Microbiological and biogeochemical Explorations in Chukchi Sea (RV *Professor Khromov*, July – August 2004)

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25 8 2004

Main aims

1. ***Methane distribution in the water column of the Chukchi Sea.***
2. ***Quantitative measurements of intensity of microbial processes involved in methane cycle.***
3. ***Influence of microbial processes on the balance of methane in the Chukchi Sea.***
4. ***Quantitative measurements of intensity of methane cycle microbial processes in bottom sediments of Chukchi Sea***

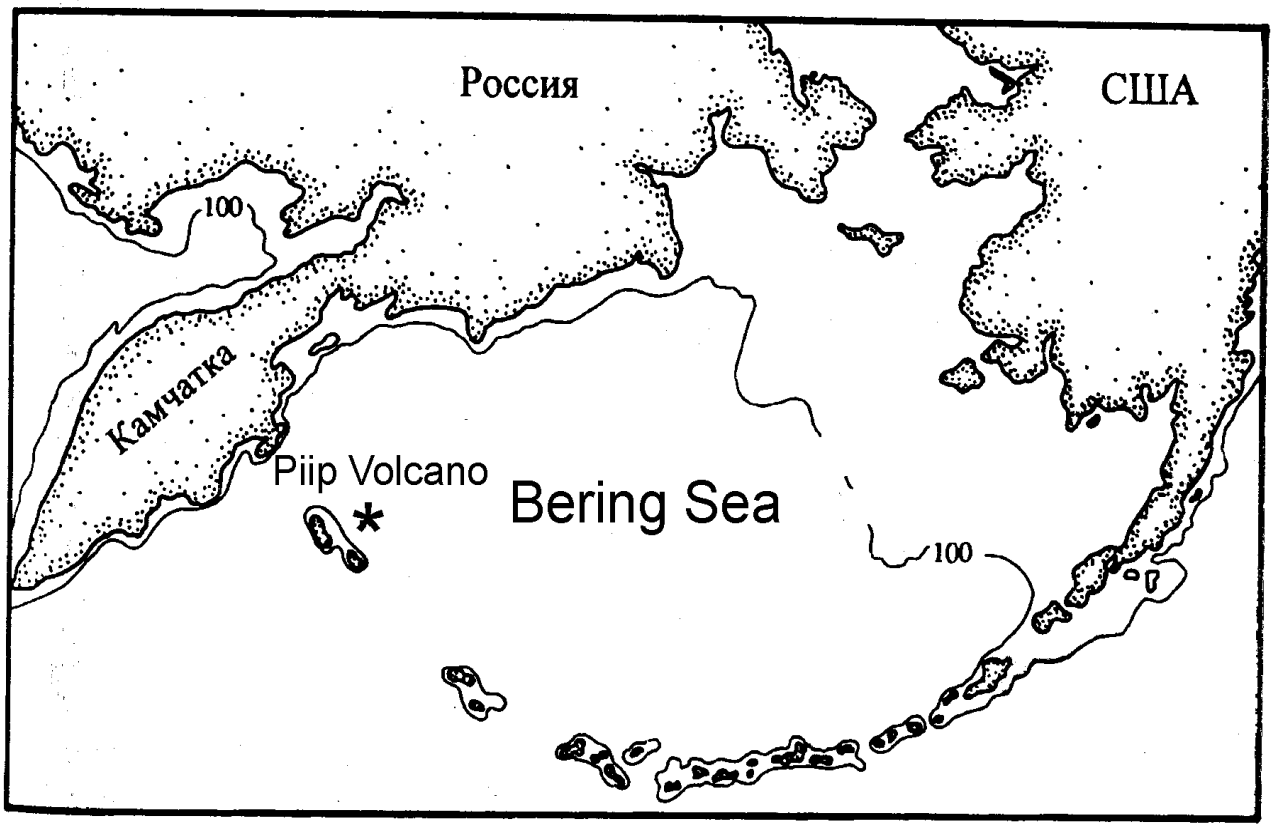
Materials and methods:
Methane concentration analysis

- For methane analysis, a headspace technique was applied [Bolshakov & Egorov, 1987].
- The water samples (5-cm^3 section of wet sediments) were placed into a glass vial, 30 cm^3 in volume.
- The sediment were flooded with distilled water, leaving 4 cm3 of the bottle volume free.
- For chromatographic analysis, 0.25 ml of the headspace gas was collected by a syringe running.
- Results were recalculated according to the volume of wet sediment using Henry's law
- The total relative error of the determinations was about 8% (by parallel definitions.

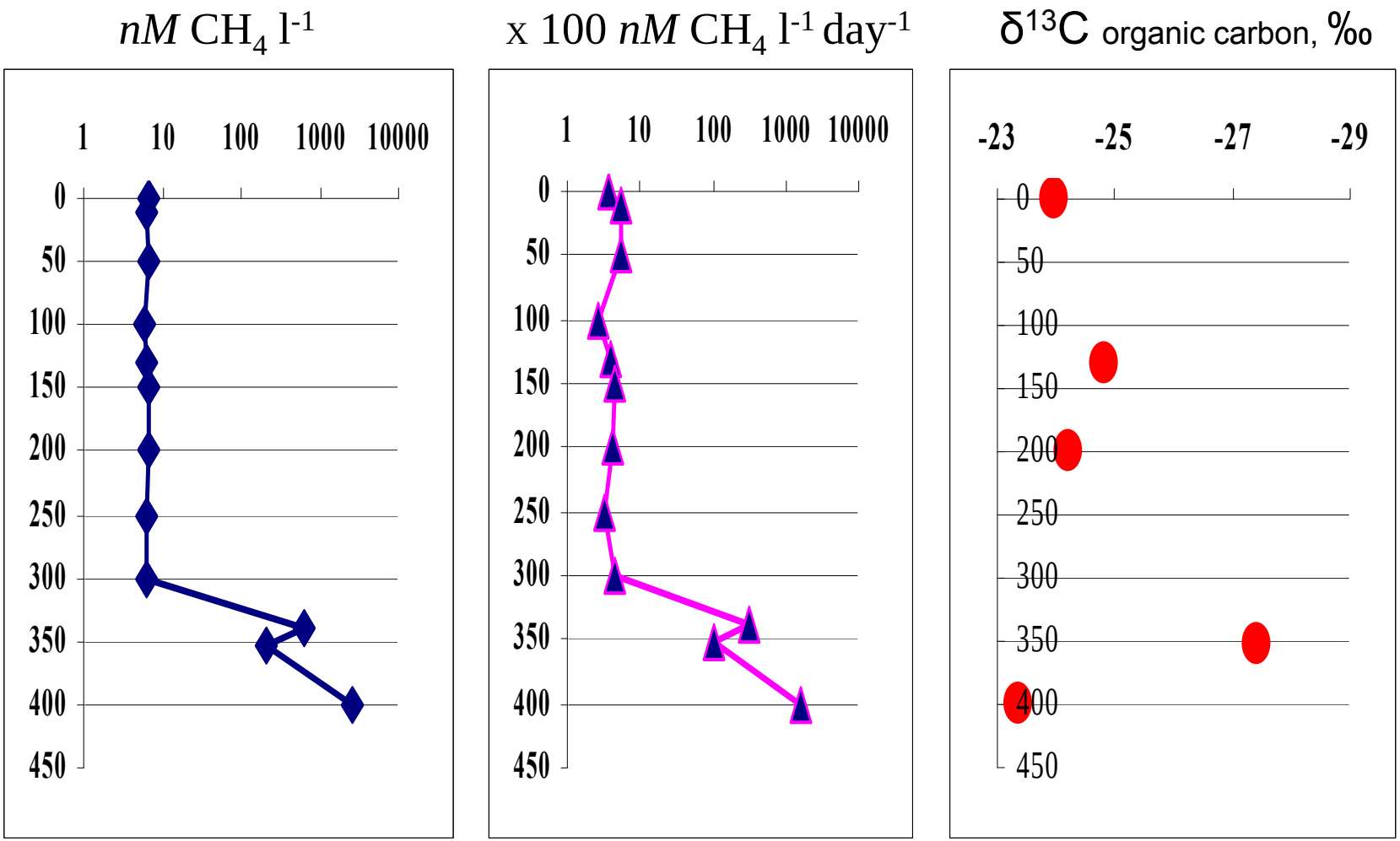
Estimation of the rates of microbial processes by means of radiotracer approach using ^{14}C and ^{35}S compounds:

- Dark $^{14}CO_2$-assimilation
- ^{14}C-methane oxidation, both aerobic and anaerobic
- Methane generation, both autotrophic ($^{14}CO_2$) and acetoclastic (^{14}C-acetate),
- ^{35}S-sulfate reduction
- Acetogenesis (from $^{14}CO_2$)
- Heterotrophic activity (^{14}C-glucose)

