C_T) in the Baltic Sea in summer 2008**

$$C_T = [CO_2^*] + [HCO_3^-] + [CO_3^{2-}]$$

- **Enhanced C_T values as a base for the quantification of mineralization processes**
- **Relations between the biological cycles of carbon and nitrogen**
- **A new approach for the measurement of nitrogen partial pressure as an indicator for denitrification processes**

PART II: Organic matter mineralization derived from the accumulation of total CO_2 (Bernd Schneider)

Sampling in June/July 2008



eastern route:

Kattegat – Gulf of Finland

western route:

Kattegat – Bothnian Bay

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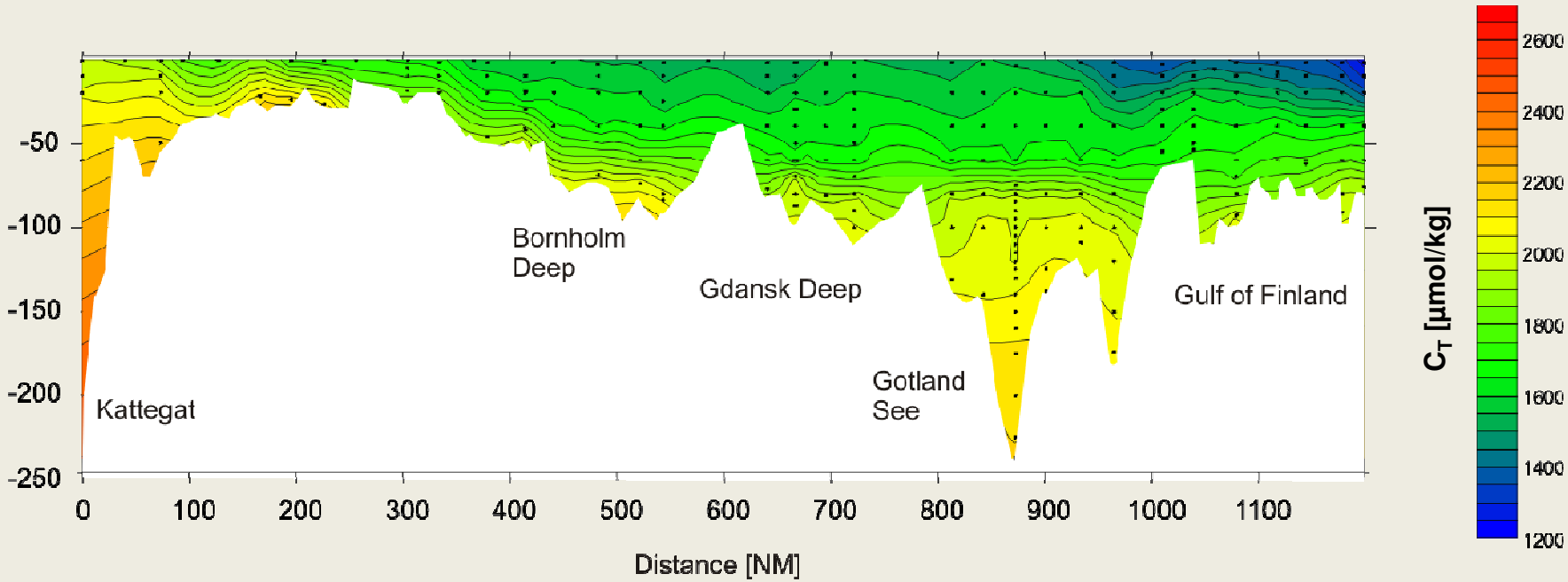
Depth distribution of total dissolved inorganic carbon (C_T) (eastern route)



C_T (= $[CO_2^*] + [HCO_3^-] + [CO_3^{2-}]$) mainly depends on:

1. Alkalinity (A_C) = $[HCO_3^-] + 2 \cdot [CO_3^{2-}]$
   - → $CaCO_3$ oversaturation in the oceans
   - → land runoff with low alkalinity in the north of the Baltic Sea
2. Biological consumtion / destruction
   - → CO_2 consumtion in the euphotic zone
   - → CO_2 release in deep water layers
   - → CO_2 accumulation during stagnation conditions

