Dissolved Oxygen at the Bottom Boundary Layer in the Ulleung Basin, the East/Japan Sea

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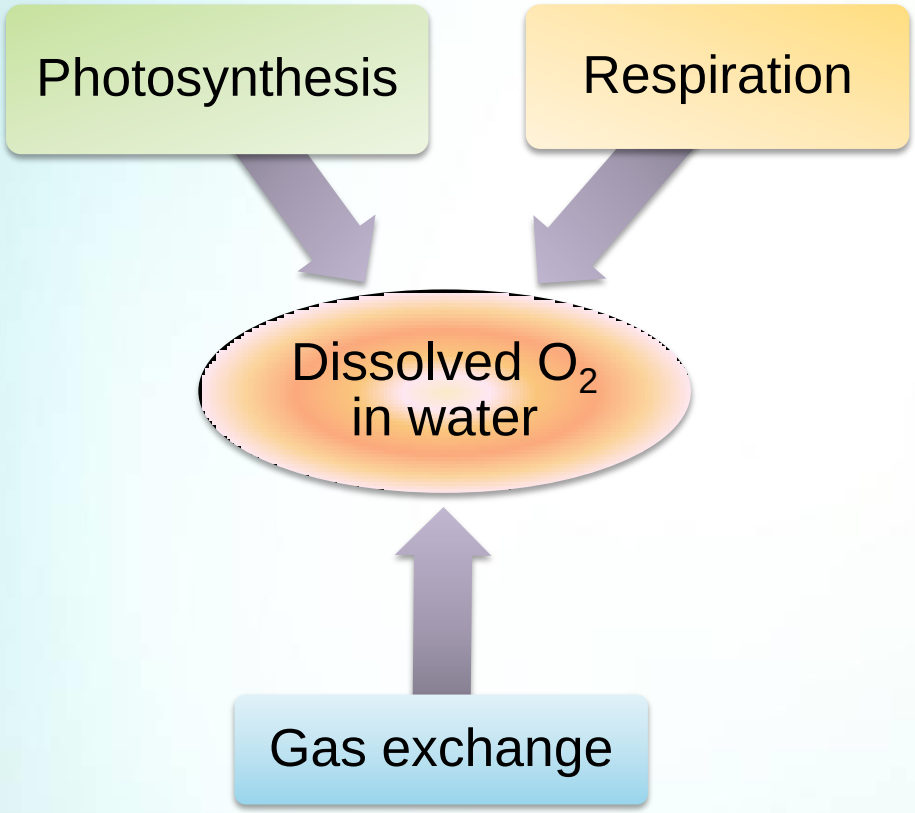
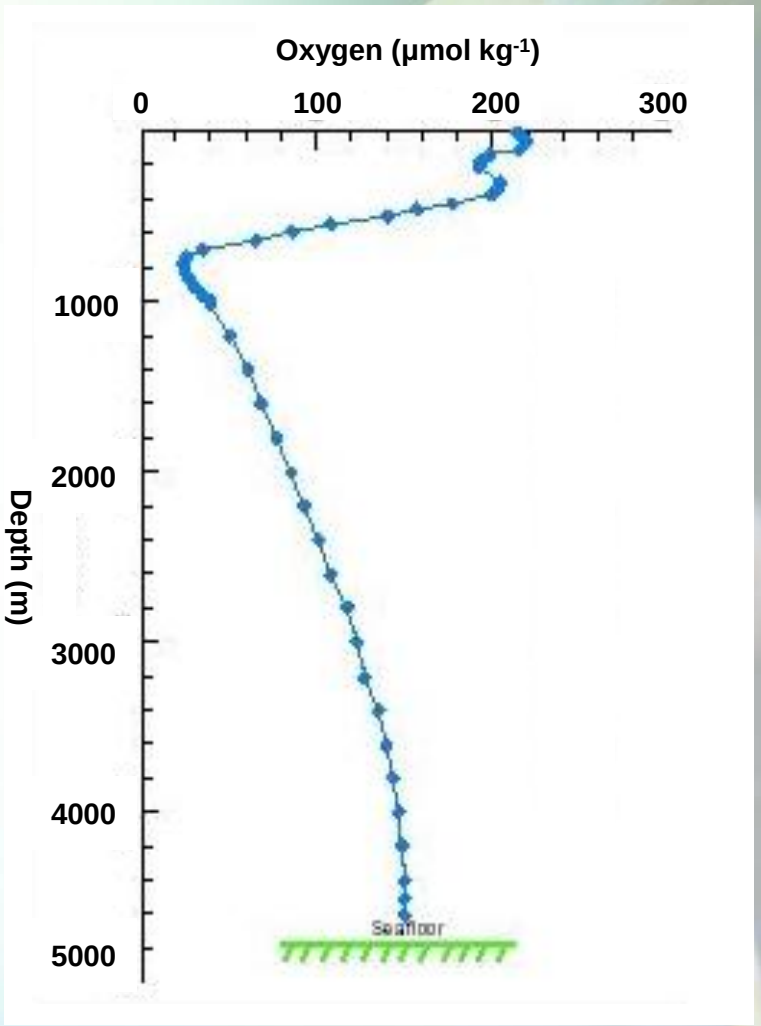
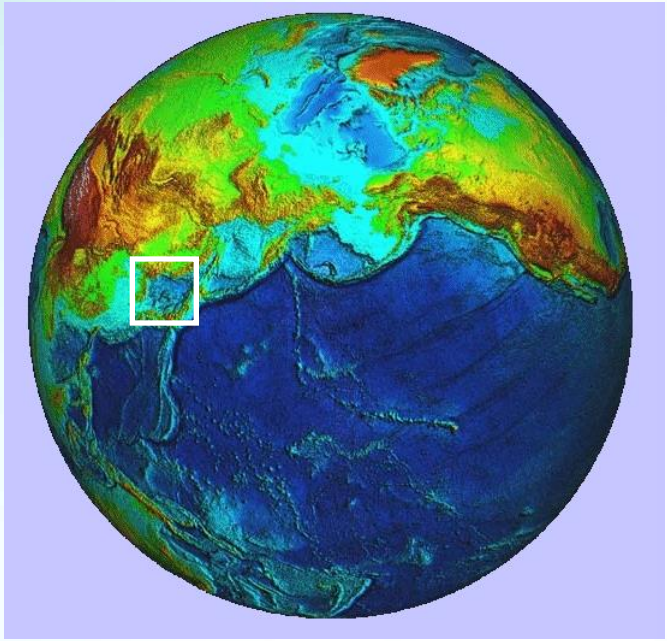
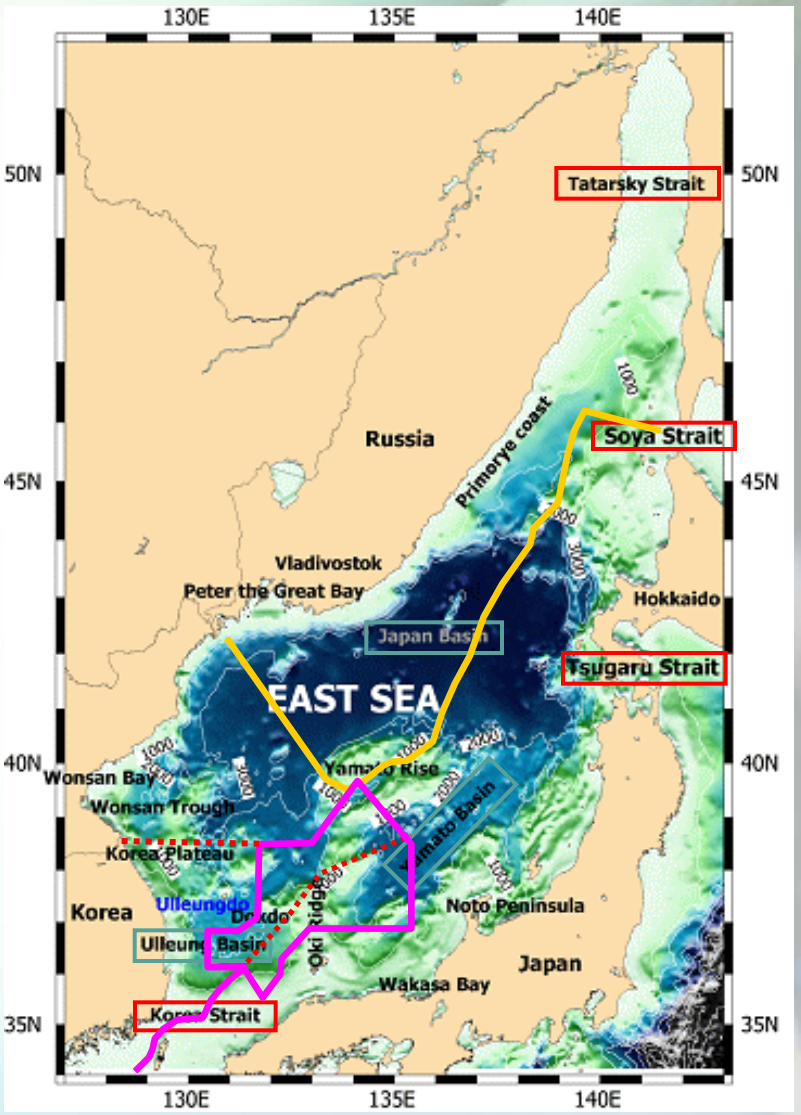
Dissolved Oxygen