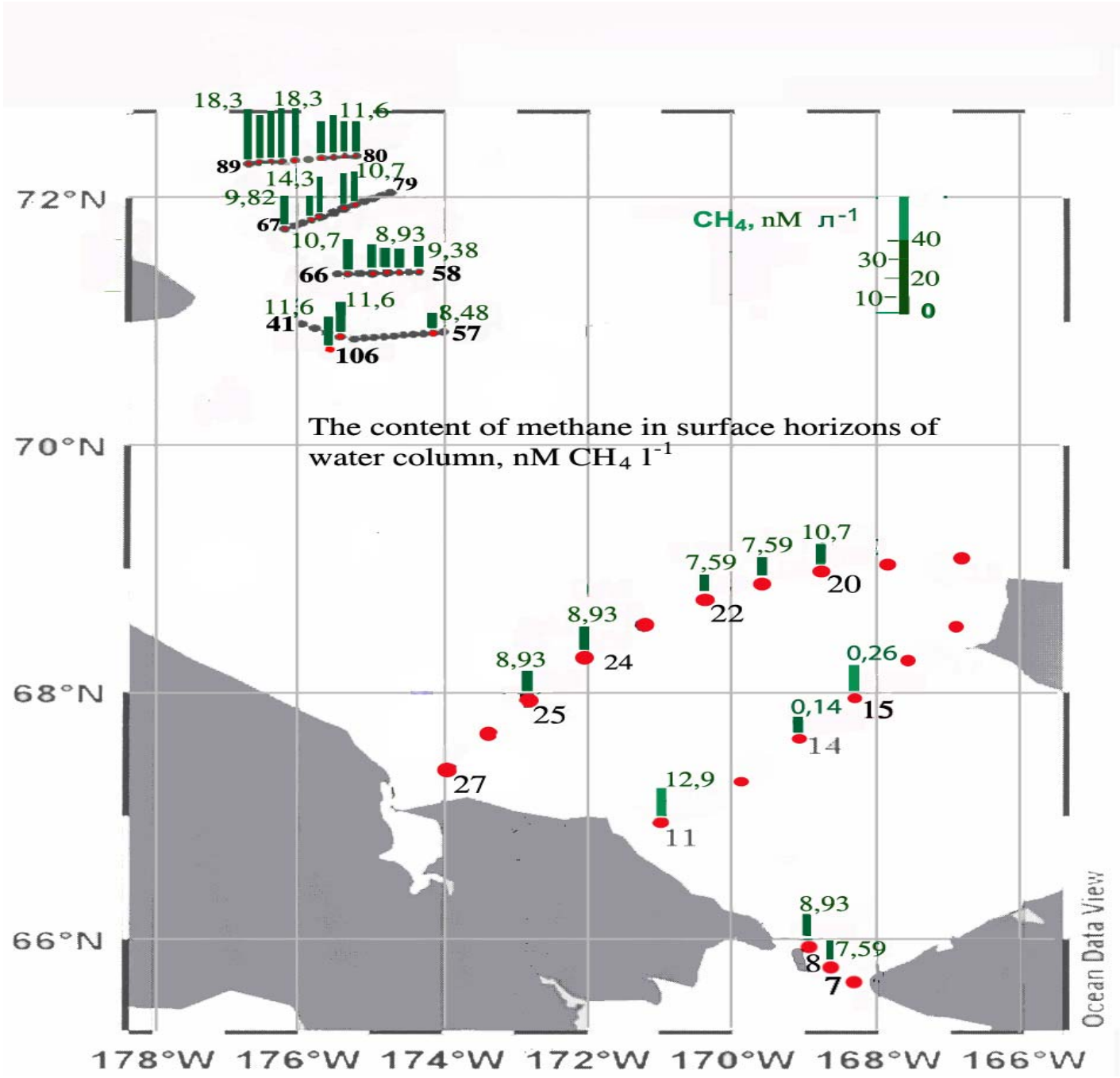
Leg. 1 The water station of the Piip submarine volcano (Komandorsky Back-Arc Basin)

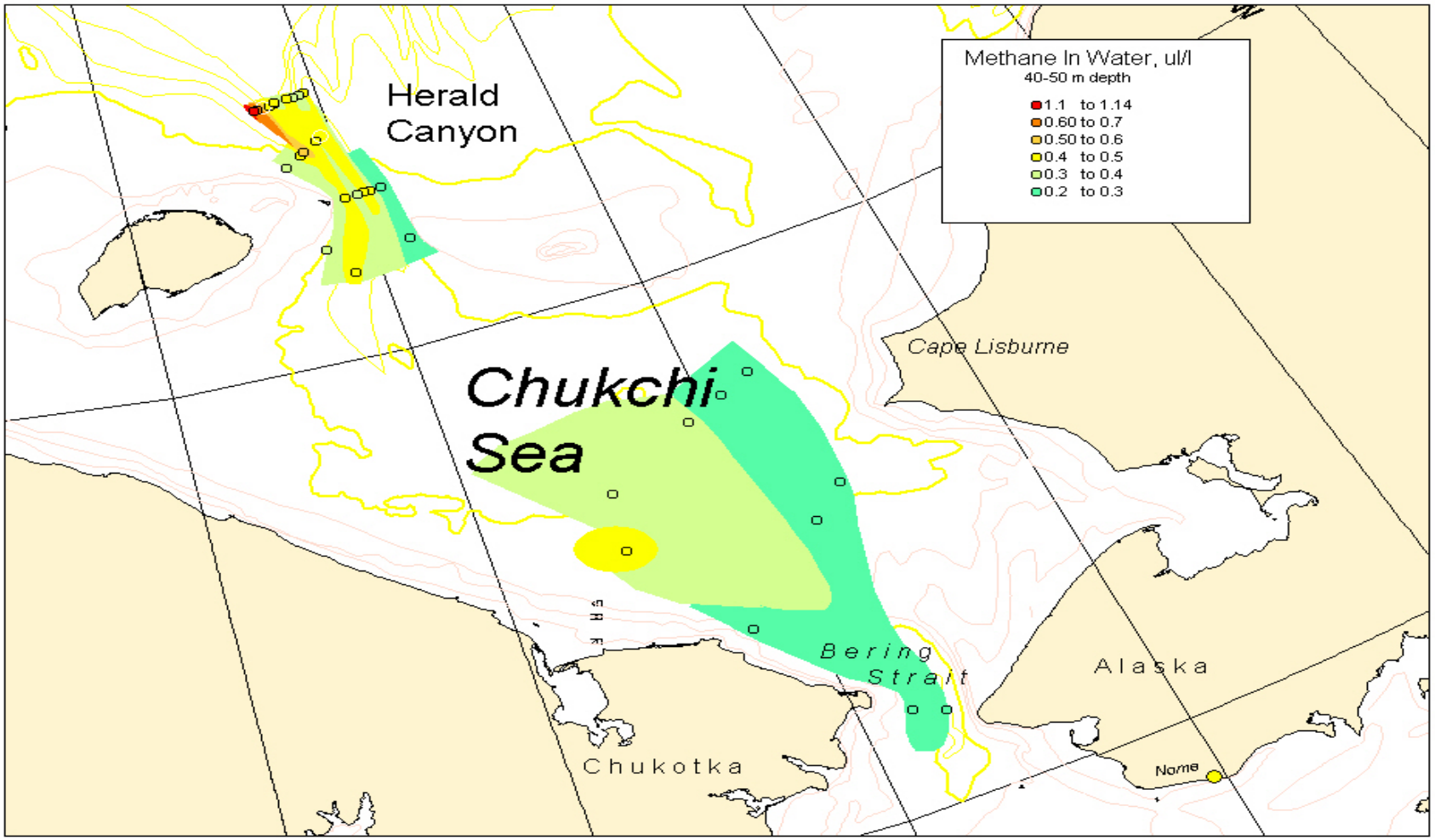


Methane concentration, the rate of microbial methane oxidation and isotope composition ($\delta^{13}C$) organic carbon of particulate matter in water column near Piip Volcano (Bering Sea) 55° 25.06 167° 16.52



Sediment core from Piip volcano station


18,3
18,3
11,6
89
80
14,3
10,7
79
9,82
67
10,7
8,93
9,38
66
58
11,6
11,6
8,48
41
57
106
CH4, nM л-1
40
30
20
10
0
The content of methane in surface horizons of water column, nM CH4 l-1
7,59
7,59
10,7
20
22
8,93
24
8,93
25
0,26
15
0,14
14
27
12,9
11
8,93
7,59
8
7
72°N
70°N
68°N
66°N
178°W
176°W
174°W
172°W
170°W
168°W
166°W
Ocean Data View



