

Passage X

The ocean is salty because of the gradual concentration of dissolved chemicals eroded from Earth's crust and washed into the ocean. Solid and gaseous ejections from volcanoes, suspended particles swept to the ocean from the land by onshore winds, and materials dissolved from sediments deposited on the ocean floor also contribute salts.

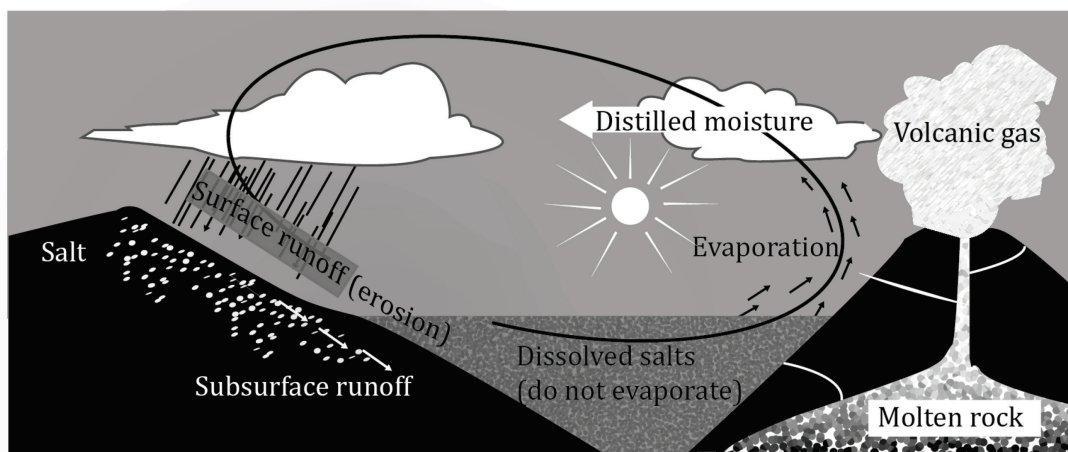


Figure 10

Salts become concentrated in the ocean because the Sun's heat distills or vaporizes almost pure water from the surface of the ocean, leaving the salts behind. In the hydrologic cycle (see Figure 10), water vapor rises from the ocean surface and is carried landward by the winds. When the vapor collides with a colder mass of air, it condenses (changes from a gas to a liquid) and falls to Earth as rain. The rain runs off into streams which in turn transport water to the ocean. Evaporation from both the land and the ocean again causes water to return to the atmosphere as vapor and the cycle starts anew. Because salts are continually added to the ocean basin and do not evaporate, the salinity of ocean water has increased over time.

Oceanographers report salinity (total salt content) and the concentrations of individual chemical constituents in seawater—for example, chloride, sodium, or magnesium—in parts per thousand (‰). That is, a salinity of 35 ‰ means 35 units of salt per 1,000 units of seawater. Similarly, a sodium concentration of 10 ‰ means 10 units of sodium per 1,000 units of seawater.

The salinity of surface seawater varies from one location to another in the world's oceans. The average salinity of surface seawater worldwide is 35 ‰, a value found at the equator. Maximum salinity values are found near the Tropics of Cancer and Capricorn (23.5° N and 23.5° S, respectively). As shown in Figure 11, at these locations, evaporation rates are higher and precipitation amounts are less than those found at the equator. High winds and high temperatures are responsible for the higher evaporation rates at these latitudes.

At still higher latitudes (45° N and 45° S), surface salinity values lower than average are found (34–34.5 ‰) because cooler temperatures result in much lower evaporation rates. Figure 11 does not show salinity values for polar waters (found at latitudes 60° N and 60° S and all locations poleward). At these locations, surface salinity values undergo significant seasonal variations. Values are higher in the autumn as sea ice forms (a process that removes water from seawater). In the spring, the melting of sea ice lowers salinity values as freshwater is once again added to the oceans (see Figure 11).

