Baltic Sea Science Congress 2003, Helsinki

Inflow waters in the deep regions of the Southern Baltic Sea - transport and transformations

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Plan of presentation:
1. Introduction
2. History of the Inflow
3. Discussion
4. Conclusions

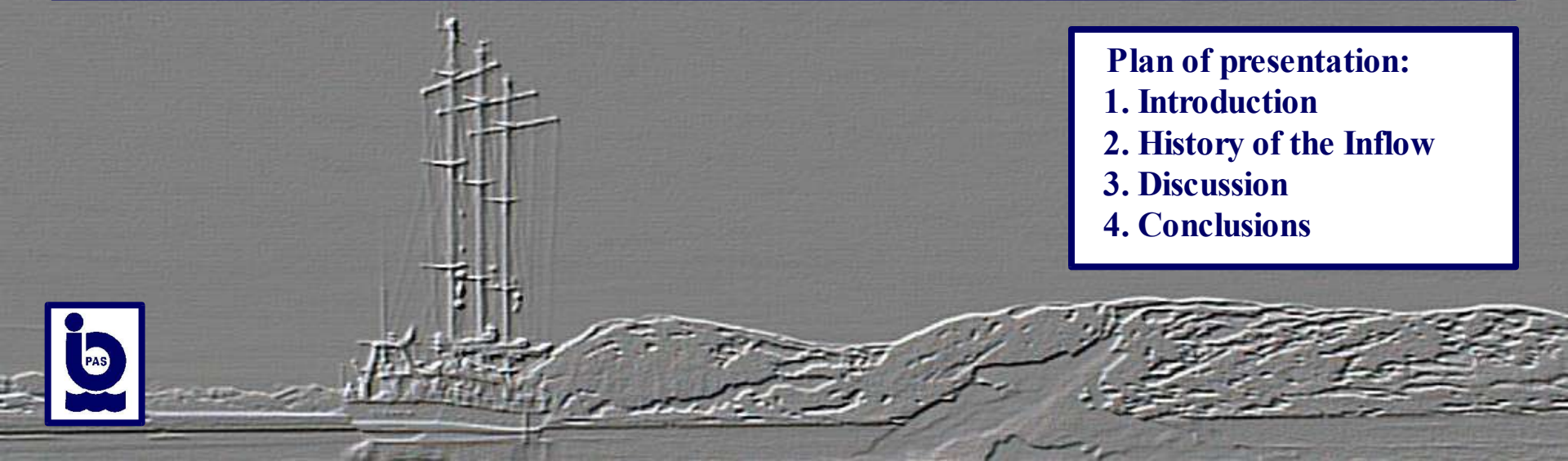
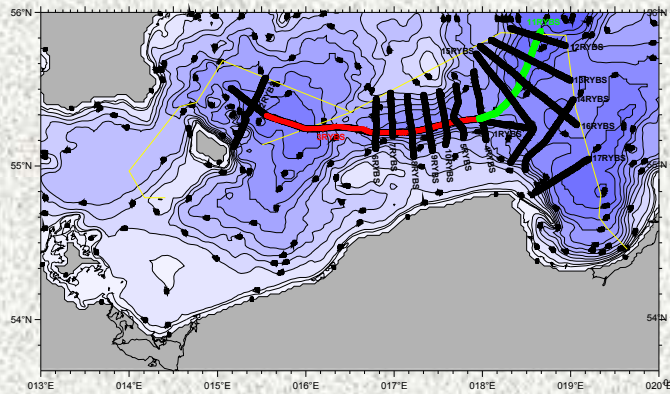
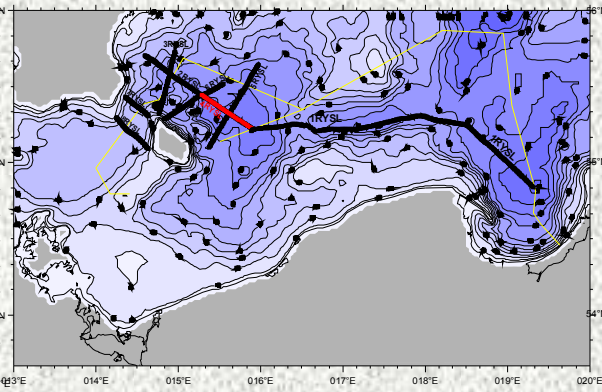


Fig. 1. Maps of investigations during the main inflow in winter, spring and summer 2003.

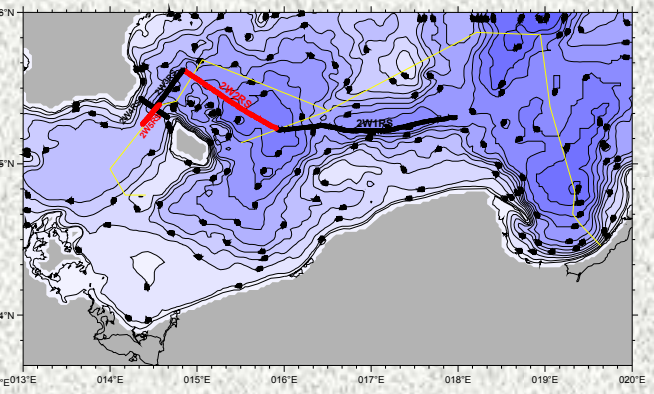
December 2002



January 2003



February (twicely) 2003



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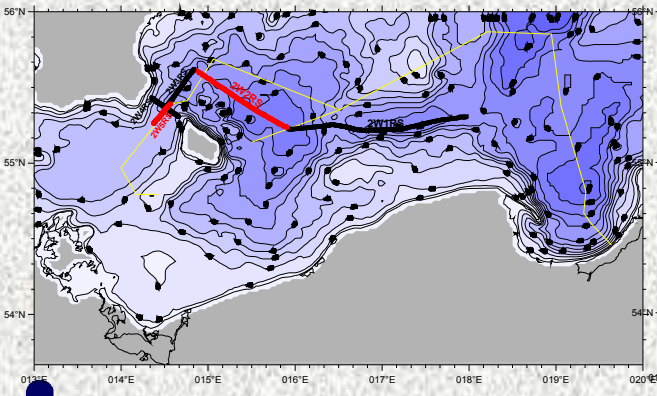
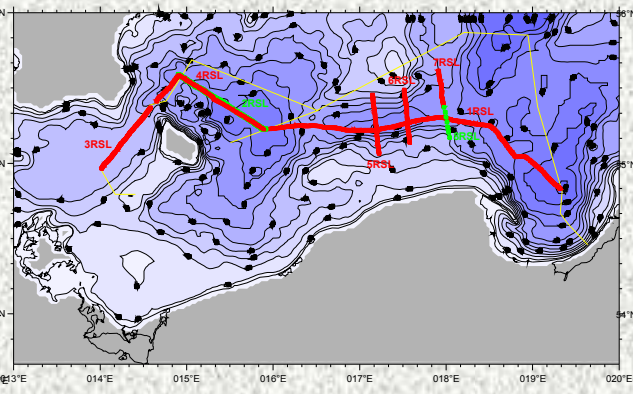


April 2003



August 2003

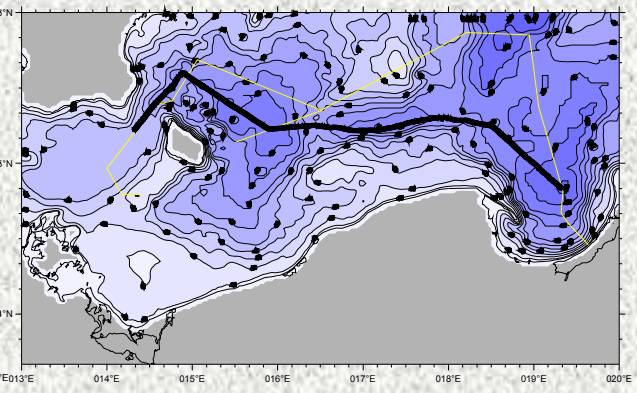


Fig. 2. Temperature (°C), salinity (psu). December 3-4, 2002.

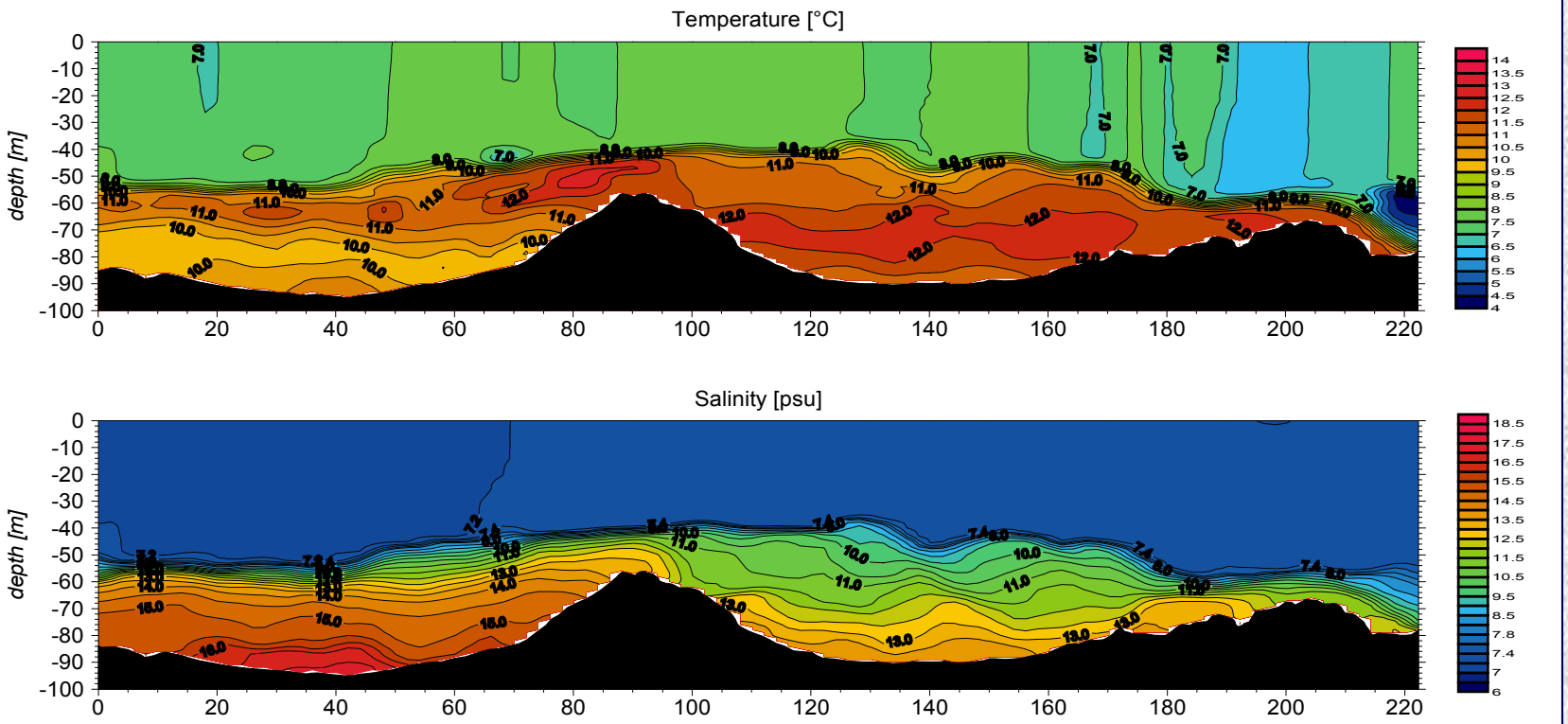
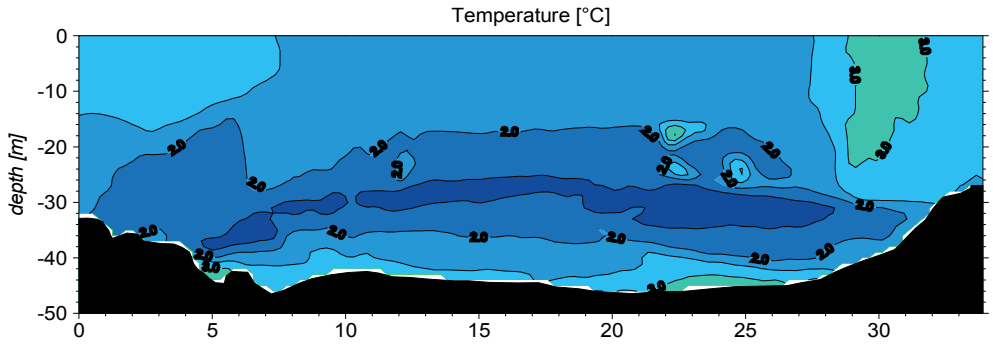
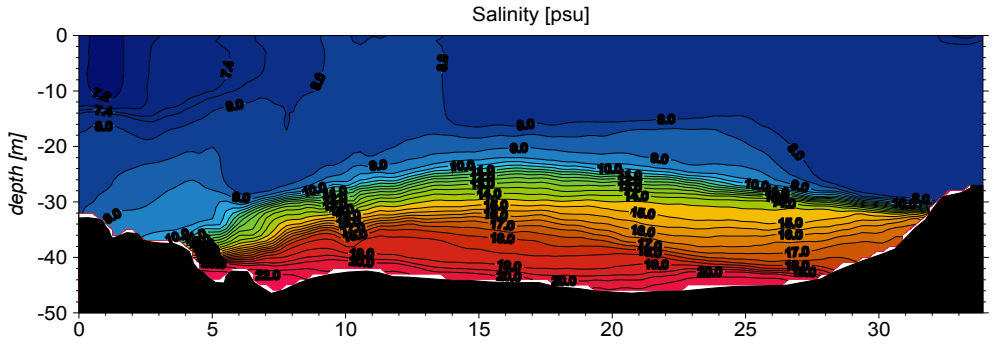
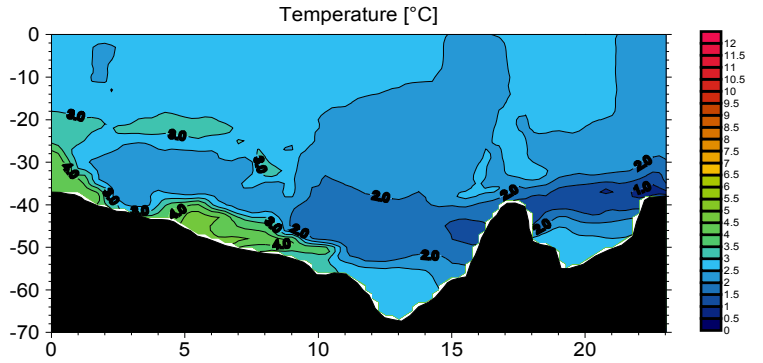
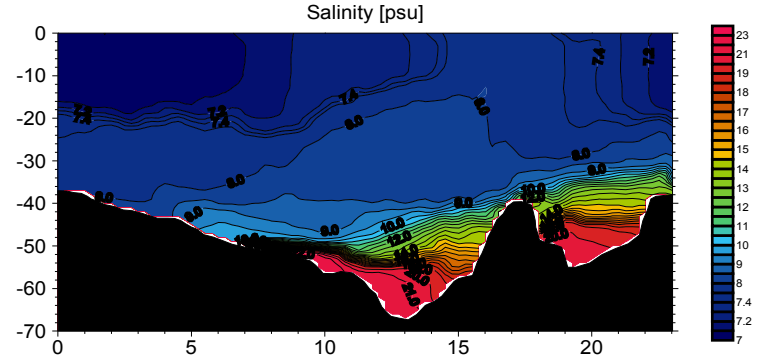


Fig. 3. Temperature (°C), salinity (psu) and currents. January 25-26, 2003. Arcona Basin and Bornholm Gate.









