PECULIARITIES OF DISTRIBUTION
PARAMETERS OF CARBONATE SYSTEM IN
THE AMURSKIIY BAY (EAST/JAPAN SEA)
DURING SUMMER 2007

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Objective:

- to recognize main features in distribution of carbonate system parameters of Amurskiy Bay in summertime.

Outline:

- Distribution of carbonate parameters of Razdolnaya River Estuary.
- Distribution of carbonate parameters of Novik Bay.
- Distribution of carbonate parameters of central part of Amurskiy Bay.
- Summary
Fig. 1. Region under consideration.
Fig. 2. Stations of Amurskiy Bay survey in August 2007.

Measured parameters:

Calculated parameters:
DIC – Dissolved Inorganic Carbon
\( pCO_2 \) – \( CO_2 \) partial pressure

The expedition was carried out 14 – 25 August on a research vessel “Malakhit”. 99 stations have been made.
Fig. 3. Distributions of temperature, °C (a) and salinity, ‰ (b) in Razdolnaya River Estuary.
- near-surface waters,
- near-bottom waters
Fig. 4. Distributions of Normalized Total Alkalinity, mmol/kg (a) and Normalized Dissolved Inorganic Carbon, mmol/kg (b) in Razdolnaya River Estuary.

- near-surface waters,
- near-bottom waters
Fig. 5. Distributions of $\text{pH}_{\text{in situ}}$ (a) and $\text{CO}_2$ partial pressure, uatm (b) in Razdolnaya River Estuary.

- near-surface waters,
- near-bottom waters
Fig. 6. Dependences of TA versus of salinity (a) and DIC versus salinity (b).

- near-surface waters,
- near-bottom waters

Both parameters reveal apparent non-conservative behavior during mixing river and sea waters.
Summarized features of carbonate system parameters of Razdolnaya River Estuary:

- Reverine waters have high NTA and NDIC up to 100 mmol/kg values because River water is calcium bicarbonate water.

- High pCO$_2$ (more than 2000 uatm) and low pH (about 7.3) values in reverine part of the estuary and vice versa (pCO$_2$ less than 200 uatm) in marine part of estuary.

- Nonlinear TA - S and DIC - S dependences are revealed. We explained this feature by temporal variability of alkalinity in the River water.
Fig. 7. Distributions of temperature, °C (a) and salinity, ‰ (b) in Novik Bay.
- near-surface waters,
- near-bottom waters
Fig. 8. Distributions of $\text{pH}_{\text{in situ}}$ (a) and $\text{CO}_2$ partial pressure, uatm (b) in Novik Bay.

- near-surface waters,
- near-bottom waters
Fig. 9. Distributions of normalized alkalinity in Novik Bay.

- near-surface waters,
- near-bottom waters

NTA and NDIC decline in shallow water
Main feature in distribution of carbonate system in Novik Bay is decline in normalized TA and DIC in the shallow part of the Bay. We explain this feature by calcification of the seaweed *zostera manna* L.
Fig. 10. Distributions of temperature (a – near-surface waters, b – near-bottom waters) and salinity (c – near-surface waters, d – near-bottom waters) in Amurskiy Bay. August 2007.
In the first time it was discovery severe hypoxia for a large area of Amurskiy Bay. Lowest oxygen concentration was about 4 \text{ umol/kg} (it is 0.1 ml/L) in near-bottom waters.

Fig. 11. Distributions of AOU, umol/kg (a – near-surface waters, b – near-bottom waters) and O$_2$, umol/kg (c – near-surface waters, d – near-bottom waters) in Amurskiy Bay. August 2007.
Fig. 12. Distributions of total alkalinity, mmol/kg (a – near-surface waters, b – near-bottom waters) and Dissolved Inorganic Carbon, mmol/kg (c – near-surface waters, d – near-bottom waters) in Amurskiy Bay. August 2007.

Shapes of distribution of carbonate system parameters are very similar with distribution of oxygen concentration in near bottom water.
CO₂ partial pressure of surface waters less than atmospheric one (370 uatm). However in near bottom water pCO₂ exceed 2000 uatm.

Fig. 12. Distributions of pH (a – near-surface waters, b – near-bottom waters) and pCO₂, uatm (c – near-surface waters, d – near-bottom waters) in Amurskiy Bay. August 2007.
Fig. 14. Distributions of NH$_4$, umol/l (a – near-surface waters, b – near-bottom waters) and NTA, mmol/kg (c – near surface waters, d – near-bottom waters) in Amurskiy Bay. August 2007.
Combination of NTA, NH$_4$ and pCO$_2$ data and low O$_2$ concentrations suggests that sulfatereduction is occurred in near bottom waters in central part of Amurskiy Bay according to scheme:

$((\text{CH}_2\text{O})_{106}(\text{NH}_3)_{16}\text{H}_3\text{PO}_4 + 53\text{SO}_4^{2-}) \rightarrow 38\text{H}_2\text{S} + 16\text{NH}_4^+ + \text{H}_2\text{PO}_4^- + 106\text{HCQ}_3 + 15\text{HS}^-$
Summary:

1. Nonlinear dependences of TA- Salinity and DIC – salinity were found for estuary of Razdolnaya River.

2. In shallow part of Novik Bay normalized TA and DIC dramatically decline which explained by removing CaCO$_3$ from solution due to calcification of the seaweed zostera manna L.

3. Surface water of Amursky Bay during the summer period is an absorber of atmospheric CO$_2$. 

4. There is an intensive process of destruction of the organic matter which consume of the oxygen and produce CO$_2$ in near-bottom water.

5. Sulphatereduction is occurred in the near-bottom water in Amurskiy Bay that is danger process for ecosystem of the Bay.
Thank you for your attention!