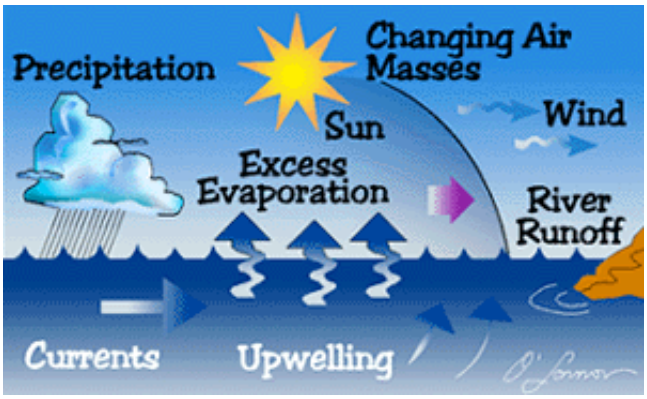
SEAWATER, SOUND & ICE

The amount of water occupying the ocean basins of the world is best illustrated when compared with the global supply of fresh water. Of the 3 percent of the earth's water that is fresh, two-thirds is frozen solid in icecaps and glaciers. The remaining 1 percent of the world's water is found in clouds, precipitation (rain and snow), rivers, lakes and ground water. Seawater is a complex solution with trace amounts of nearly 60 chemical elements including gold. Common salt is the most abundant ingredient, making up approximately 78 percent of the total dissolved solids in seawater.

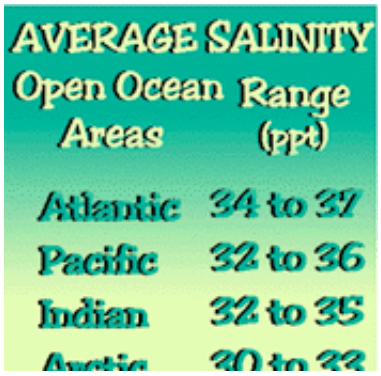
SEAWATER SALINITY: The first thing that comes to mind about seawater is that it is salty. Salt content, or salinity is the total amount of dissolved solids contained in one kilogram of seawater. In that there are one thousand grams in a kilogram, salinity is numerically expressed in parts per thousand (ppt). Salinity in the oceans varies from about 32 to 37 ppt except in the polar regions and near shore where it may be less than 30 ppt. The average salinity of the world's oceans is 35 ppt, which is the same as 35 grams of salt in each kilogram of water. (One kilogram is equal to 2.205 pounds or 35.27 ounces.)

Sodium chloride, common table salt, is the most abundant of the many salts found in seawater. Other salts come from the leaching process of the Earth's crust. Fresh river water runoff entering coastal waters will dilute salt water making it less saline. Weather also has an influence on salinity. In the North Pacific rainfall is greater than evaporation, resulting in lower salinity than in parts of the Indian Ocean, where evaporation exceeds precipitation. An isolated salt water body is frequently more saline than an open sea. The Mediterranean is an example where waters are more saline due to evaporation than those in the adjacent Atlantic.



In comparison with the Pacific and the Indian Oceans, the Atlantic is the saltiest. The Pacific Ocean is less salty because of meteorological conditions. Salinity in the deeper waters of the Pacific averages about 34.65 ppt.

Waters of the Arctic and Antarctic are the least salty. It has been calculated that if all the salts in the oceans of the world were dried up they would yield approximately 4.4 million cubic miles of rock salt. That's enough salt to cover all the landmasses of the world to a depth of 150 feet.



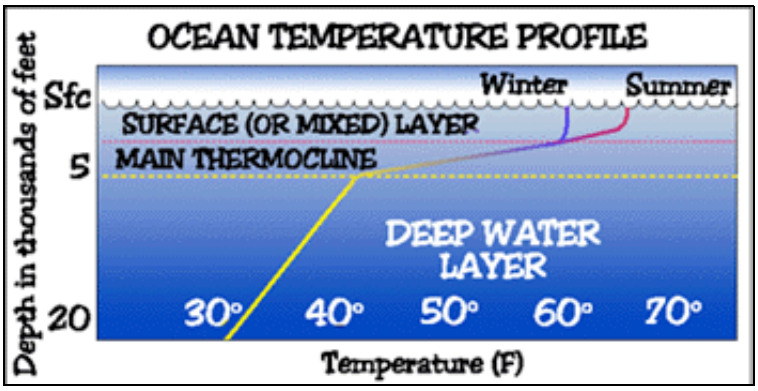
SEAWATER PRESSURE: A major problem in working at great depths is the tremendous weight of water. Oceans, like the atmosphere, exert pressure on the surface upon which they rest. For example, a one inch by one inch column of the earth's atmosphere resting on Earth's surface weighs 14.7 pounds. Weight of the atmosphere, like the weight of the sea, is of little