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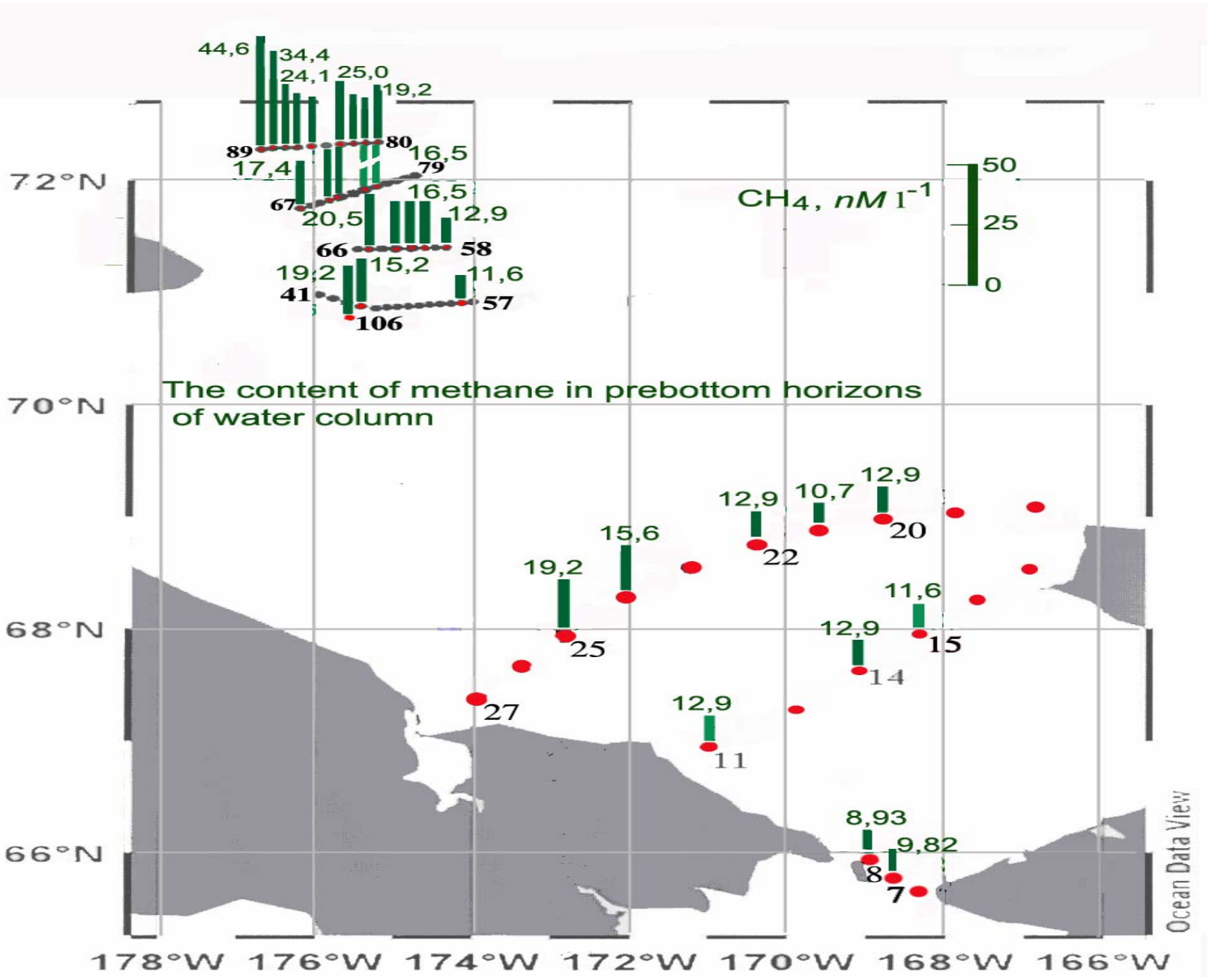
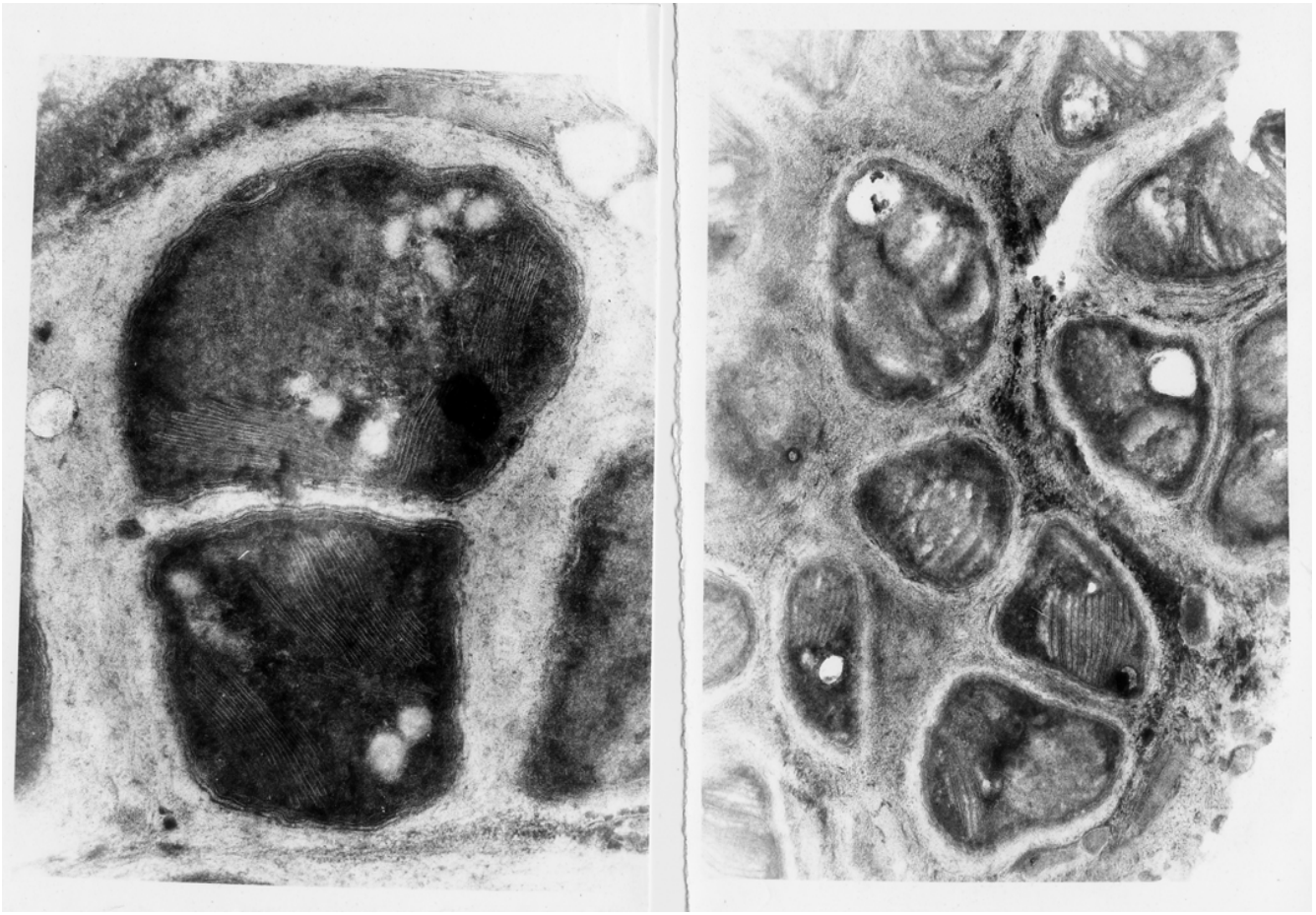
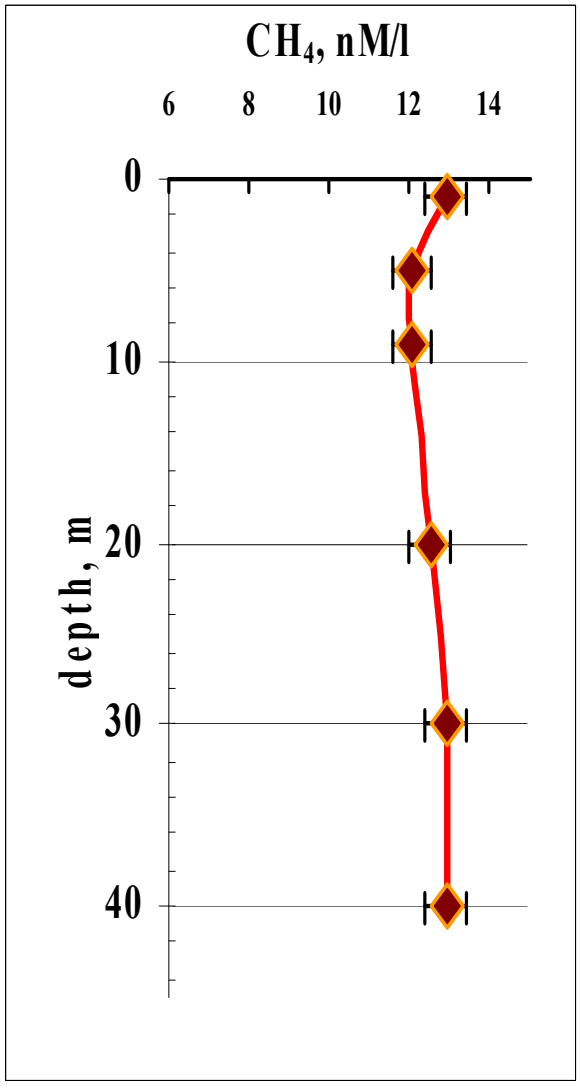
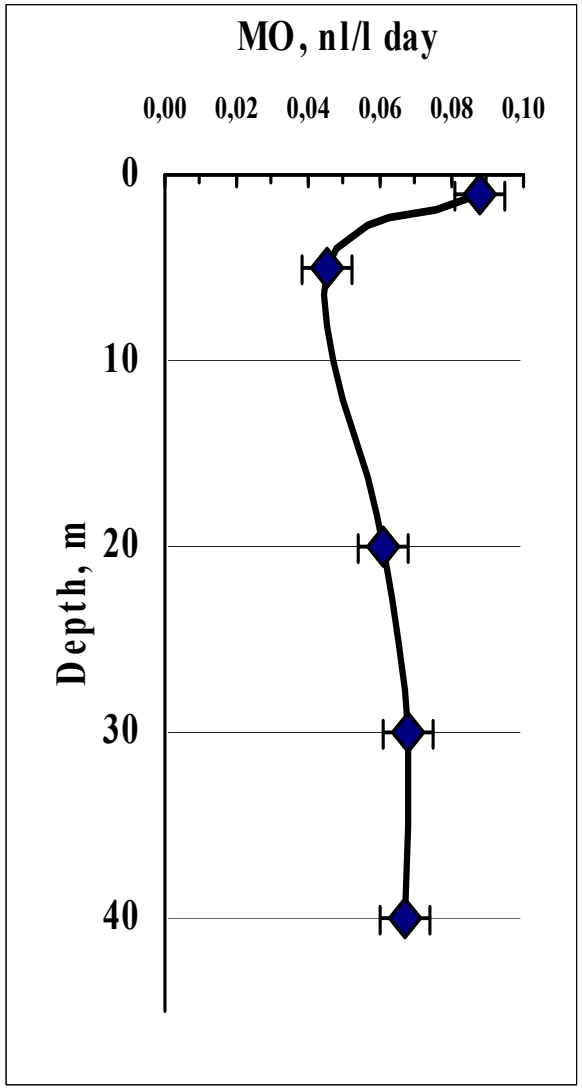

The content of methane in prebottom horizons of water column
CH4, nM l-1
50
25
0
72°N
70°N
68°N
66°N
178°W
176°W
174°W
172°W
170°W
168°W
166°W
44,6
34,4
24,1
25,0
19,2
89
80
16,5
17,4
79
67
16,5
20,5
12,9
66
58
19,2
15,2
11,6
41
57
106
12,9
10,7
12,9
20
22
15,6
19,2
25
11,6
15
12,9
14
27
12,9
11
8,93
9,82
8
7
Ocean Data View

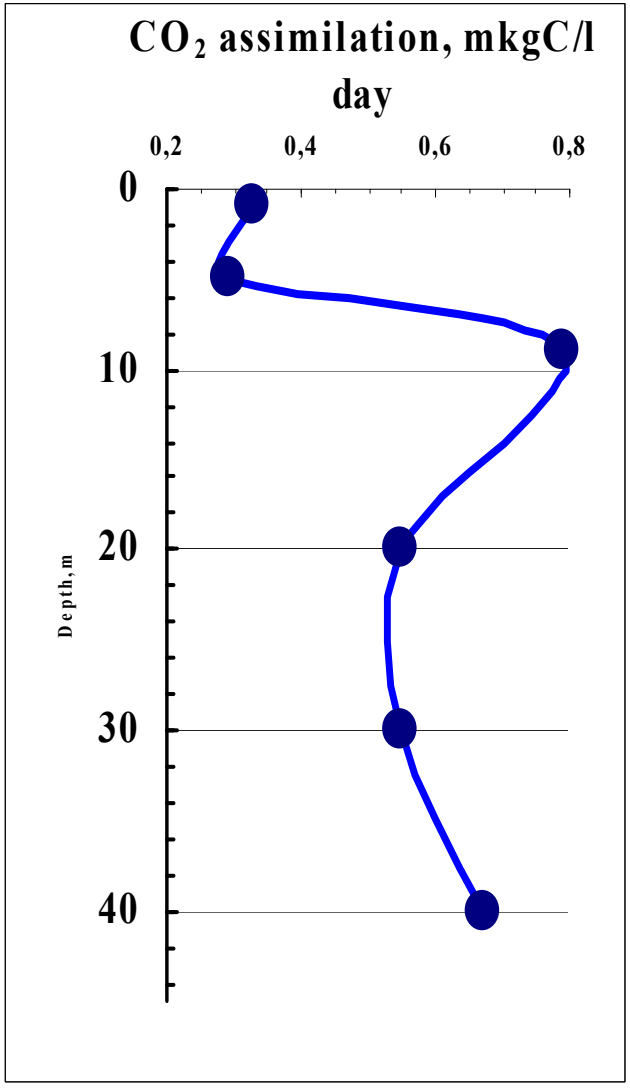
Methanotrophic bacteria are unique in their ability to utilize methane as a sole carbon and energy source.