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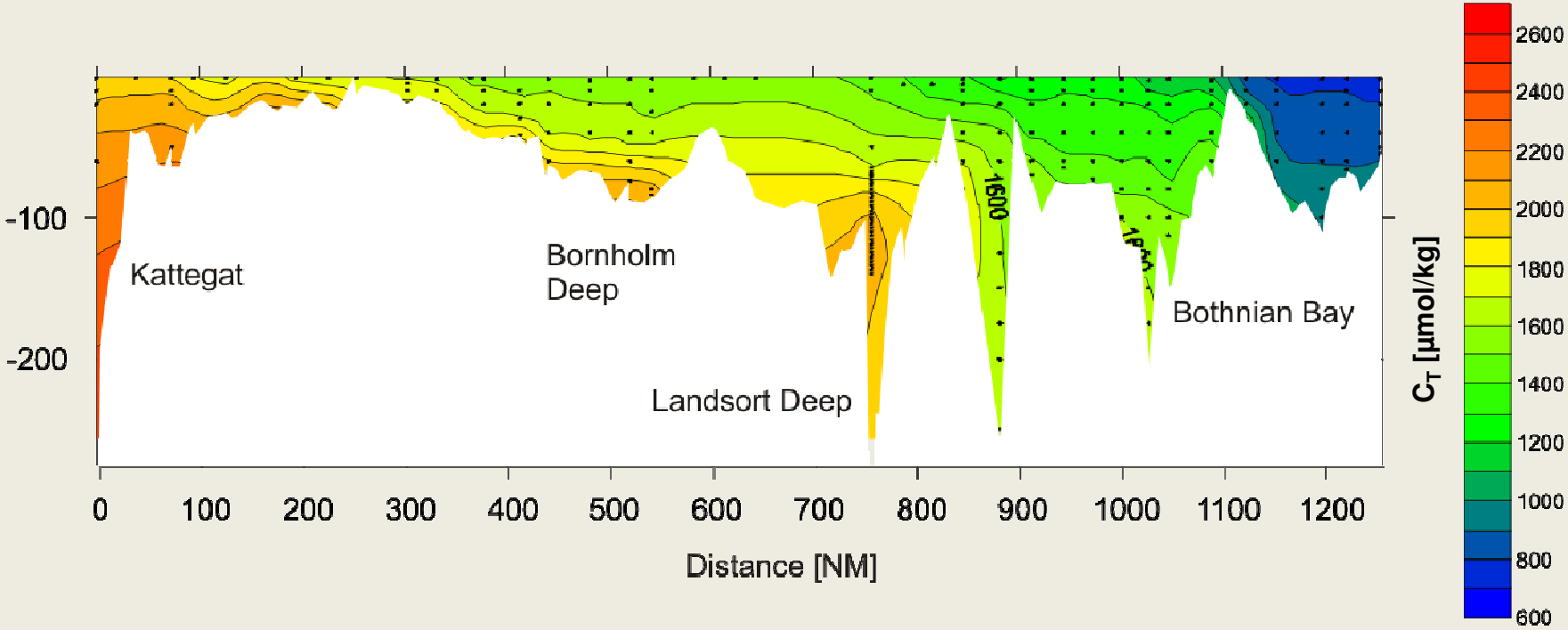
Depth distribution of total dissolved inorganic carbon (C_T) (western route)



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Enhanced C_T values as a base for the quantification of mineralization processes

$C_T^{min} = \Delta C_T = C_T^{measured} - C_T^{background}$ (counterpart to the AOU – „apparent oxygen demand“)

$C_T^{background}$ = total dissolved inorganic carbon when the water mass was in contact with the atmosphere last time (calculated from p_{CO2} and alkalinity for a given S and T)

(calculation is reasonable for deep water, only raw values for surface waters)

PART II
(Bernd Schneider)

