



# **Ocean Water Masses-Intermediate, Deep and Bottom Waters**

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General Physical Oceanography

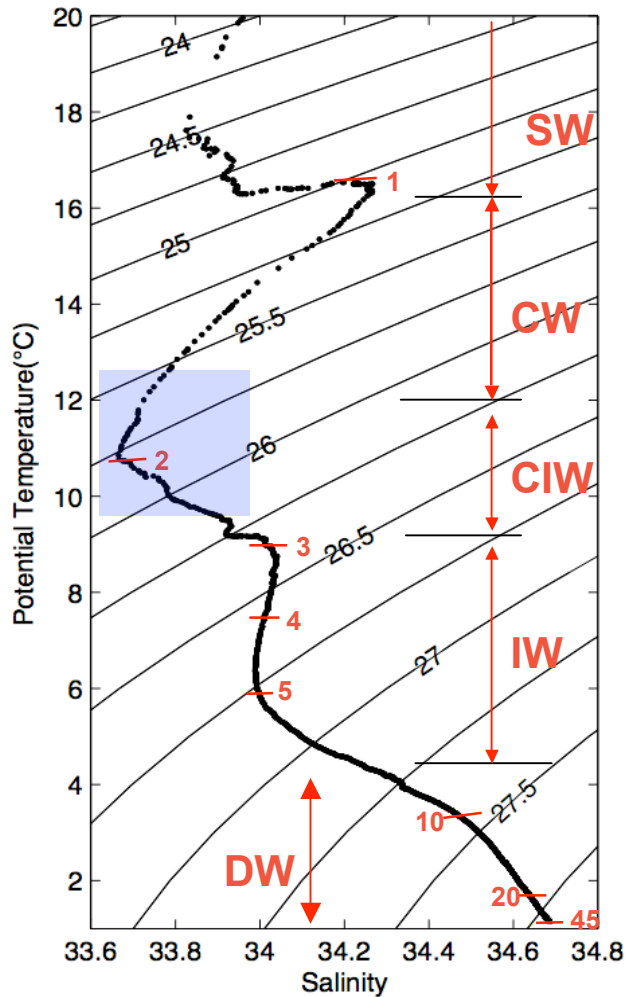
MAR 555

School for Marine Sciences and Technology

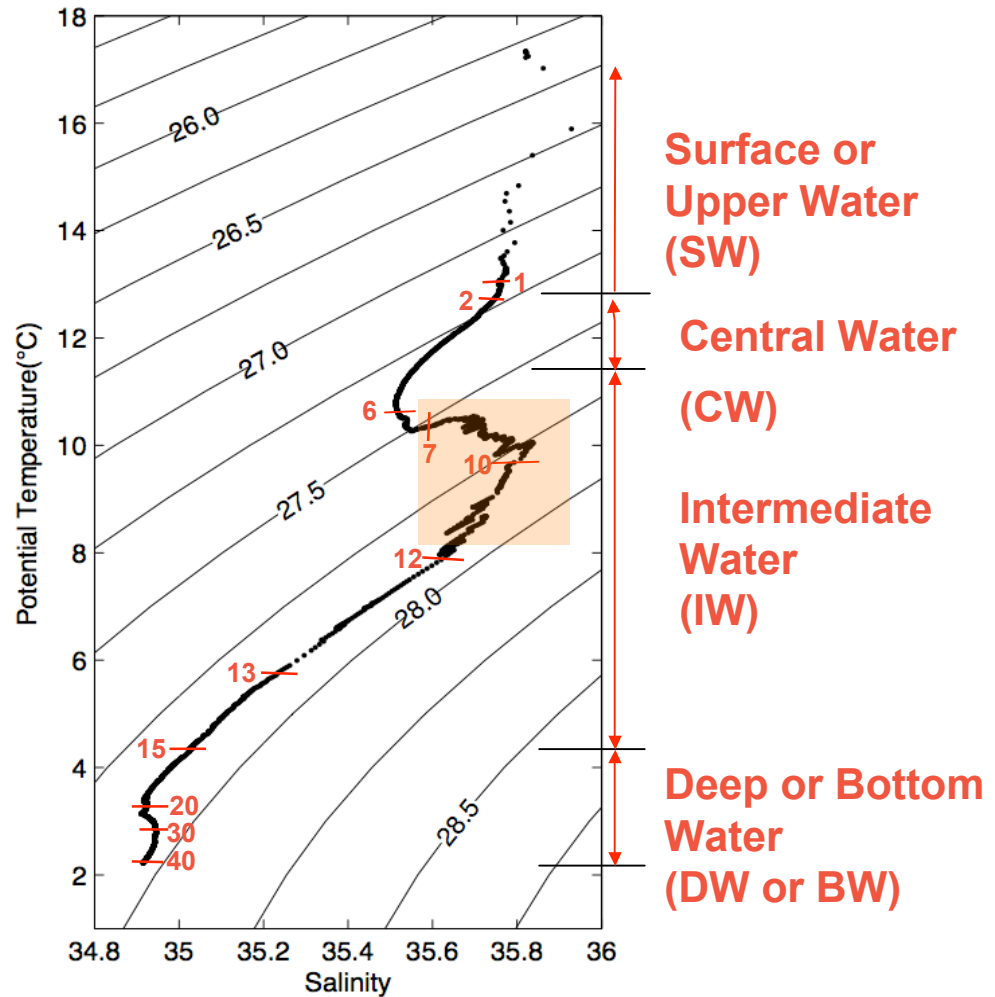
Umass-Dartmouth

# MAR 555 Lecture 11: Ocean Water Masses-Intermediate, Deep and Bottom Waters

East Pacific Ocean



East Atlantic Ocean

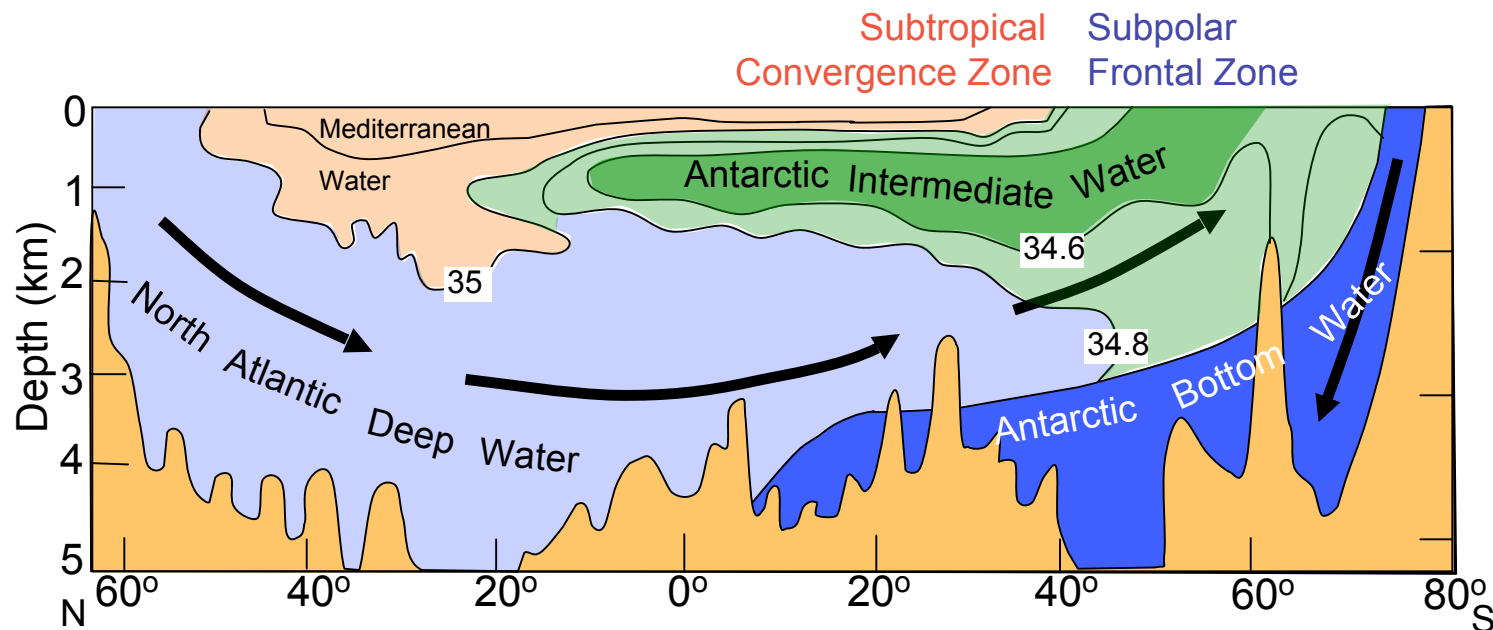