The East/Japan Sea (EJS)

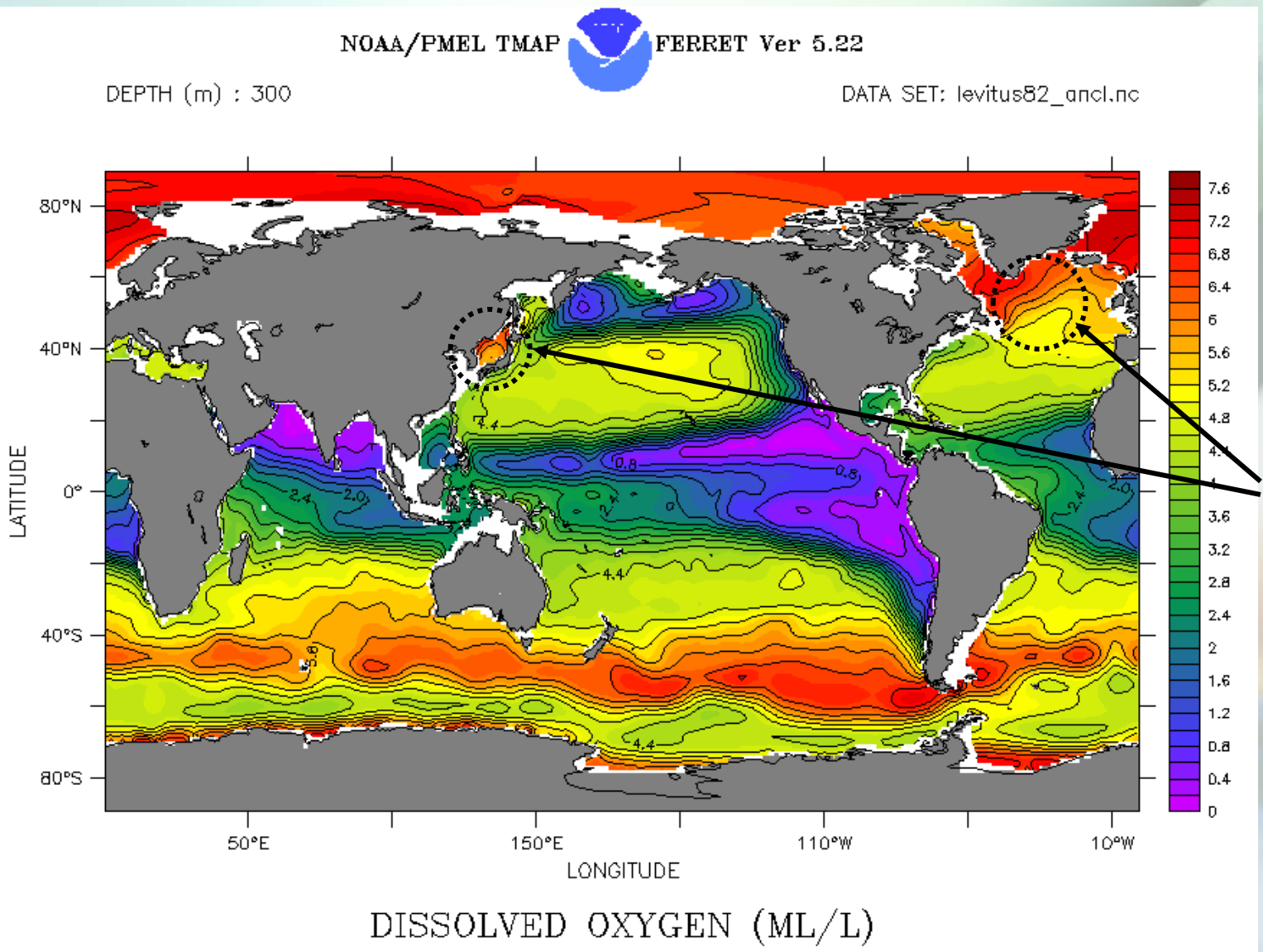




A marginal sea of the Pacific
3 basins deeper than 2000 m
Max sill depth: ~150 m

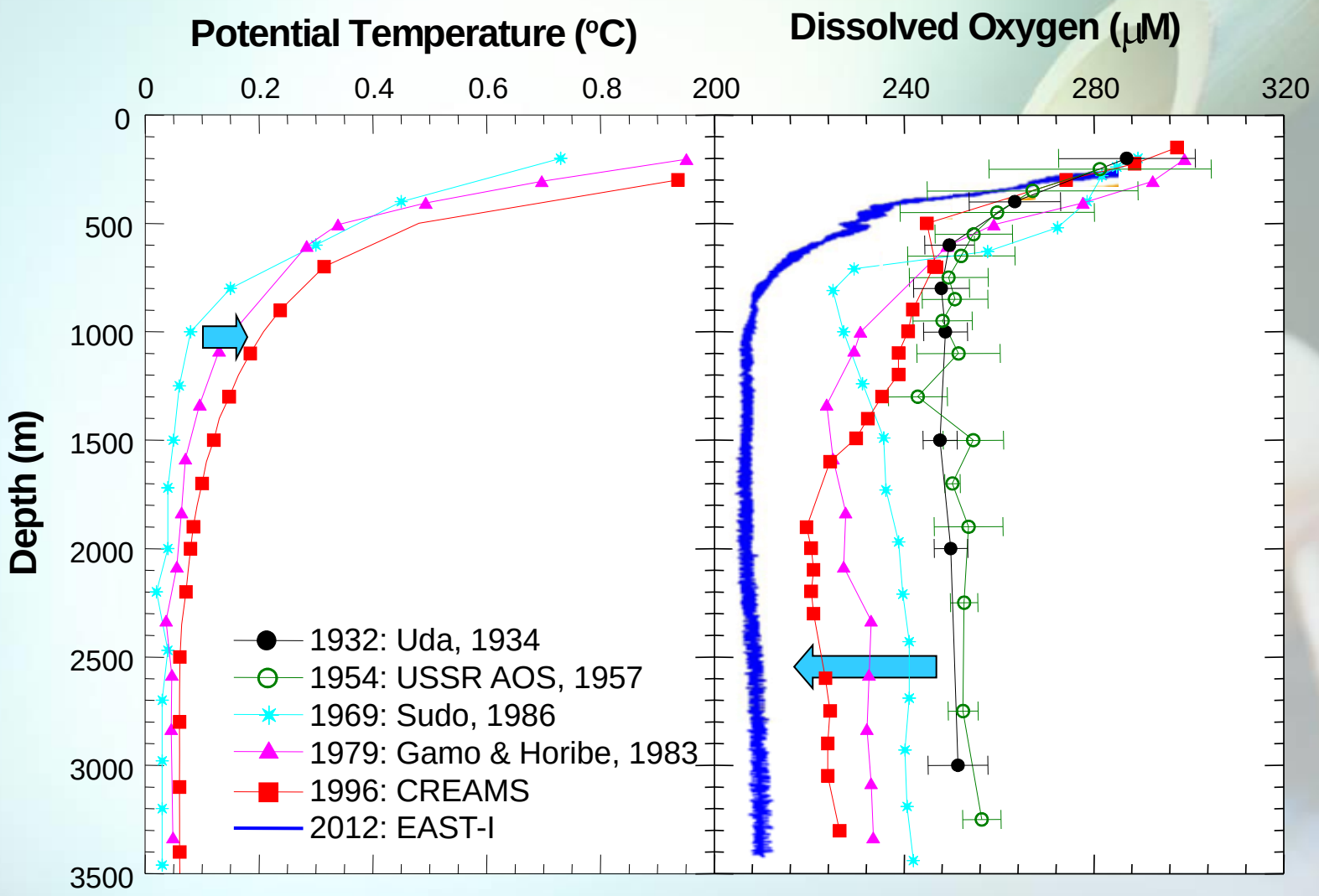
Semi-isolated basin