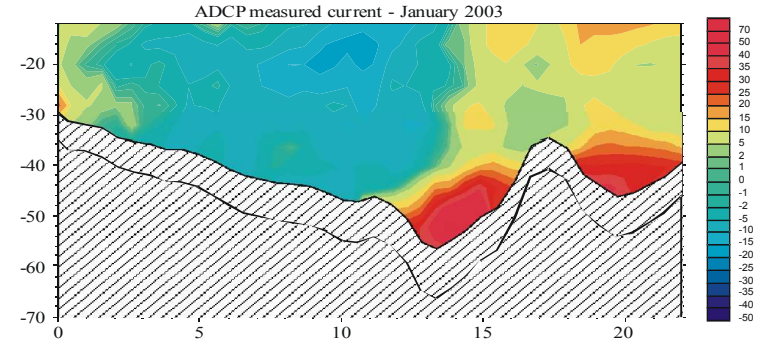


Fig. 4. Temperature (°C), salinity (psu) along the Main Transect. January 25-26, 2003.

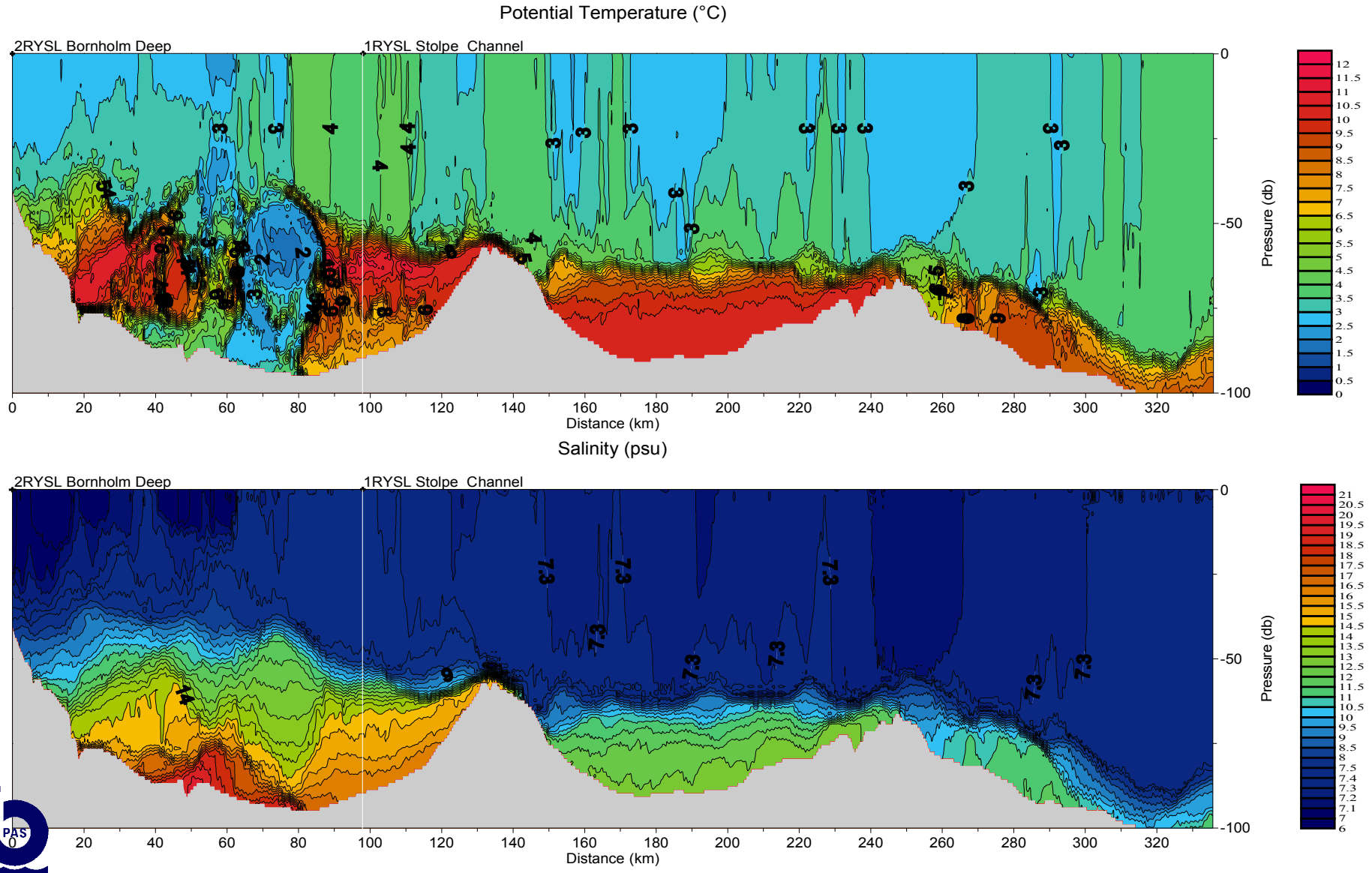
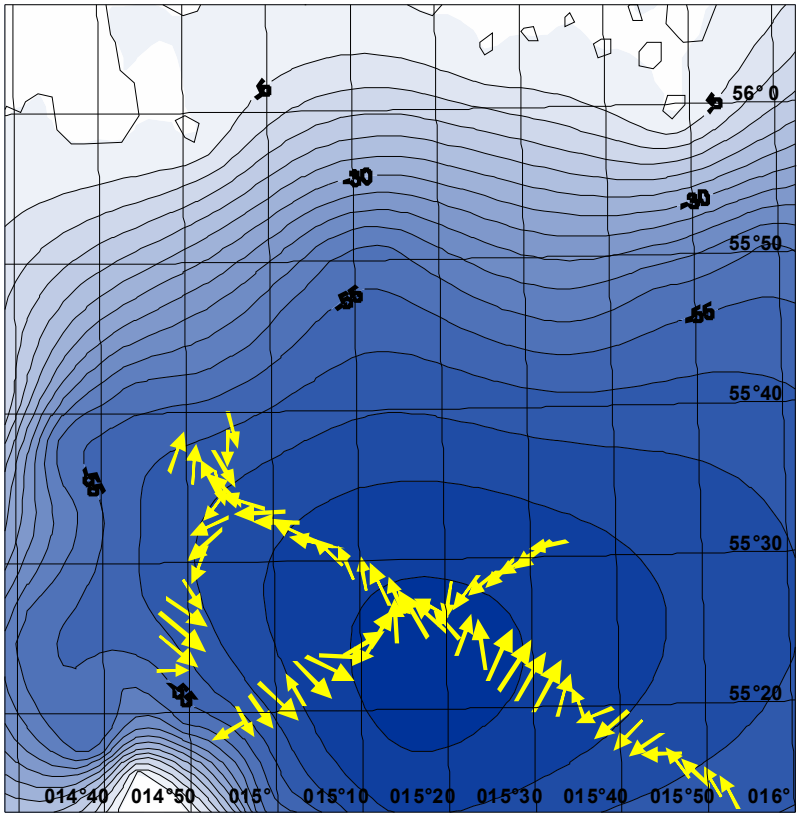


Fig. 5. Currents, 50 and 60 m level. ADCP data, (VM BB 150 kHz). January 2003.

50 m



60 m

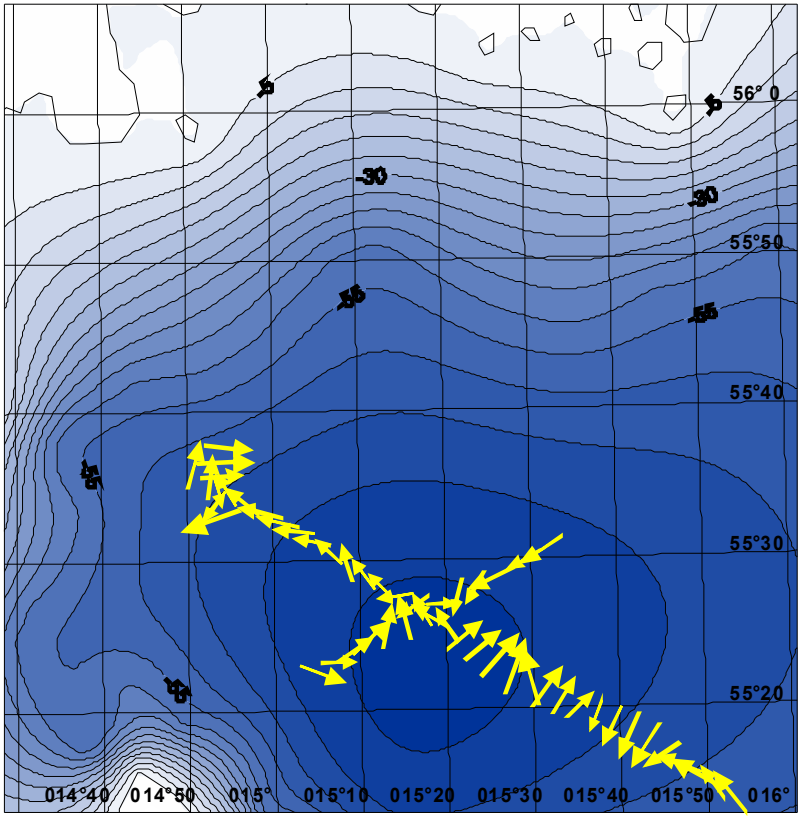


Fig. 6. Temperature (°C), salinity (psu) in the Bornholm Gate. February 07, 2003.

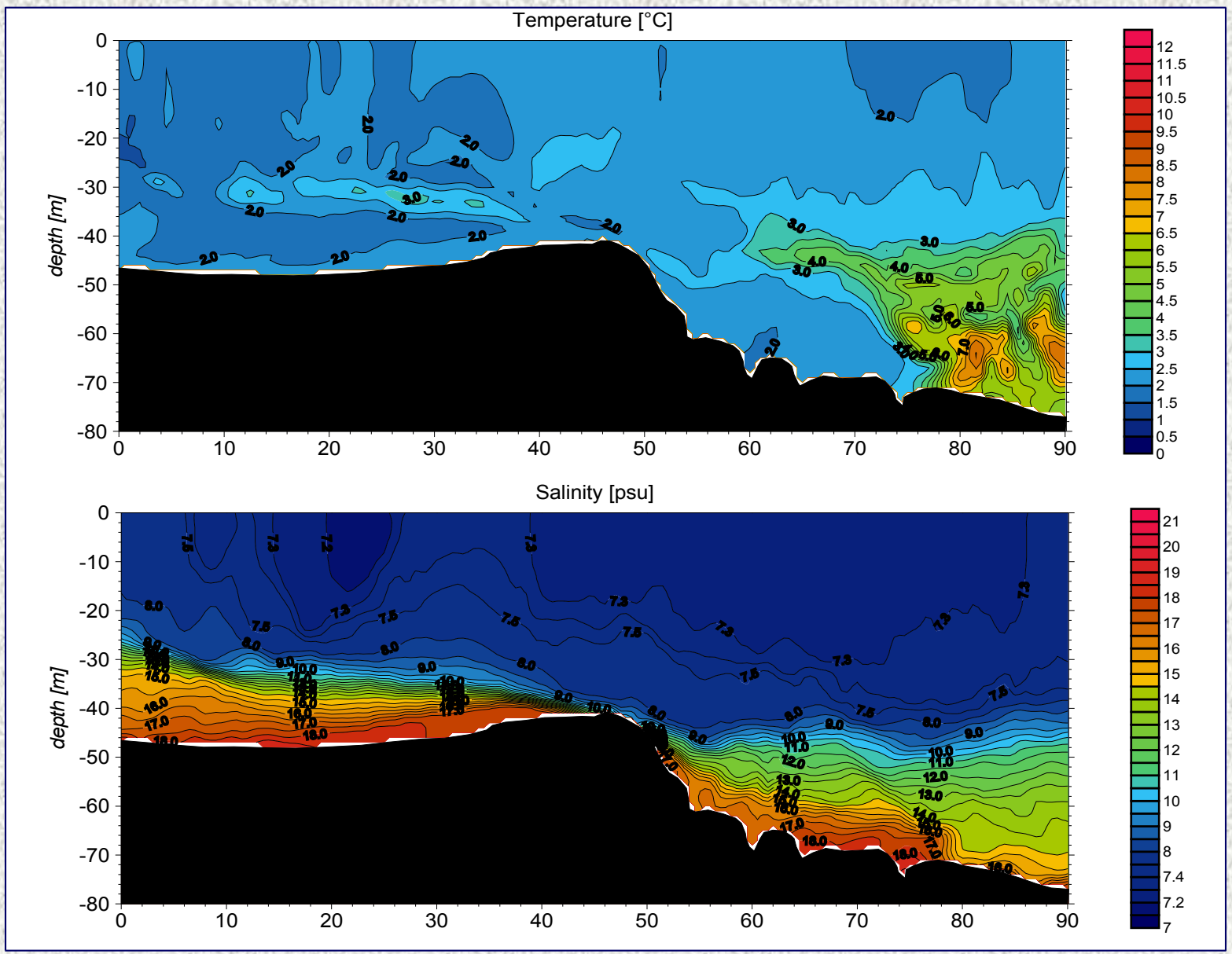


Fig. 7. Temperature (°C), salinity (psu) along the Main Transect. February 04-07, 2003.