**CIW**-California Intermediate Water: **low salinity**

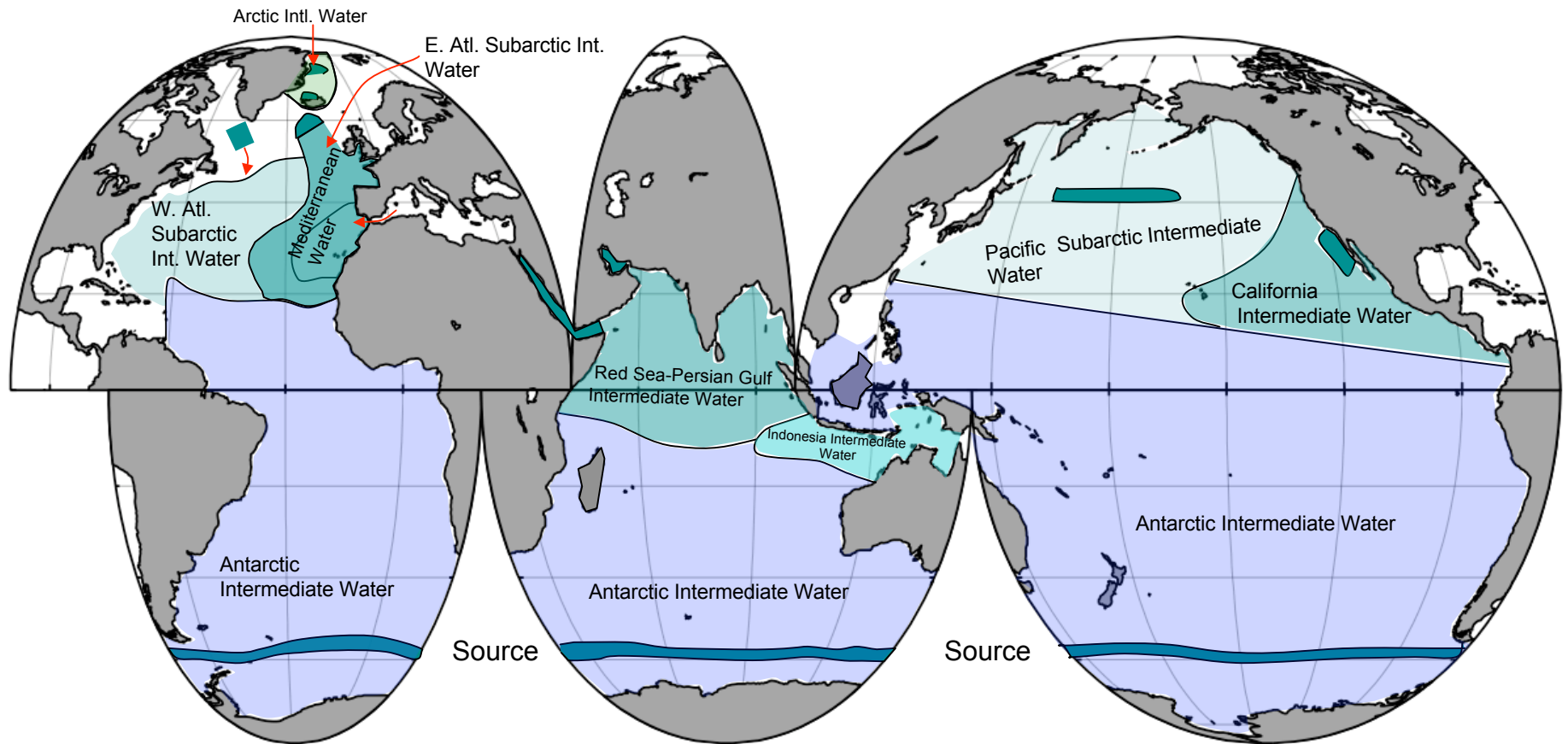
**MIW**-Mediterranean Intermediate Water: **high salinity**

## Formation of Intermediate Waters

1. Form in subpolar region where precipitation exceeds evaporation, so it is characterized by low-temperature and low-salinity
2. Sinking of the relatively denser water at the surface in subpolar convergence zone. Since the salinity of this water is relatively low, it only stays in the depth region below the central water and above the deep and bottom water