Dissolved Oxygen in Deep Layer

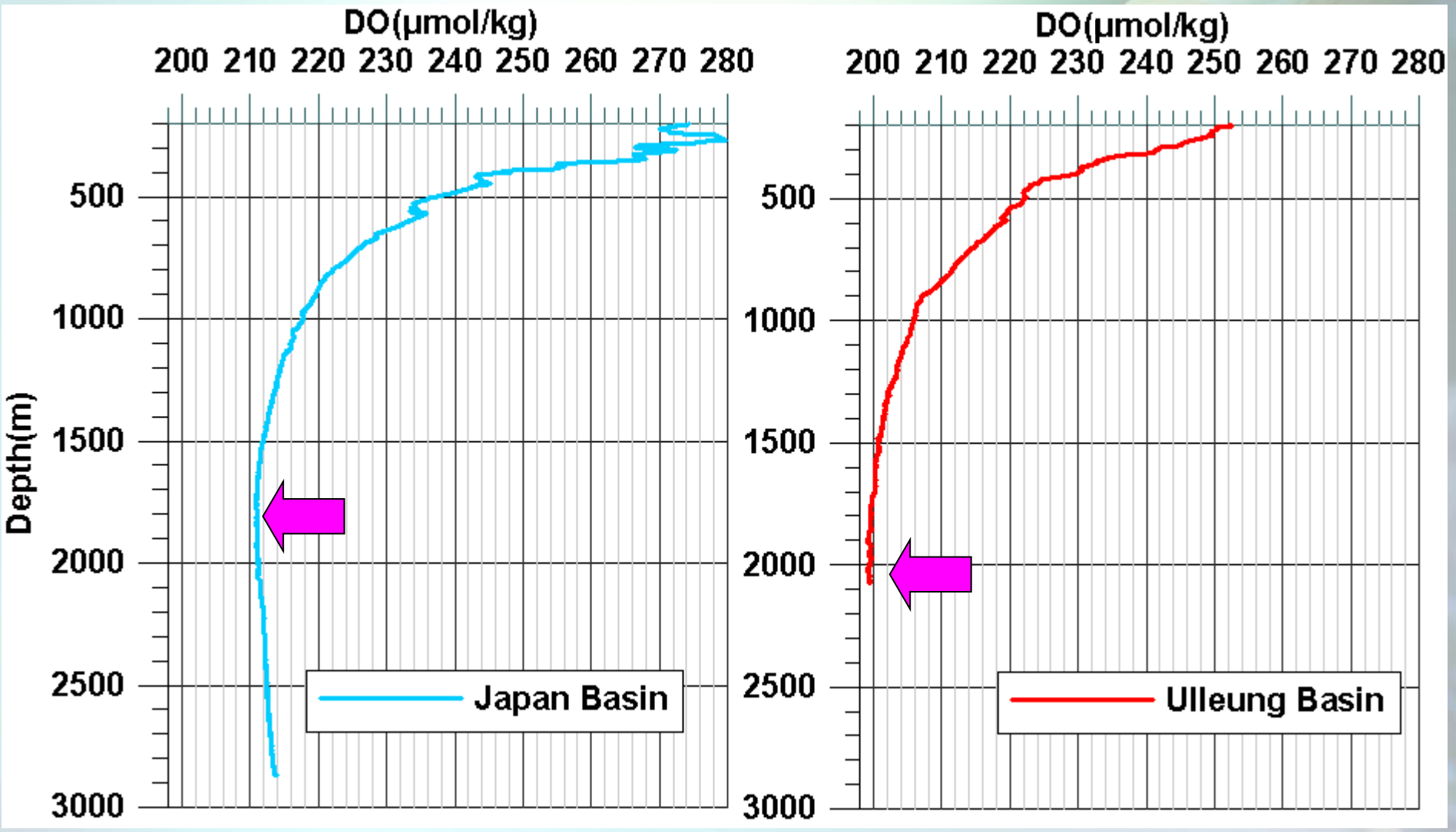


Deep Water Formation

Changing EJS

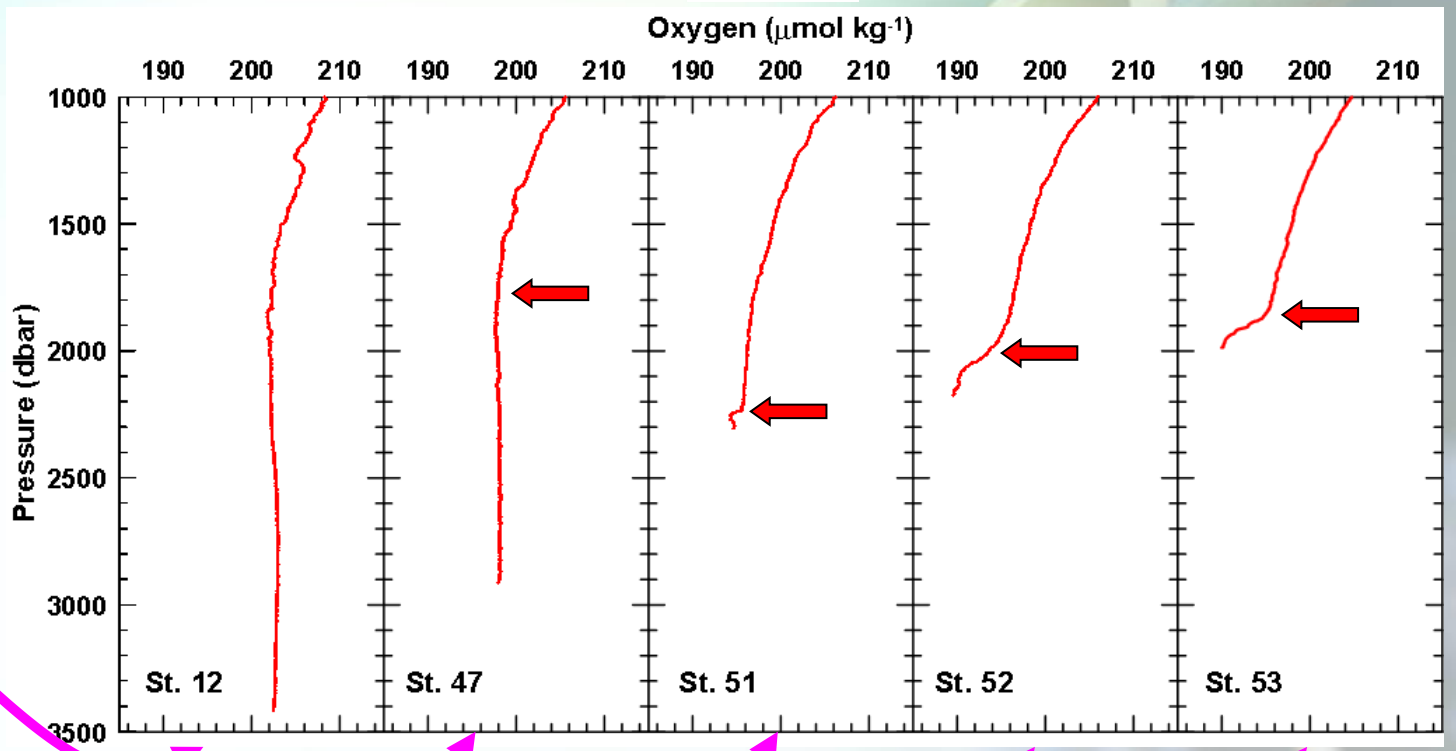


Dissolved Oxygen in the East Sea

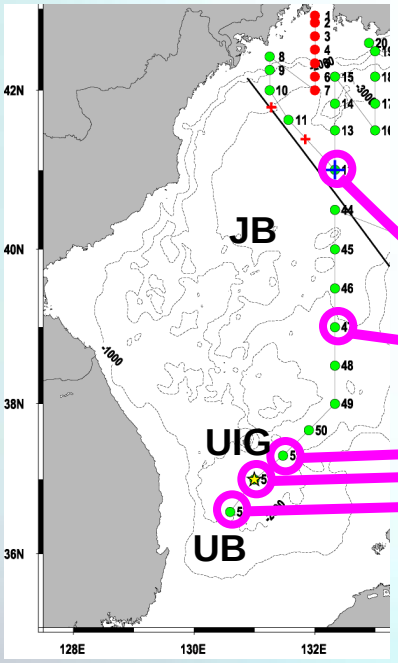