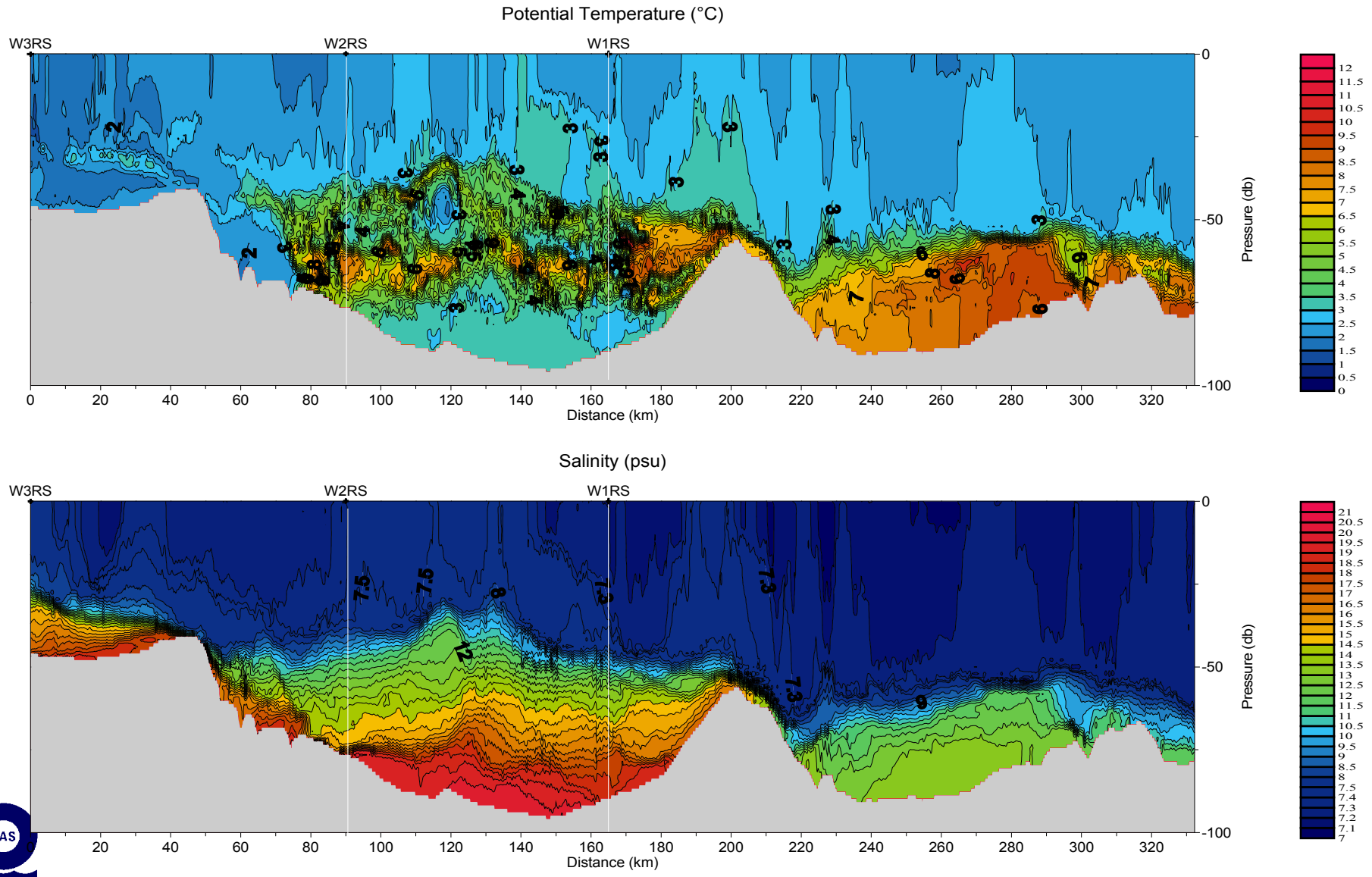


Fig. 8. Temperature (°C), salinity (psu) in the Bornholm Deep. February 06-07, 2003.

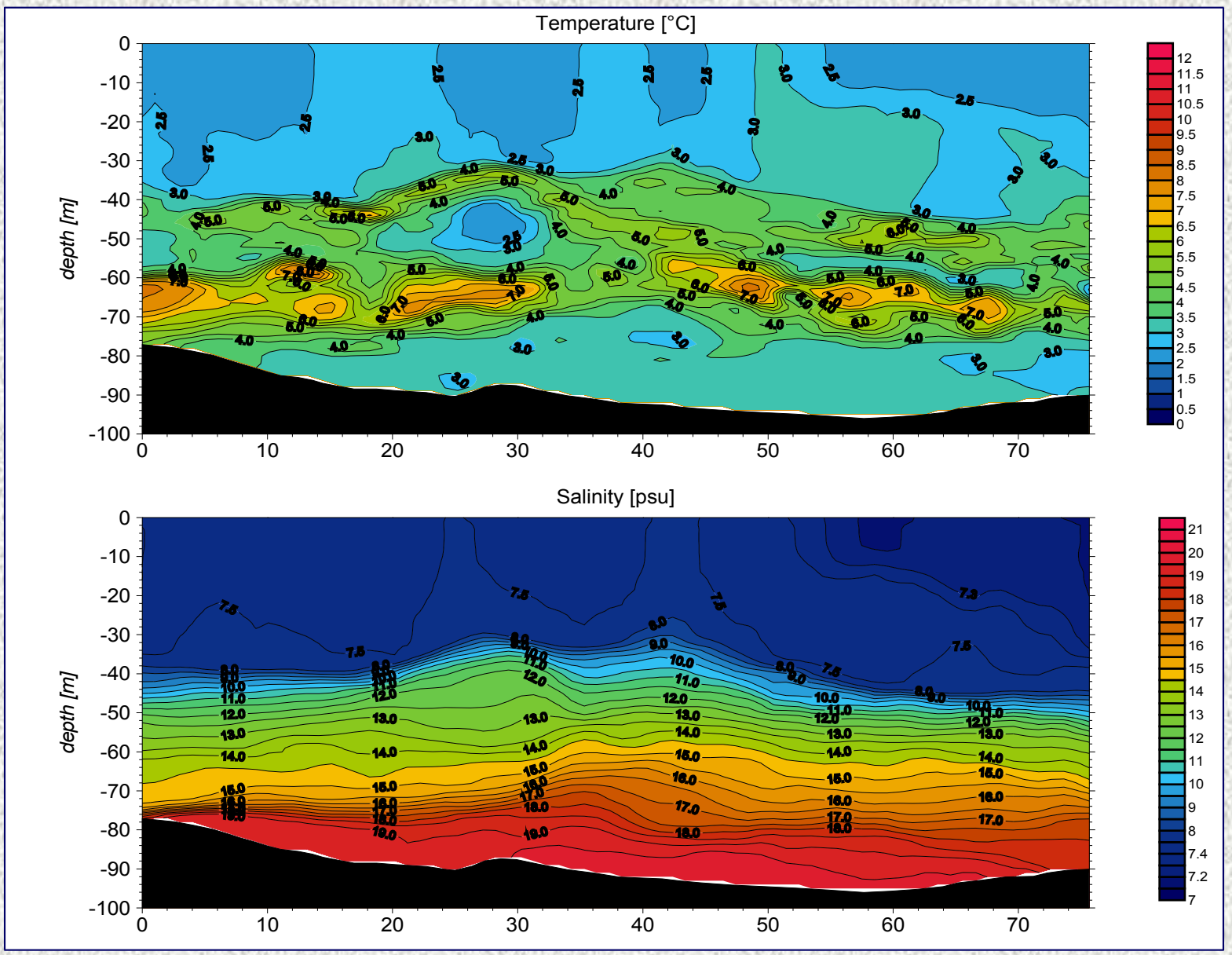
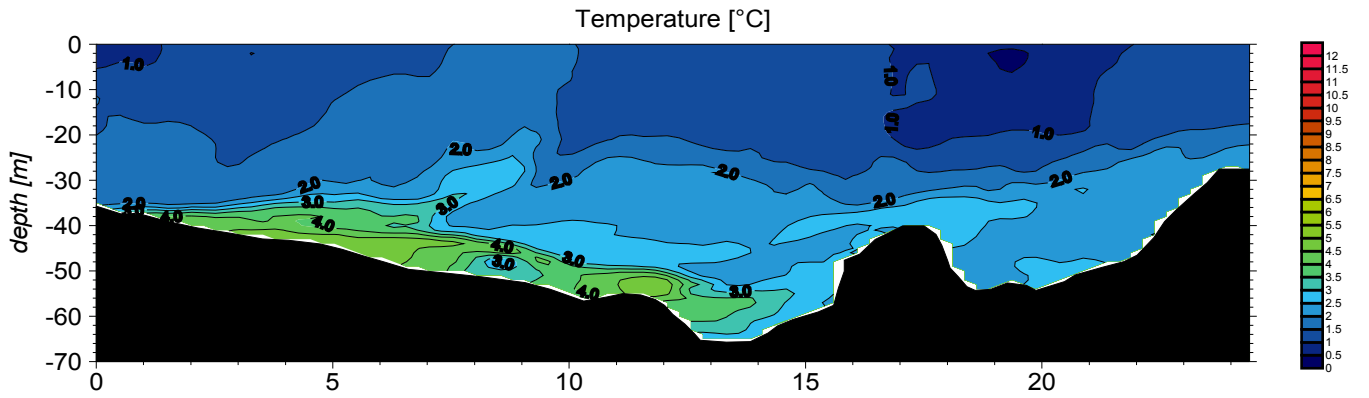
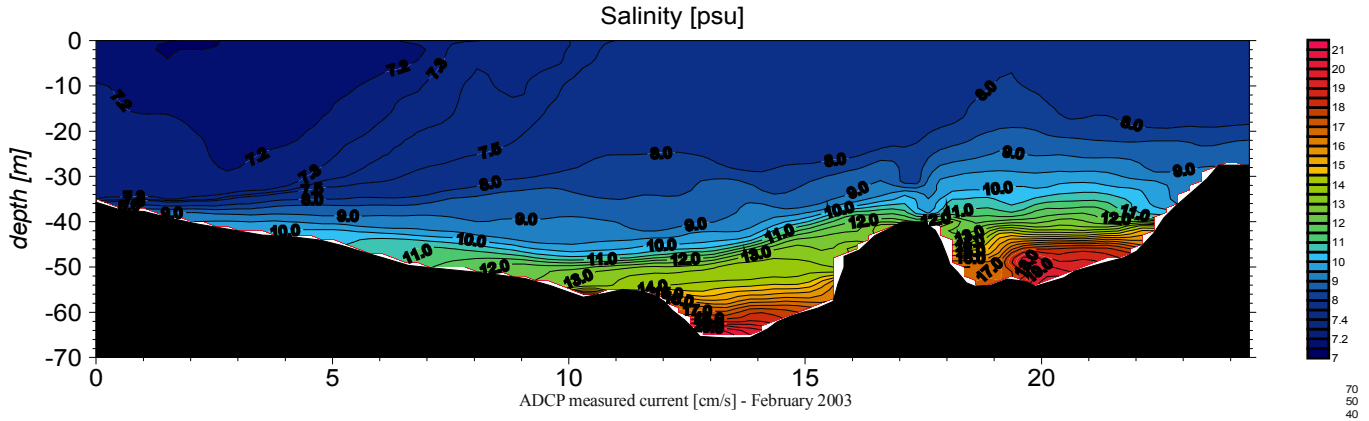


Fig. 9. Temperature (°C), salinity (psu) across the Bornholm Gate. February 16-18, 2003.





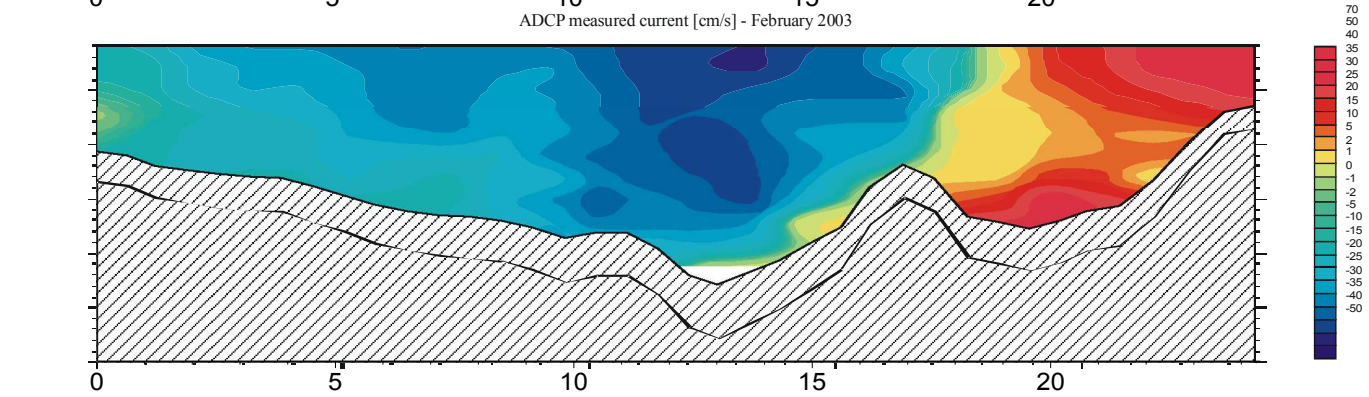


Fig. 10. Temperature (°C), salinity (psu) along the Main Transect. February 16-18, 2003.

