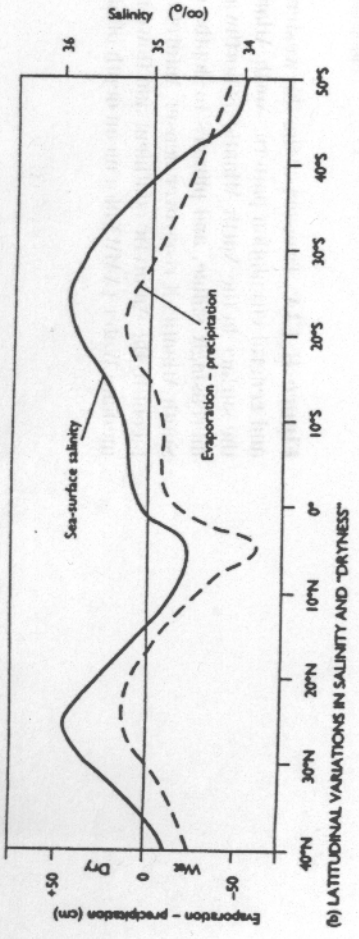
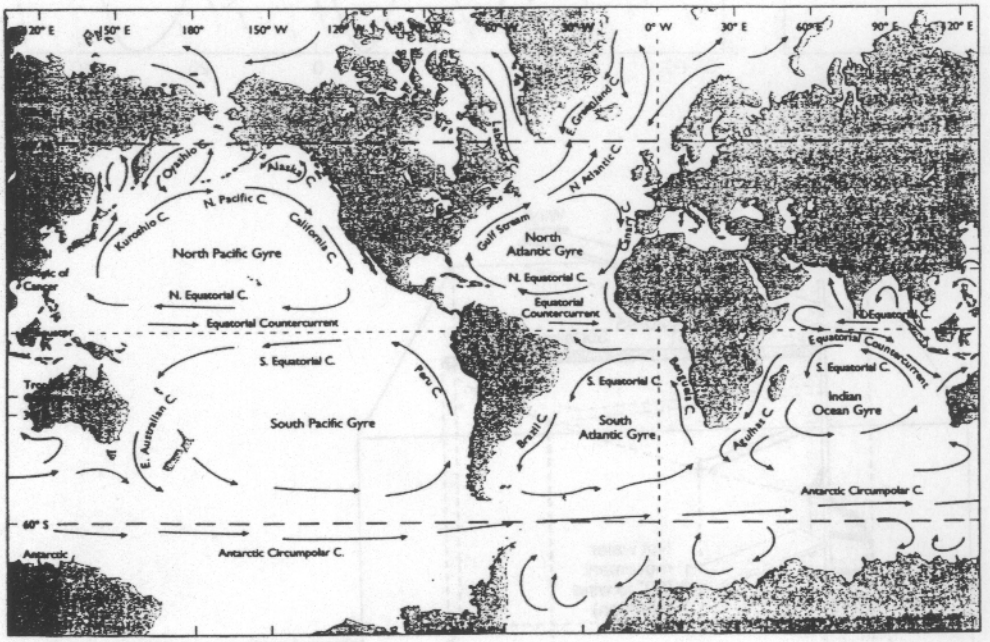
ES10 February 14 2001 **Inez Fung**