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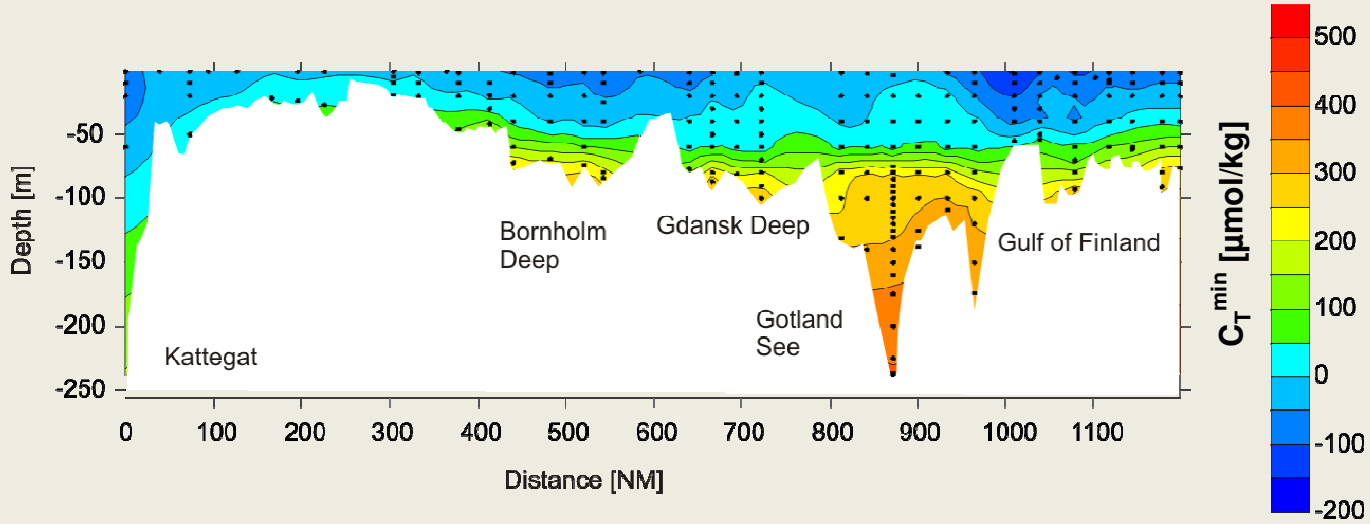
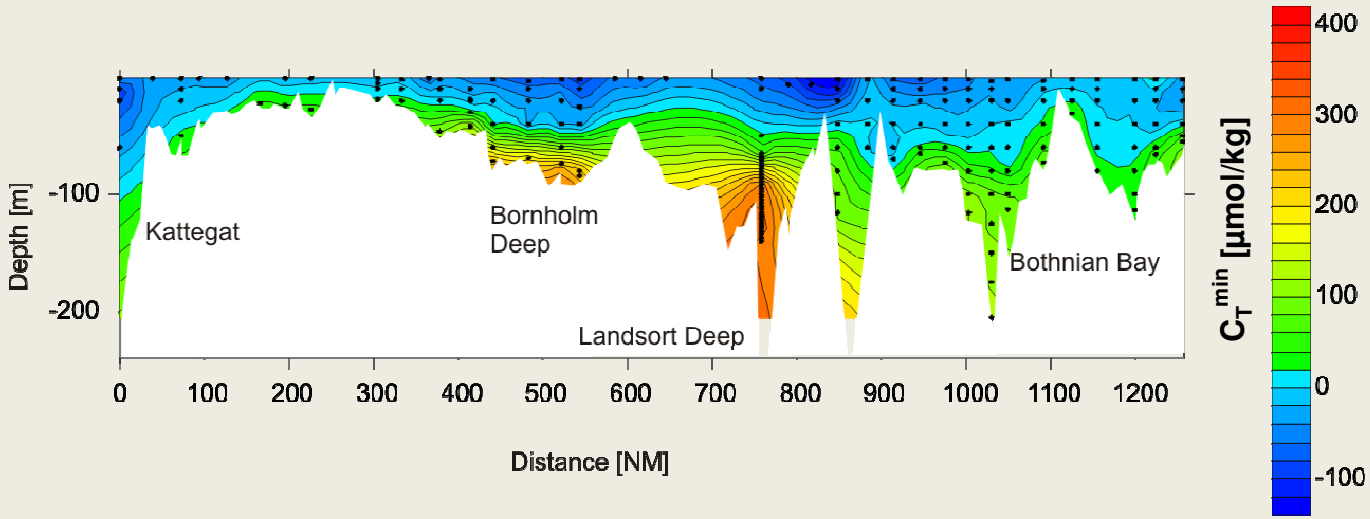
Differences between measured C_T and calculated saturation values = C_T^{min}

eastern route:



western route:



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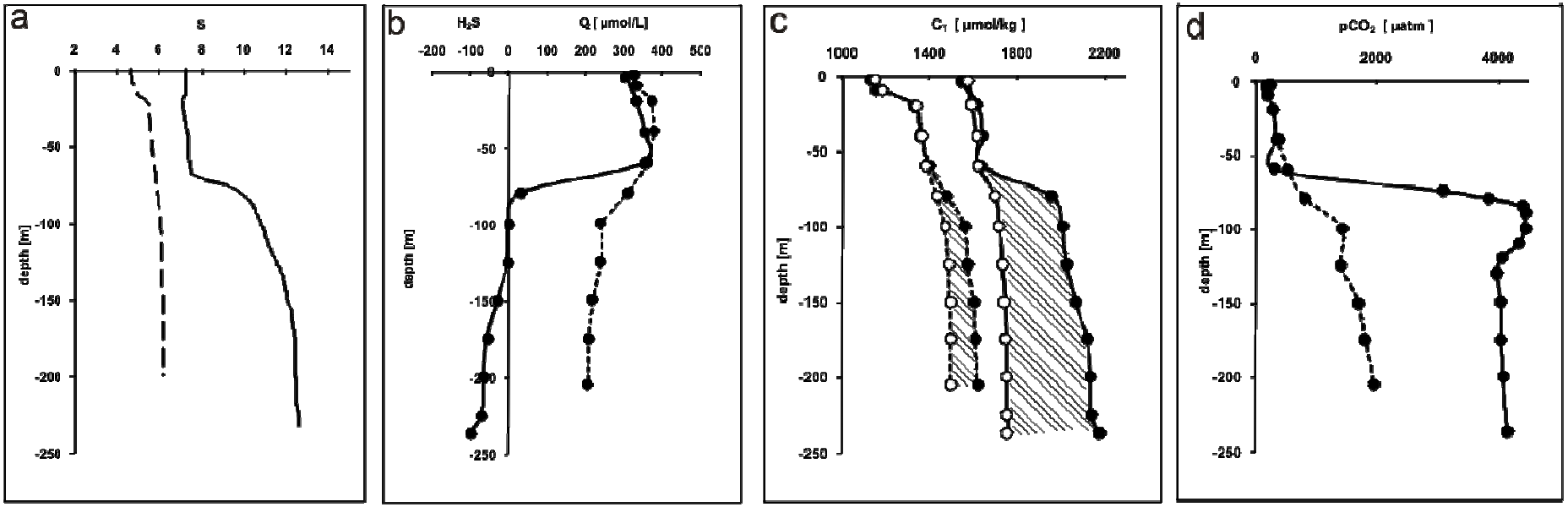
Vertical profiles of C_T^{min} at the Bothnian Sea and the eastern Gotland Sea