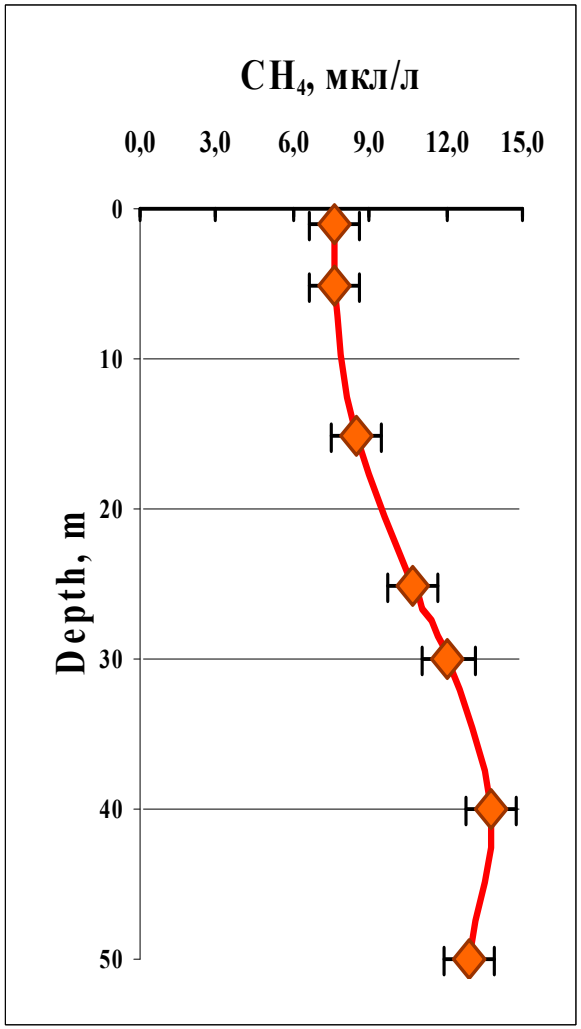
Station 11 (water column)

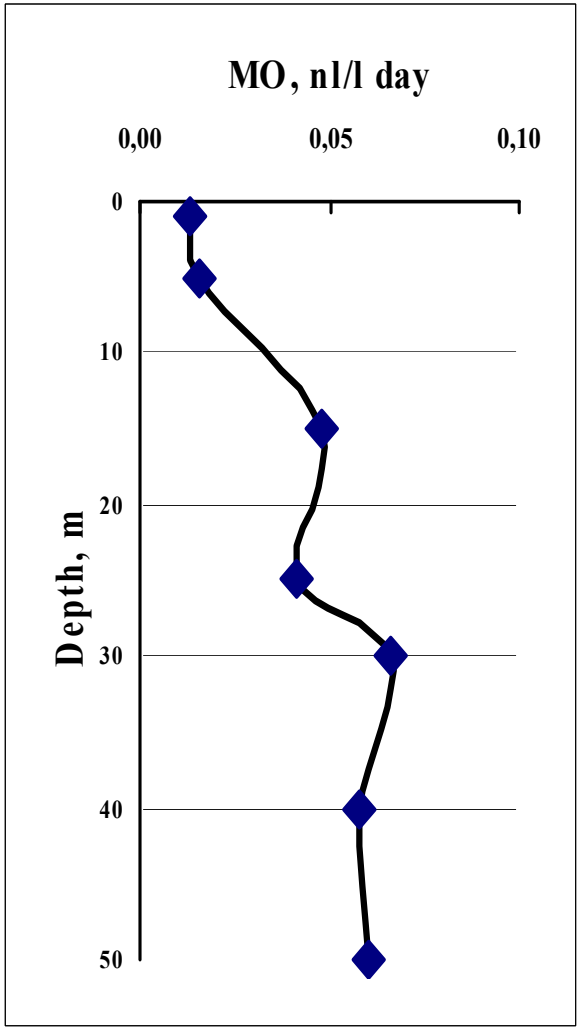


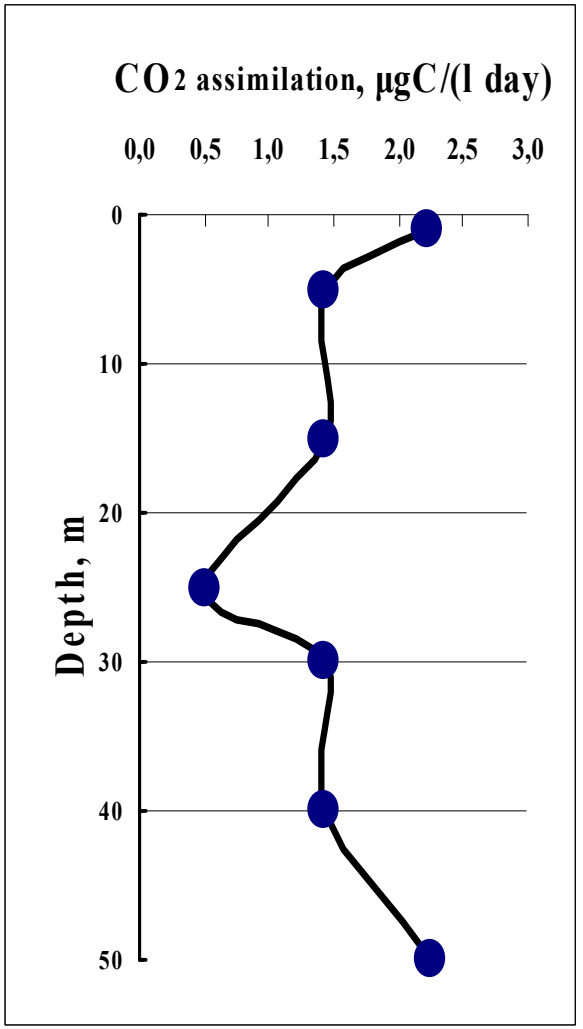




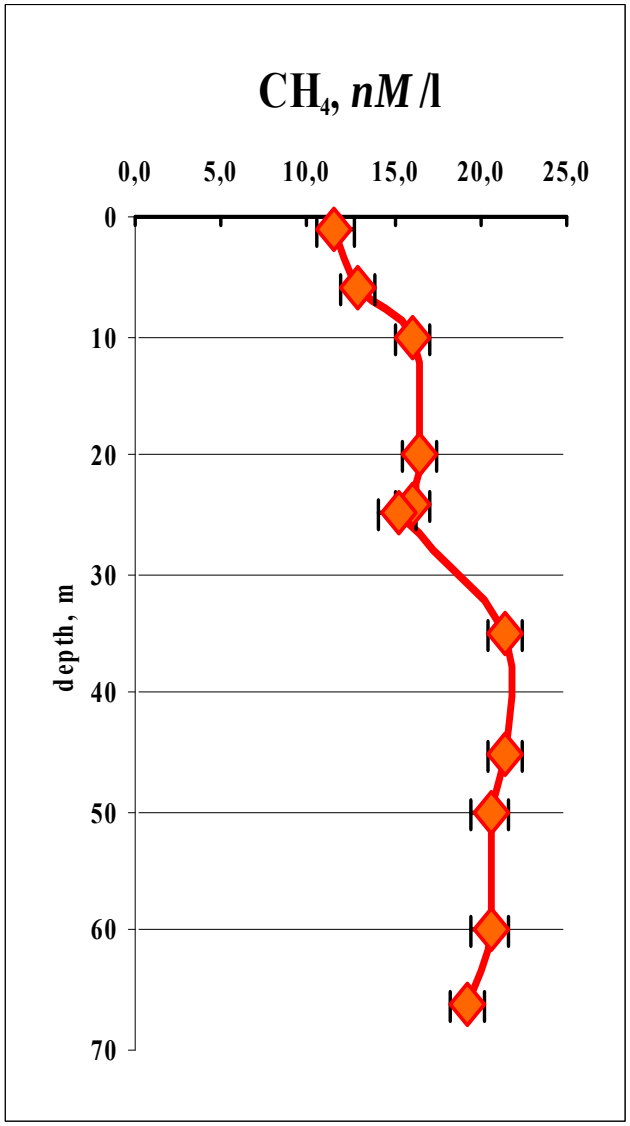
Station 22 (water column)

