

CHEMISTRY OF SEA WATER

Distribution of Nitrogen compounds

Nitrate in Oceans

Nitrate in the oceans, is the end product of decomposition of organic nitrogen. Decomposition proceeds through organic nitrogen, ammonia, nitrite and nitrate in successive stages. Plankton utilizes all the inorganic nitrogen forms for their live processes and especially during spring and summer they tend to deplete the inorganic nitrogen supply in surface waters. Regeneration of nitrogen is accomplished mainly by bacterial action although some chemical breakdown does occur.

Nitrate is found at all depths in the oceans in higher concentrations than the other forms of nitrogen. Maximum nitrate concentrations are found at greater depths than that of [phosphorus](#), which suggests that nitrate generation is somewhat faster than that of [phosphorus](#).

The distributions of nitrate and of phosphate are quite similar in the oceans. Figure 1 gives the nitrate distribution with depth for the Atlantic, Pacific, and Indian Oceans. It is apparent from figure that the nitrate concentrations in [the Atlantic Ocean](#) are much lower than those in either the Indian or [Pacific oceans](#). [The Antarctic Ocean](#) has about twice the nitrate concentration of Atlantic Ocean.

All deep waters of [the Atlantic Ocean](#) are relatively rich in nitrate while the surface waters of the South Atlantic are generally richer in nitrates than surface waters of the North Atlantic. The Northern Pacific Ocean waters are higher in nitrates than the Southern Pacific waters. In [the Antarctic Ocean](#) the nitrate concentrations may reach 0.5ppm, but surface waters in the tropical areas are nearly devoid of both phosphate and nitrate. The table shows the variation in nitrate along the 30°W longitude line and points out clearly the high polar nitrate concentrations compared to the small nitrate concentrations found in the tropical surface waters.

Ammonium concentrations are most pronounced in the surface waters of the oceans but never are as high as the concentrations of nitrates. Surface waters contain their maximum amount of ammonium during winter. During the spring the minimum ammonium concentrations occurs; in fact, there may be complete depletion. In deep ocean layers ammonium concentrations are around 0.002 ppm. Since ammonium compounds are a result of the first step in the decomposition of organic nitrogen, it is reasonable that the maximum concentrations would occur in winter. Except for anoxic basins, such as the Cariaco Basin, ammonia does not occur in significant quantities below the euphotic zone in the deep oceans.

Nitrite is found in very low concentrations in the oceans (on the order of a few milligrams per cubic meter) and almost entirely nil in the surface layers, the maximum nitrite being found at depth somewhere between 100 and 300m. Maximum nitrite concentrations are usually found just below the photic zone.

Chapter 3: Distribution of [silicates](#) and [manganese](#)

Silicates

Silica is required as a nutrient by all organisms, but it is especially necessary for the formation of skeletons for many diatoms and some other organisms. Regeneration of silica appears to be due to chemical rather than bacterial action. Silica that has passed through the digestive tract of some marine organism seems to be broken down much faster than silica not subjected to an organism's digestive processes. Turnover time for silica is not known but

some estimates indicate that the turnover rate is faster than for phosphate and nitrate. Silica concentrations vary widely in the oceans. The variation in frustules-forming diatom populations and the difference between the regeneration processes for silica and for phosphate and nitrate cause silica distribution to differ somewhat from distribution for phosphate and nitrate. The vertical distribution of silica is shown for the various oceans in figure. In upper layers where silica is used by biological organisms, concentrations of less than 0.014ppm are often found. Deep waters of the North Atlantic Ocean contains about 0.98ppm silica, while North Pacific contain much more, about 4.8ppm. Deep water in [the Antarctic Ocean](#) and [the Indian Ocean](#) contains about 3.4ppm. Generally there is no intermediate ocean depth at which a maximum silica concentrations occurs, as there is with phosphate and nitrate. The concentration of silica increases with increasing depth in deep waters.

Variation of silicon

The reduction of silicon in the surface layer is the result of biological activity and the sinking of the organisms of the skeletal remains. Diatoms accumulate silicon from the sea and is returned to the sea after death of the organism. The skeletal remains forms permanent constituent of the sediments. Siliceous sediments in form of diatom are found in higher latitudes and in other regions, radiolarian skeletons form the major portion of the sediments.

Manganese

Manganese occurs in sea water usually as a divalent ion. Particulate manganese is not found in the sea except in surface waters. Although manganese has been proven to be necessary for growth of various phytoplankton species, it is found in very low concentrations in the sea, usually ranging from less than 0.001 to about 0.01ppm.