concern to the native inhabitants immersed in one or the other of the environments.

Pressure at various ocean depths is usually expressed in units of atmosphere. Pressure in the ocean increases one atmosphere with about every 33 feet of depth. For example, at a depth of 99 feet, the absolute pressure would be about four atmospheres, or four times greater than on the surface. (Absolute pressure is the sum of the atmospheric pressure plus the water pressure.) Absolute pressure at a depth of 6,000 feet is more than 2,687 pounds per square inch. In the Challenger Deep (35,810 feet) pressure would be more than 15,966 pounds per square inch or the equivalent of about 1,086 atmospheres.

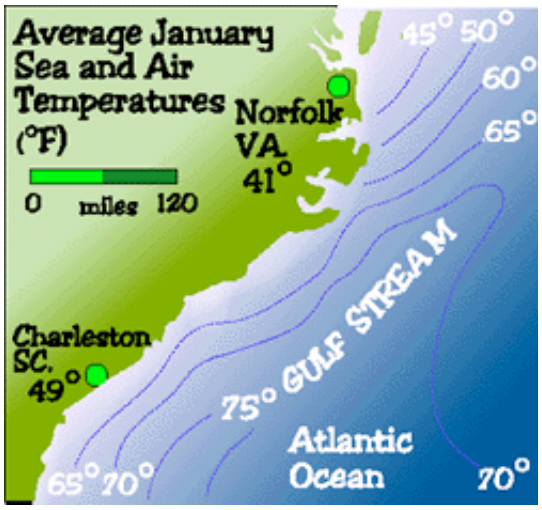
SEAWATER TEMPERATURE: The temperature of water is of interest to fishermen, swimmers and people who work in the oceans (like navies). Considered globally, seawater, has a relatively large temperature range that depends upon location and time of year. Warm or cold ocean currents can also influence water temperature. Water temperature in the open ocean varies from a low of 28.4 degrees F (the freezing temperature of sea water) to about 86 degrees F. (The formula used to convert Fahrenheit temperature to Centigrade is: C= 5/9 (F - 32).

The temperature can reach nearly 100 degrees F in shallow coastal waters. The usual thermal structure of the ocean consists of three zones. First is the surface layer where temperatures are almost uniform with depth.



The next zone is the thermocline where the temperature decreases rapidly with depth. The third zone is the deep layer where temperature decreases very slowly with depth. The surface layer, frequently called the mixed layer, varies in depth according to location and season. During the winter months it becomes more defined at all latitudes, and may extend to depths of a 1,000 feet or more in mid-latitudes during heavy weather. In polar regions, water can also be thoroughly mixed from surface to bottom during the winter months, so that it is nearly the same temperature from top to bottom. The daily temperature of the surface layer of the ocean changes less than 5 degrees F under normal conditions.

With significant changes in the weather however, sea water temperature can vary as much as 5 degrees F in a 24-hour period. Warm water of the Gulf Stream just off the East Coast of the U. S. is a classic example of ocean influence on climate. Easterly surface winds passing over the Gulf Stream in the winter are warmed from below and bring milder air to a chilled landmass. The Gulf Stream extends to near the British Isles, which accounts for their milder and less snowy climate than areas considerably to the south.