# Intermediate Water Masses

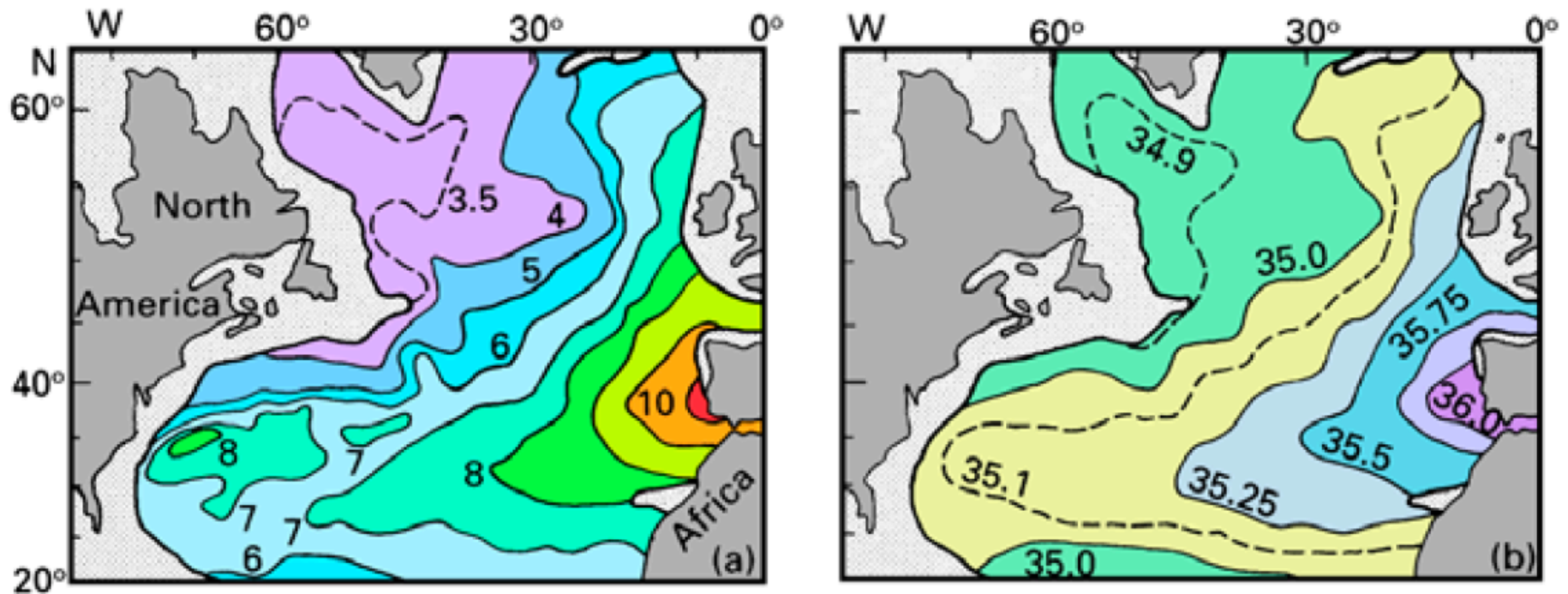


**Characteristics:** low-salinity and low temperature

**Depth range:** 550-1500 m (California Int. Water ~ 200 m)

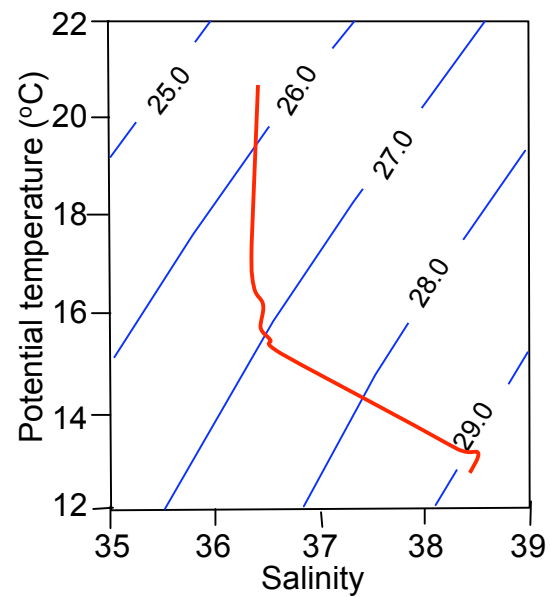
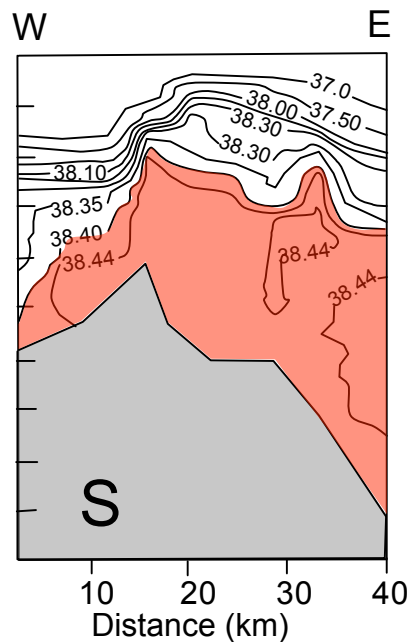
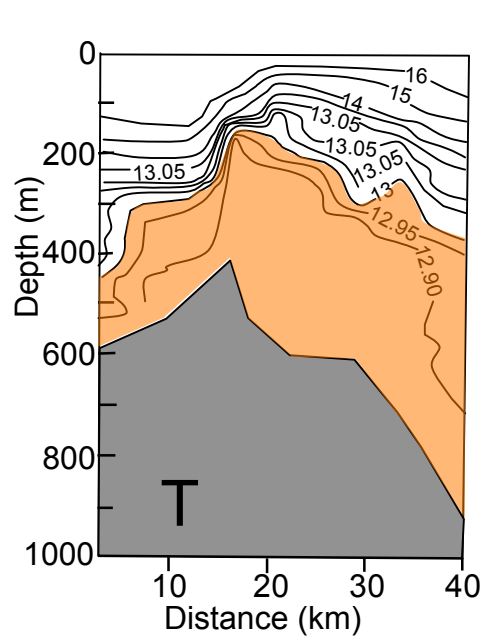
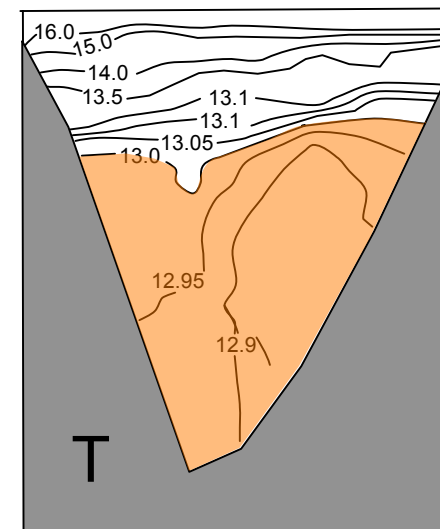
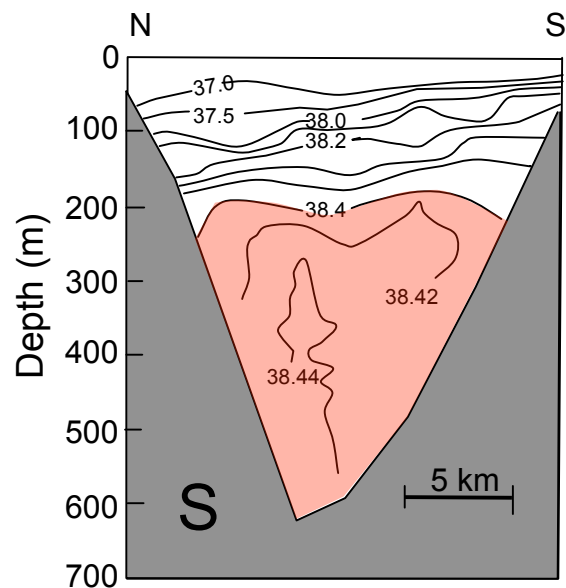
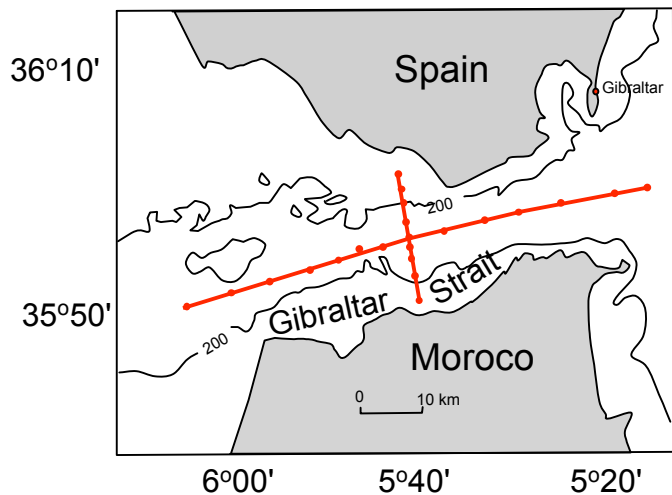
Atlantic Ocean	Pacific Ocean	Indian Ocean
Arctic Intermediate Water ( <b>AIW</b> ) <b>T: -1.5-3.0°C</b> <b>S: 34.7-34.9 PSU</b>	Pacific Subarctic Intermediate Water ( <b>PSIW</b> ) <b>T: 5.0-12.0°C</b> <b>S: 33.8-34.3 PSU</b>	Indonesian Intermediate Water ( <b>IIW</b> ) <b>T: 3.5-5.5°C</b> <b>S: 34.6-34.7 PSU</b>
East Atlantic Subarctic Intermediate Water ( <b>EASIW</b> ) <b>T: 3.0-9.0°C</b> <b>S: 34.4-35.3 PSU</b>	California Intermediate Water ( <b>CIW</b> ) <b>T: 10.0-12.0°C</b> <b>S: 33.9-34.4 PSU</b>	Red Sea-Persian Gulf Intermediate Water ( <b>RSPGIW</b> ) <b>T: 5.0-14.0°C</b> <b>S: 34.8-35.4 PSU</b>
West Atlantic Subarctic Intermediate Water ( <b>WASIW</b> ) <b>T: 3.0-9.0°C</b> <b>S: 34.0-35.1 PSU</b>	Eastern South Pacific Intermediate Water ( <b>ESPIW</b> ) <b>T: 10.0-12.0°C</b> <b>S: 34.0-34.4 PSU</b>	Antarctic Intermediate Water ( <b>AAIW</b> ) <b>T: 2.0-10.0°C</b> <b>S: 33.8-34.8 PSU</b>
Mediterranean Water ( <b>MW</b> ) <b>T: 2.6-11.0°C</b> <b>S: 35.0-36.2 PSU</b>	Antarctic Intermediate Water ( <b>CDW</b> ) <b>T: 2.0-10°C</b> <b>S: 33.8-34.5 PSU</b>	
Antarctic Intermediate Water ( <b>AAIW</b> ): <b>T: 2.0-6.0°C</b> <b>S: 33.8-34.8 PSU</b>		

