MARINE AND OCEAN CHEMISTRY

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Read the details of the information provided below from the sources recommended as a reference.

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PLAN – CONTENT – REFERENCES

1. Introduction
2. The water in seawater
3. Salinity, chlorinity, conductivity, and density
4. Major constituents of seawater
5. Simple gases
6. Salts in solution
7. Carbon dioxide
8. Nutrients
9. Trace metals and other minor elements
10. Chemical extraction of useful substances from the sea

References:

1. An Introduction to the Chemistry of the Sea, Michael E. Q. Pilson
2. Marine Chemistry & Geochemistry, John H. Steele et al.
3. Chemistry in the Marine Environment, R. E. Hester and R. M. Harrison
4. Marine Chemistry, P. J. Wangersky

NUTRIENTS

1. Phosphorus
2. Nitrogen
3. Silicon
4. Other nutrients
5. Quantitative relationships
6. Initial nutrients

PHOSPHORUS

- Phosphorus has certain unique properties that appear to qualify it for its role as both an essential constituent of the genetic material (RNA and DNA) of all organisms, and an essential participant in many energy-transforming mechanisms (via ATP, etc.) of all organisms.

Forms Of Occurrence In Seawater

- Inorganic phosphate
- Polyphosphates
- Organic phosphorus

NITROGEN

- As with phosphorus, nitrogen is an absolutely essential ingredient of all living things, and is required in amounts commonly about 16 times greater than is phosphorus.
- The complex chemistry and biochemistry of nitrogen, however, introduce corresponding complexity into the oceanic behavior of this element.
- Because of the extreme inertness of nitrogen when in the form of N_2, a major focus of interest has been the processes whereby N_2 is exchanged with other forms.

SILICON

- Silicon is a major constituent of earth and is always found combined with oxygen. Silicon dioxide, SiO_2, is commonly called silica.
- It occurs in this form mostly as the abundant crystalline mineral quartz, but most of the mass of Earth consists of silicate minerals, in which the SiO_2 is combined with various other elements.
- The layman does not often think of silica as a soluble nutrient. Nevertheless, numerous organisms both terrestrial and marine have an absolute requirement for this substance.
- It is an important oceanic tracer, it affects the physical properties of seawater to some minor extent, and by its presence or absence it exerts a considerable influence on the species composition of the plankton.

OTHER NUTRIENTS

- In addition to these major and micro components, other elements are essential in trace amounts.
- All living things contain iron, as this is an essential component of some proteins that are part of the respiratory pathway, so all organisms have an absolute requirement for iron.
- In addition, in photosynthetic plants iron is an essential component of the electron pathways in the photosynthetic apparatus.
- Iron is also required for many other enzyme systems.

- It is probable that copper, zinc, manganese, and cobalt, at least, are also essential for all organisms, because of their varied role in many enzymes.
- Some organisms require molybdenum, and some are believed to require boron.
- Perhaps these elements could be called nano-nutrients, because their requirements by marine organisms usually can be satisfied by nanomolar concentrations.
- Many phytoplankton also have specialized requirements for various organic compounds, such as vitamins, which could therefore also be considered as nutrients. These are important to consider when dealing with the species composition of the plankton.

QUANTITATIVE RELATIONSHIPS

- When the results of some of the early measurements of nutrient elements in the deeper water of major ocean basins were examined, it appeared that these elements were found in rather constant ratios to each other.
- Redfield (1934) showed that the linear relationship had a slope of about 16 N to 1 P in mole units. He suggested that this should reflect the average composition of the organic debris that is metabolized and mineralized in the deep sea and, by extension, the average composition of the plankton that produces the organic debris.
- Subsequent work generally confirmed this suggestion and extended the ratios to include carbon, as well as the oxygen used for respiration or produced during photosynthesis.