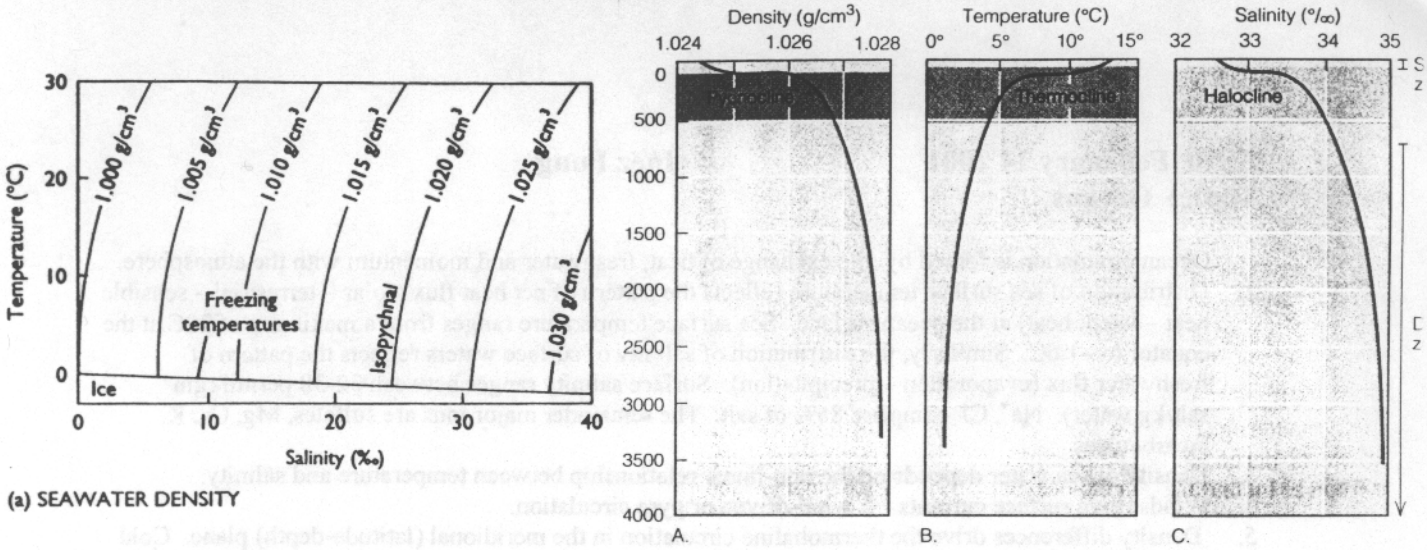
Topic: Oceans

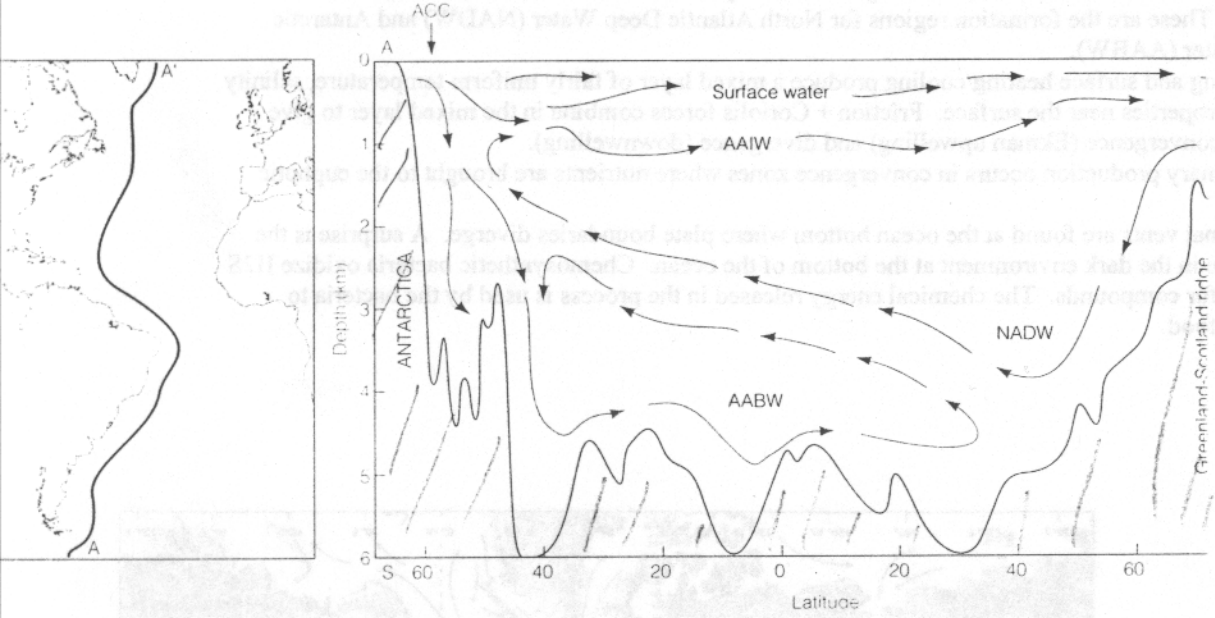
1. Ocean circulation is forced by the exchange of heat, freshwater and momentum with the atmosphere.
2. Distribution of sea surface temperature reflects the pattern of net heat flux (solar – terrestrial – sensible heat – latent heat) at the ocean surface. Sea surface temperature ranges from a maximum of 30C at the equator to –1.6C. Similarly, the distribution of salinity of surface waters reflects the pattern of freshwater flux (evaporation – precipitation). Surface salinity ranges between 32-38 permil (gm salt/kg water). Na^+, Cl^- comprise 86% of salt. The remainder major ions are sulfates, Mg, Ca, K, bicarbonates.
3. Density of sea water depends on the non-linear relationship between temperature and salinity.
4. Winds drive surface currents → wind-driven or gyre circulation.
5. Density differences drive the thermohaline circulation in the meridional (latitude-depth) plane. Cold very salty water is found in the North Atlantic; very cold salty water is found in the Wedell Sea, off the coast of Antarctica. The dense waters are gravitationally unstable and sink to depth of neutral buoyancy. These are the formation regions for North Atlantic Deep Water (NADW) and Antarctic Bottom Water (AABW).