– – – – – **Bothnian Sea (periodic mixed water column)**

——— **Gotland Deep (stagnation of the deep water)**

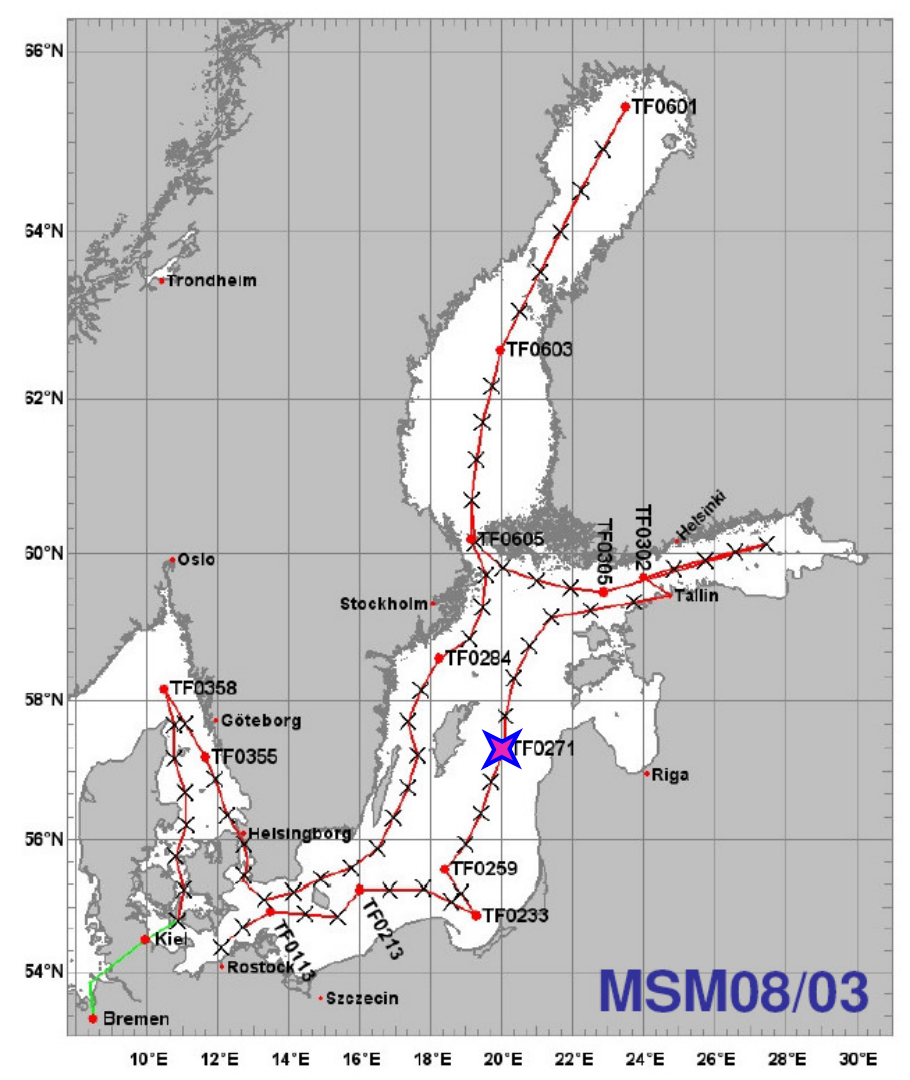


Salinity | Oxygen (µmol/l) H_2S (µmol/l) | C_T (µmol/kg) | pCO2 (µatm)

measured values

saturation values (calculated)