The Distributions of Water Temperature and Salinity of the Intermediate Water in North Atlantic Ocean influenced by the Mediterranean output



Download from the web source

# Gibraltar Strait

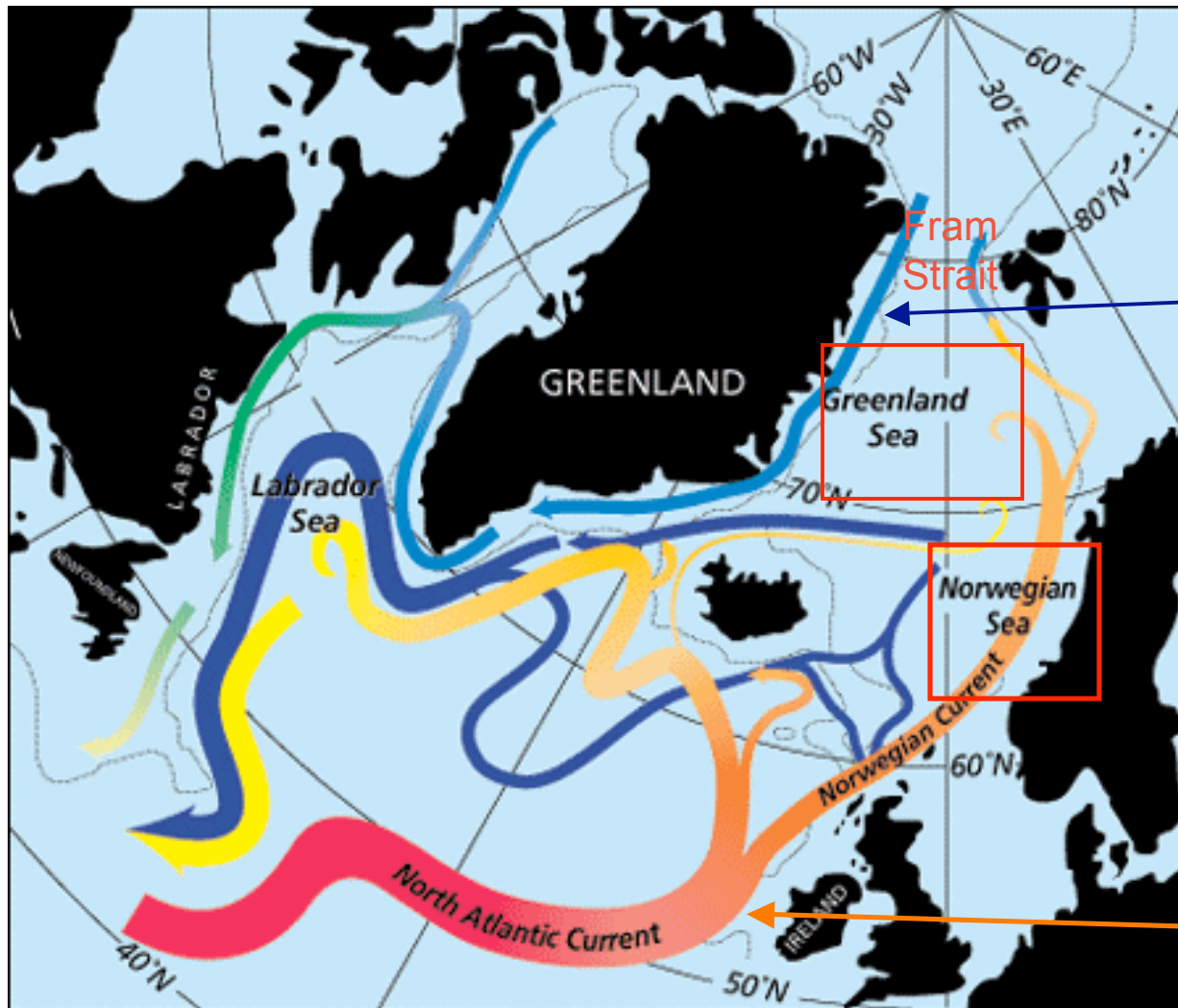


## Deep and Bottom Waters

Atlantic Ocean	Pacific Ocean	Indian Ocean
<p>North Atlantic Deep Water (<b>NADW</b>)  <b>T: -1.5-4.0°C</b>  <b>S: 34.8-35.0 PSU</b></p>	<p>Circumpolar Deep Water (<b>CDW</b>)  <b>T: 0.1-2.0°C</b>  <b>S: 34.62-34.73 PSU</b></p>	<p>Circumpolar Deep Water (<b>CDW</b>)  <b>T: 0.1-2.0°C</b>  <b>S: 34.62-34.73 PSU</b></p>
<p>Antarctic Bottom Water (<b>AABW</b>)  <b>T: -0.9-1.7°C</b>  <b>S: 34.64-34.72 PSU</b></p>	<p>Antarctic Bottom Water (<b>AABW</b>)  <b>T: -0.9-1.7°C</b>  <b>S: 34.64-34.72 PSU</b></p>	<p>Antarctic Bottom Water (<b>AABW</b>)  <b>T: -0.9-1.7°C</b>  <b>S: 34.64-34.72 PSU</b></p>
<p>Arctic Bottom Water Intermediate Water (<b>ABW</b>)  <b>T: -1.8-(-10.5°C)</b>  <b>S: 34.88-34.94 PSU</b></p>		



