

## **Ocean Layering: Density, Temperature, Salinity, and Circulation**

Sylvia Cole, Scripps Institution of Oceanography, San Diego CA

Maureen Quessenberry, University City High School, San Diego CA

### **Glossary of useful terms**

#### **For the Students:**

*Density*: The ratio of mass to volume, or how much stuff (mass) is compacted into a certain space (volume). Density is measured in  $\text{kg} / \text{m}^3$ .

*Temperature*: How hot or cold something is. Temperature is related to but not the same as heat. Temperature is measured in  $^{\circ}\text{C}$ .

*Salinity*: The amount of dissolved solids in the ocean. It is mostly NaCl, but includes other forms of salt as well. Salinity is measured in practical salinity units (psu), see entry below.

*PSU*: practical salinity unit. Salinity was originally measured by titration in parts per thousand. Now, salinity is calculated by measuring seawater's conductivity. The scale used is no longer parts per thousand, but is the same general range of numbers (35 psu versus 35 ppt).

*Current*: movement of the ocean, or a part of the ocean, in a certain direction.

*Circulation*: a description of all of the ocean currents in a particular area, as in the global circulation or the North Atlantic circulation.

*Wave*: An oscillating motion of the ocean surface, or the ocean interior. Waves transport energy, and mix fluids when they break.

*Tide*: The movement of the ocean caused by the gravitational pull of the moon and sun. Tides oscillate back and forth and carry energy just like a wave.

*Transect / section*: a slice through the ocean. Sections can be horizontal, such as temperature at the surface, or vertical, such as temperature along  $30^{\circ}\text{N}$  in the Atlantic from top to bottom.

*Nutrients*: elements found in seawater that life needs to live. Nutrients are carried around with the currents in the ocean.

*Mixing*: when two things are permanently combined. Fresh water and salty water can be mixed to form water with a different salinity.

*Stirring*: when two things are stretched out next to each other but still retain their separate identities. Fresh water flowing from a river to the ocean is still fresh for some distance. The fresh river water and salty ocean water do not immediately mix.

#### **For the Instructor:**

*Topography*: also known as bathymetry. This is all of the mountains, valley, ridges, and seamounts that are under the ocean. The ocean cannot flow through land, so knowing the topography is important.

*Tracer*: A dye or marker in the ocean that the water carries with it. Tracers can tell you where the water goes or has come from and what the water gets mixed with. Tracers can be man-made,

such as a dye, and intentionally released at a specific location or natural, such as oxygen or salinity.

*Volume transport:* How much water passes a certain plain in a given time. The Gulf Stream has a transport of about  $3 \times 10^7 \text{ m}^3/\text{sec}$ .

*Heat transport:* How much heat passes a certain plain in a given time. The Gulf Stream has a northward heat transport equivalent to about  $1 \times 10^{15}$  Watts.

*Glider:* An autonomous underwater vehicle used to observe the ocean. It has no propulsion, communicates with satellites, and sinks and floats by controlling its buoyancy. See <http://spray.ucsd.edu>.

*CTD:* Conductivity-Temperature-Depth instrument. Measures conductivity, temperature, and pressure. Conductivity is used to determine salinity and pressure is used to determine depth.

*WOCE:* World Ocean Circulation Experiment. A multinational effort to sample the ocean from the surface to the bottom. Many vertical sections were taken in each ocean between 1990 and 1998. Several of the sections were sampled prior to and have been sampled since this time period. See <http://woce.nodc.noaa.gov/wdiu/index.htm>.

*World Ocean Atlas:* A compilation of ocean measurements taken over the last several decades. Average global properties are calculated from these observations. See [http://www.nodc.noaa.gov/OC5/WOA05/pr\\_woa05.html](http://www.nodc.noaa.gov/OC5/WOA05/pr_woa05.html).