Deep Oxygen Profile from JB to UB

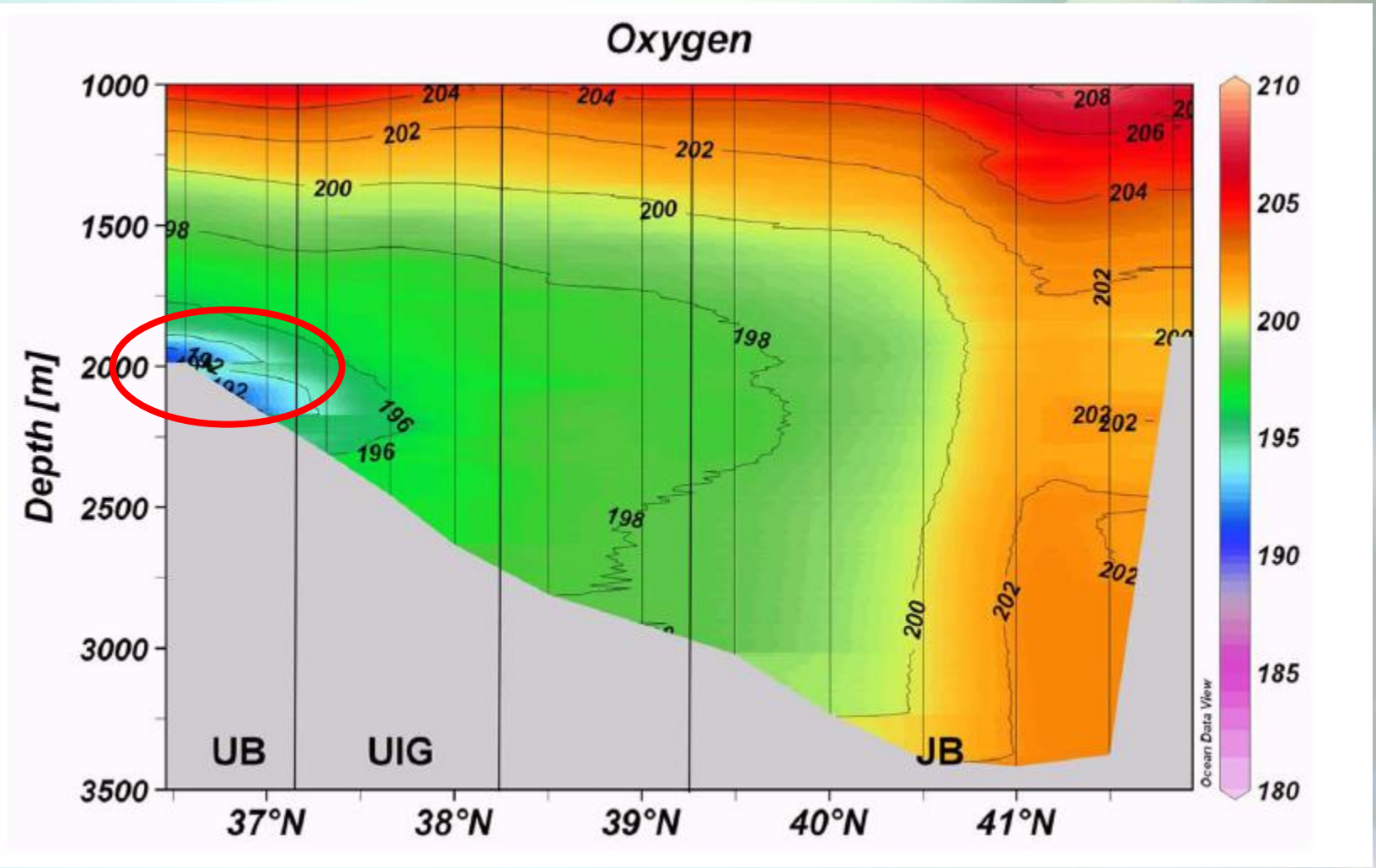
JB ← UIG → UB



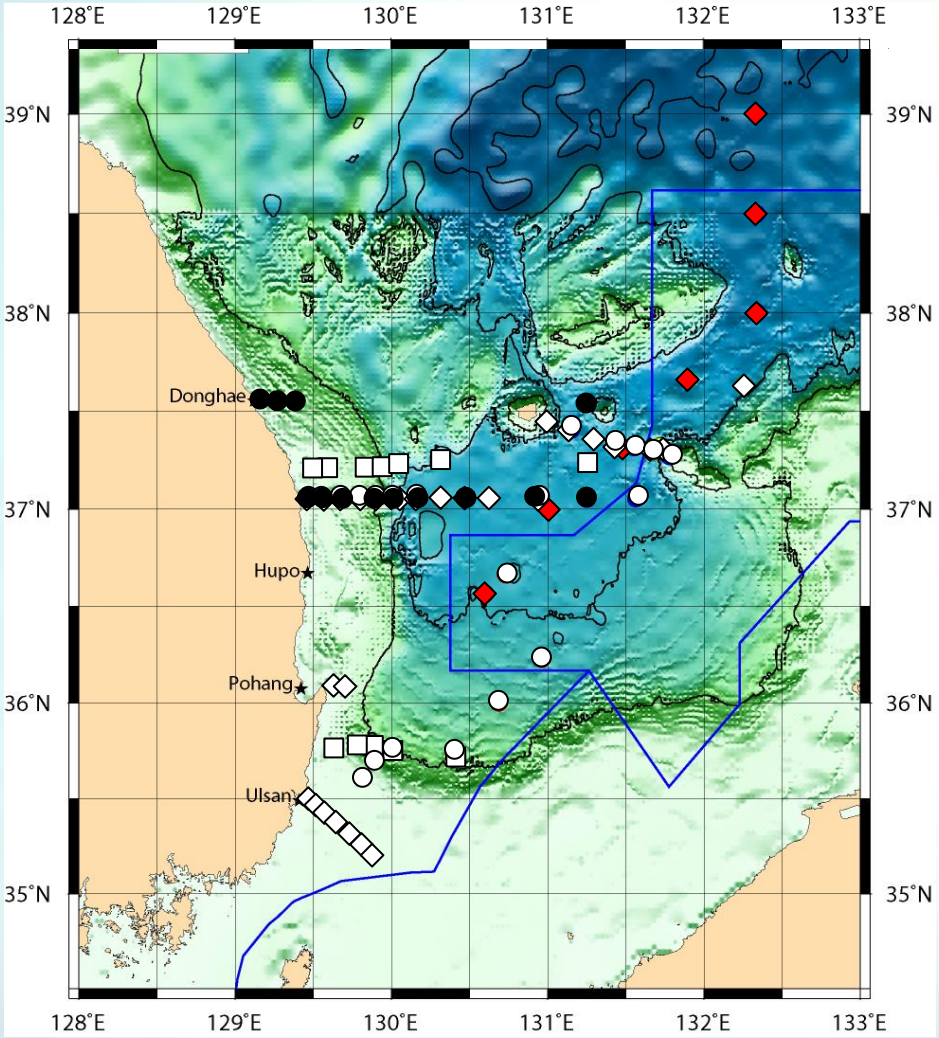
2005/10



Deep Oxygen Profile from JB to UB



CRUISES (2005/10 – 2006/9)



