**Chemical Oceanography II: Control of Seawater Composition**

**Summary.** Although seawater is mostly water, it is the concentration of dissolved substances in seawater that determine most of the chemical, biological and geological processes in the ocean. In this lecture, we will consider the processes that determine the concentration of several important constituents of seawater and discuss how these relate to important processes on a global scale.

**Learning objectives.** These are the major organizing points of the lecture. You should understand how all of the materials presented in lecture and readings related to these learning objectives.

1) All of the components of seawater (the water and the substances dissolved in the water) are continuously being added to and removed from the ocean. For most of these substances, there is good evidence that the amount of these substances in the ocean have not changed much over geologic time – we call this condition “steady state”. What this means is that the rate that a substance is added to the ocean by one group of processes is equal to the rate that the substance is lost from the ocean by some other group of processes. That is, for each substance there is a cycle of processes adding and removing that substance from the ocean.

2) Conservative properties of seawater are those properties that can change only at the surface of the ocean (temperature, salinity). The distribution of conservative properties is determined entirely by the physical movement of water in the ocean. Nonconservative properties can change anywhere in the water column (through biological or geological processes); their distribution is determined by a more complex mix of physical, biological and geological processes.

3) Global warming has been attributed to an increase in CO2 content in the atmosphere due to the combustion of fossil fuels. The ocean contains 50 times more CO2 than the atmosphere, and biological processes in the ocean control the exchange of CO2 between the atmosphere, the ocean and the sediments at the bottom of the ocean. Our understanding of this suggests some interesting approaches to curbing global warming.

4) There is good evidence that the availability of nutrients (not light or temperature) is the primary factor that limits primary production (photosynthesis) in the world’s oceans. Some people have speculated that iron is the critical nutrient that contributes to this limitation. Experiments to evaluate iron limitation have provided mixed results.
5) The deep waters of the Pacific Ocean contain much higher concentrations of nutrients than the deep waters of the Atlantic. This can be understood by the loss of low nutrient surface water from the Pacific to the Atlantic, and the loss of high nutrient deep water from the Atlantic to the Pacific.