**Week 1: Lecture 1**

**Slides**

Concerned with

* Reservoirs
* Rates
* Reactions

Studying

* Budgets (big scales)
* Speciation (small scales)
* Links among
  + Life
  + Energy
  + Matter

Gradients (from cells to the planet)

Oxygen Biogeochemistry

* Where does the O2 we breath come from

Nitrogen Biogeochemistry

* 40 to 60% of the nitrogen in your body was produced in a factory

Anatomy of a Chemical Equation

Mass Conversation

Stoichiometry

Key Concepts

* Law of Conservation of Mass
* Law of Conservation of Energy
* Electro neutrality (charge balance)
  + In seawater chemistry positive and negative charges must equal
* First Law of Thermodynamics
  + Energy cannot be created or destroyed only transformed
* Second Law of Thermodynamics
  + All systems move towards increasing entropy (decreasing order)
* Gibbs Free Energy
  + Gibbs Free Energy = Enthalpy – Entropy
* Energy Available for Work = Total Energy – Energy Not Available
* If the Change in G is Negative the reaction is spontaneous or favored

Thermodynamics

* The study of equilibriums but does not speak to the rate of the reaction
* Just if they can or cannot happen

Kinetics

* The study of rates and mechanisms of reactions
* The change in concentration over time

Elements

* Conservative
  + Generally controlled by physical properties
* Non-Conservative
  + Generally biology alters distribution

**Reading (Cappellen Chapter 12)**

Biogeochemical Cycles provide framework in which geochemists organize their knowledge and interpret their data

Progress has been made in the development of global scale models

* Based on simple representations of biosphere and hydrosphere

Overview

* This chapter focuses on basic concepts of global biogeochemical cycles
* Then looks at box models used to represent them
  + Then looks at carbon cycle
* Next looks at impact of bio mineralization on the C, Ca, Si, P Cycles

**Biogeochemical cycles**

Forcing Mechanisms

Time Scales

Small Scale

* On an individual ecosystem scale biogeochemical fluxes are controlled by interactions between organisms and by external forcings that typically fluctuation on diurnal to decadal time scales
* Forcings
  + Air temperature
  + Rainfall
  + Tidal parasistism
  + predation
* Biogeochemistry is linked to ecology

Long Scale

* Plate tectonics

Lithosphere

* the rigid outer part of the earth, consisting of the crust and upper mantle.

With passing of time cumulative loss of bioessential elements to lithosphere becomes significant

* Countered by volcanic and chemical outgassing of rocks

Solar radiation also drivees hydrologic cycle

**Models**

**Week 2: Lecture 3**

**Reading (Lyons and Reinhard)**

Great Oxidation Event- when oxygen gathered in atmosphere