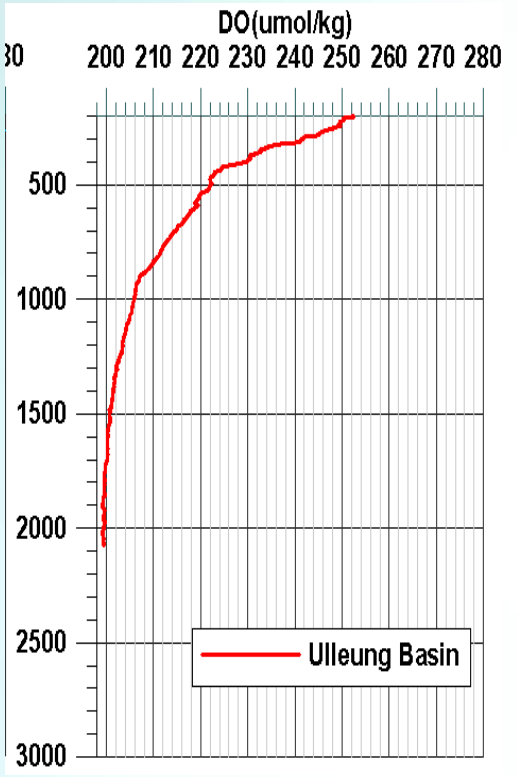
Altimeter sensor

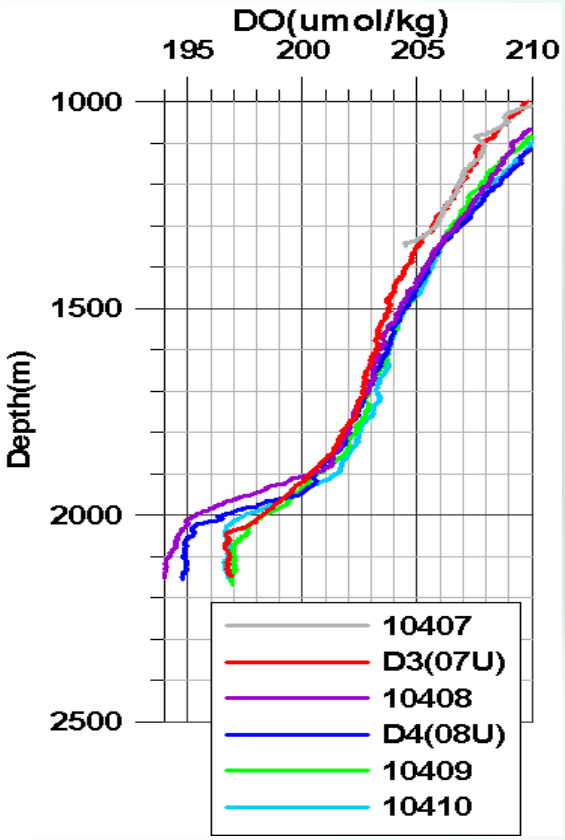
Closer than 10 m above bottom

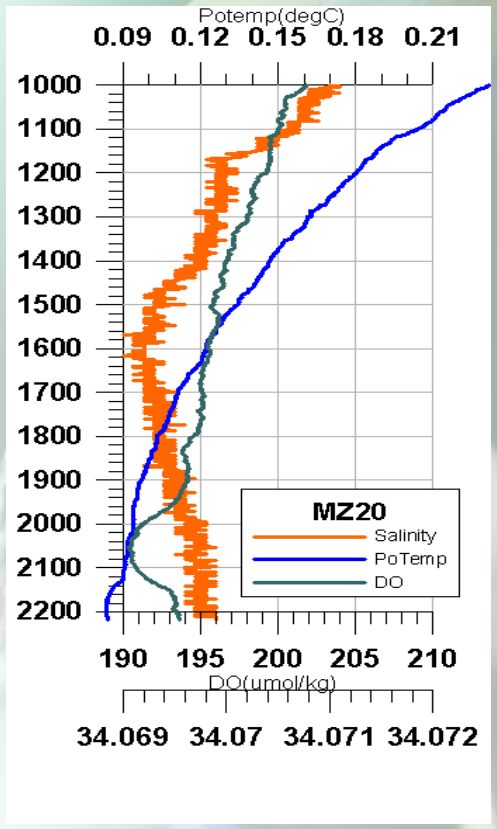
Oxygen sensor [SBE43]

- ◆ Oct. 2005 (R/V Laverntiev)
- ◇ May 2006 (R/V Tamyang)
- ○ Jul. 2006 (R/V HaeYang2000)
- □ Sep. 2006 (R/V Tamyang)
- ● Sep. 2006 (R/V Tamgu5)

