Encyclopedia of Earth

Seawater

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Seawater is a mixture of various salts and water. Most of the water in the ocean basins is believed to originate from the condensation of water found in the early atmosphere as the Earth cooled after its formation. This water was released from the lithosphere as the Earth's crust solidified. Additional water has also been added to the oceans over geologic time from periodic volcanic action. Some scientists have recently speculated that comets entering the Earth's atmosphere may be another important source of water for the oceans.

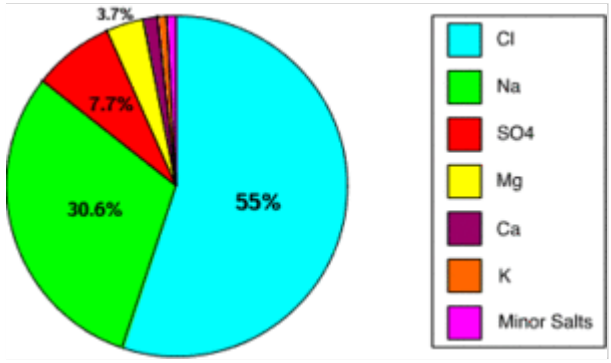

Figure 1: Relative proportions of dissolved salts in seawater. (Source: PhysicalGeography.net)

Most of the dissolved chemical constituents or salts found in seawater have a continental origin. It seems that these chemicals were released from continental rocks through weathering and then carried to the oceans by stream runoff. Over time, the concentration of these chemicals increased until an equilibrium was met. This equilibrium occurred when the ocean's water could not dissolve any more material in solution. Similarities between fossilized sea life and organisms living today indicate that the composition of seawater stopped changing drastically about 600 million years ago.

Only six elements and compounds comprise about 99% of sea salts: chlorine (Cl^-), sodium (Na^+), sulfur (SO_4^{-2}), magnesium (Mg^{+2}), calcium (Ca^{+2}), and potassium (K^+) (Figure 1). The relative abundance of the major salts in seawater are constant regardless of the ocean. Only the amount of water in the mixture varies because of differences between ocean basins because of regional differences in freshwater loss (evaporation) and gain (runoff and precipitation).

The chlorine ion makes up 55% of the salt in seawater. Calculations of seawater salinity are made of the parts per 1,000 of the chlorine ion present in one kilogram of seawater. Typically, seawater has a salinity of 35 parts per thousand.

Water is one of the few substances existing on the Earth's surface in all three forms of matter. At zero degrees Celsius liquid water turns into ice and has a density of approximately 917 kilograms per cubic meter. Liquid water at the same temperature has a density of nearly 1,000 kilograms per cubic meter. The density of seawater generally increases with decreasing temperature, increasing salinity, and increasing depth in the ocean. The density of seawater at the surface of the ocean varies from 1,020 to 1,029 kilograms per cubic meter. Highest densities are achieved with depth because of the overlying weight of water. In the deepest parts of the oceans, seawater densities can be as high as 1,050 kilograms per cubic meter.

Seawater freezes at a temperature that is slightly colder than fresh water (0.0° Celsius). The freezing temperature of seawater also varies with the concentration of salts. The more salt, the lower the initial freezing temperature. At a salinity of 35 parts per thousand, seawater freezes at a temperature of -1.9° Celsius.

Sea ice normally contains considerably less salt than seawater. Most of the salts found in liquid seawater are forced out it when freezing occurs. The reason for the exclusion is because the molecules of the various salts do not fit well in the highly orderly molecular structure of frozen water. Because of the density difference between ice and seawater, ice floats on the surface of the ocean.

Seawater also contains small amounts of dissolved gases. Many of these gases are added to seawater from the

atmosphere through the constant stirring of the sea surface by wind and waves. The concentration of gases that can be dissolved into seawater from the atmosphere is determined by temperature and salinity of the water. Increasing the temperature or salinity reduces the amount of gas that ocean water can dissolve. Some of the important atmospheric gases found in seawater include: nitrogen, oxygen, carbon dioxide (in the form of bicarbonate HCO_3), argon, helium, and neon. Compared to the other atmospheric gases, the amount of carbon dioxide dissolved in saturated seawater is unusually large.

Some gases found within seawater are also involved in oceanic organic and inorganic processes that are indirectly related to the atmosphere. For example, oxygen and carbon dioxide may be temporally generated or depleted by such processes to varying concentrations at specific locations within the ocean.

Further Reading

- PhysicalGeography.net

Citation

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