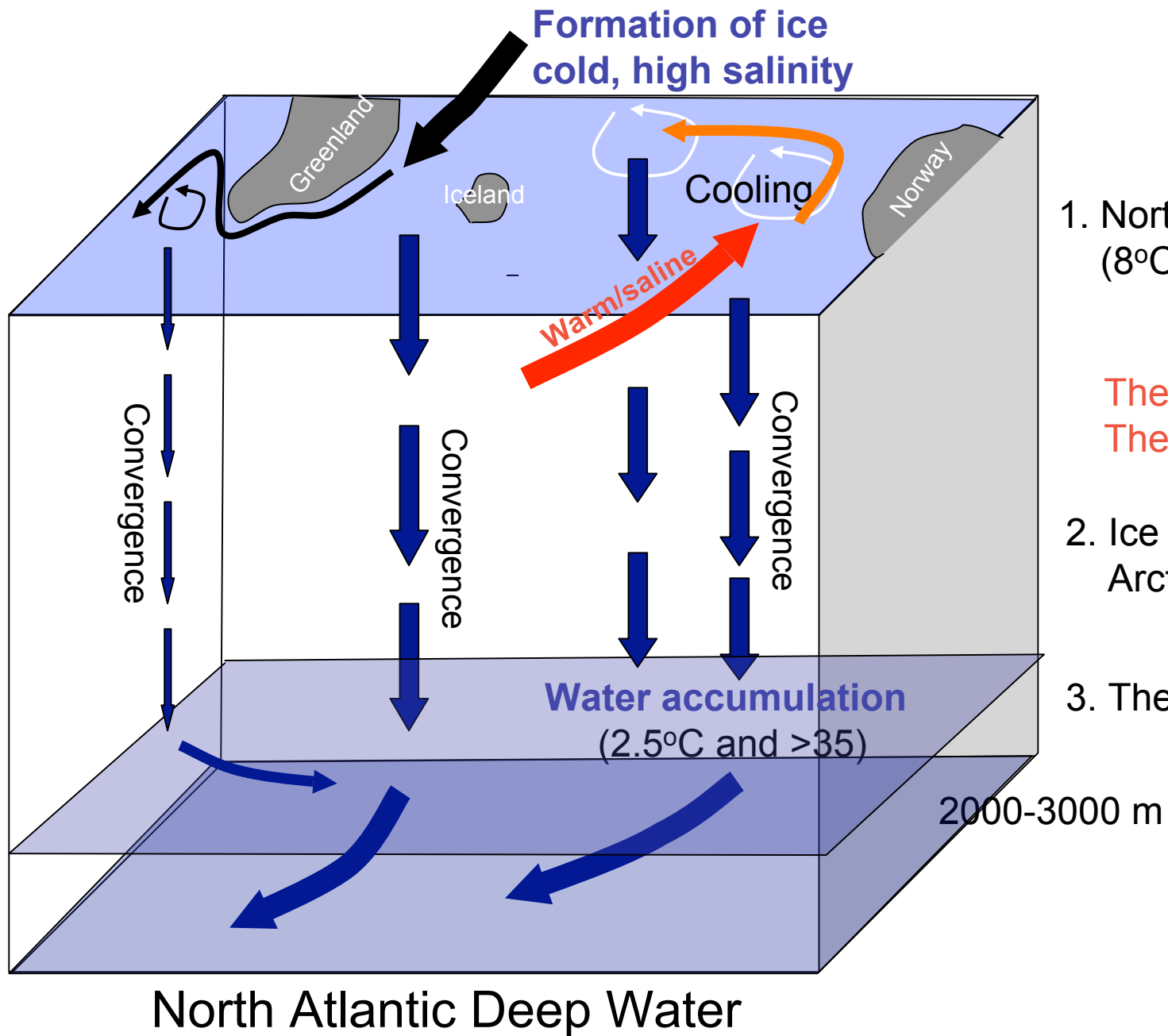
# North Atlantic Deep Water (NADW)



Low temperature  
high salinity

Cool and sink  
In Norwegian  
and Greenland  
Sead

Warm and  
high salinity



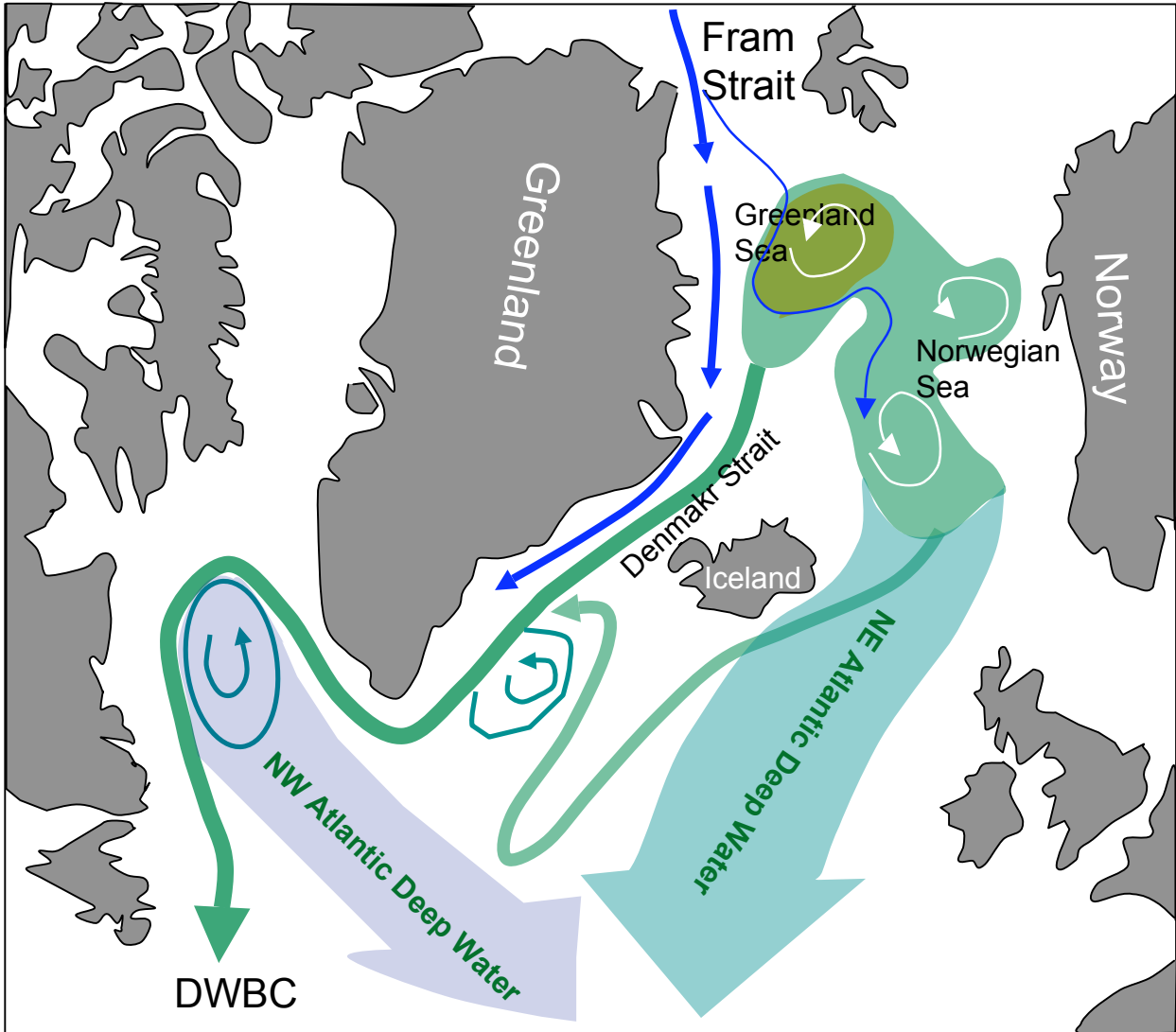
1. North Atlantic Current  
(8°C and 35.25)