Sampling in June/July 2008



Gas Tension measurements

total partial pressure of all dissolved gases

→ determination of dissolved N_2

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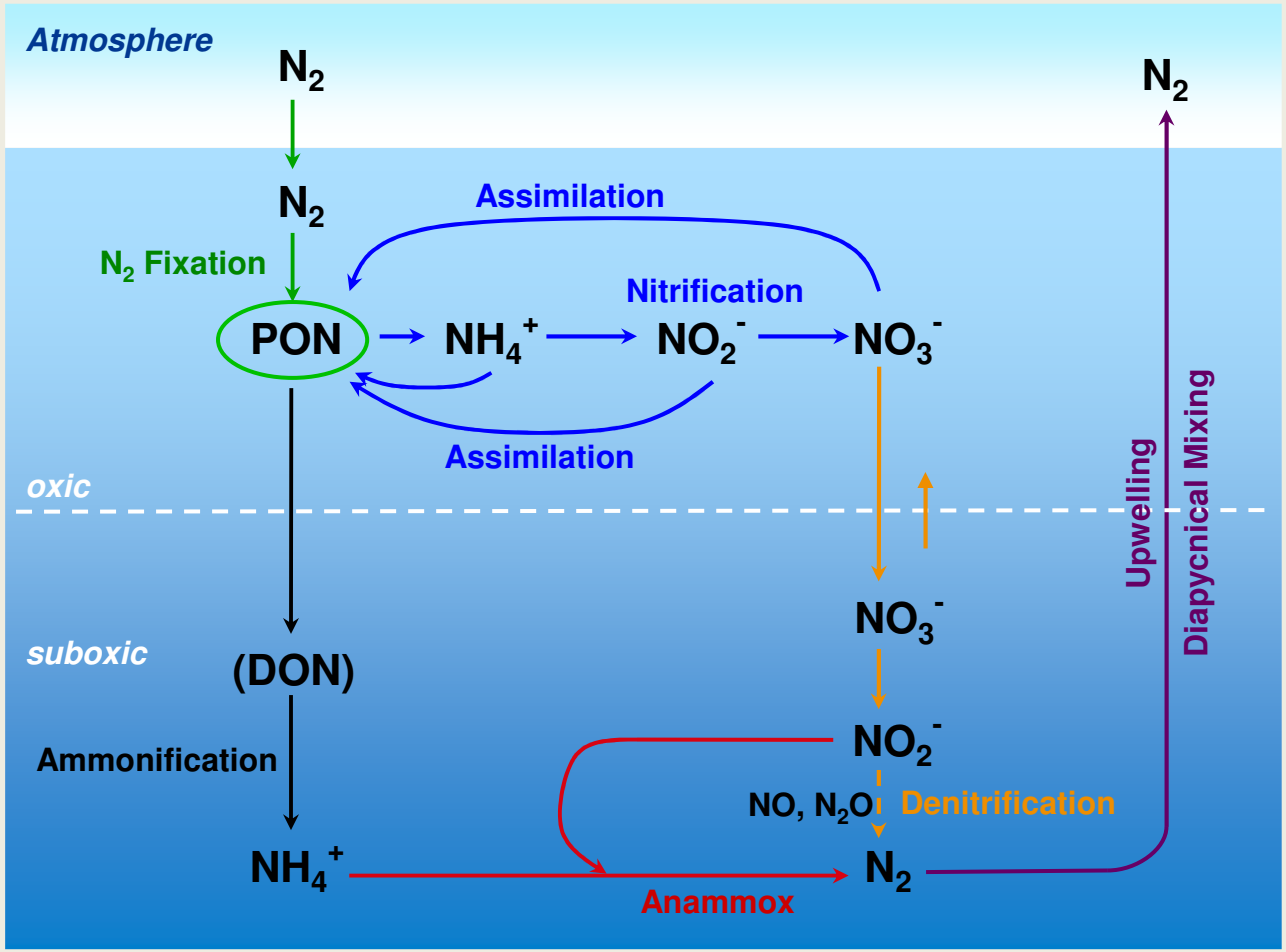
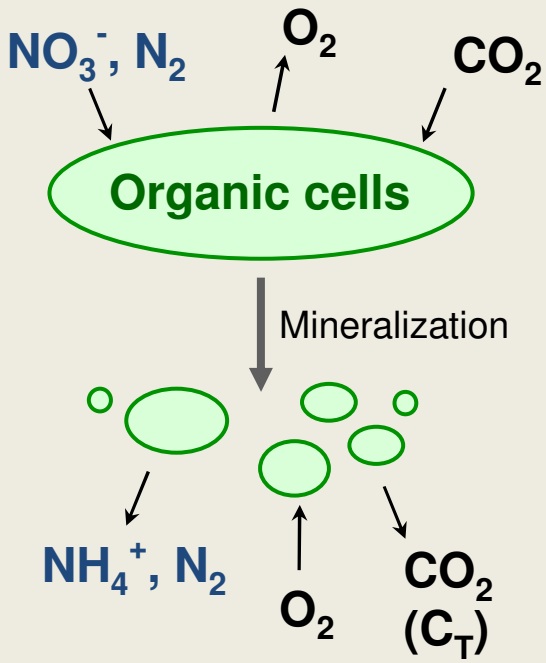
The marine nitrogen cycle