Dissolve Oxygen in Ulleung Basin

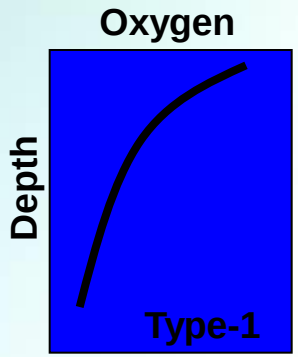


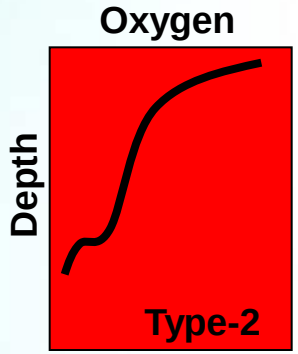


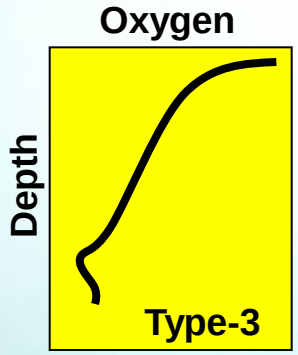


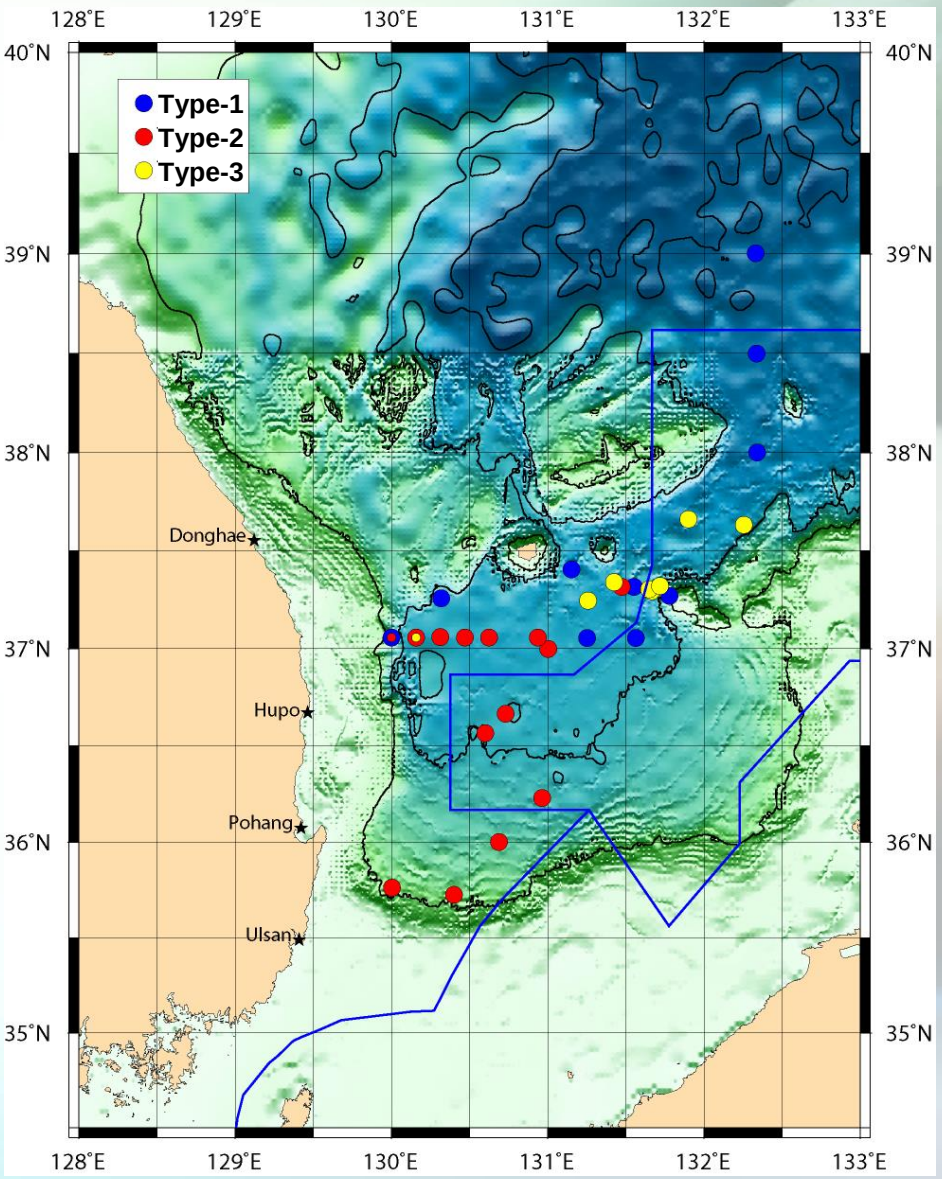
Type 1 **Type 2** **Type 3**

Oxygen Distribution Types in Ulleung Basin









Summary on Type 2

Cruise	Ulleung Interplain Gap	ΔO_2	Thickness	
2005/10	51	1 μmol/kg	90 m	70 m
2006/5	KU, EC1	3 μmol/kg	100-150 m	30-70 m
2006/9 - 1	-	-	-	-
2006/9 - 2	-	-	-	-

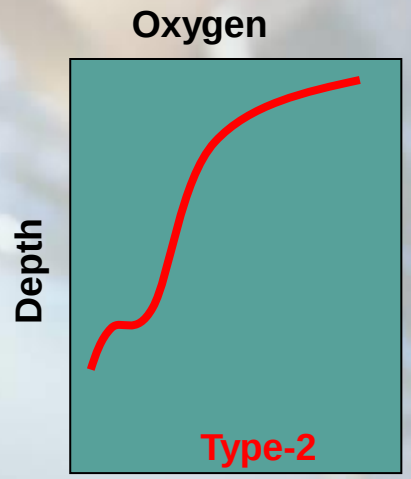
DATE	Ulleung Basin	ΔO_2	Thickness	
2005/10	52,53	5 μmol/kg	150-250 m	50-80 m
2006/5	10407U, 08, 08U, 09, 10	5 - 7 μmol/kg	250 m	50-100 m
2006/7	PU7, PU10	2 - 3 μmol/kg	20-30 m	10-20 m
2006/9 - 1	10407, 08U, 10, UA6, UA7	4 - 6 μmol/kg	100-200 m	30-100m
2006/9 - 2	10407U, 08U	3 μmol/kg	200 m	100-120 m

Some Possibilities

- **Physical process**
  - Relatively Older Waters in Bottom Boundary Layer
  - Extend of Oxygen Minimum Layer from Japan Basin
- **Biochemical process**
  - De-nitrification process

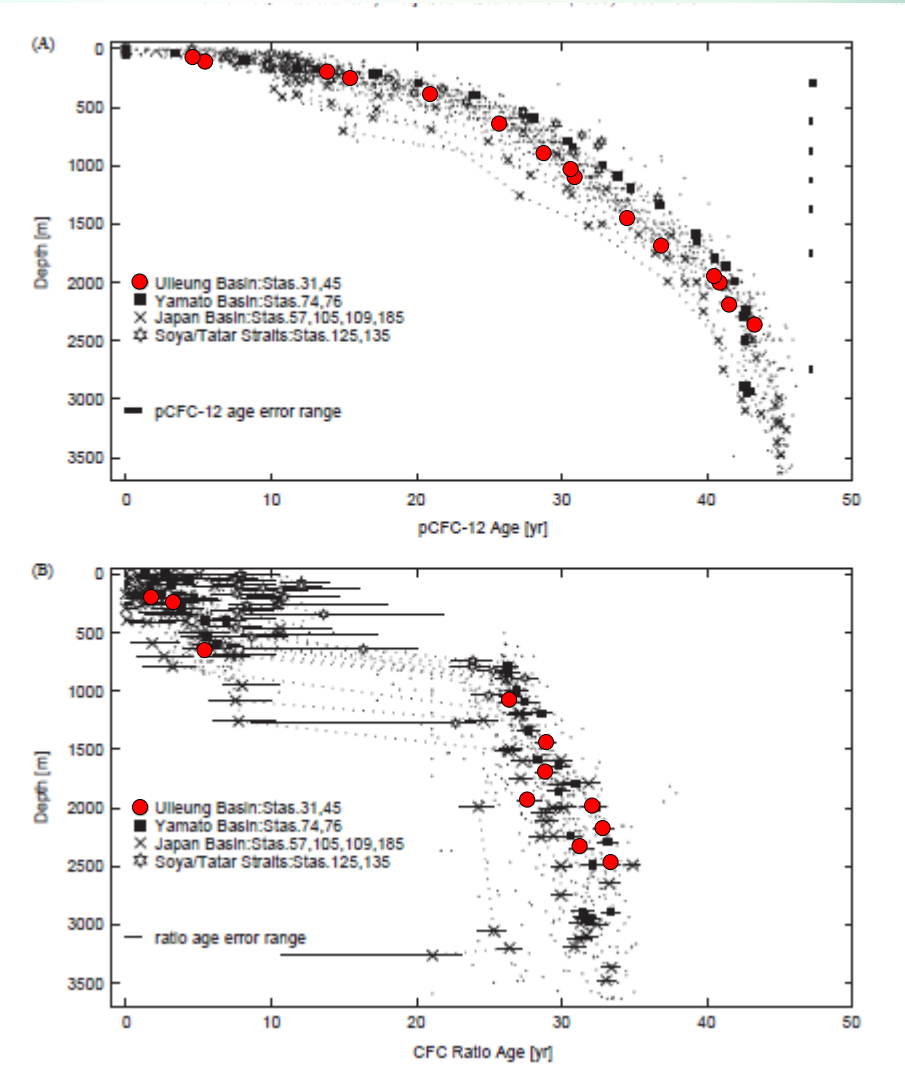
    (Talley et al., 2001; Yanagi, 2002)
  - Organic Matter Decomposition