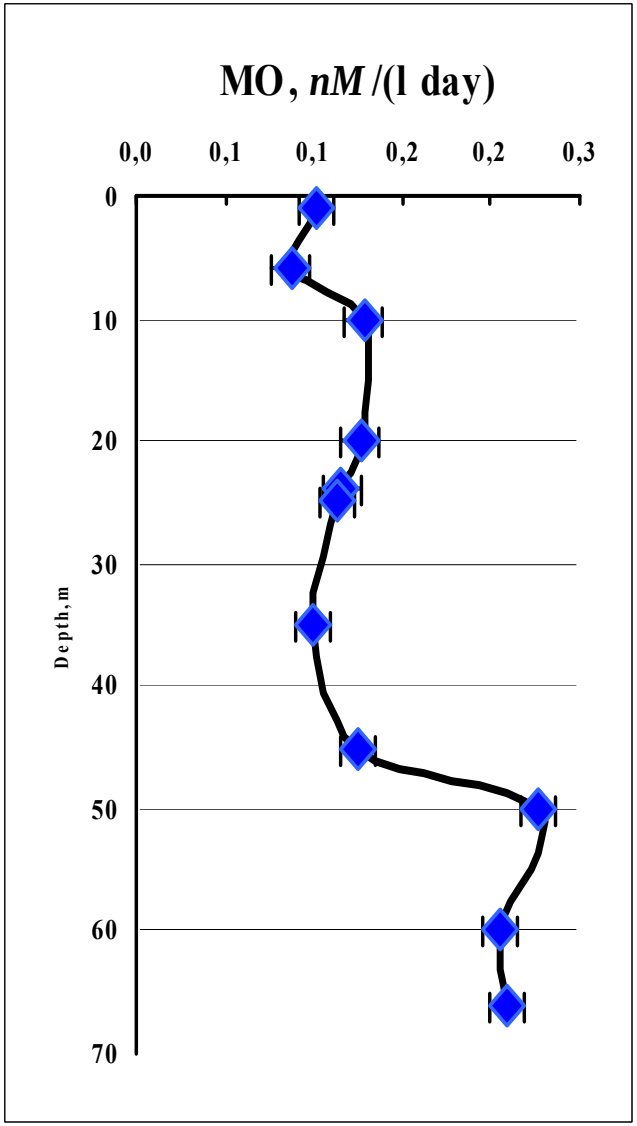


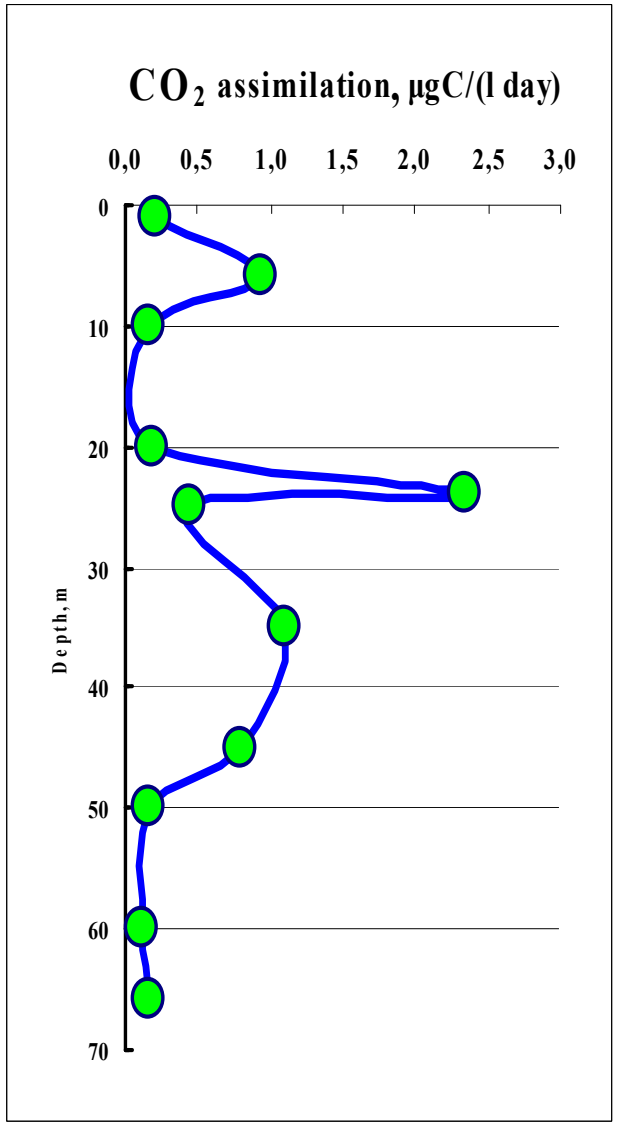




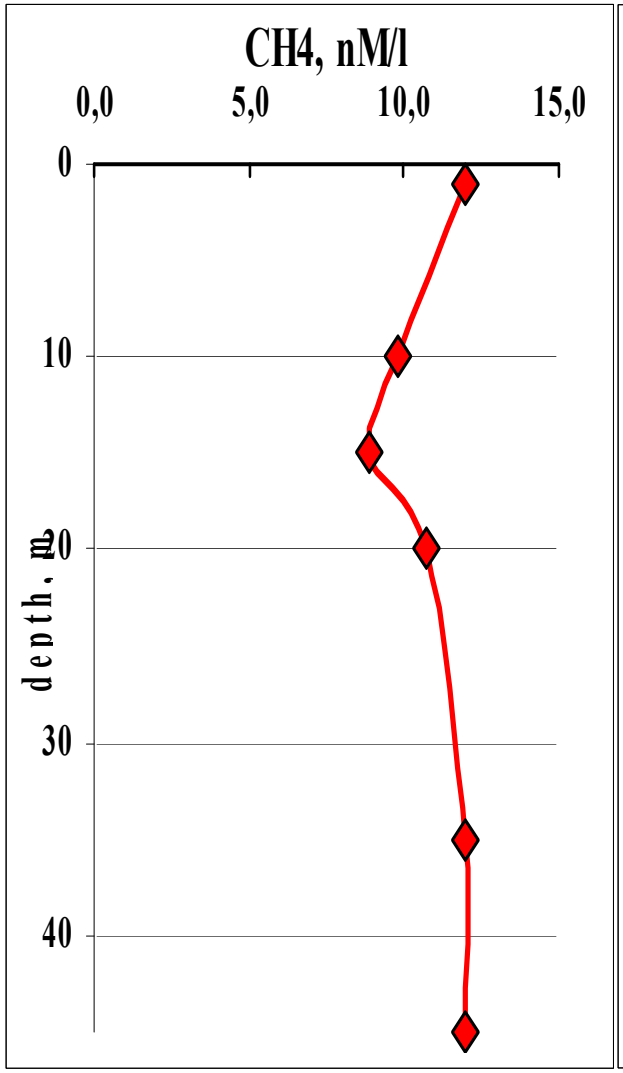
Station 106 (water column)

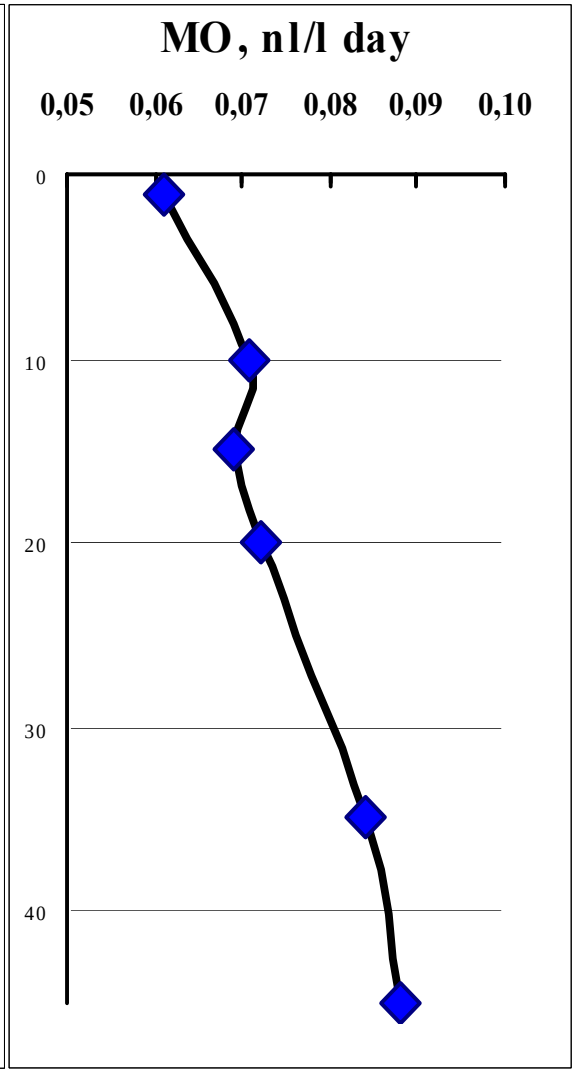


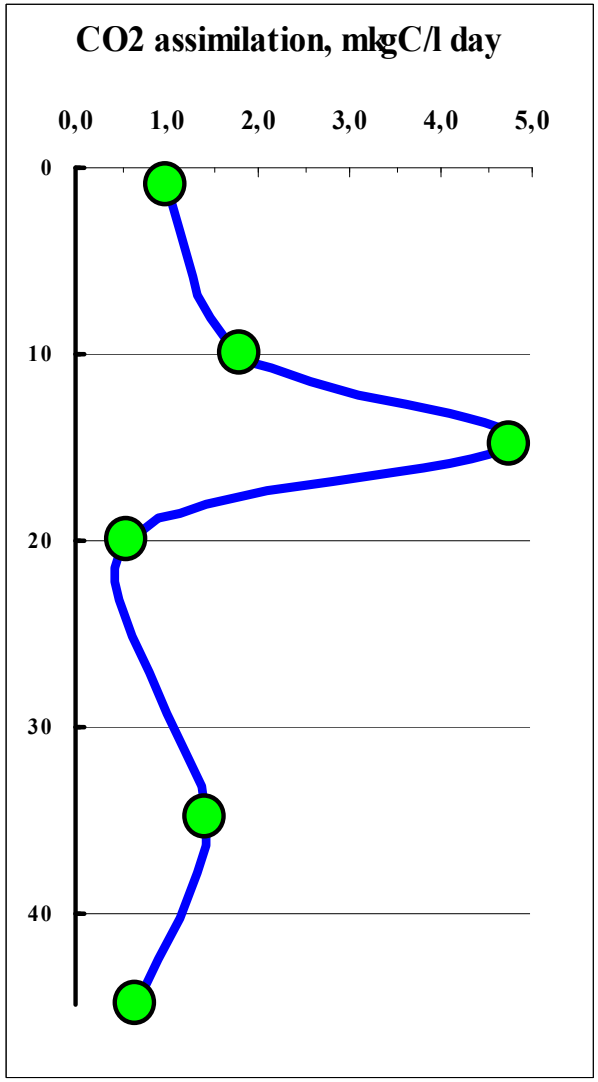




Station 15 (water column)