Assimilation/Photosynthesis

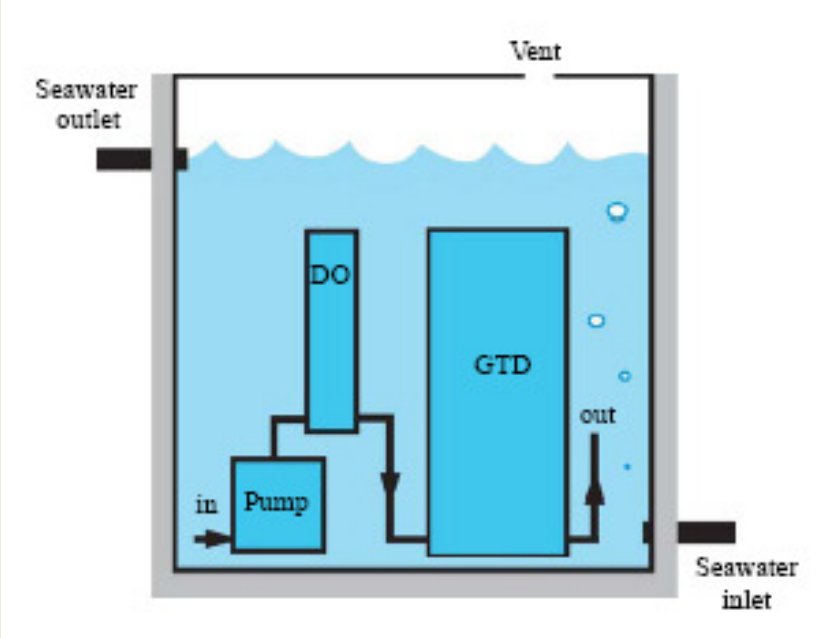


Organic matter:

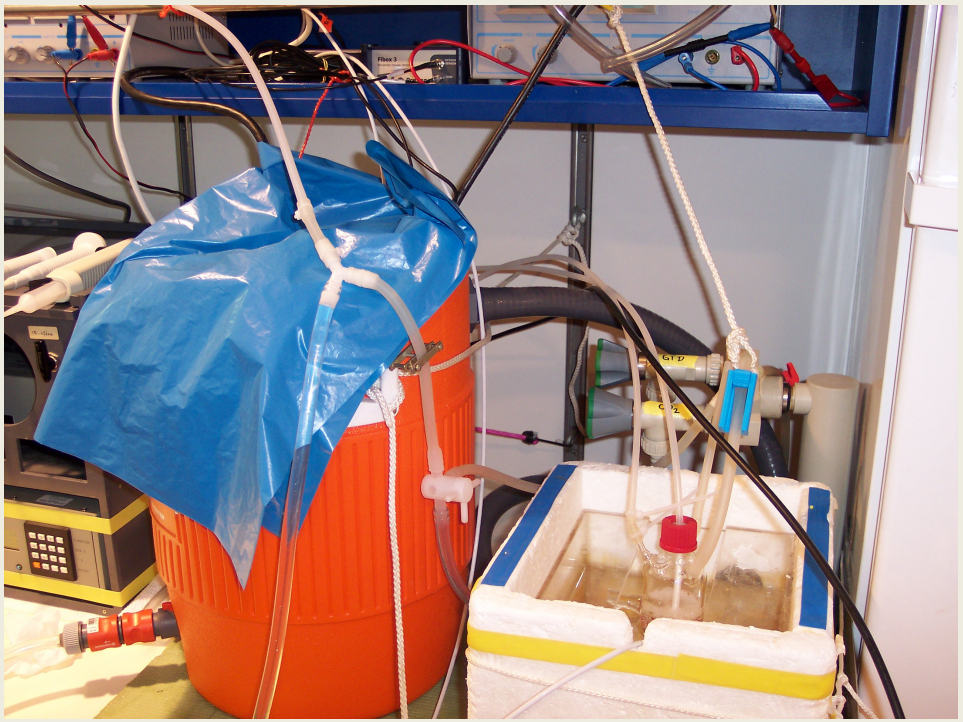
C : N : P = 106 : 16 : 1

(Redfield) C:N ≈ 6,6 ?