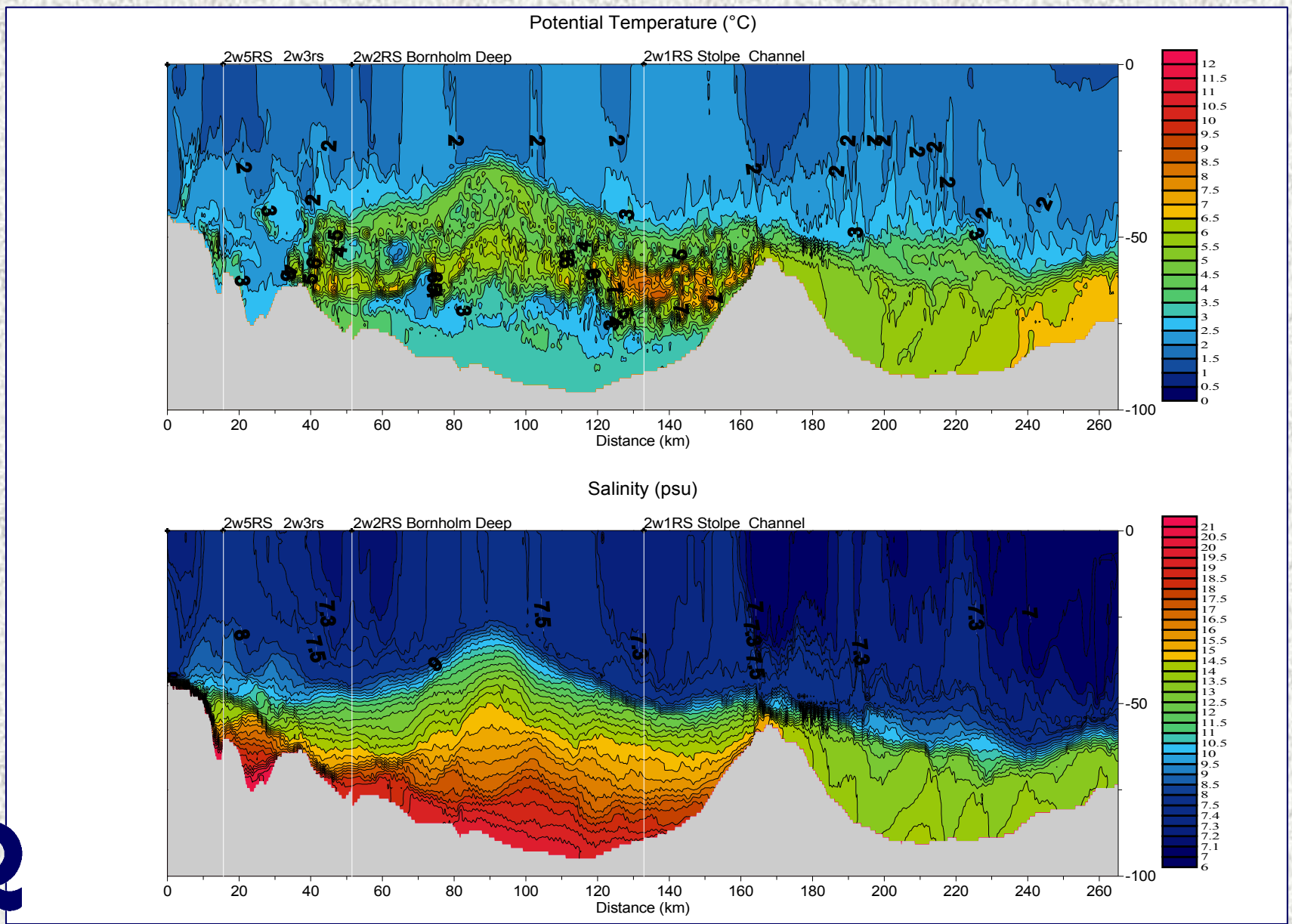


Fig. 11. Temperature (°C), salinity (psu) along the Main Transect. March 15-17, 2003.

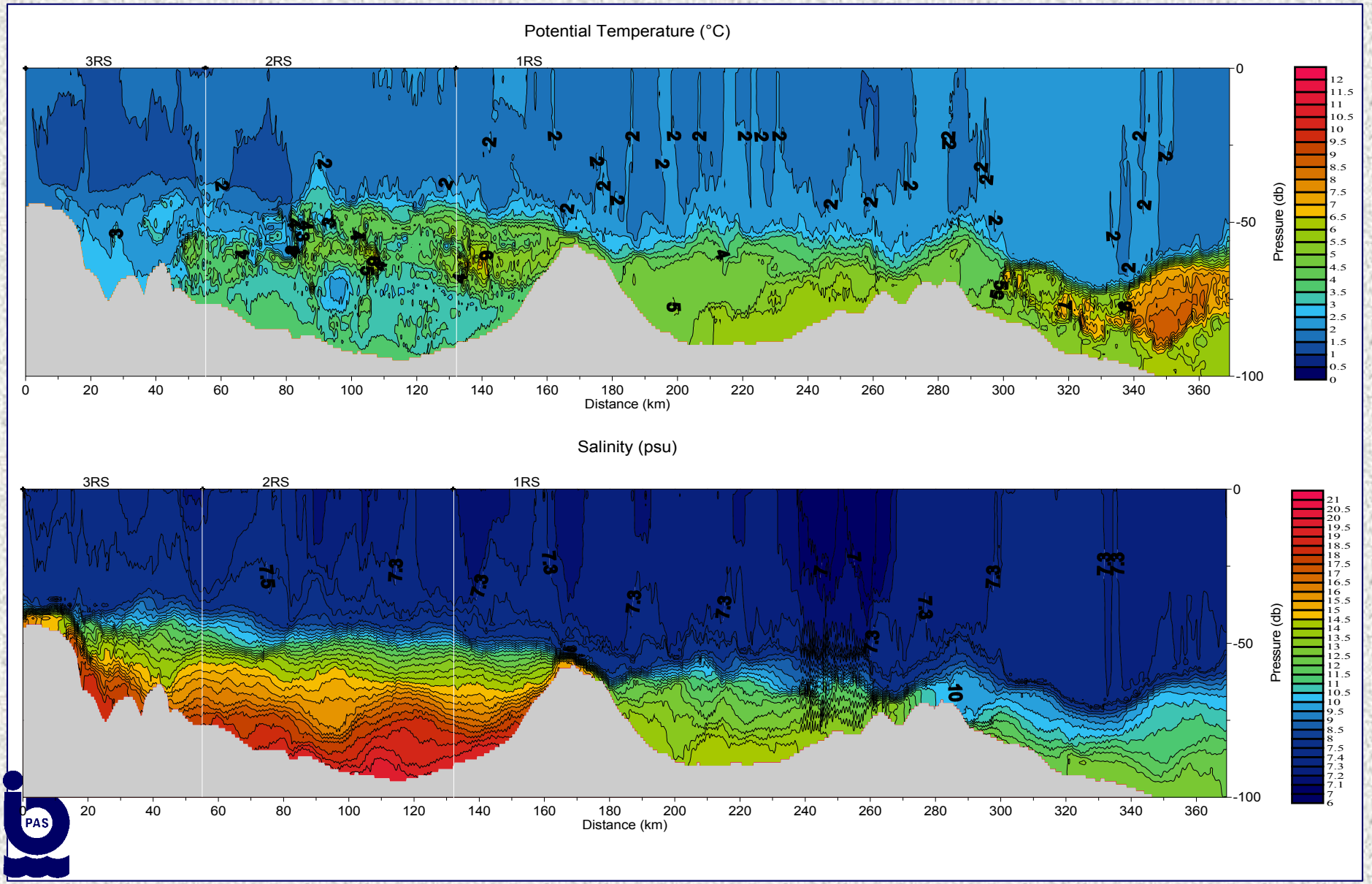


Fig. 12. Temperature (°C), salinity (psu) along the Main Transect. April 22-26, 2003.

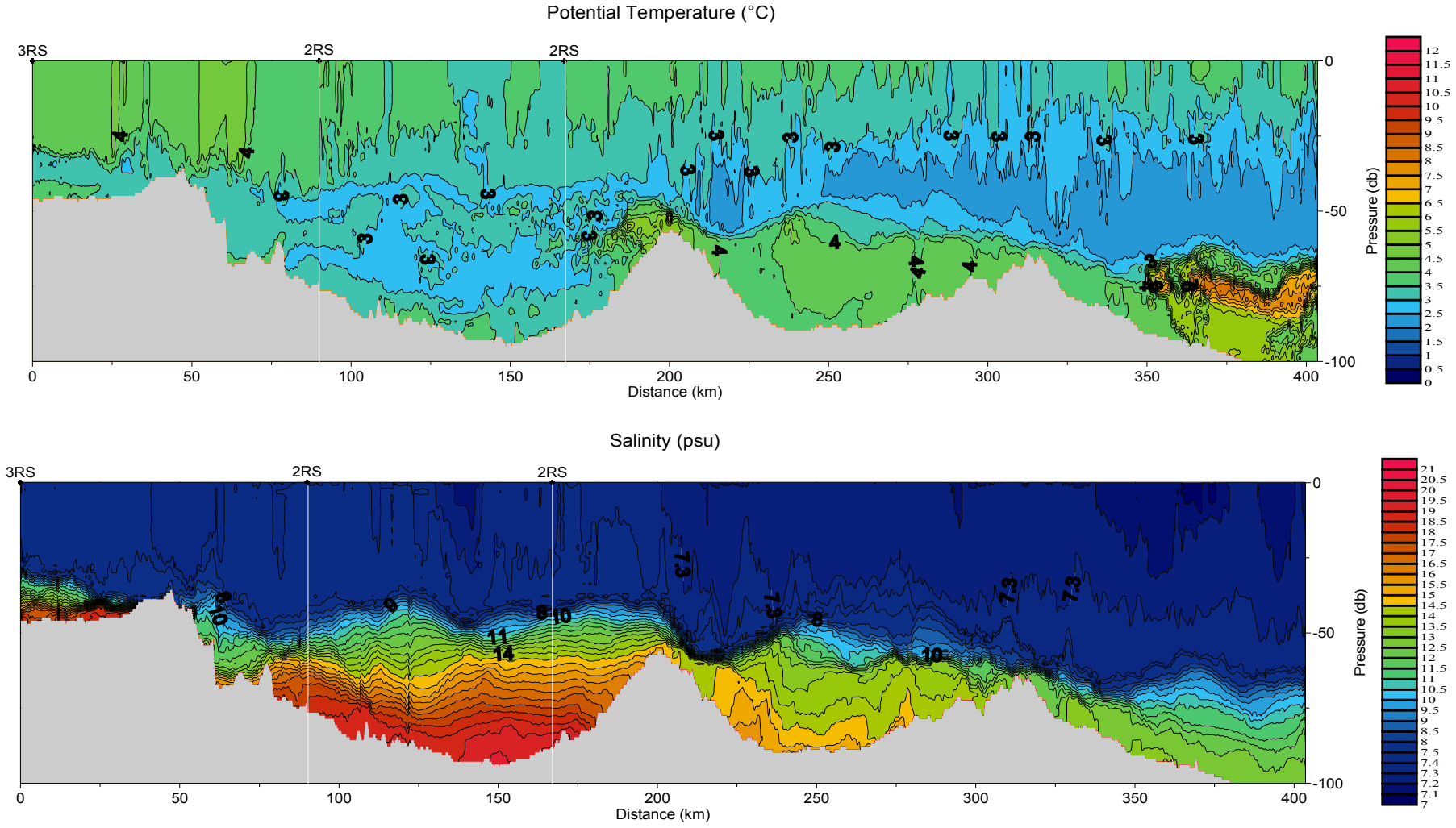


Fig. 13. Temperature (°C), salinity (psu) along the Main Transect. August 15-17, 2003.