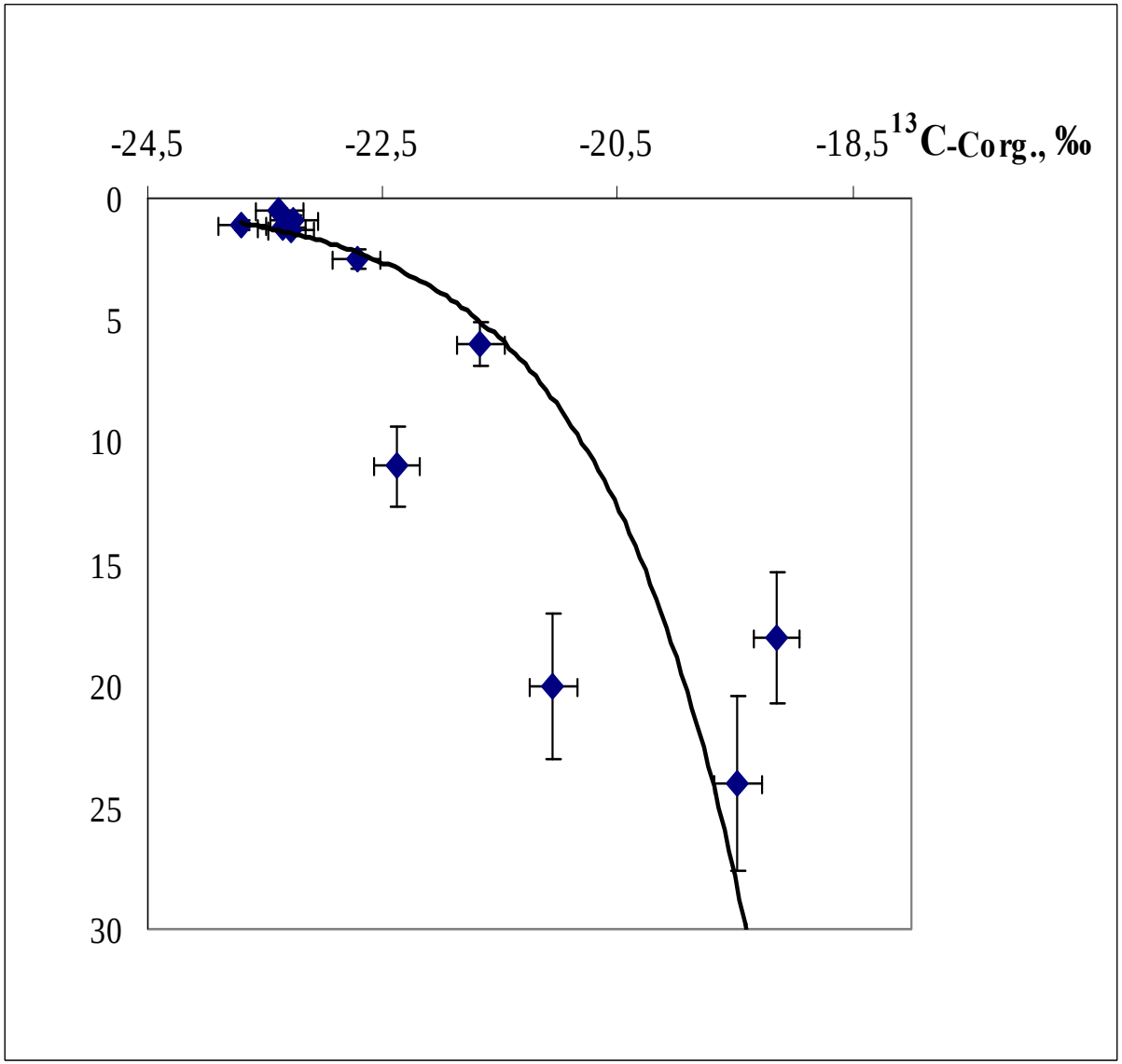


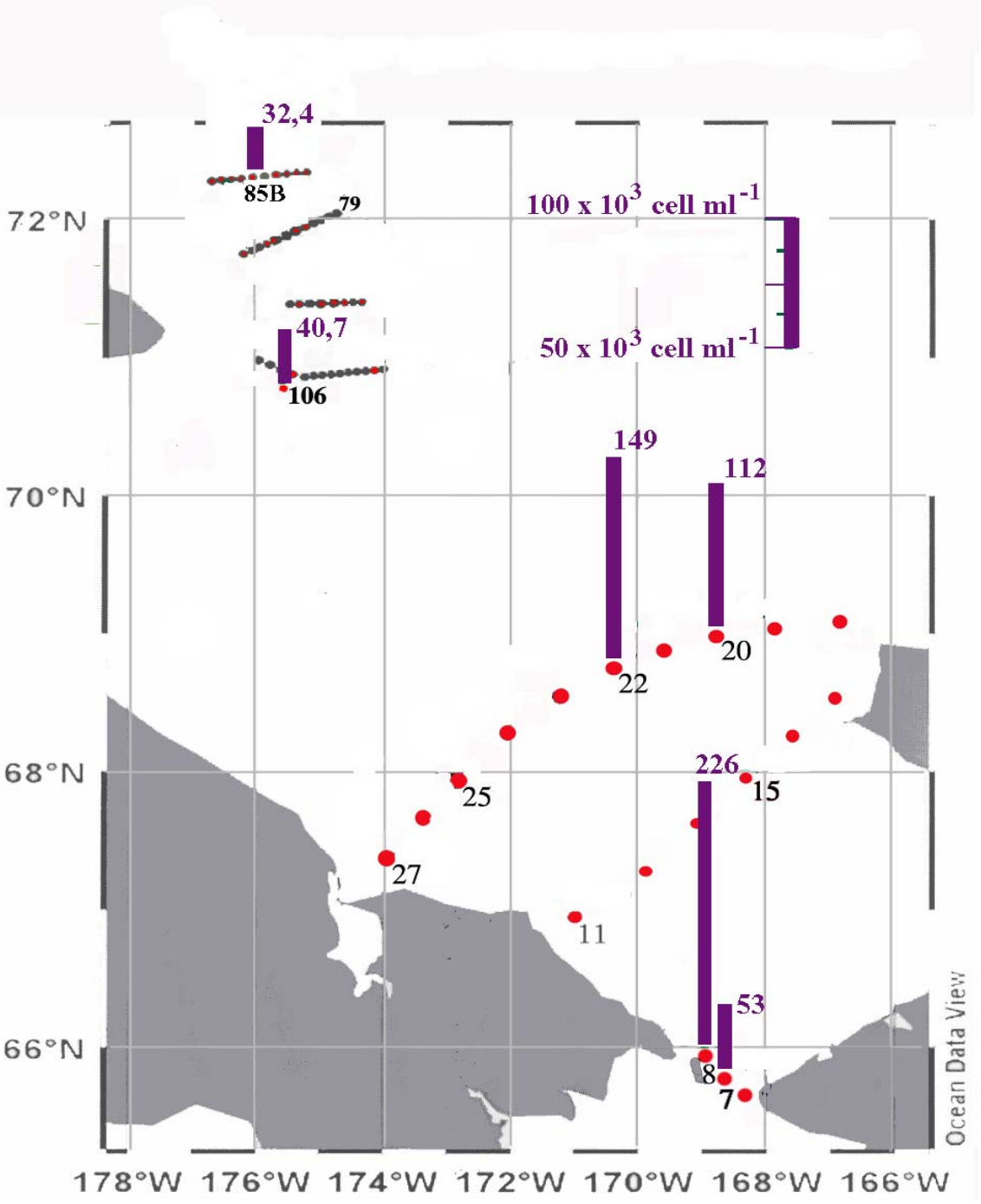




Fluorescence value and isotopic composition (^{13}C-$C_{org.}$, ‰) of particle organic carbon (average in water horizons), water column of Chukchi Sea

STATION	$\delta^{13}C$-Corg., ‰	Fluorescence (kg/m³)
7	-22,72	2,5
8	-23,7	1,1
11	-21,67	6
14	-19,15	18
15	-19,48	24
20	-23,38	0,5
20	-23,26	0,85
22	-23,28	1,3
25	-21,05	20
106	-22,38	11
85B	-23,36	1,2

