Activity #8 - Finding the Deep Water Masses of the Atlantic Ocean

Concepts # 4, 7, & 8

#4 The ocean is one continuous body of water with global currents that interact, with water surrounding all landforms.
#7 Water density is affected by temperature and salinity, resulting in deep water currents.
#8 At the poles very cold, salty water sinks to the ocean bottom and flows toward the equator.

Objective:

Students will be able to describe the role of density in driving deep ocean currents and the density layers of the ocean.

Materials:

- water masses data table
- temperature - density - salinity graph
- water masses worksheet (on cross section of the Atlantic)
- Atlantic ocean map and cross section

Procedure:

1. Complete the Water Masses Worksheet and Water Masses Data Table as instructed.
2. Start by matching the temperature and salinity for each water mass to find the density (σ_t) using the Temperature-Density-Salinity graph. Record these densities on your Water Masses Worksheet (Cross Section of the Atlantic Ocean).
2. Next, on the Water Masses Data Table, match the latitude, temperature and salinity to find the density (σ_t) and the name of each water mass.
3. Last, fold the page with the Atlantic Ocean Map and Atlantic Ocean Cross Section 90^O to get a three dimensional view of the water masses and their origins. This will help you answer the Evaluation questions on the next page.

Key to Water Mass Abbreviations:

NADW = North Atlantic Deep Water
SW = Surface Water
AABW = Antarctic Bottom Water
MI = Mediterranean Intermediate
AAIW = Antarctic Intermediate Water

Evaluation:

- If a person had a very long fishing line, why might it be possible to catch an Antarctic species of shark while fishing at the Equator?
- Wind driven surface currents travel at approximately one kilometers per hour, while density driven deep ocean currents travel much slower, about one meter per hour. How long would it take Antarctic Bottom Water to travel to the North Atlantic sample site at 45^{O}N, approximately 9,000 km from its Antarctic source area?
- What relationships can you describe between water temperature and salinity at the 0^{O} sample site?
- What happens to the water density at the 45^{O}N sample site?
- From the Temperature-Density-Salnity Graph, what happens to the density of seawater at temperature increases? As the temperature decreases the density of the seawater does what?
- What factor(s) increase sea surface water density at high latitudes ?
- What factor(s) cause the density of the surface water in the low latitude regions to increase?
- Explain why density driven circulation in the ocean depths is caused by the interaction of the atmosphere and the ocean.
- Why is the sun considered the source of energy for driving the density circulation in ocean depths? Explain

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WATER MASSES DATA TABLE

Station Code	Latitude	Depth m	Temp ^{o}C	Salinity $^{o}/_{oo}$	Density s_t	Water Mass
A	0^{o}	400	25	36.6		
B	0^{o}	1000	5	34.4		
C	0^{o}	2500	3	34.9		
D	0^{o}	4100	0.5	34.8		
E	$50^{o}S$	2000	4	34.9		
F	$50^{o}S$	4800	0.5	34.8		
G	$45^{o}N$	250	13	36.5		
H	$45^{o}N$	900	10	35.5		
I	$45^{o}N$	4100	2	34.9		
J	$45^{o}N$	4700	0.5	34.8		