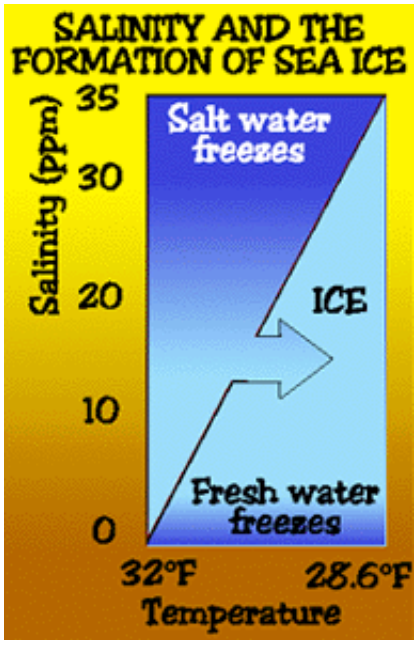
UNDERWATER SOUND: Light and radio waves are highly absorbed by the oceans, but sound waves are not. Sound waves are used to probe the oceans' depth, locate objects in the ocean, measure bottom sediment thickness and communicate underwater.

The speed that sound travels underwater varies from about 4,750 - 5,150 feet per second. It increases with temperature at a rate of about 7 feet per second per degree Fahrenheit; it increases with salinity at 4.3 ft./sec. per one thousandth part increase in salinity; and it increases in depth at 1 ft./sec./60 ft.. The sound velocity profile for a particular part of the ocean is often determined by lowering or towing an instrument called a sound velocimeter.

ICEBERGS: Glaciers that end at an ocean's edge create icebergs when large chunks of the glacier break off (calving). Approximately 7,500 icebergs are formed by this process each year. Portions of an iceberg may have hues of blue or green depending upon the age of the ice. Blue ice is old ice, while green ice usually contains algae. Glaciers on the west coast of Greenland produce most of the icebergs found in the Northern Hemisphere. The icebergs vary in size, but are typically irregular with pinnacles. About seven-eighths of an iceberg is submerged. Thus iceberg drift is affected more by ocean currents than by wind. When they drift into shipping lanes, they become a serious hazard.

On April 15, 1912 the Titanic, on her maiden voyage from England, collided with an iceberg off Newfoundland. More than 1,500 passengers and crew perished. Icebergs are rare in the Arctic Ocean although extensive sea ice exists year-round. In Antarctica, they are common and gigantic. Due to their size and the cold temperatures of Antarctica, they can survive up to ten years. A mammoth iceberg the size of Rhode Island was sighted off the coast of Antarctica during the summer of 1996. It had apparently split from the coast of East Antarctica a few months earlier. The iceberg, with sheer walls rising 100 to 160 feet above the water line, extends into the water to a depth of 1,000 feet. The huge iceberg, covering more than 1,400 square miles, was first observed by a research ship working with the Antarctic Cooperative Research Center.

SEA ICE: Sea ice, formed in saltwater, accounts for about 95 percent of ice found in the oceans. Ice covers about three percent of the world's water surface. It persists in the Arctic Ocean and around the Antarctica continent throughout the year. New ice growth is greatest during the first year of formation, and attains a thickness of 5 to 6 feet, but has been observed to grow as much as 9 feet in one year. Ice growth depends upon weather and sea conditions. Above normal temperatures, strong winds, or powerful wave action will significantly retard ice formation.



Pure water normally freezes at 32 degrees F, but the freezing point of sea water varies considerably. The freezing point of seawater decreases approximately a 0.5 degrees F for each 5 ppt increase in salinity. At 35 ppt sea water will begin to freeze at 28.6 degrees F. Shallow bodies of water freeze more rapidly than deep basins because there is less volume to be cooled. This is why the first ice of winter usually appears at river mouths, where the water is shallower and fresher. Sea ice first forms as salt-free crystals near the surface. The resulting formation of crystals is one of

nature's better engineering jobs. The newly produced ice is flexible against the rolling action of the sea.

Pack ice consists of pieces of sea ice that drift under the influence of winds and ocean currents. An individual piece of sea ice in the pack is called a floe and can vary from several feet to several hundred yards in length. The size of the pack depends upon temperature and surface wind. If wind pushes pack ice together or onto shore, it piles up until pressure causes the ice to buckle, forming mounds, hummocks, and ridges up to 25 feet or higher. Ice packs grow to their largest sizes in areas of extreme cold and survive longer during periods of light wind. The two largest areas of pack ice are in and near the Arctic Ocean and in the region of coastal Antarctica.

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