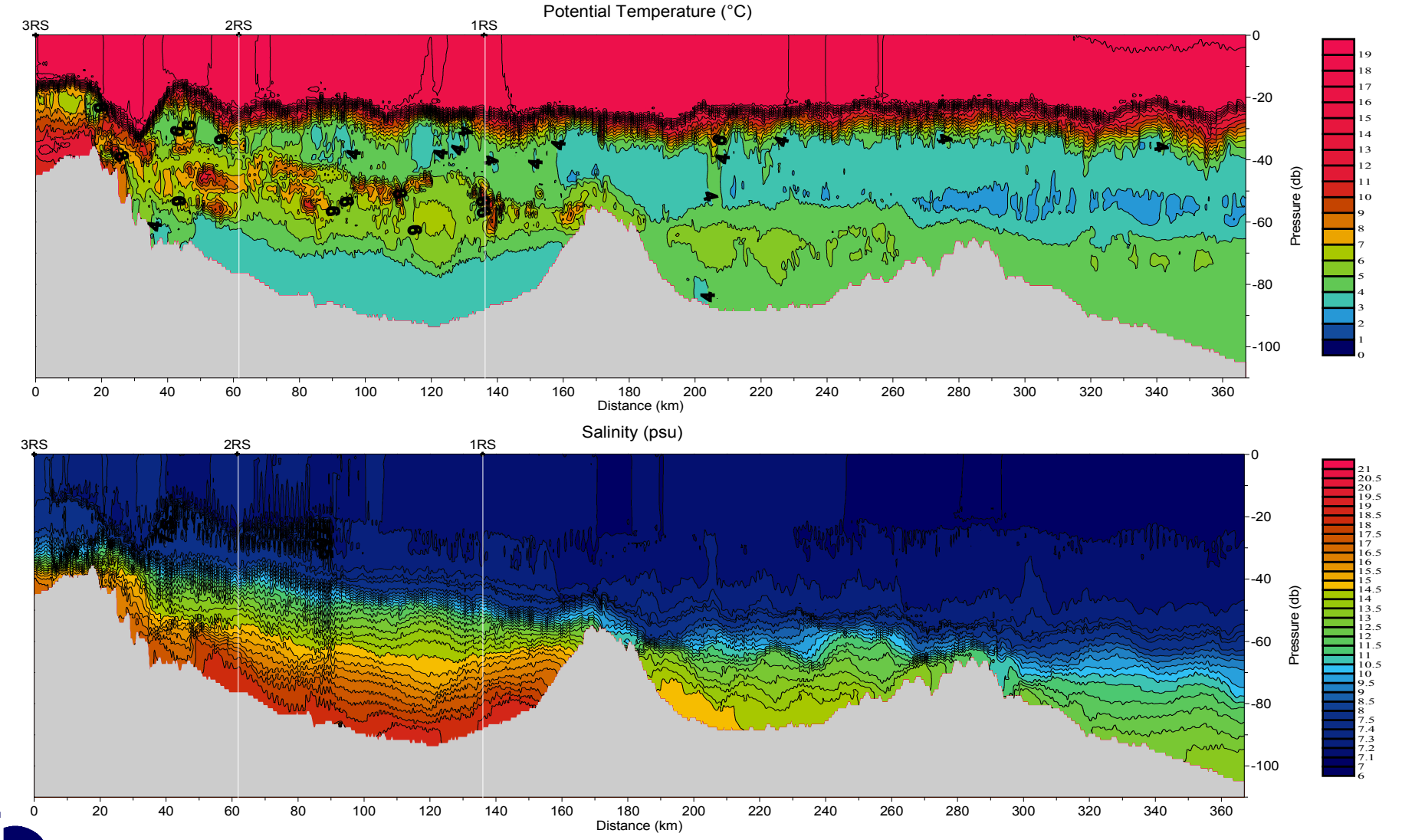


Fig. 14. Pool of the inflow waters in the Arkona Basin. January 26, 2003.

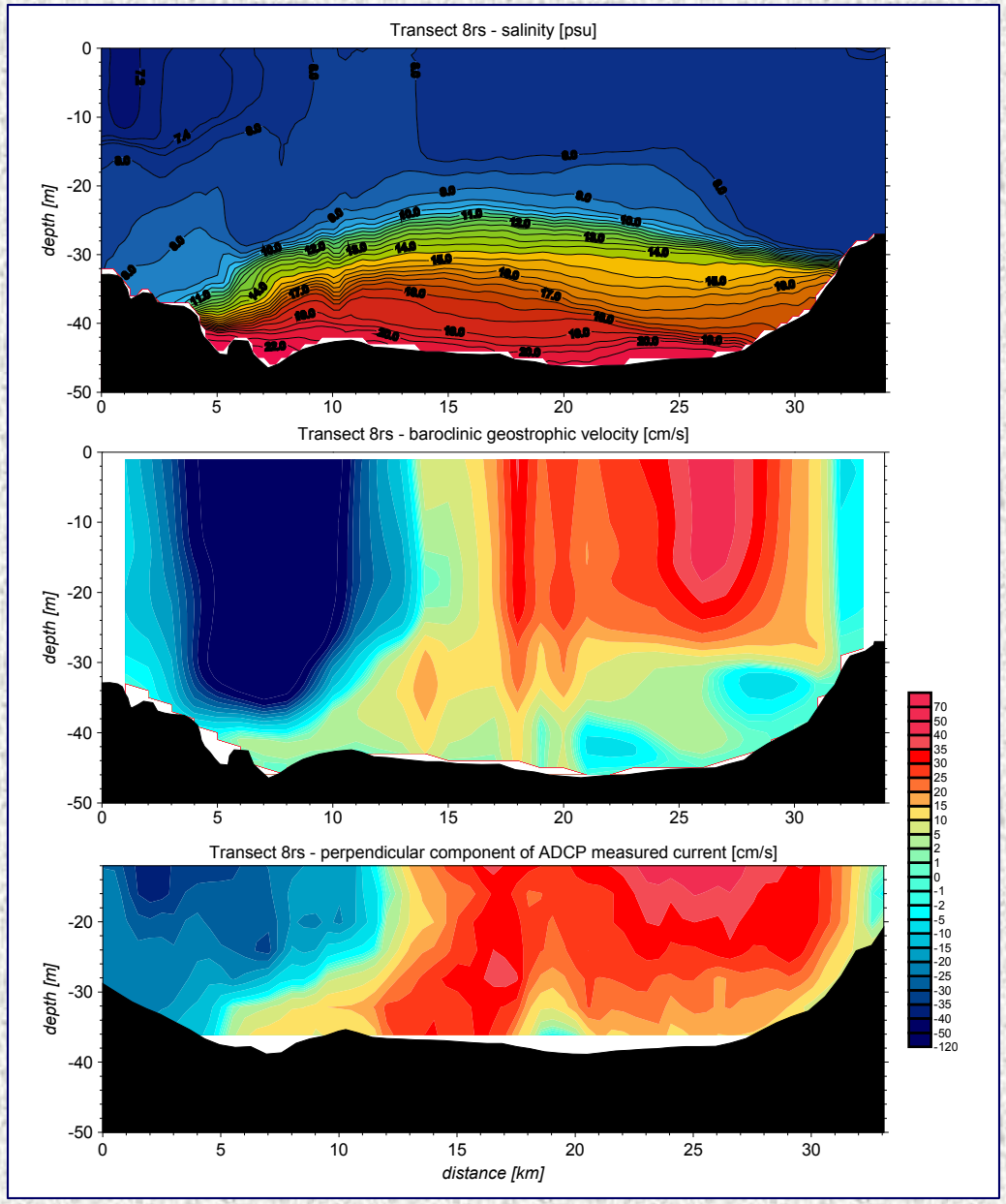


Fig. 15. Transportation of the inflow waters through the Bornholm Channel.

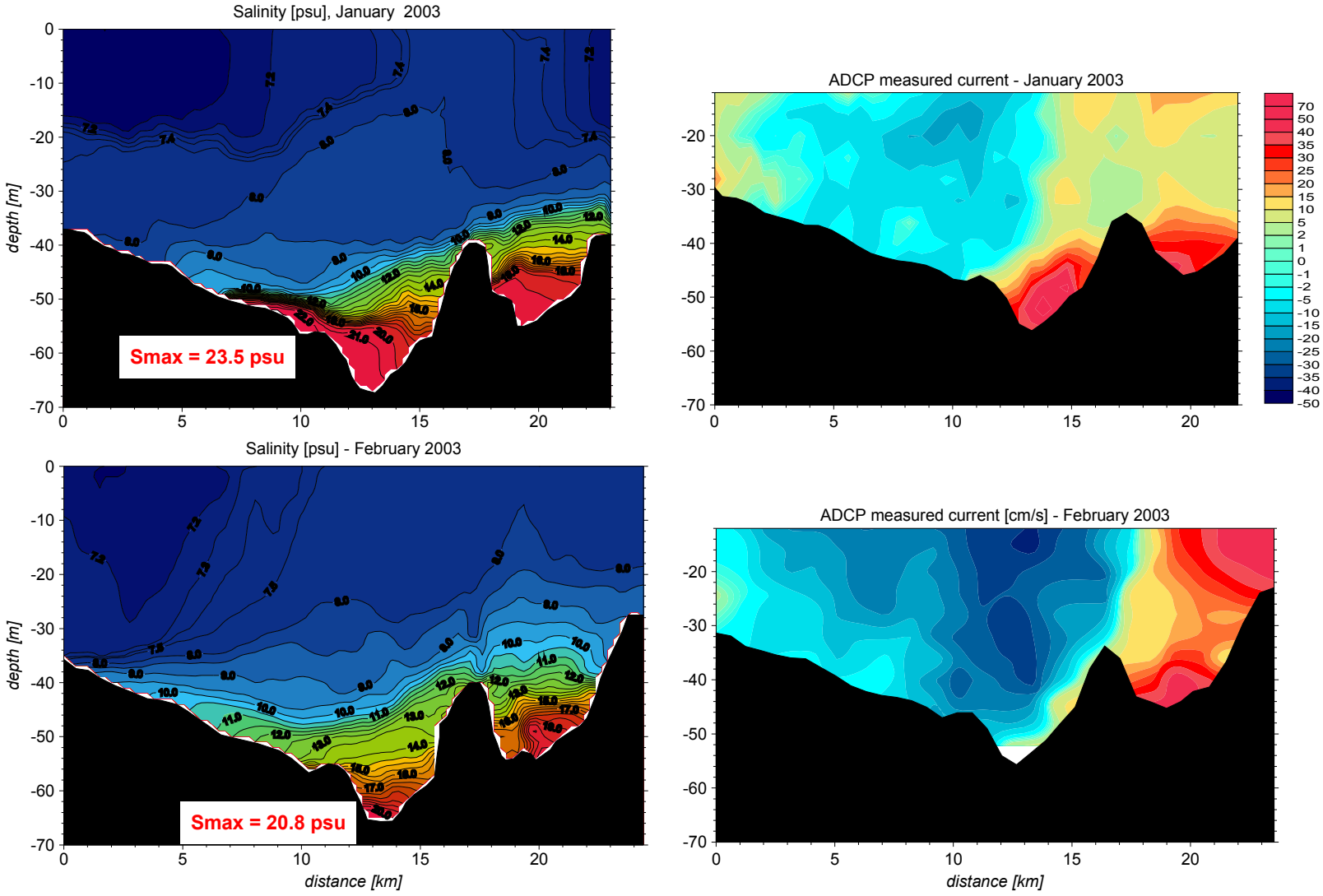


Fig. 16. Dense bottom current entering into the Bornholm Basin. January 2003.

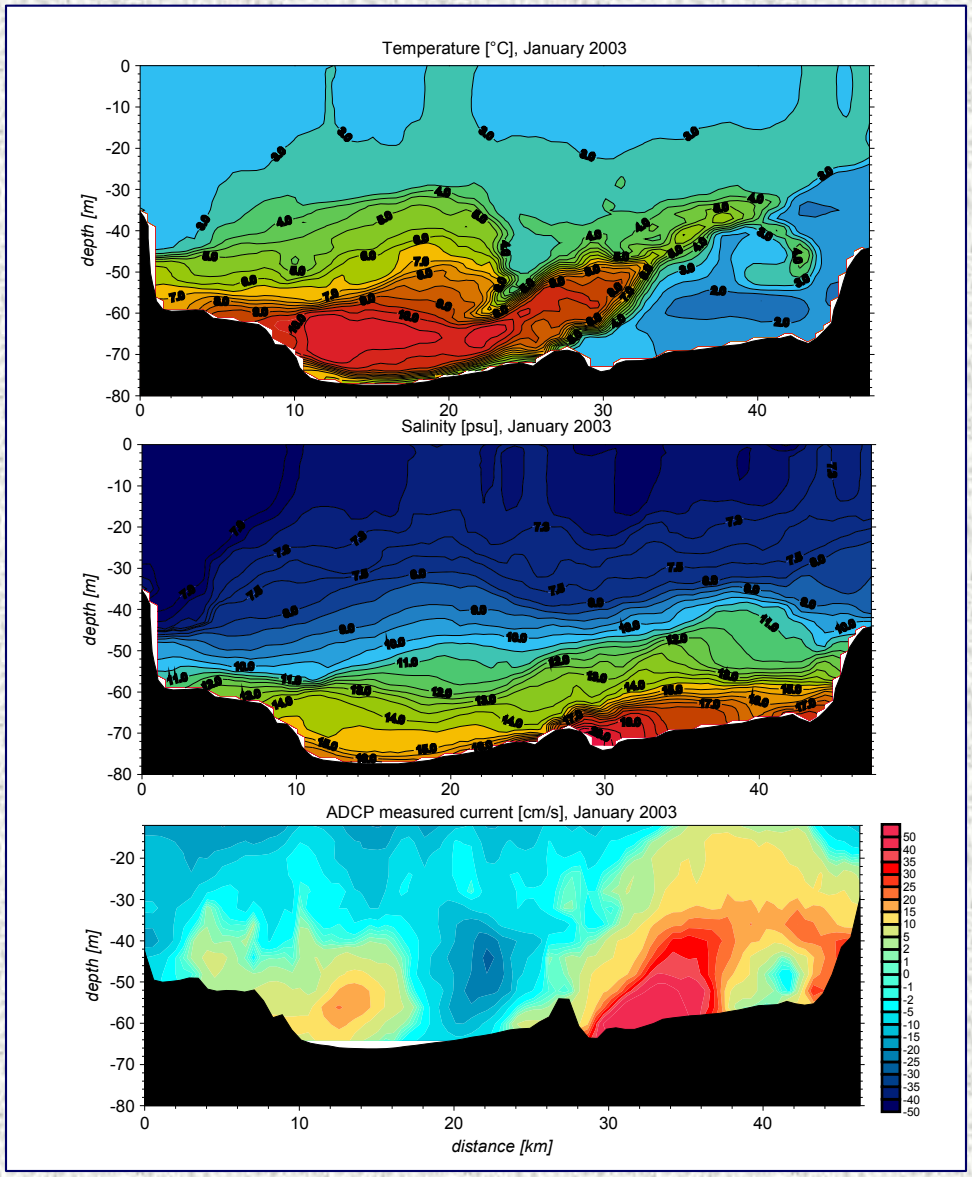
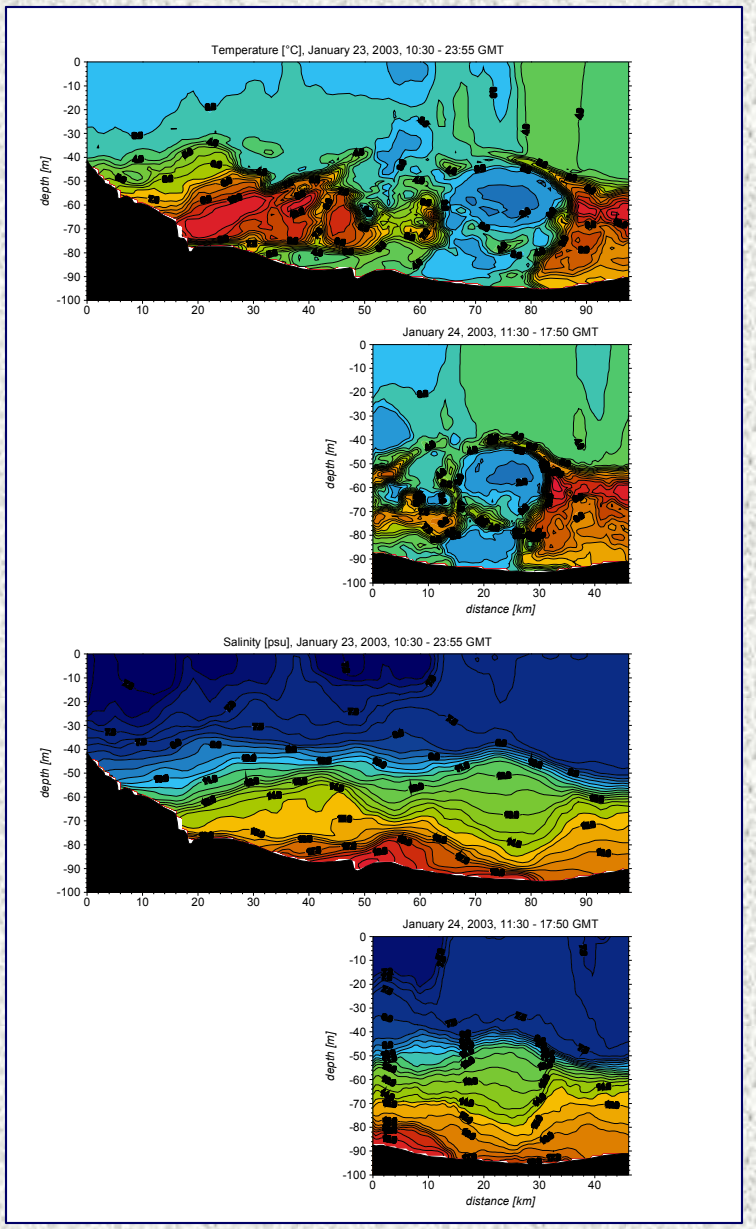


