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The Influence of Plate Tectonics and its Importance in Marine Chemistry

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Commentary

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DESCRIPTION

Plate tectonics and seafloor spreading, turbidity currents, sediments, pH levels, atmospheric constituents, metamorphic activity, and ecology all have an impact on marine chemistry, also known as ocean chemistry or chemical oceanography. Chemical oceanography is the study of the chemistry of marine environments, including the effects of various variables. Marine life has adapted to the chemistries found only in the world's oceans, and marine ecosystems are sensitive to changes in ocean chemistry. Over time, human activity has a growing impact on the chemistry of the earth's oceans, with pollution from industry and diverse land-use practises having a considerable impact on the oceans. Furthermore, rising carbon dioxide levels in the earth's atmosphere have resulted in ocean acidification, which has a negative impact on marine ecosystems. The international community has agreed that restoring the chemistry of the oceans is a top priority, and progress towards this goal is tracked as part of SDG 14.

The study of the chemistry of the Earth's oceans is known as chemical oceanography. Chemical oceanographers, an interdisciplinary field, study the distributions and reactions of both naturally occurring and anthropogenic chemicals on molecular to global scales.

Because the ocean is so interconnected, chemical oceanographers frequently work on problems involving physical oceanography, geology and geochemistry, biology and biochemistry, and atmospheric science. Many chemical oceanographers study biogeochemical cycles, with the marine carbon cycle attracting particular attention due to its role in carbon sequestration and ocean acidification. Other major areas of interest include oceanic analytical chemistry, marine pollution, and anthropogenic climate change.

Coloured Dissolved Organic Matter (CDOM) is estimated to account for 20%-70% of ocean carbon content, with concentrations higher near river mouths and lower in the open ocean.

Marine life is biochemically similar to terrestrial organisms, except that it lives in a salty environment. As a result of their adaptation, marine organisms are the most abundant source of halogenated organic compounds.

Plate tectonics

A global scale ion-exchange system is seafloor spreading on mid-ocean ridges. At spreading centers, hydrothermal vents release varying amounts of iron, sulphur, manganese, silicon, and other elements into the ocean, some of which are recycled into the ocean crust. Helium-3, an isotope associated with mantle volcanism, is emitted by hydrothermal vents and can be detected in plumes within the ocean. Spreading rates on mid-ocean ridges range from 10 to 200 mm/year. Increased basalt reactions with seawater are caused by rapid spreading rates. Because more magnesium ions are removed from seawater and consumed by the rock, and more calcium ions are removed from the rock and released to seawater, the magnesium/calcium ratio will be lower. The ridge crest hydrothermal activity is effective at removing magnesium. A lower Mg/Ca ratio favours the precipitation of calcium carbonate polymorphs with low Mg (calcite seas). Slow spreading at mid-ocean ridges has the opposite effect, favoring the precipitation of aragonite and high-Mg calcite polymorphs of calcium carbonate (aragonite seas).

Experiments show that in past calcite seas, most modern high-Mg calcite organisms would have been low-Mg calcite, implying that the Mg/Ca ratio in an organism's skeleton varies with the Mg/Ca ratio of the seawater in which it was grown.

Chemical reactions occurring along the mid-ocean ridge, the rate of which is controlled by the rate of sea-floor spreading, thus regulate the mineralogy of reef-building and sediment-producing organisms.