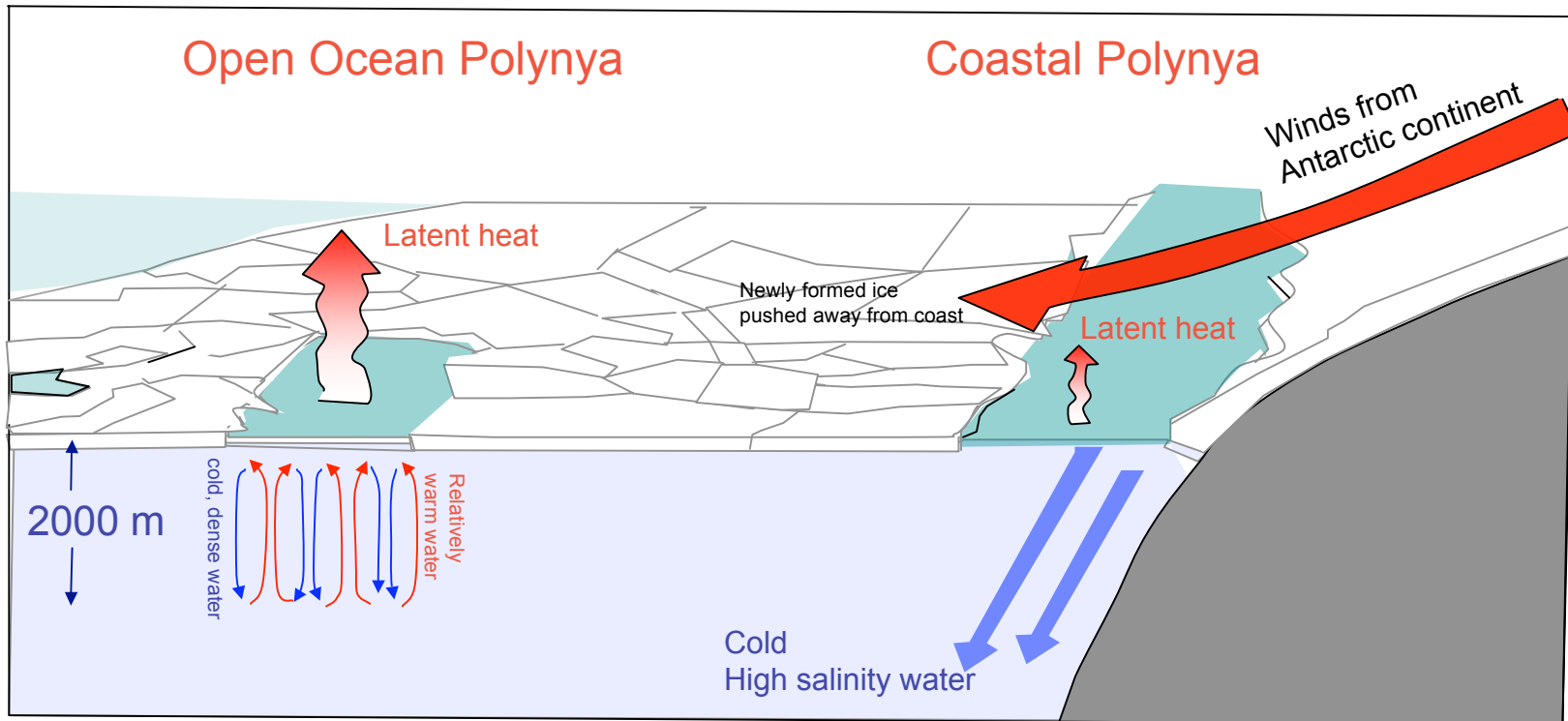
The Norwegian Sea  
The Greenland Sea

2. Ice formation in the  
Arctic Ocean

3. The Labrador Sea

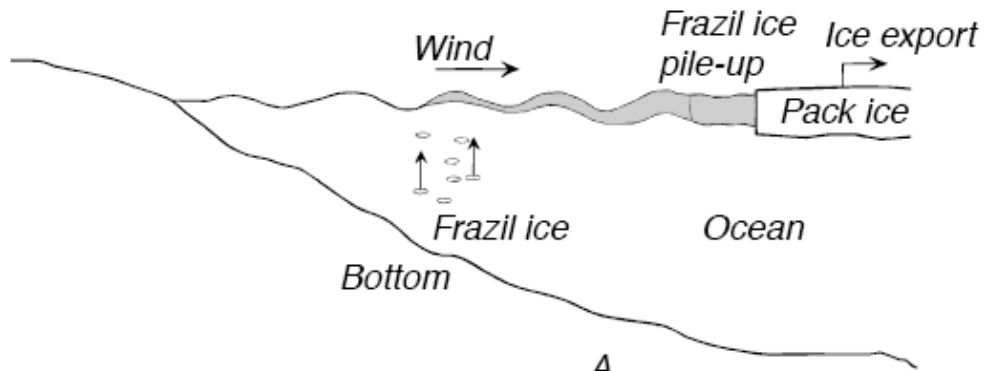


# Formation of the Antarctic Bottom Water

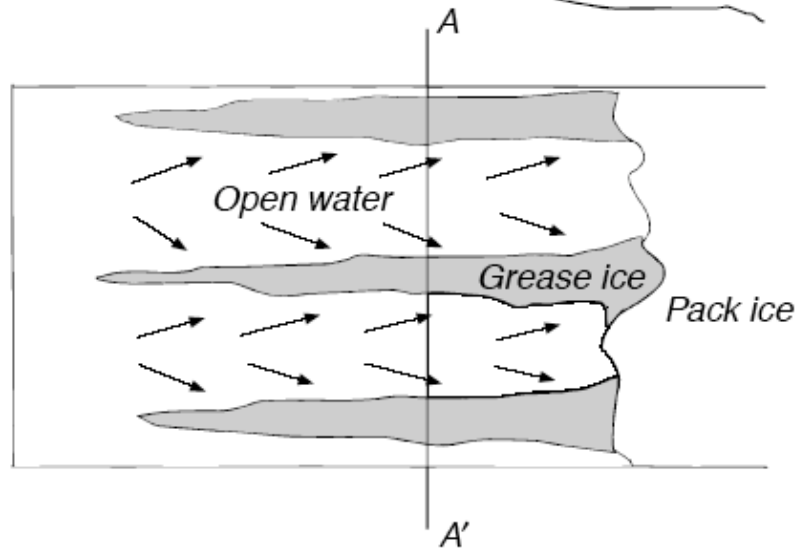


“Polynya” is a Russian word meaning “an enclosed area of unfrozen water surrounded by ice”