Fig. 17. Eddies and meandering of slope current in the Bornholm Basin. January 2003.



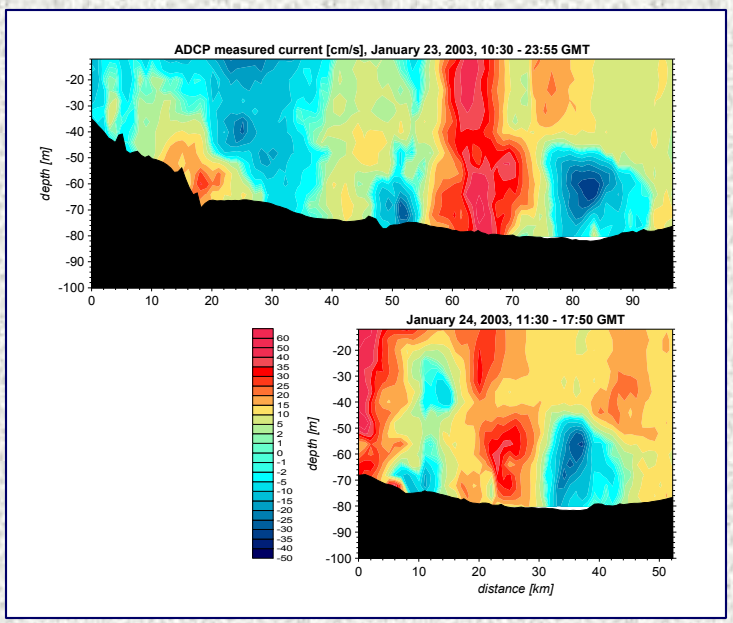
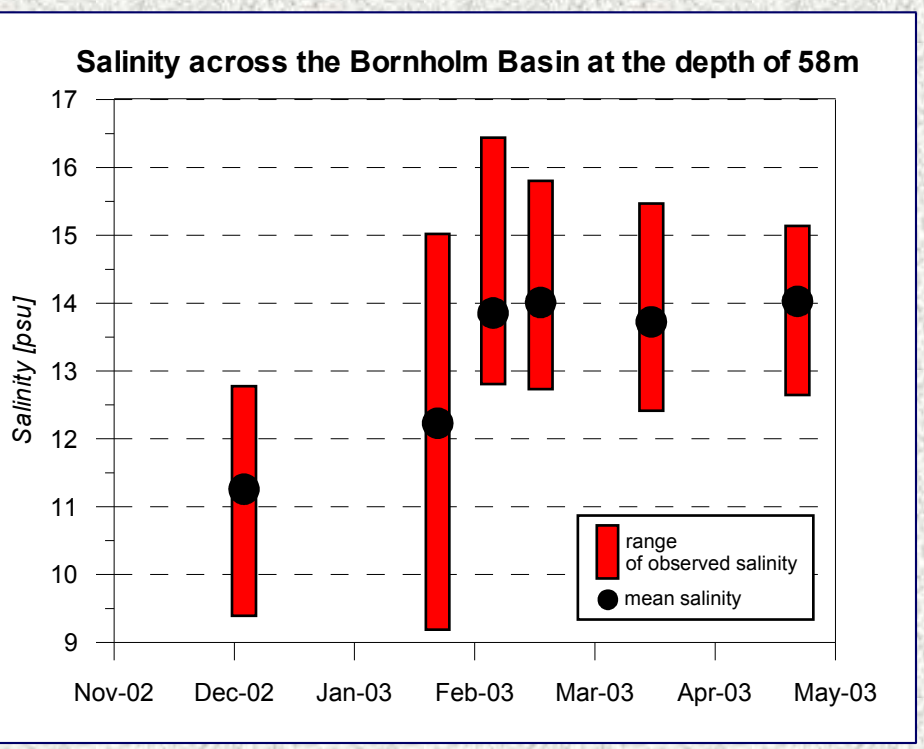
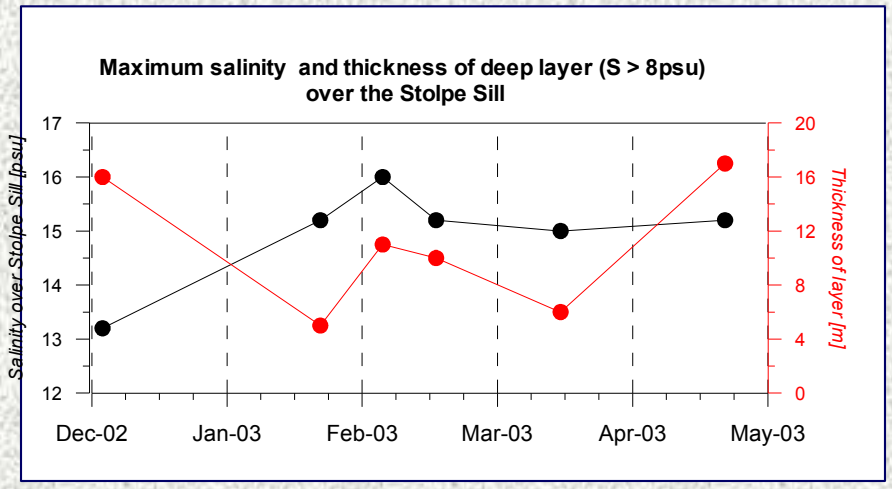


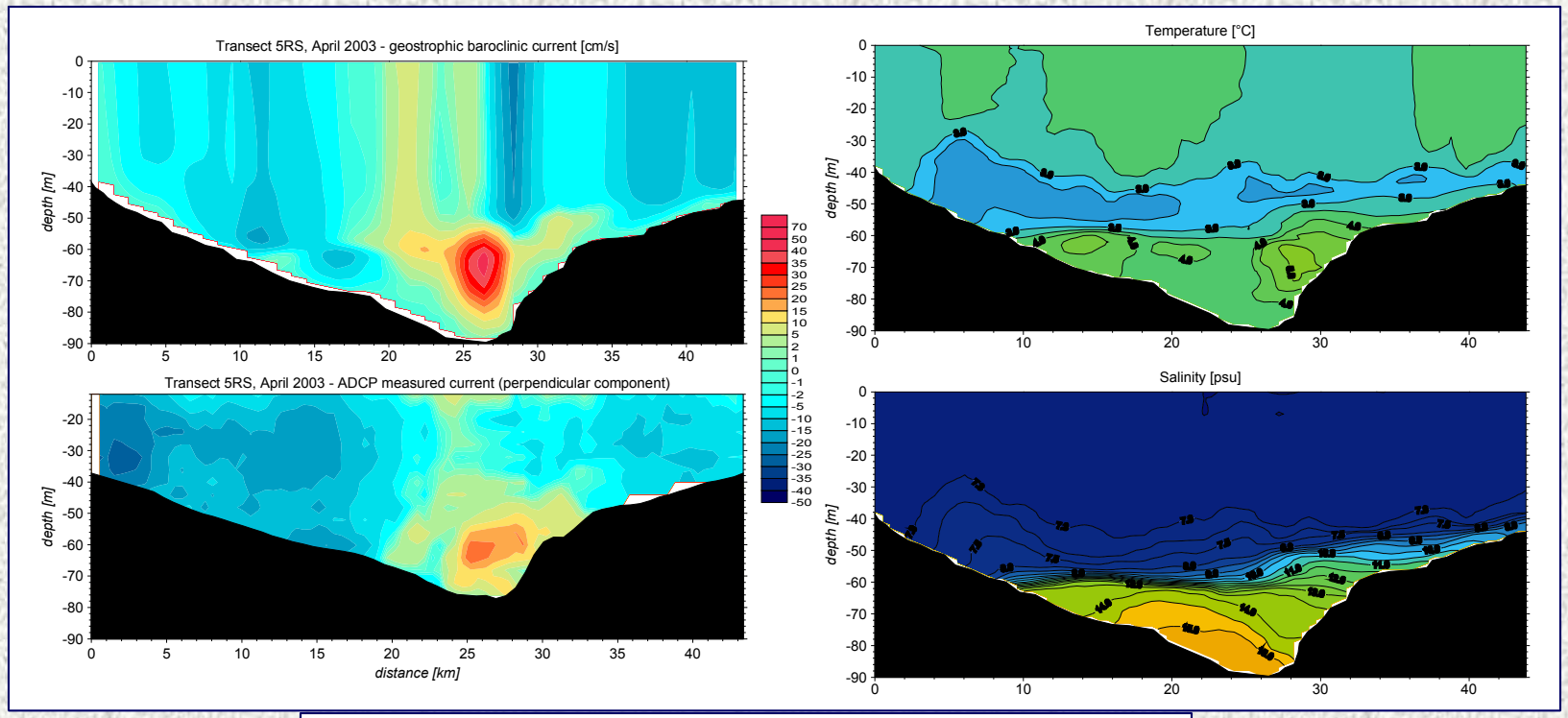
Fig. 18. Transport of the inflow waters over the Slupsk Sill.





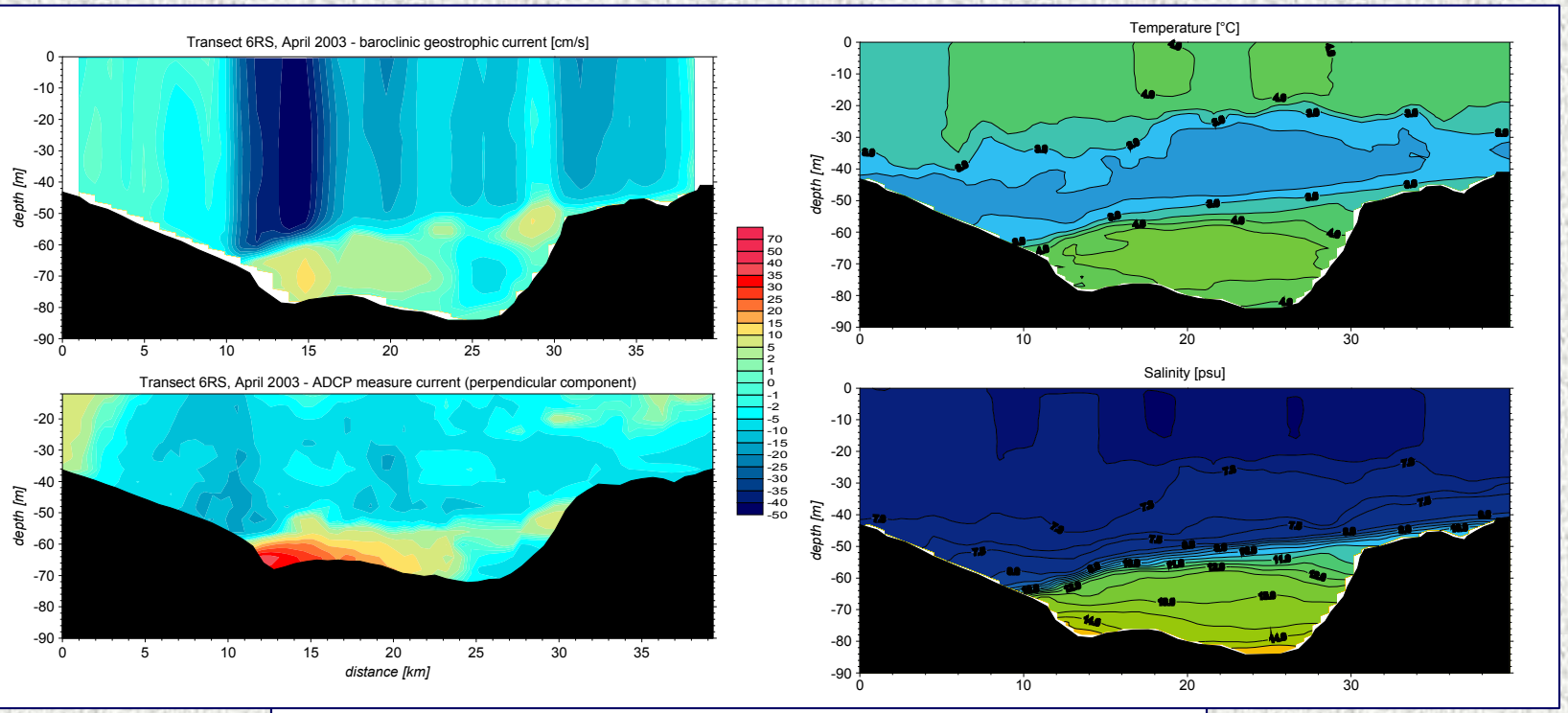
	Halocline depth in Bornholm Basin			
	Mean H_d [m]	*Min H_d [m]*	*Max H_d [m]*	*STD H_d [m]*
December 2002	48.9	40.4	54.8	5.1
January 2003	43.3	31.6	54.6	7.3
February 2003 (beg)	41.0	25.5	53.8	6.5
February 2003 (mid)	40.5	26.2	49.6	6.9
March 2003	44.1	37.6	51.8	3.3
April 2003	41.5	36.9	47.7	2.4

Fig. 19. Transport of the inflow waters in the Slupsk Channel. April 2003.