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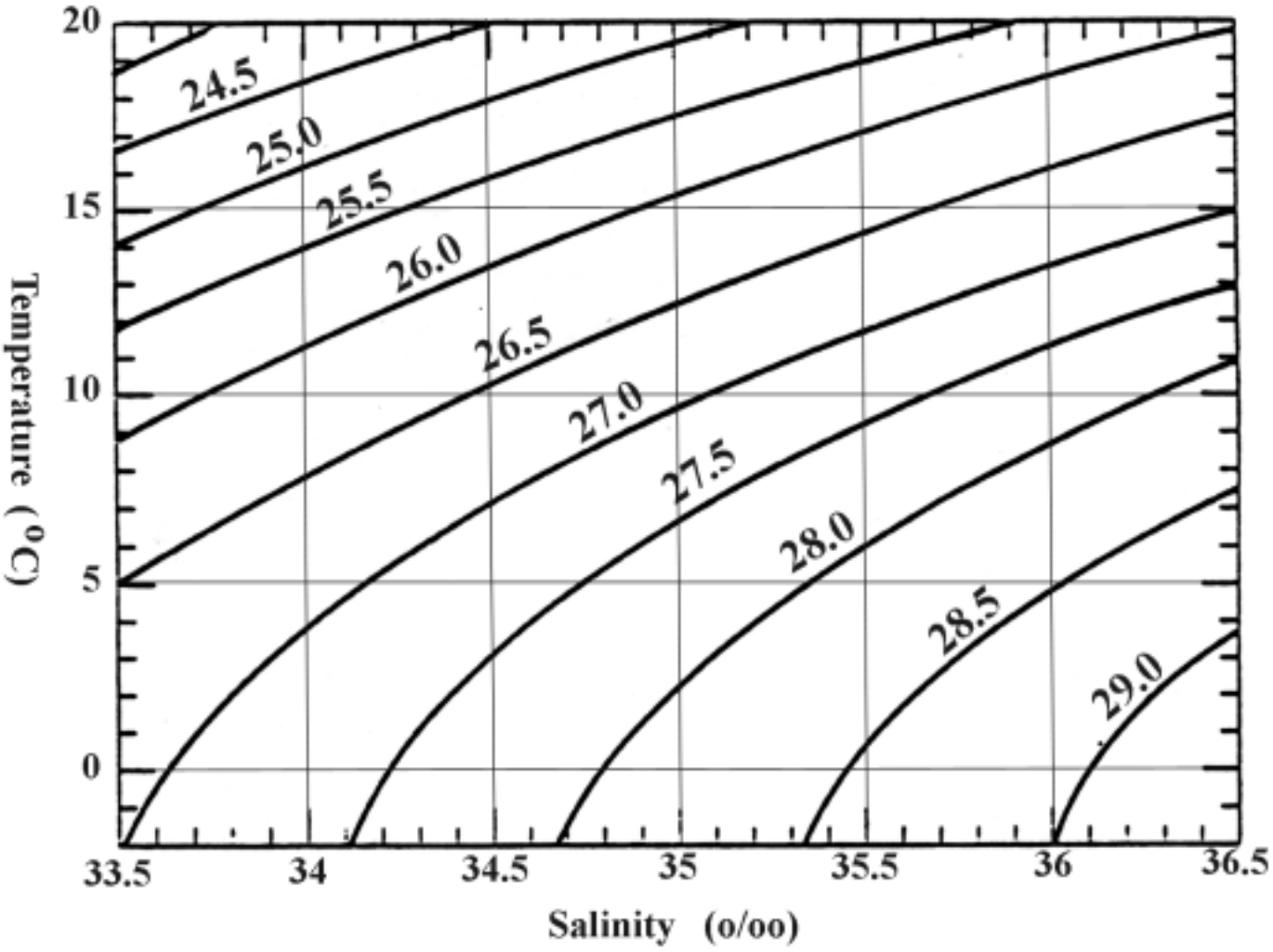
TEMPERATURE - DENSITY - SALINITY GRAPH



Lines of Density (pycnoclines) are given in S_t (sigma theta or sigma-t units).

S_t = (specific gravity in g/cm^3 - 1) x 1000

[Example: specific gravity 1.0240 g/cm^3 = S_t 24.0]

