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

TRACE METALS AND OTHER MINOR ELEMENTS

1. Analytical considerations
2. Various patterns of distribution
3. Mercury
4. Iron

ANALYTICAL CONSIDERATIONS

- Among the metallic elements that attracted the early interest of seawater analysts were iron, cobalt, copper, cadmium, and gold.
- A great deal of time and material effort is required to achieve reliable results for some of the important elements (such as cadmium, cobalt, copper, iron, lead, and nickel) that are present at very low concentrations in the central water masses of the oceans.
- The real concentrations are so vanishingly small that the quantities present are easily swamped by contamination.

MERCURY

- This element is selected for extended treatment because it provides examples of complexity in its chemistry and biogeochemical cycling, it has numerous anthropogenic and natural sources, and it has potential for causing harm.
- Mercury is generally rare in Earth's crust; the usually quoted average concentration is 0.085 ppm but, being concentrated in its ores, it is readily obtainable and easily separated from the ore.
- Mercury vapor is very toxic, however, causing neurological damage, kidney damage, and death; and probably the work was normally assigned to slaves.

- In ocean and lake water, in soils, and in marine sediments, Hg^{2+} is strongly adsorbed onto particles and organic matter, but some is also taken up by bacteria and other biota. Under mildly reducing conditions, such as are found in marine sediments, bacteria methylate mercury to form monomethylmercury (CH_3Hg^+), and dimethylmercury (CH_3HgCH_3).
- Divalent mercury is also reduced to elemental mercury (Hg^0) by bacteria, and in surface waters can also be photochemically reduced.

IRON

- This metal is abundant on earth and essential for all life, but in its normally oxidized form ($Fe(OH_{)3}$) it is quite insoluble. This insolubility, and thus its presumed unavailability to phytoplankton, has worried biologists for many decades since long before it was possible to make accurate assessments of its concentration in seawater.
- Iron exists in seawater in both ferrous and ferric oxidation states. In the presence of oxygen the ferric state is the stable condition.

- All organisms absolutely must have some minimum amount of iron in their cellular machinery; the amount required varies with the biochemical processes involved.
- A typical concentration of iron in marine bacteria is about 1 atom of iron for each 125 000 atoms of carbon.

- The very low maximum solubility of the inorganic species of iron, and the biological stripping of iron from surface waters and downward transport along with carbon and other nutrients, lead to the situation where considerable areas of the ocean do not have enough iron to support the production of enough biomass to use up all the nitrogen and phosphorus in surface water. Such parts of the ocean have been termed **high-nutrient low-chlorophyll (HNLC)** regions.