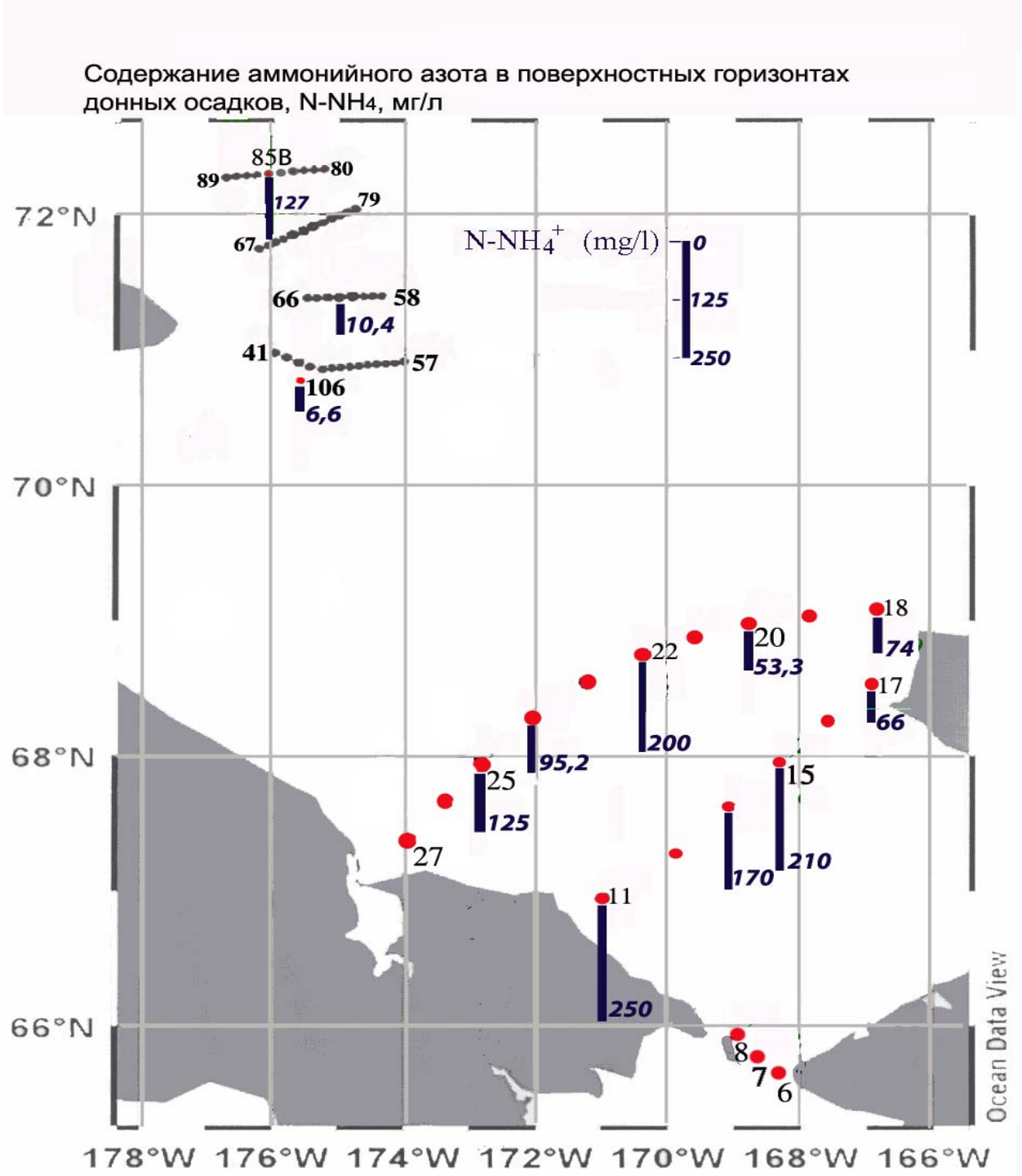




The Number of bacteria (x 10^3 cell ml^{-1}) in water column of Chukchi Sea

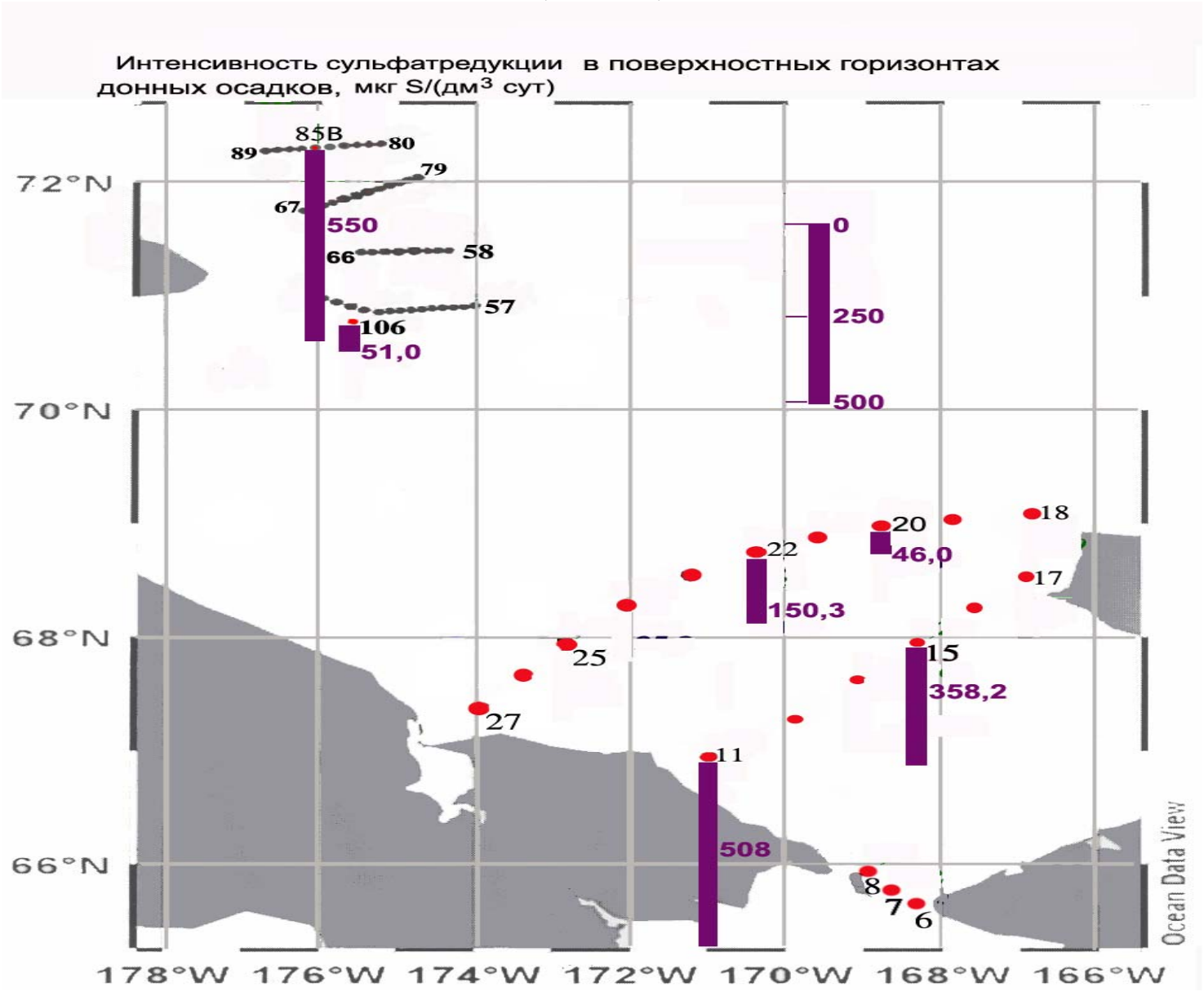
(average date)

Sampling of surface bottom sediments

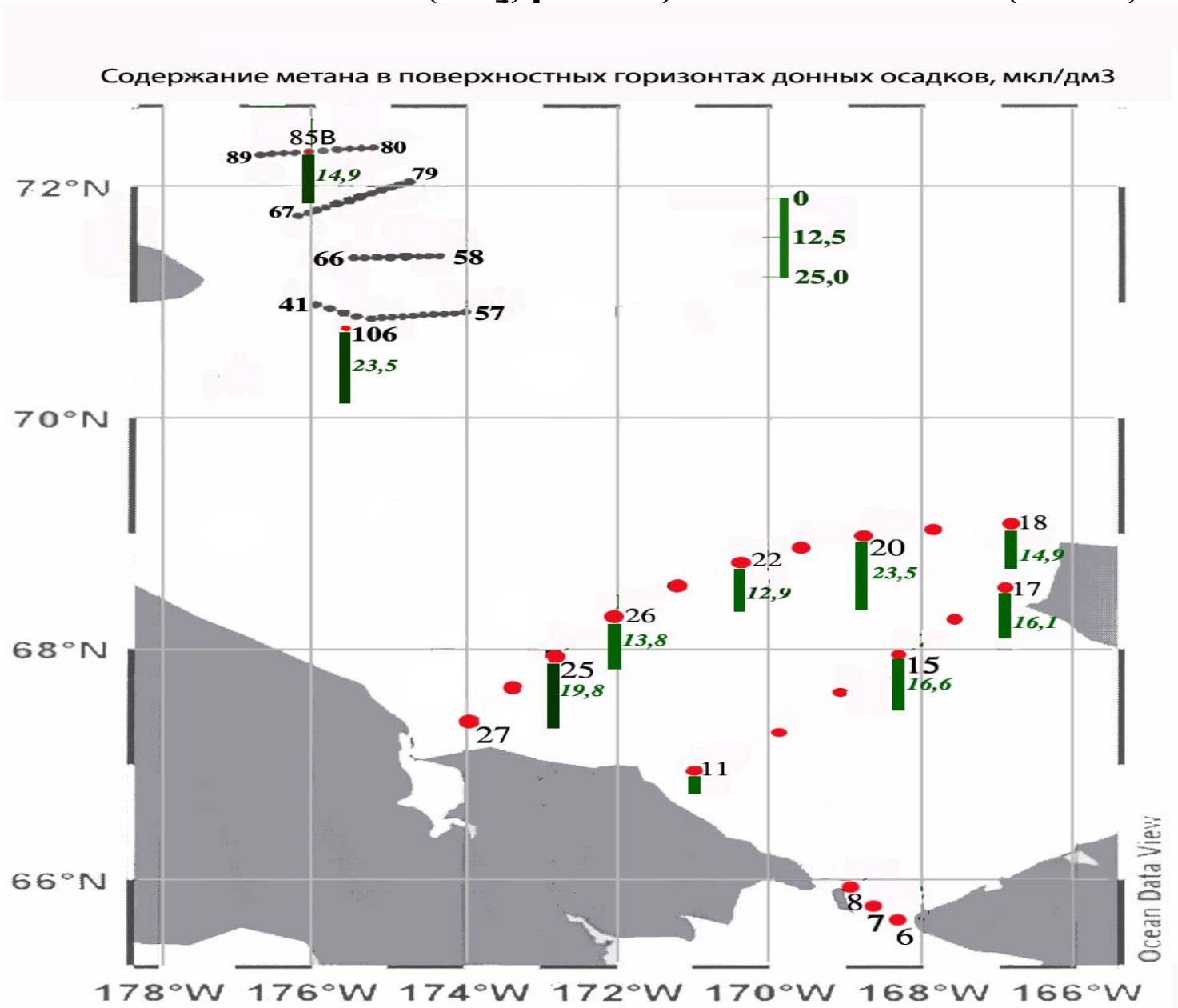


The content of ammonium ($N\text{-}NH_4^+$, mg dm^{-3}) in surface horizons (0-3 cm) of sediments

The Rate of Microbial Sulphate Reduction (μg S dm^{-3} day^{-1}) in Surface Horizons (0-3 cm) of Sediments



The content of methane (CH_4, μl dm^{-3}) in surface horizons (0-3 cm) of sediments