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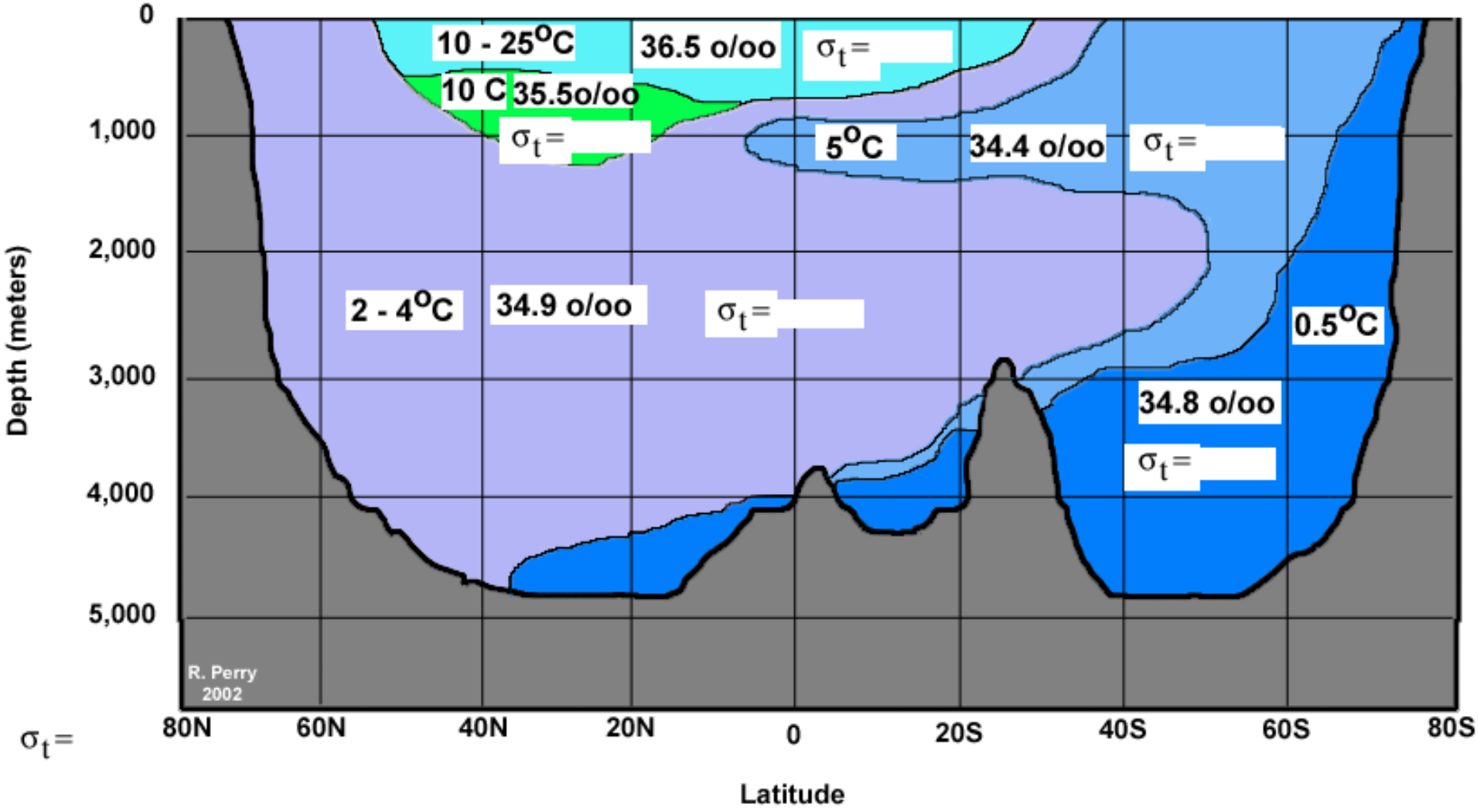
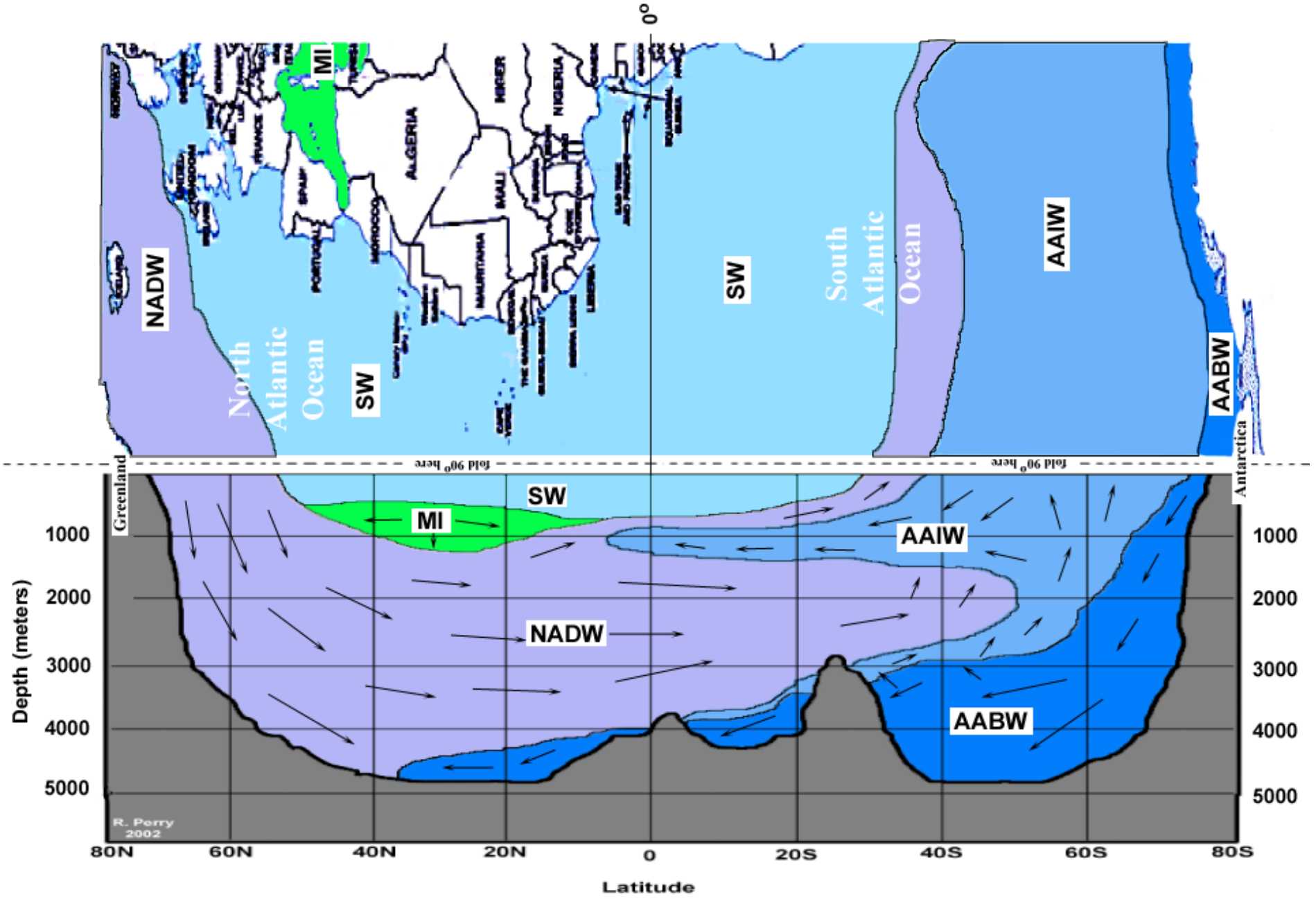
WATER MASSES WORKSHEET





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ATLANTIC CROSS SECTION & MAP