	Baroclinic geostrophic calculations	ADCP measured transport
Entire water column		
Eastward transport	47.1 x 10^3 m^3/s	29.3 x 10^3 m^3/s
Westward transport	132.6 x 10^3 m^3/s	176.3 x 10^3 m^3/s
Net transport	- 85.5 x 10^3 m^3/s	- 147.0 x 10^3 m^3/s
Mean current	-3.1 cm/s (westward)	-6.5 cm/s (westward)
Deep layer with S>8psu		
Eastward transport	35.7 x 10^3 m^3/s	24.0 x 10^3 m^3/s
Westward transport	11.7 x 10^3 m^3/s	21.6 x 10^3 m^3/s
Net transport	24.0 x 10^3 m^3/s	2.4 x 10^3 m^3/s
Mean current	3.8 cm/s (eastward)	0.5 cm/s (eastward)

Fig. 20. Transport of the inflow waters in the Slupsk Channel. April 2003.



	Baroclinic geostrophic calculations	ADCP measured transport
Entire water column		
Eastward transport	9.7 x 10^3 m^3/s	50.8 x 0^3 m^3/s
Westward transport	260.3 x 10^3 m^3/s	111.2 x 10^3 m^3/s
Net transport	- 250.6 x 10^3 m^3/s	- 60.3 x 10^3 m^3/s
Mean current	-10.1 cm/s (westward)	-2.5 cm/s (westward)
Deep layer with S>8psu		
Eastward transport	9.6 x 10^3 m^3/s	37.3 x 10^3 m^3/s
Westward transport	16.3 x 10^3 m^3/s	8.3 x 10^3 m^3/s
Net transport	- 6.7 x 10^3 m^3/s	30.3 x 10^3 m^3/s
Mean current	-1.1 cm/s (westward)	6.6 cm/s (eastward)

Fig. 21. Transformation of water masses during succeeding stages of inflow in 2003 – Borbholm Basin.

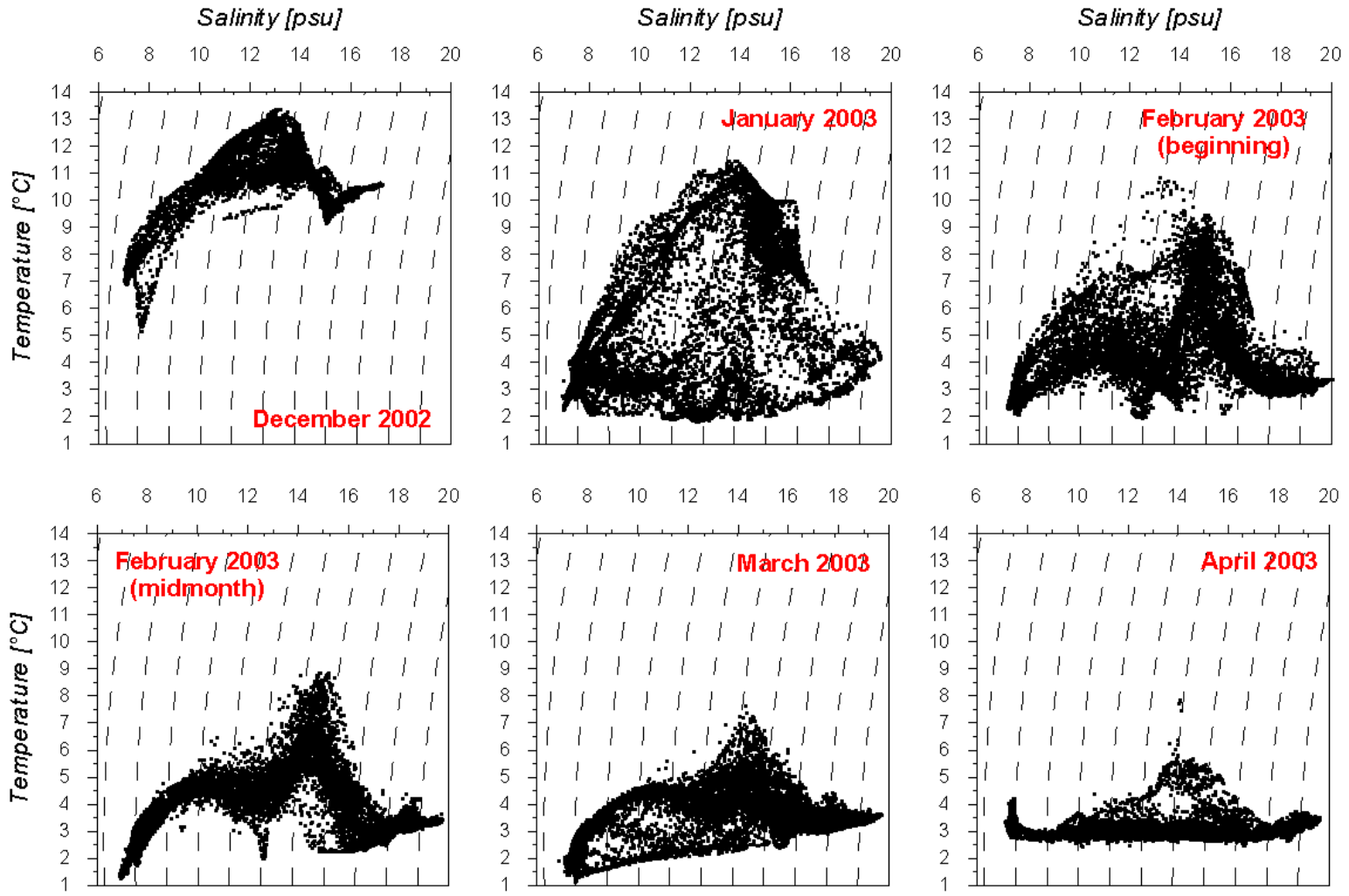


Fig. 22. Transformation of water masses during succeeding stages of inflow in 2003 – Slupsk Channel.

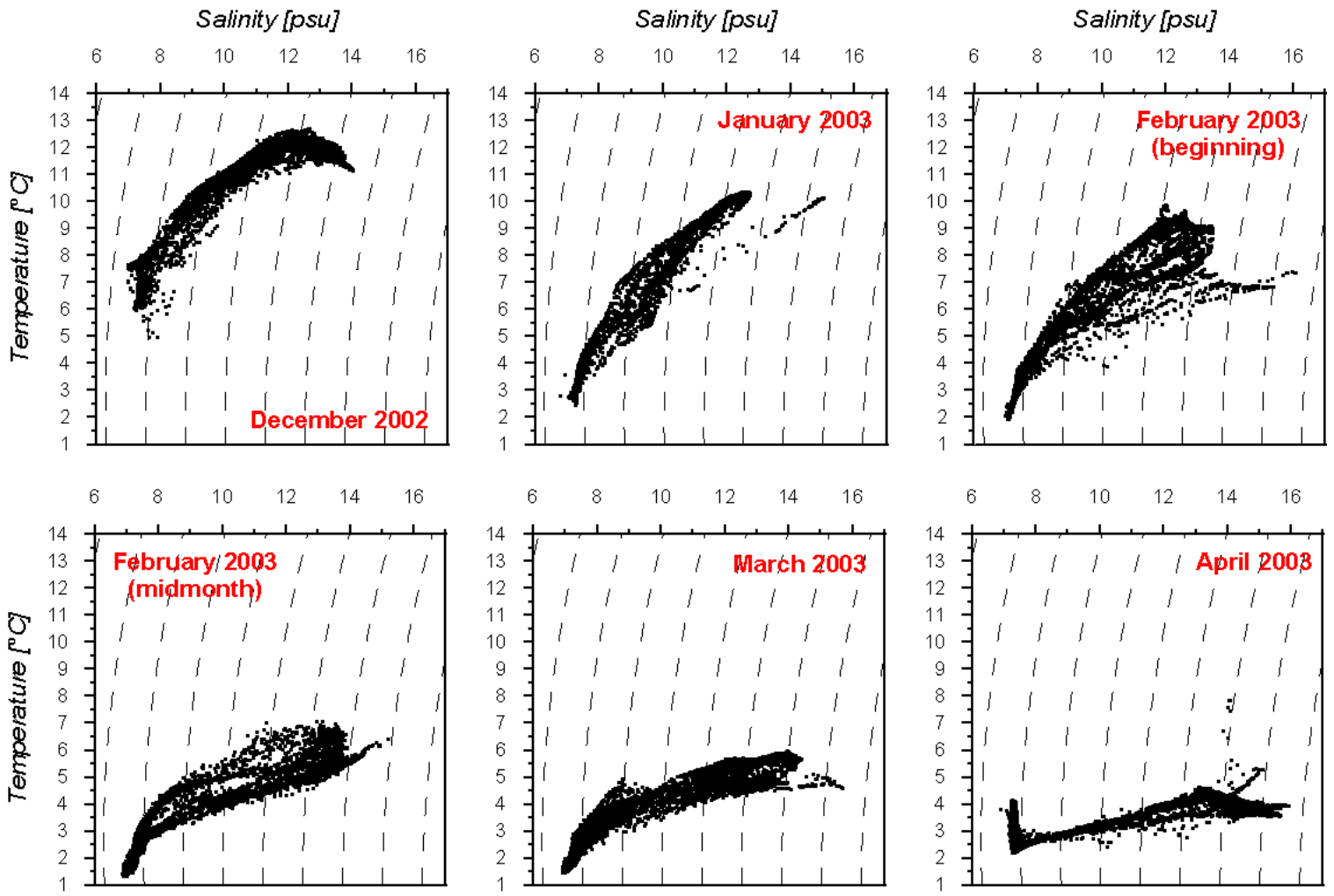
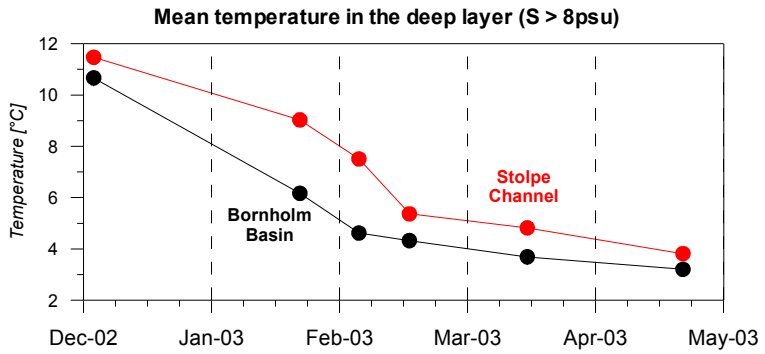
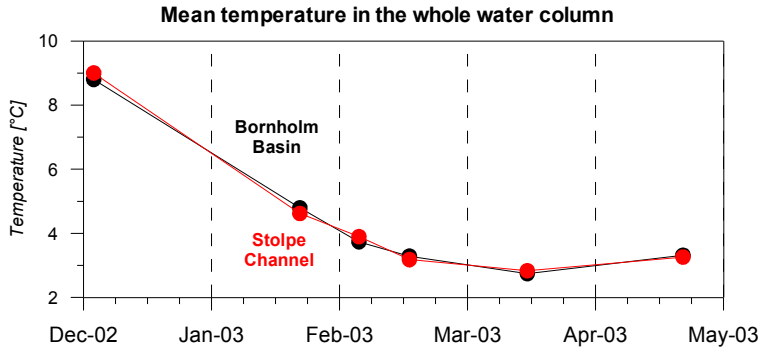
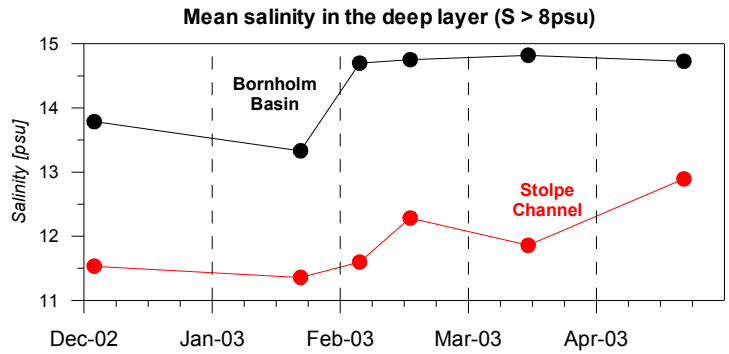


Fig. 23. Time lag of the inflow waters downstream transport.