6. Wind-stirring and surface heating/cooling produce a mixed layer of fairly uniform temperature, salinity and other properties near the surface. Friction + Coriolis forces combine in the mixed layer to give regions of convergence (Ekman upwelling) and divergence (downwelling).
7. Marine primary production occurs in convergence zones where nutrients are brought to the euphotic zone.
8. Hydrothermal vents are found at the ocean bottom where plate boundaries diverge. A surprise is the oases of life in the dark environment at the bottom of the ocean. Chemosynthetic bacteria oxidize H2S to form sulfur compounds. The chemical energy released in the process is used by the bacteria to synthesize food.





GLOBAL SURFACE-WATER CURRENT PATTERN





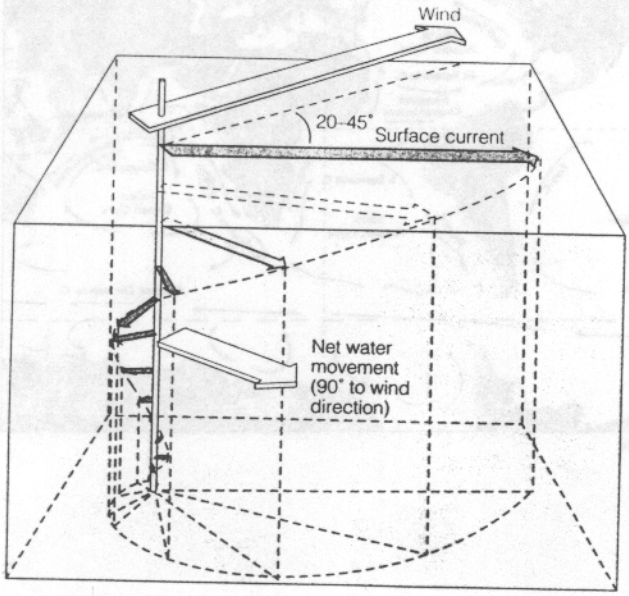


Figure 8.13A Transect along the western Atlantic Ocean showing water masses and general circulation pattern. North Atlantic Deep Water (NADW) originates near the surface in the North Atlantic as northward-flowing surface water cools, becomes increasingly saline, and plunges to depths of several km. As NADW moves into the South Atlantic, it rises over denser Antarctic Bottom Water (AABW), which forms adjacent to the Antarctic continent and flows into the North Atlantic as Antarctic Intermediate Water (AAIW) at a mean depth of about 1 km.