Longitudinal Variations in Evaporation and Precipitation

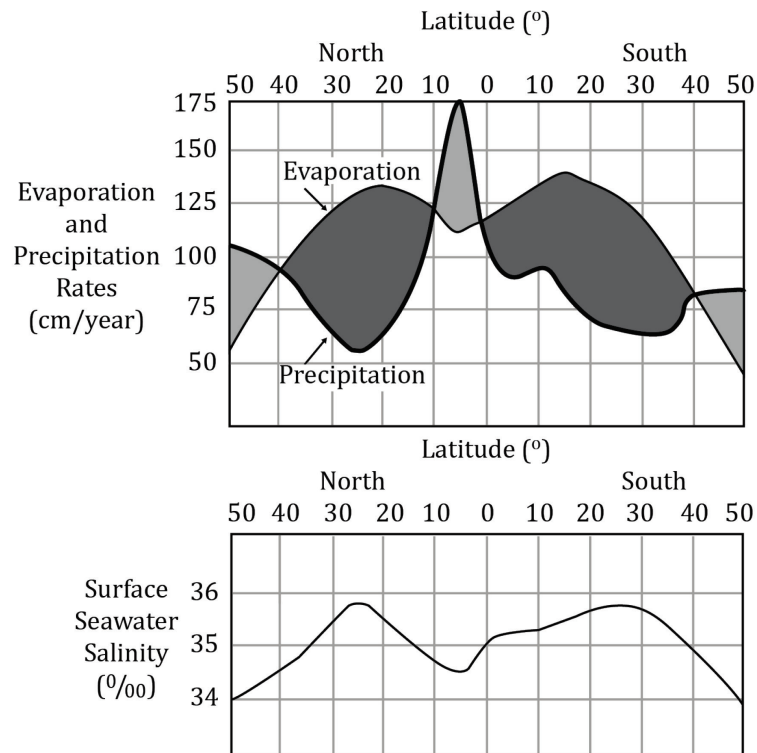


Figure 11

Table 13: Principal Constituents of Seawater	
Chemical Constituent	Concentration (parts per thousand)
Calcium (Ca)	0.419
Magnesium (Mg)	1.304
Sodium (Na)	10.710
Potassium (K)	0.390
Bicarbonate (HCO ₃)	0.146
Sulfate (SO ₄)	2.690
Chloride (Cl)	19.350
Bromide (Br)	0.070
Total dissolved solids (salinity)	35.079



Table 14: Comparison between Seawater and River Water		
Chemical Constituent	Percentage of Total Salt Content	
	Seawater	River Water
Silica (SiO_2)	—	14.51
Iron (Fe)	—	0.74
Calcium (Ca)	1.19	16.62
Magnesium (Mg)	3.72	4.54
Sodium (Na)	30.53	6.98
Potassium (K)	1.11	2.55
Bicarbonate (HCO_3)	0.42	31.90
Sulfate (SO_4)	7.67	12.41
Chloride (Cl)	55.16	8.64
Nitrate (NO_3)	—	1.11
Bromide (Br)	0.20	—
Total	100.00	100.00

Passage I

Nuclear reactors release enormous amounts of nuclear energy through controlled chain reactions. For this reason, nuclear power has been considered a source of abundant energy. Nuclear power, however, poses several problems, the most serious of which is the radioactive waste produced by the use of nuclear energy. The waste is very dangerous and remains so for thousands of years. How and where to dispose of this waste safely is a dilemma that has not been resolved. In 1987, the US Congress authorized the Department of Energy to study Yucca Mountain in the southern desert of Nevada as a place to bury the highly radioactive nuclear fuel rods from nuclear power plants.

Geologist 1

The most feasible and safe method for disposing of highly radioactive material is to store it underground. Yucca Mountain was chosen because the thick layer of volcanic rock under the mountain could keep the radioactive waste isolated for thousands of years. Other factors that make the Yucca mountain region a good disposal site candidate include its remote location and sparse population. Also, there is little rainfall in the area, thus reducing the likelihood of seepage into and out of the disposal area. While there is evidence of past volcanic activity, the last volcanic activity is thought to have occurred several hundred to several thousand years ago. Research conducted in 2002 suggested that the probability of volcanic activity occurring near the Yucca Mountain site during the next 10,000 years is between 1 in 1,000 and 1 in 10,000.

Geologist 2

Burial of radioactive waste is the best disposal method. Yucca Mountain, however, is not the best site because it is hydrologically and geologically active. Burial at this site poses the risk of radioactive materials leaking out and contaminating surrounding soil and ground water. If a leak did occur, ground water contamination would be a major problem. Many of the surrounding cities, including parts of Las Vegas, receive some of their water from the aquifers in the area. The area around Yucca Mountain has numerous faults and even a small volcano nearby. Any significant geological activity could disturb waste containers. If earthquakes or volcanic eruptions occurred, the radioactive material at the site could be carried to the surface, threatening the entire region.