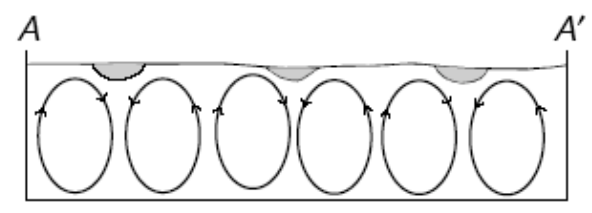
# Schematic of the physical process in a coastal polynya



Side view



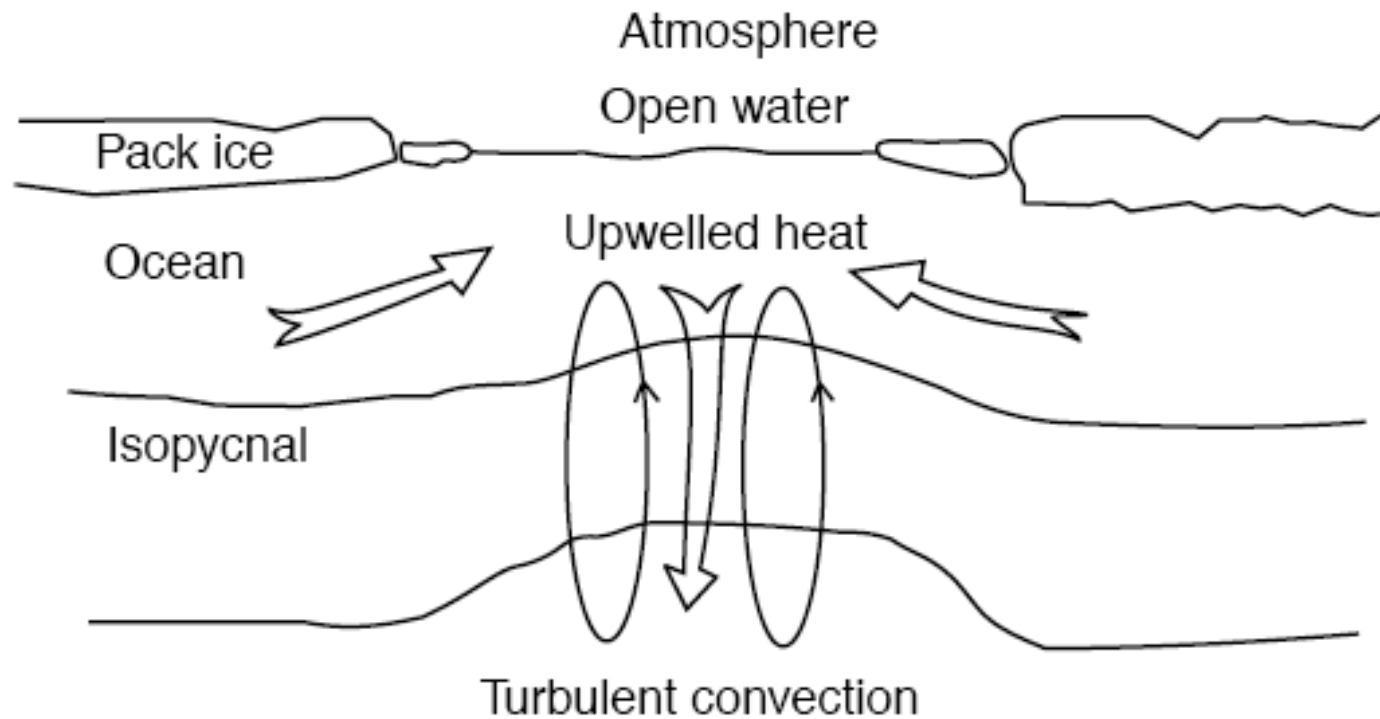
Top view



Front view

From Seelye Martin (2007)

## Open-ocean polynya mean circulation and mixing



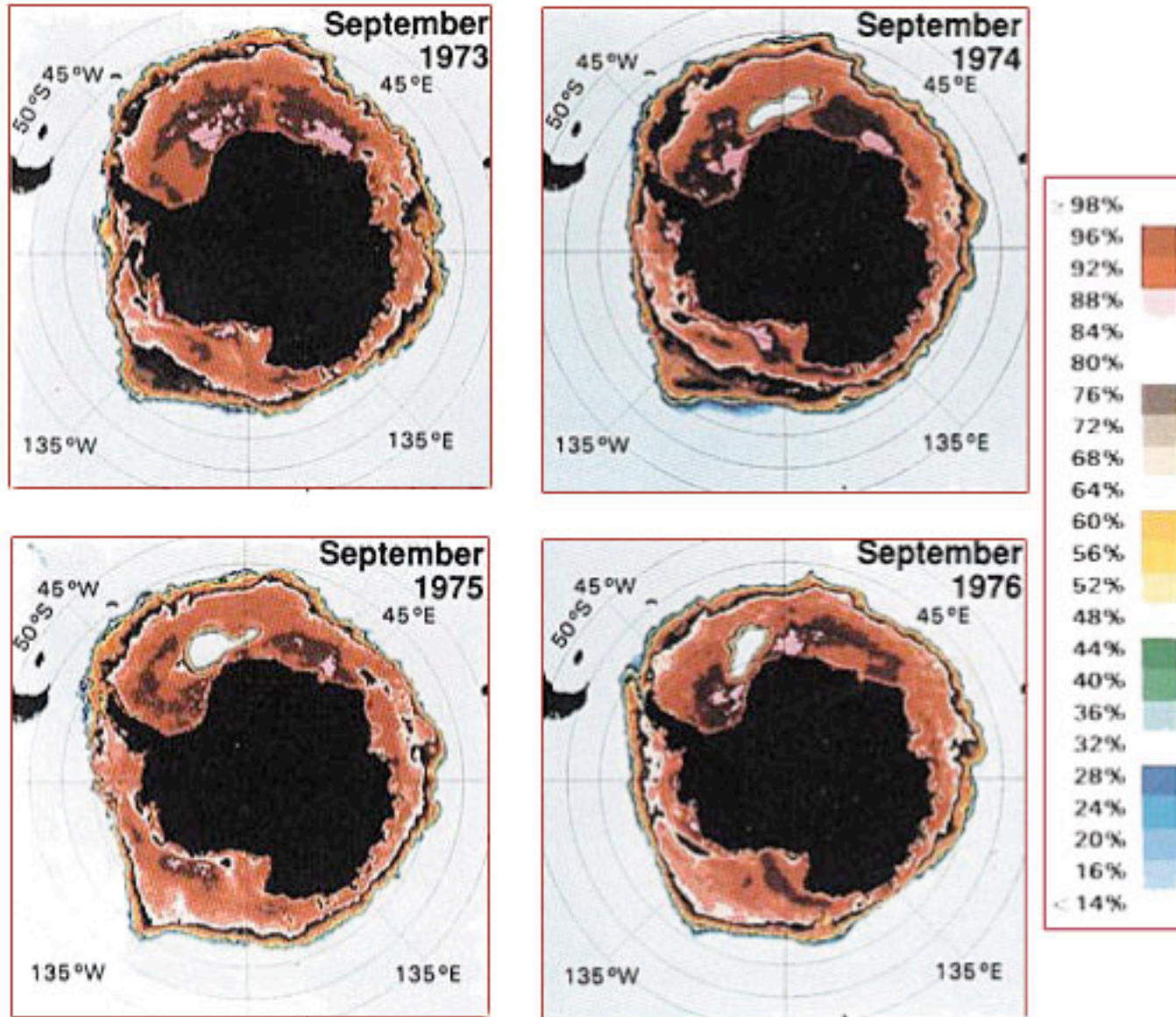
From Seelye Martin (2007)