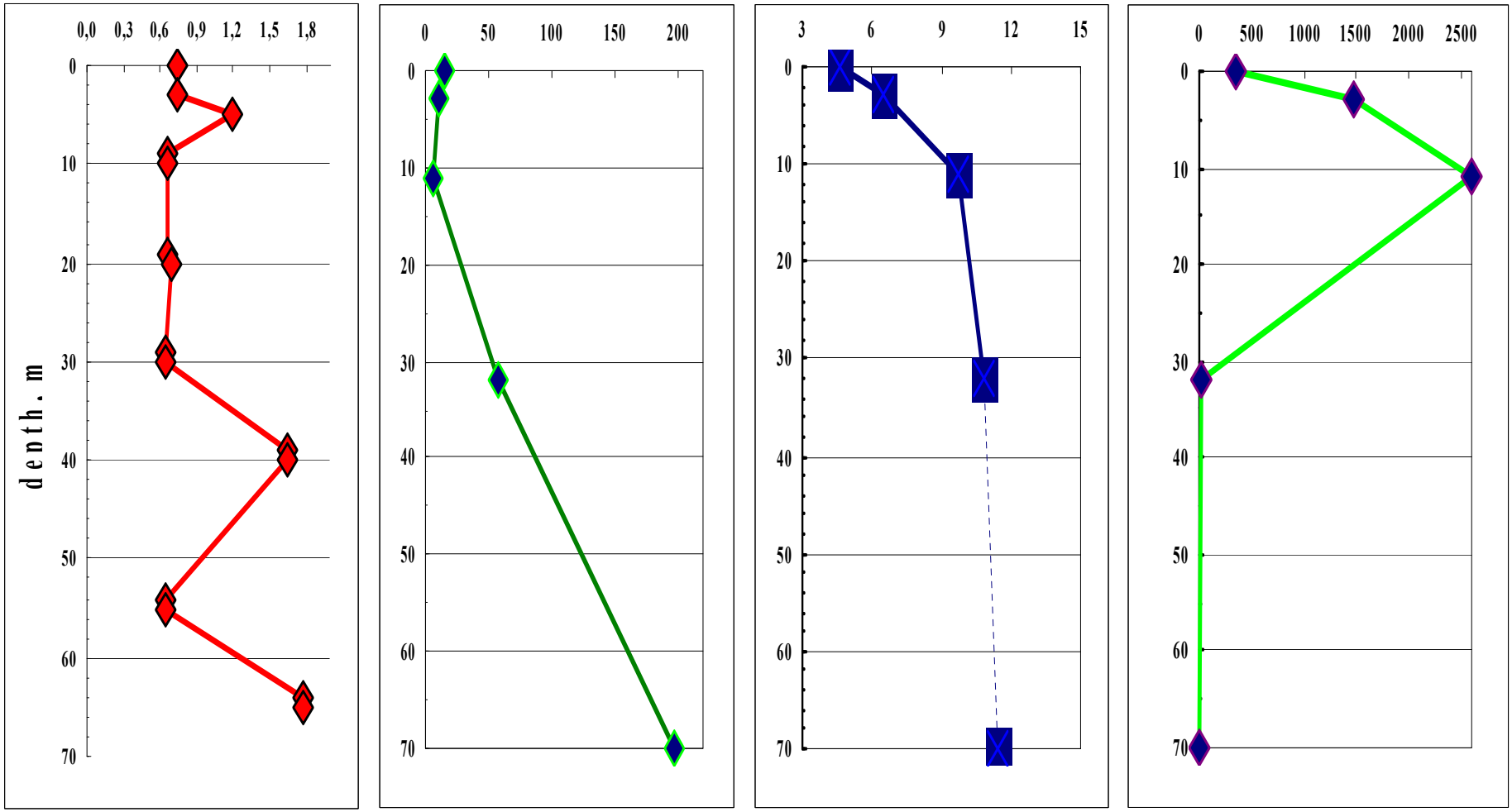

55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
15 8 2004


71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102
15 8 2004


96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117
15 8 2004

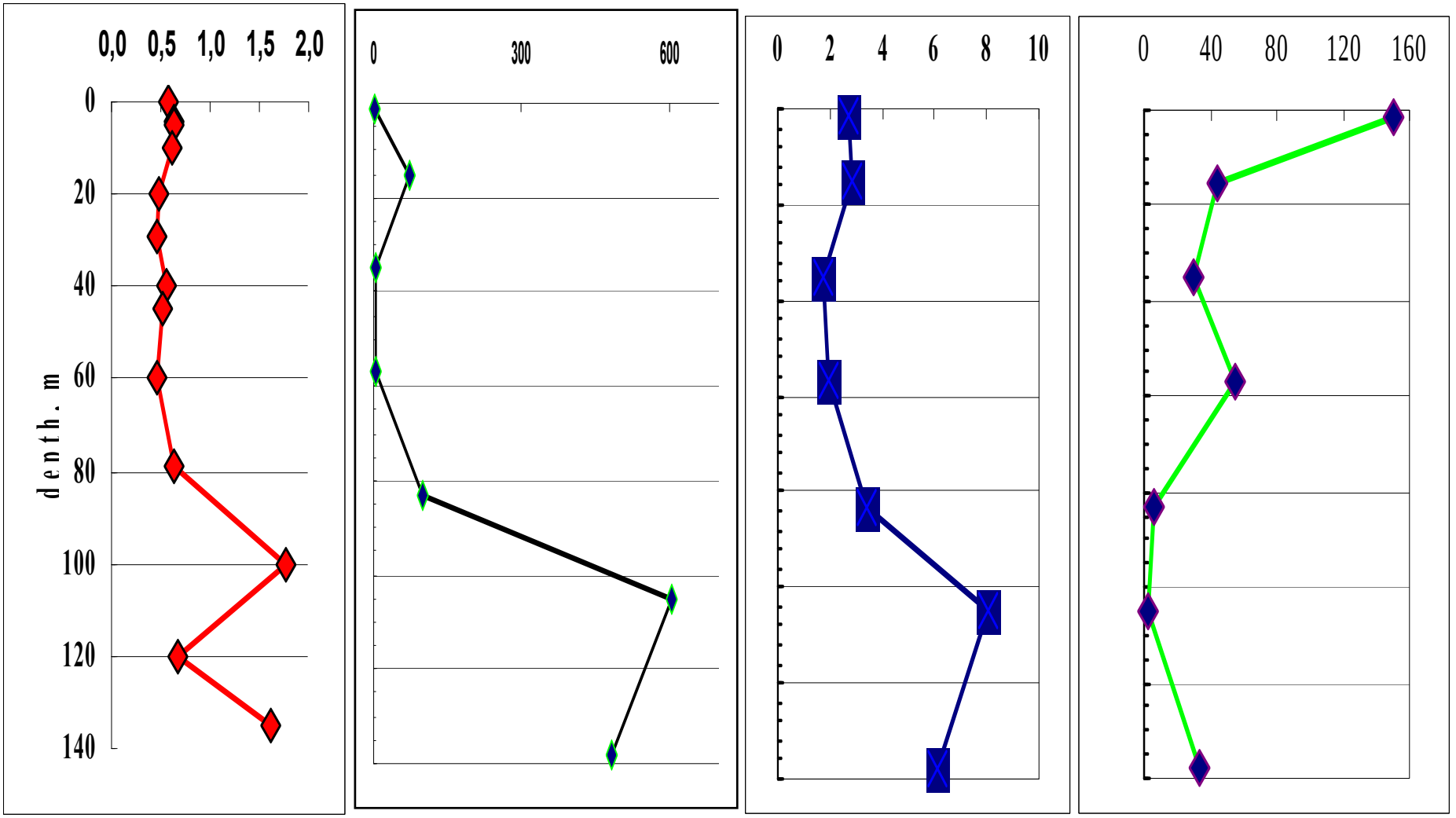
Station 15 bottom sediments

CH_4 *μM* dm^{-3} MG, *nM* $dm^{-3}day^{-1}$ MO, *nM* $dm^{-3}day^{-1}$ SR, μg S $dm^{-3}day^{-1}$



Station 22 bottom sediments

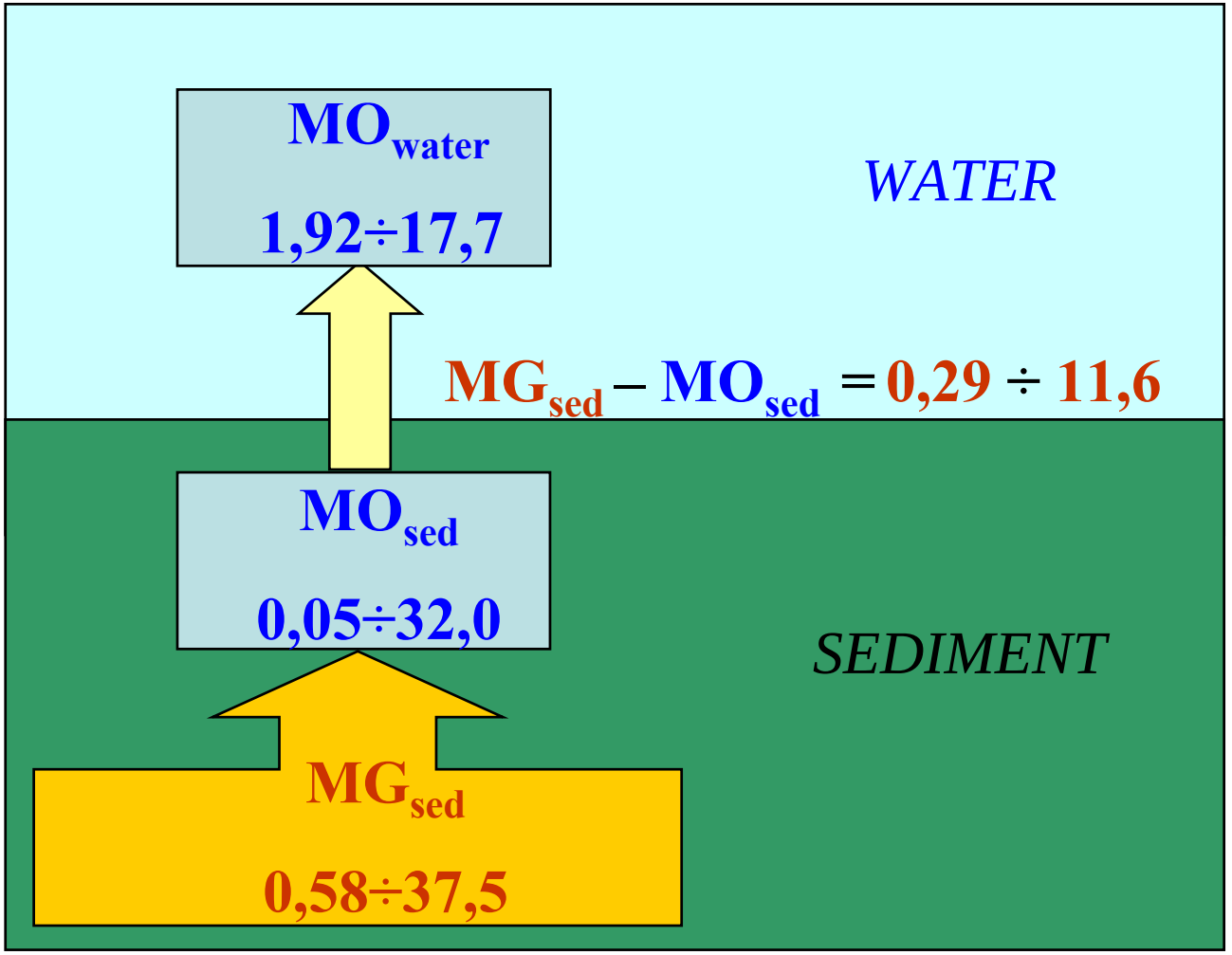
CH_4 *μM* dm^{-3} MG, *nM* $dm^{-3}day^{-1}$ MO, *nM* $dm^{-3}day^{-1}$ SR, μg S $dm^{-3}day^{-1}$



The rate of methane generation and methane oxidation in sediments as well methane oxidation in water column (**μM m^{-2} day^{-1}**)

Station, depth, m Sediment, depth, cm	**Methane oxidation in water, μM m^{-2} day^{-1}**	**Methane generation in sediment, μM m^{-2} day^{-1}**	**Methane oxidation in sediment, μM m^{-2} day^{-1}**	**MG sediment – MG sediment, μM m^{-2} day^{-1}**
11, 40 m 3 cm	**2,27**	**0,58**	**0,049**	**0,53**
15, 45 m 65 cm	**3,33**	**17,9**	**6,3**	**11,6**
20, 50 m 3 cm	**1,92**	**0,58**	**0,29**	**0,29**
22, 50 m 135 cm	**2,38**	**12,9**	**5,13**	**7,77**
106, 66 m 210 cm	**9,24**	**37,5**	**32,0**	**5,5**
85B, 101 m 117 cm	**17,7**	**5,52**	**3,61**	**1,91**

Balance of the microbial processes methane generation (MG) and methane oxidation (MO) under meter square at the sediments and water column (**µM × m^{-2} × day^{-1}**)




6 8 2004


17 8 2004