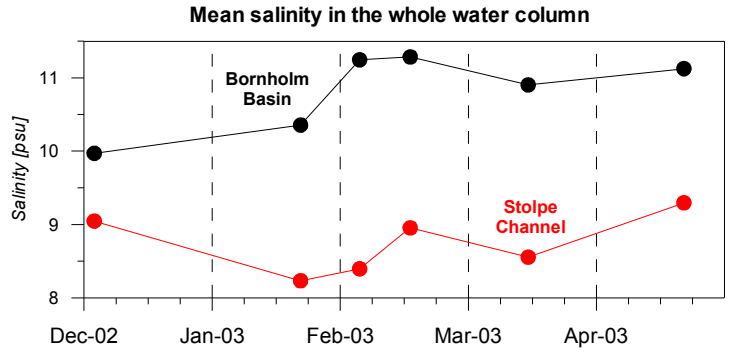
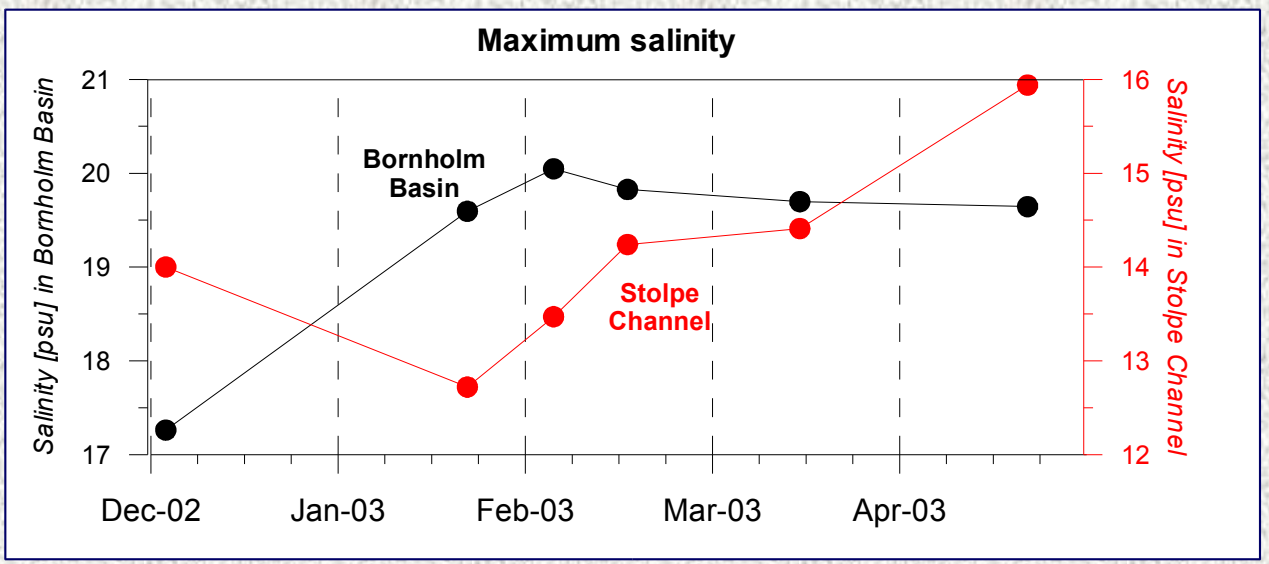


Fig. 24. Time lag of the inflow water downstream transport.



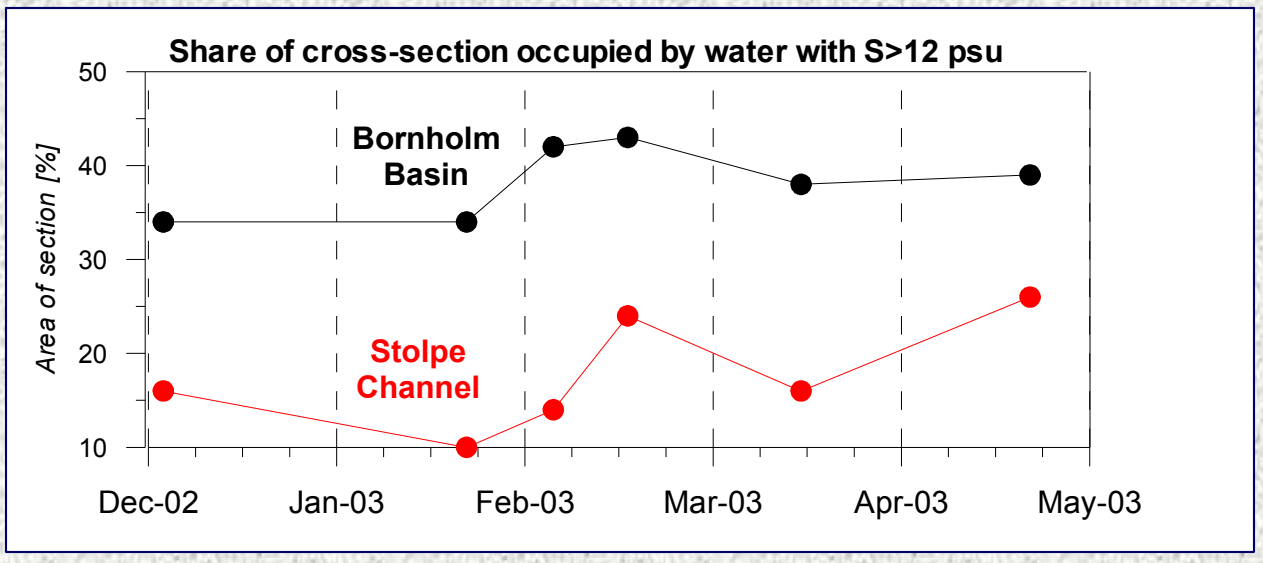


Fig. 25. Temperature changes along the Main Transect. December 2002 – August 2003.

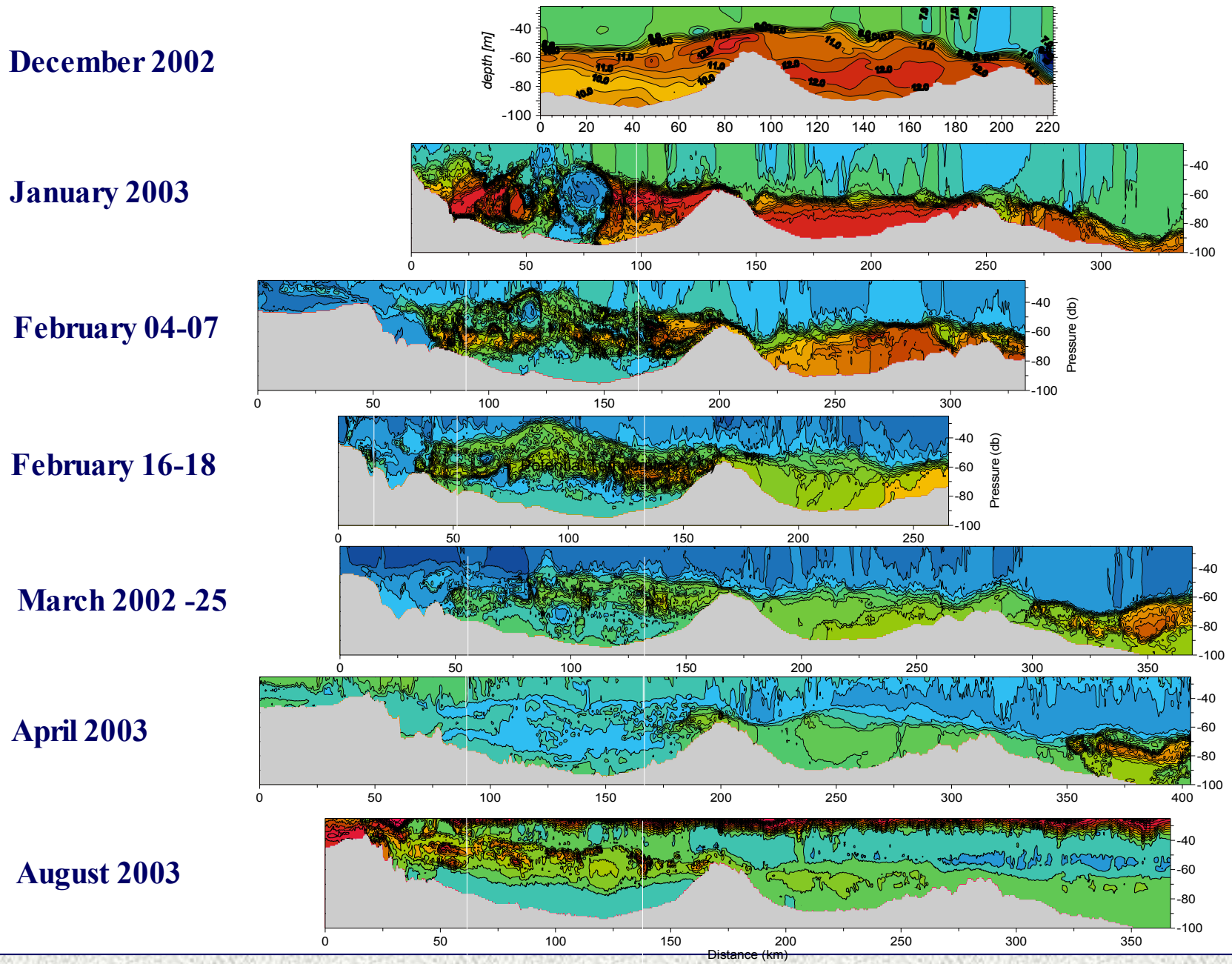


Fig. 26. Salinity changes along the Main Transect. December 2002 – August 2003.

December 2002

January 2003

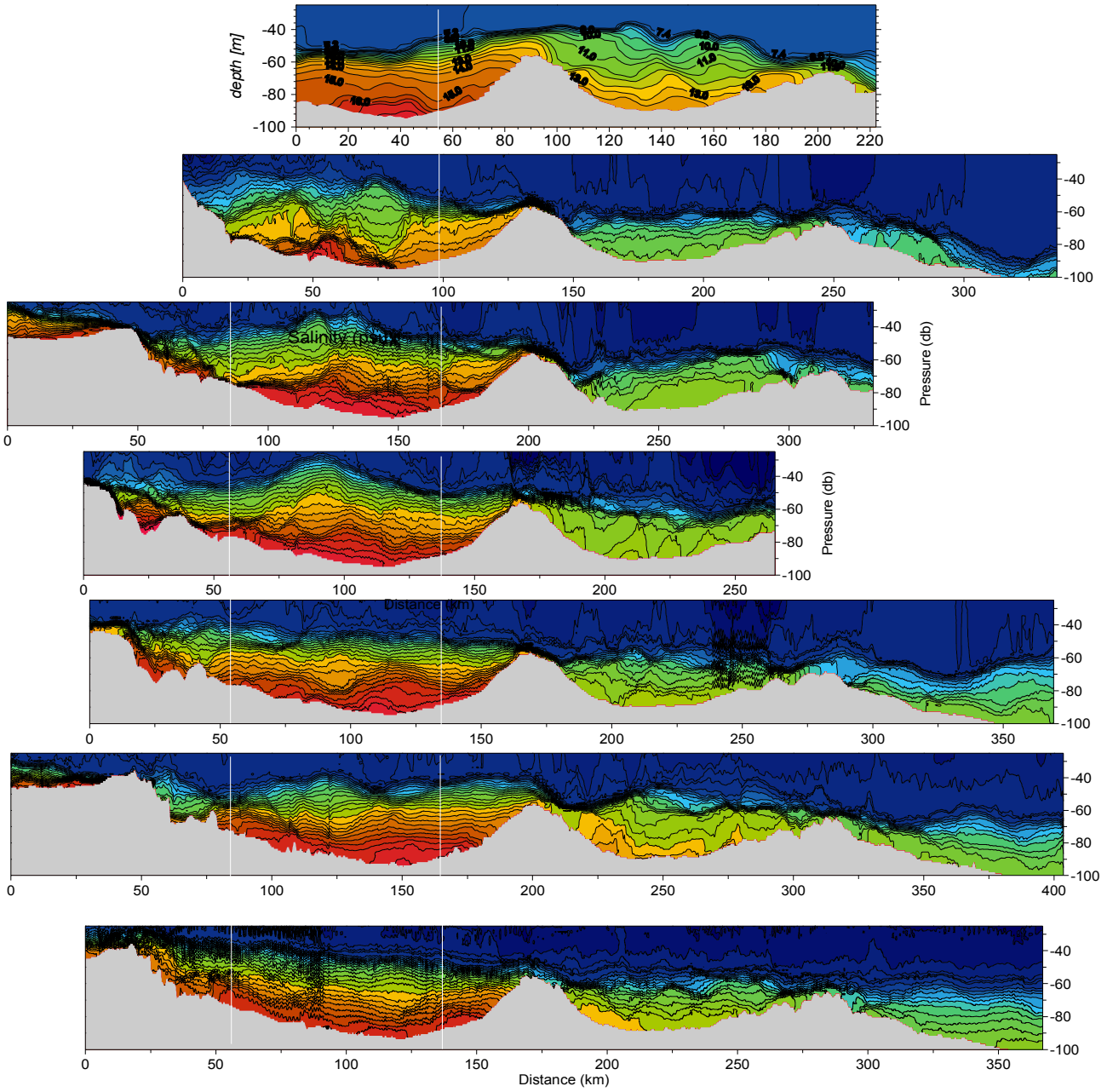
February 04-07

February 16-18

March 2002 -25

April 2003

August 2003



CONCLUSIONS

- In January 2003 we have witnessed exceptionally interesting feature: the medium size inflow bringing about 200 km^3 of highly saline, and exceptionally cold water into the deep layer of exceptionally warm waters.
- Inflow waters moved exceptionally fast into the Arkona Basin and through the Bornholm Gate into the Bornholm Basin: estimated speed would be about 30 cm/s.

- Flow of inflow waters was disturbed by frequent baroclinic eddies, particularly numerous in the Bornholm Deep.
- Bornholm Basin was the main area of mixing of cold inflow waters with the local warm waters

- To the east of Bornholm Basin no "pure" inflow waters were seen, mixed waters only.

- Inflow pushed ambient waters upwards by 20-30m, thus the volume of the inflow grew considerably by entrainment and mixing.
- As a consequence of the inflow more saline and colder, mixed waters from the intermediate layers of the Bornholm Deep were flowing to the Słupsk Furrow over the Słupsk Sill
- Intensive heat exchange through the thermal conductivity was observed in spite of strong density stratification.

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