Measurements of dissolved gases: p_{CO2}, p_{O2}, Gas Tension



Gas Tension Device (GTD) underway system on board

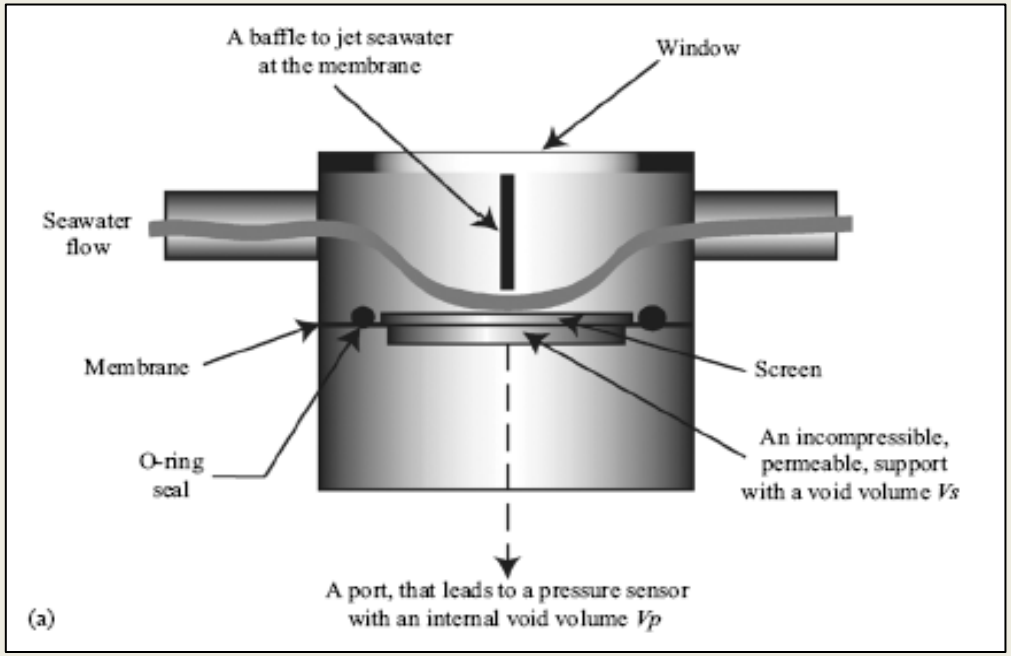


Gas Tension = total partial pressure of all dissolved gases:

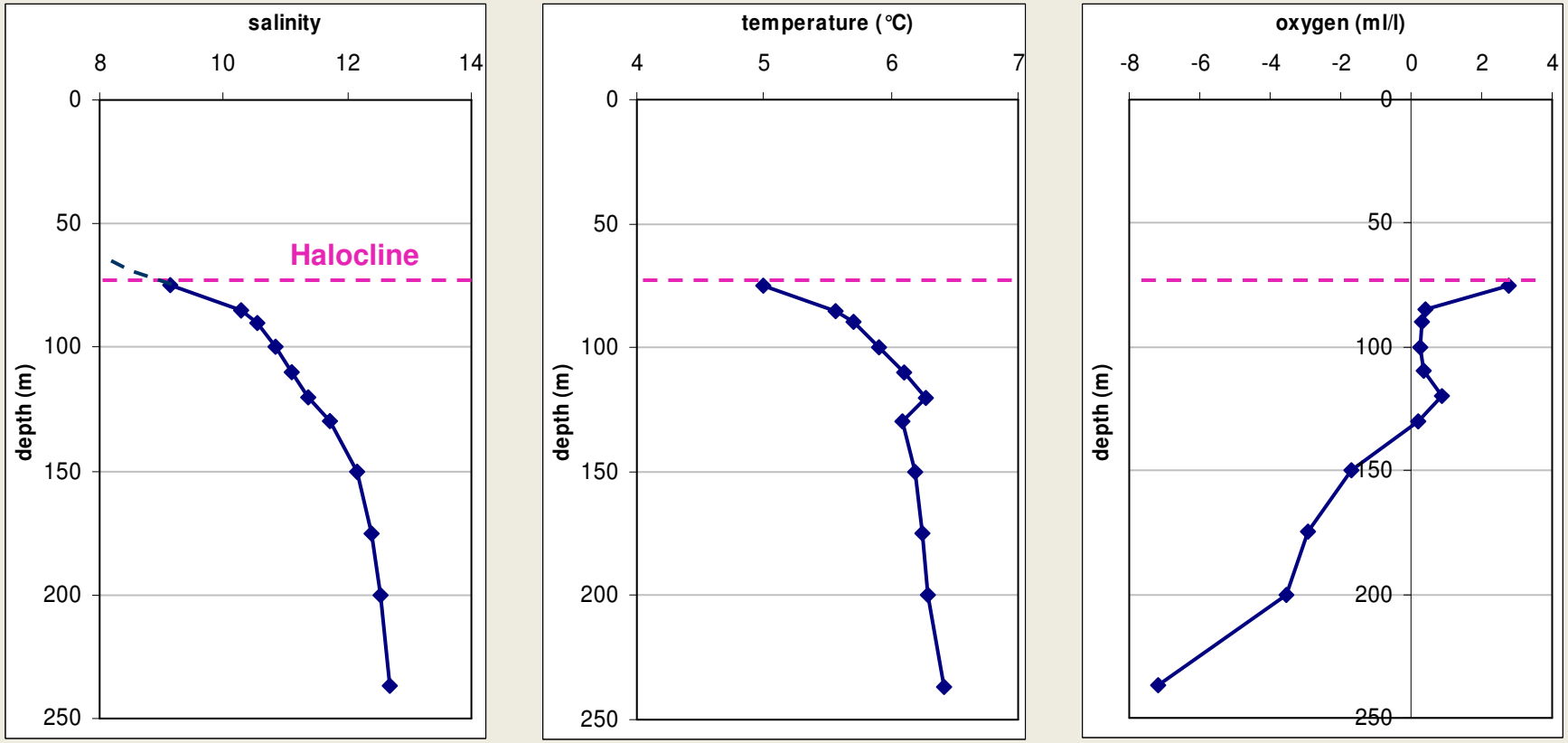
$$p_t = p_{N2} + p_{O2} + p_{CO2} + p_{Ar} + p_{H2O} + p_r$$