    (Respiration on Surface Sediment)
- **Another process**



Physical Processes

Relatively Older Waters in Bottom Boundary Layer

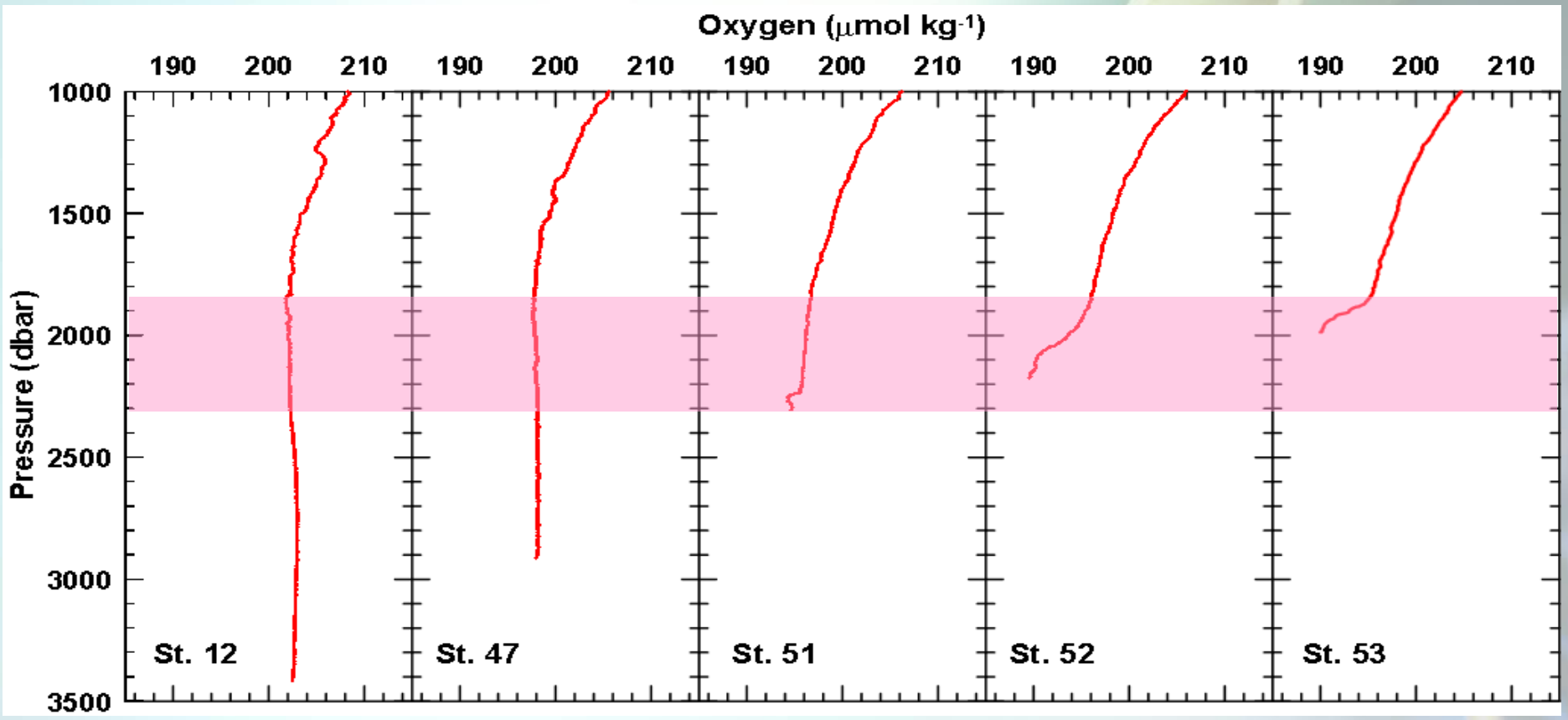


Min & Warner, 2005

Physical Processes

Extend of Oxygen Minimum Layer from Japan Basin

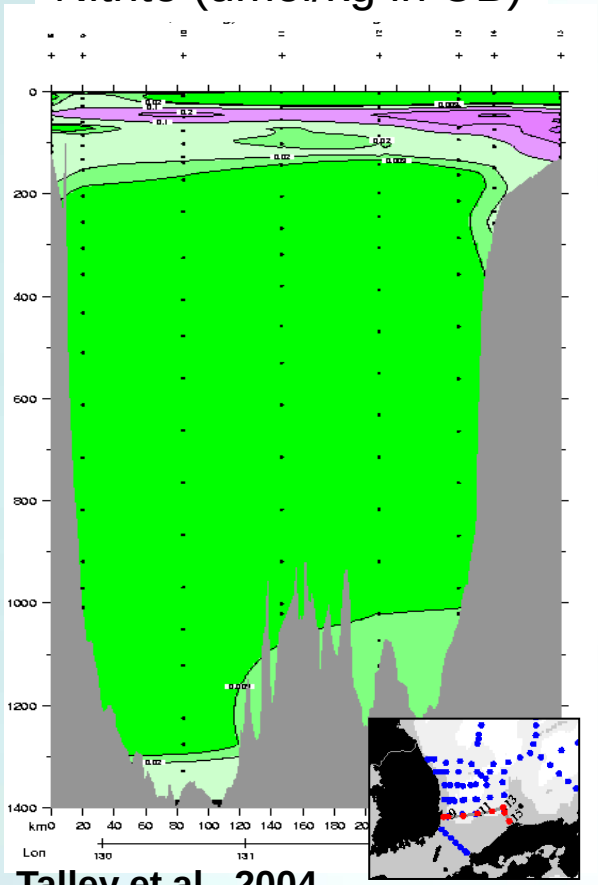
JB ← UIG → UB



Biochemical Processes

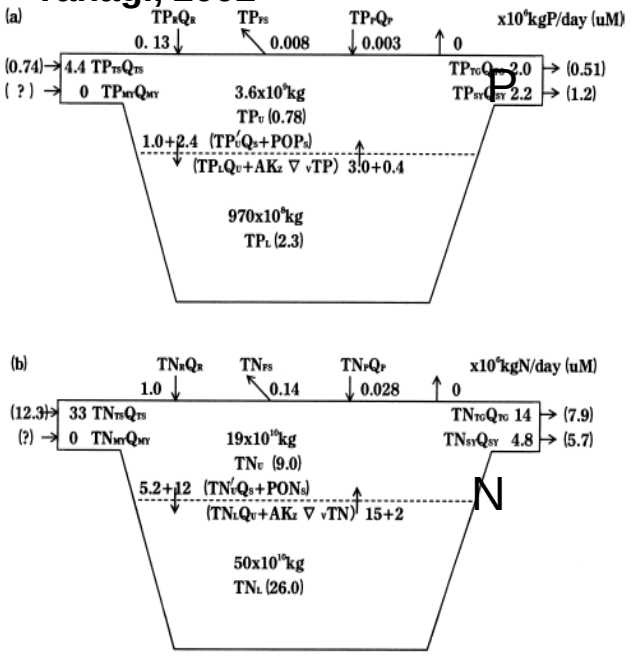
De-nitrification process

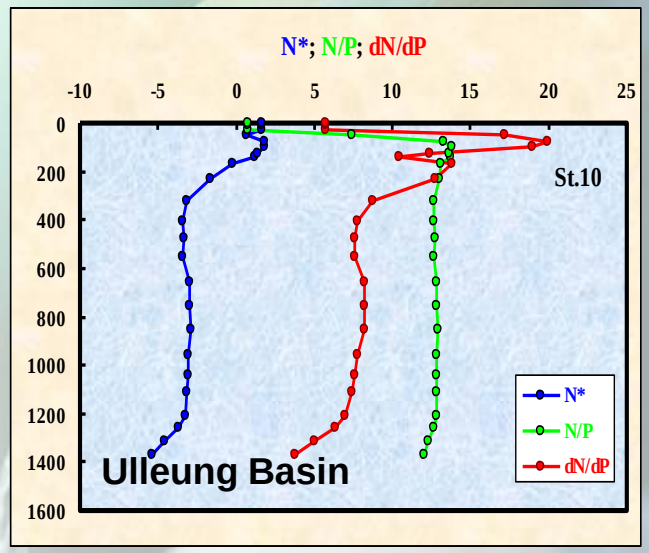
Nitrite (umol/kg in UB)



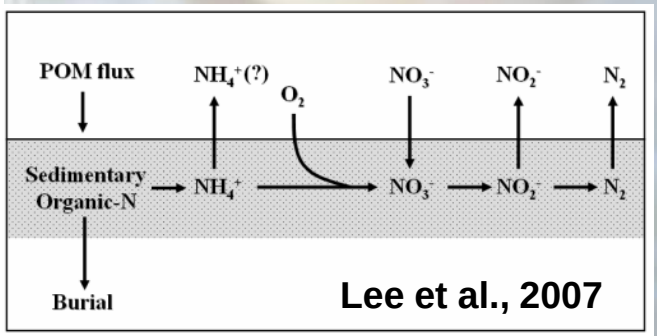
Talley et al., 2004

Yanagi, 2002





Tishchenko et al., 2006



Lee et al., 2007

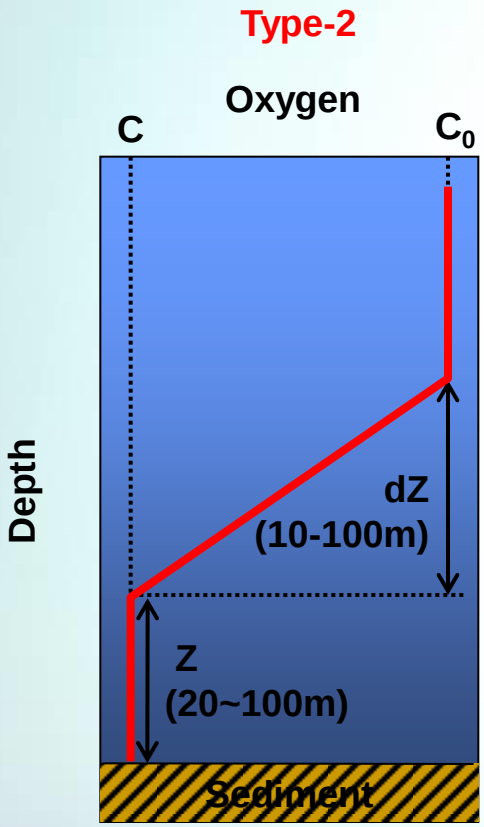
Denitrification is not a process which consume Oxygen