From Seelye Martin (2007)

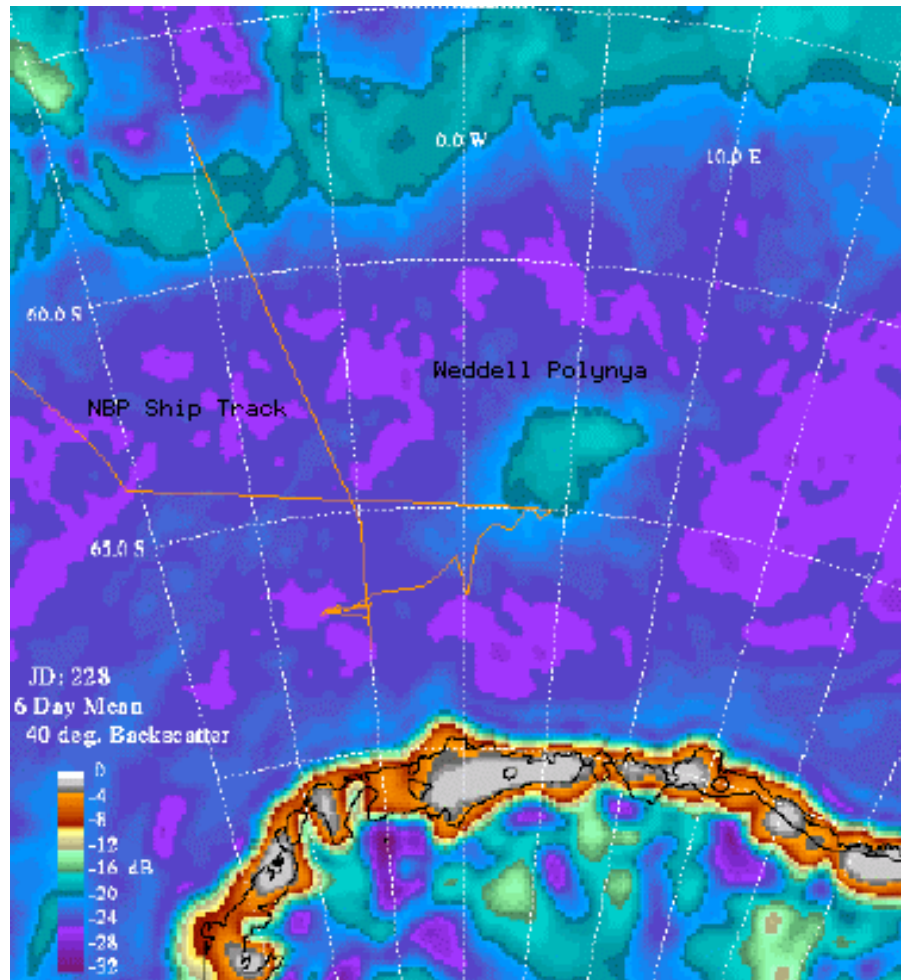


# Weddell Polyna during 1973-1976





<http://earth.esa.int/workshops/ers97/papers/drinkwater/>



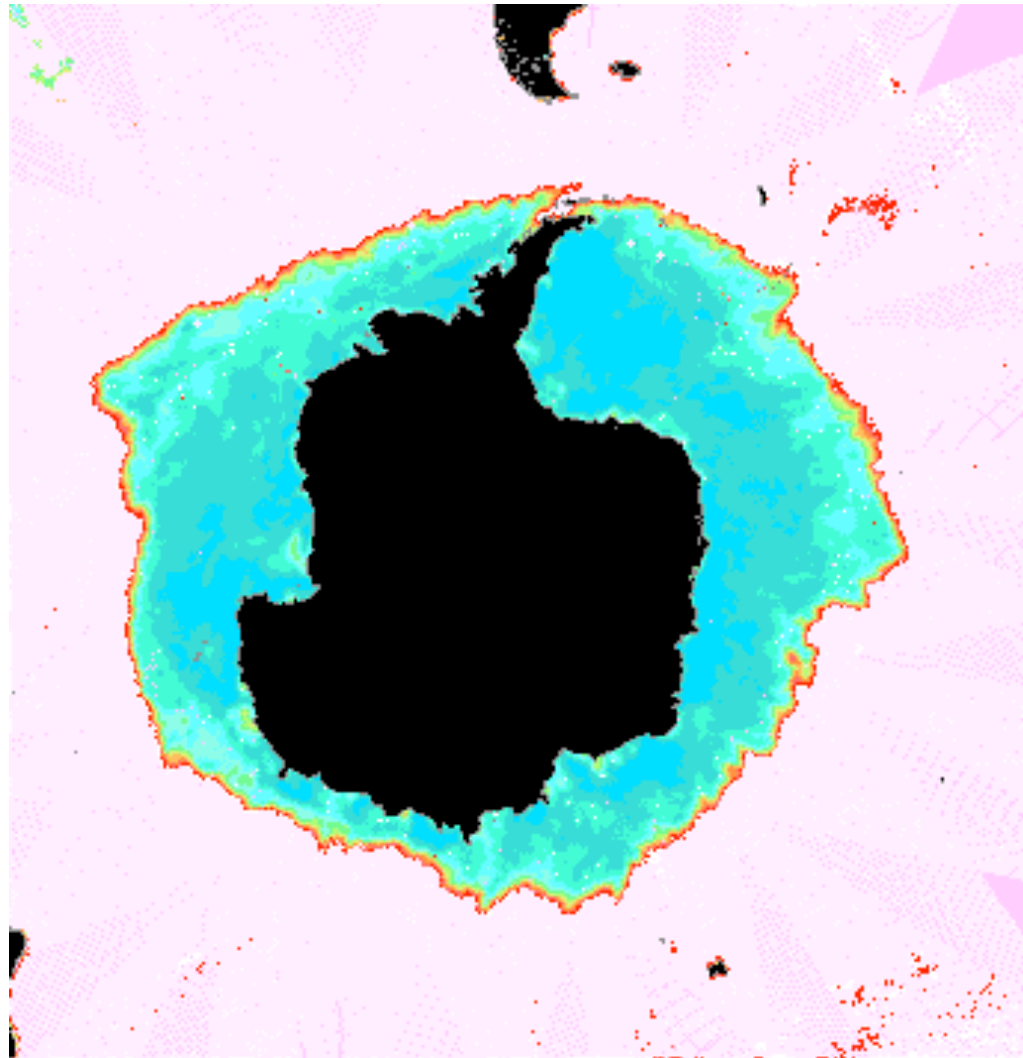
Reappearance of the Weddell Polynya in scatterometer image August 1994. The orange line indicates the cruise track of the Nathaniel Palmer during the Anzflux experiment.



A view of the Terra Nova Polynya in the western Ross Sea

Download from

<http://arise-in-antarctica.blogspot.com/>



<http://polar.ncep.noaa.gov/seaice/Weddell.html>

# Global distribution of NADW and AABW