(r = insignificant trace gases: Kr, Xe...)

Gas Tension Device – underway system („PRO-OCEANUS“, Canada)



Depth profiles at the central Gotland Deep below the Halocline



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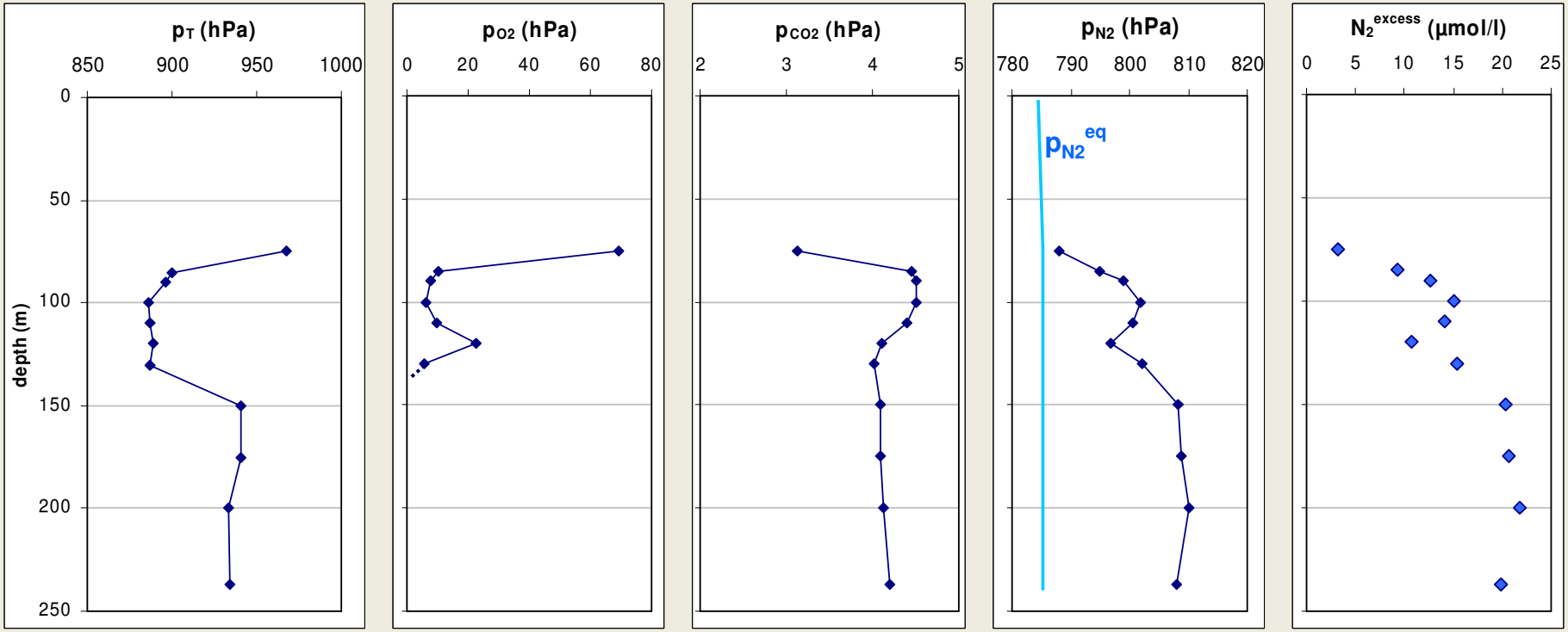
Results of gas tension measurements



N release ≈ 10 µmol L^{-1} y^{-1}

Calculation of C_T and N_T accumulation due to mineralization:

$$C_T = [CO_2^*] + [HCO_3^-] + [CO_3^{2-}]$$

$$N_T = [N_2] + [NH_4^+] + [NO_3^-] + [NO_2^-]$$

$$C_T^{min} = C_T^{measured} - C_T^{background}$$

$$N_T^{min} = N_T^{measured} - N_T^{background}$$

background values: **values from the last contact of the water mass with the atmosphere**

(last North Sea water inflow event was in winter 2003)

Comparison of C_T^{min} and N_T^{min}