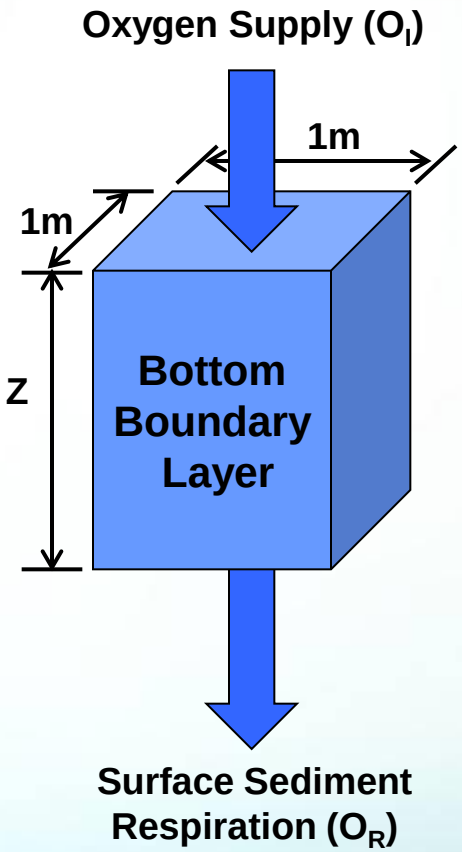
Saturation % in the bottom layer is ~55%

Biochemical Processes

Organic Matter Decomposition

Simple Box Model for Bottom Layer Oxygen





$$O(t) = O(t\text{-}dt) - (O_I - O_R)\cdot dt$$

$$O_I = D\cdot(C_0\text{-}C)/dZ$$

$$O_R = K\cdot O(t)$$

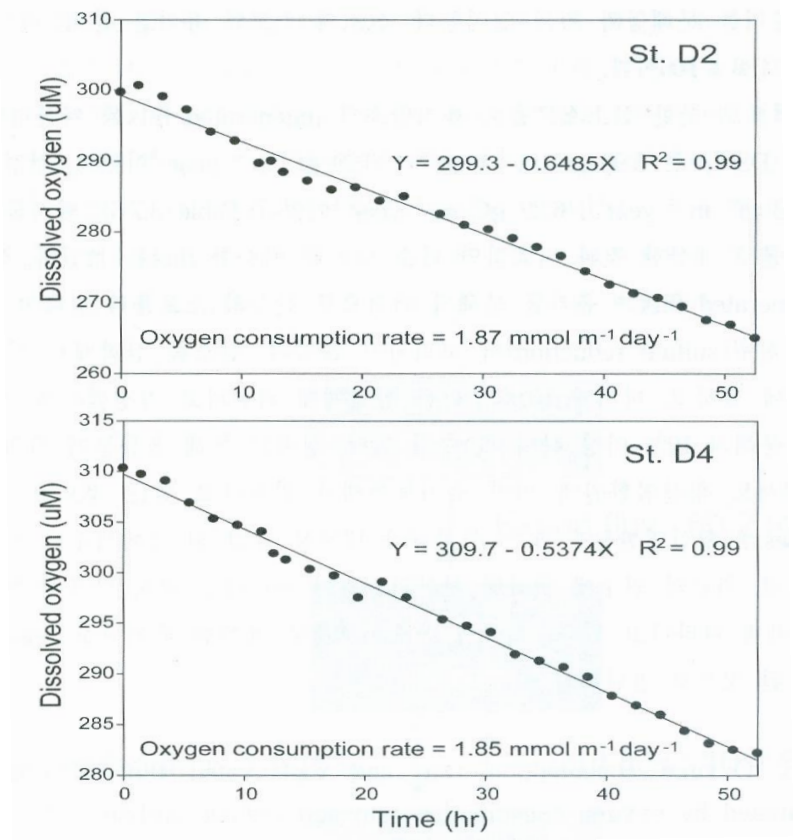
$D = 1.2 \times 10^{-5}\ cm^2\ sec^{-1}$
$C_0 = 200\ \mu mol\ kg^{-1}$
$C = 195.6\ \mu mol\ kg^{-1}$
$Z = 20 - 100\ m$
$dZ = 10 - 100\ m$

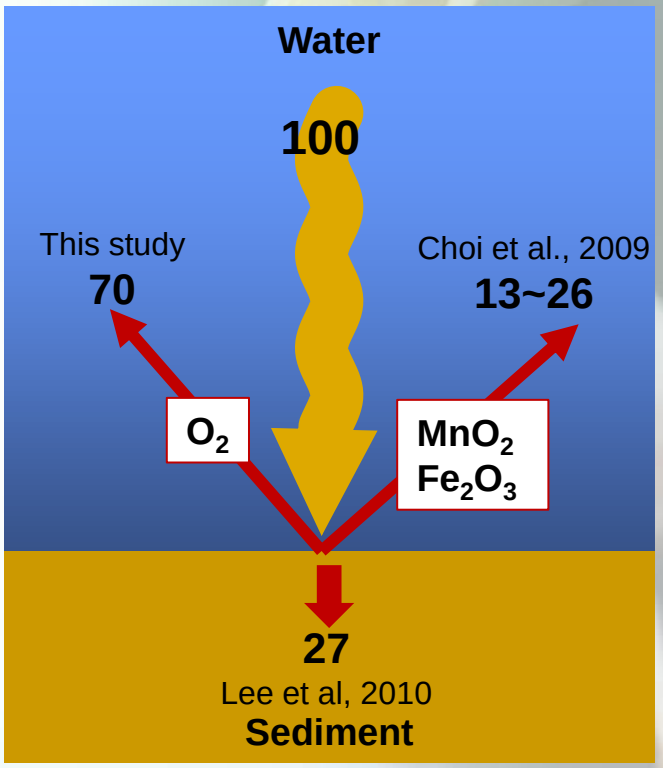
$O_R = 0.2 \sim 5.8\ mmol\ m^{-2}\ day^{-1}$

Biochemical Processes

Organic Matter Decomposition

Core Incubation





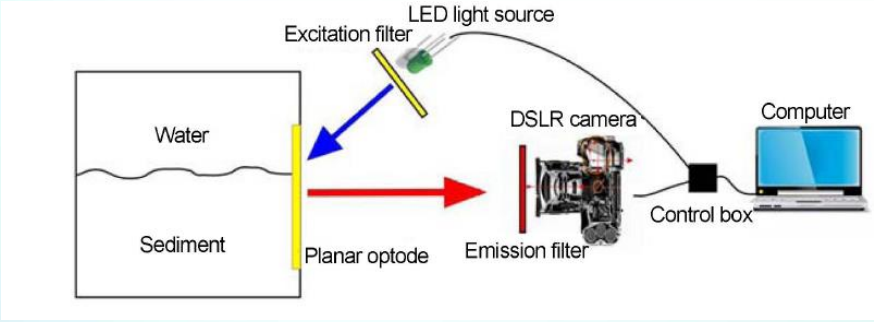
1.85 ~ 2.05 mmol m^{-2} day^{-1} (Lee et al., 2010)
1.04 ~ 9.08 mmol m^{-2} day^{-1} (Jeong et al., 2009)

O_R = 0.2 ~ 5.8 mmol m^{-2} day^{-1}

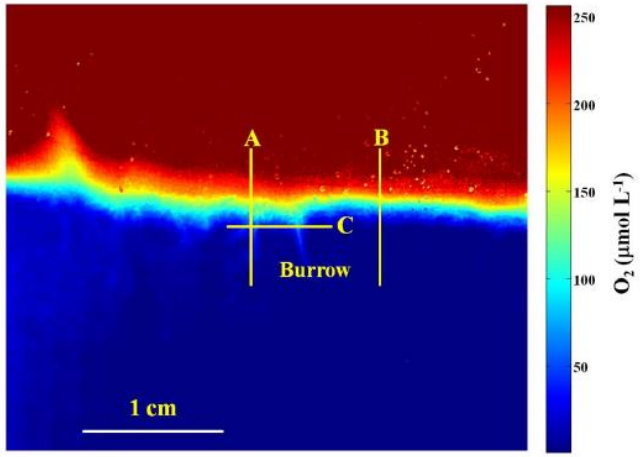
Further Studies

Benthic Lander (Developed)

Multiple Fiber Optic Sensor Array (under developing)



RGB Color Ratiometric Planar Optode (under developing)




Thank You !!