## **Geologic Cycle**

### Earth consists of several systems:

- Atmosphere
- Hydrosphere
- Geosphere
- Biosphere



**Cyclic interactions of earth systems are called geological cycles** 

### The Hydrologic Cycle

### : shows movement of water through different reservoirs



## **The Chemical Cycles**

: transfer of chemical elements through various reservoirs

e.g.,

- Carbon
- Nitrogen
- Oxygen
- > Ozone-oxygen
- Methane
- > Hydrogen
- Phosphorus
- Sulfur
- Mercury



#### **Carbon cycle**





Taken from Chisholm, 2000

http://www.nature.com/nature/journal/v407/n6805/fig\_tab/407685a0\_F1.html

#### **Exchange between ocean and atmosphere**



Houghton et al. 1996

http://www.sd-commission.org.uk/panel-sd/position/co2/annb.htm



Global CO<sub>2</sub> budget for 1990-2000 (blue) and 2000-2008 (red) (gtC per year). (Taken from C. Le Quéré, 2009. Global Change magazine, 74, December 2009) 7

#### CO2 and pH time series in the North Pacific Ocean



Figure credit:

Richard A. Feely, Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, USA, with atmospheric data from Pieter Tans and seawater data from David Karl. Adapted from Feely (2008) in Levinson and Lawrimore (eds), *Bull. Am. Meteorol. Soc*, 89(7): S58.



(Hoegh-Guldberg et al., 2007)

# Prebleaching

## Bleached



(Manzello D P et al. PNAS 2007;104:12035-12039)









#### coccolithophorids under different CO<sub>2</sub> concentrations



a~c pCO<sub>2</sub> about 300 ppmv

d~f pCO<sub>2</sub>=780~850 ppmv

(Riebesell, U., et al., Nature 407, 2000 [7])

pteropod snail shell in acidic waters equal to expected 2100 levels





### Nitrogen cycle



### **The Rock Cycle**

#### : involves cycling among different rock types

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### **Tectonic Cycle**

: large-scale processes that involve the creation, destruction, and movement of tectonic plates



### **Energy on Earth**

#### **Solar Energy**

- Comprises > 99.9% of energy received by Earth
- Drives circulation in atmosphere & hydroshpere



#### **Energy on Earth**

#### **Energy from meteorite impacts**

meteorites impacts generate very high temperature (10,000° C or more) & pressure



### Energy

#### **Gravity**



#### **Internal Energy**

### **Primordial heat**:

heat left over from the formation of the earth







Wax cools down, contracts, and sinks

#### **Global map of the flux of heat**



## **Internal Energy**

### **Radioactive Decay**

- Elements such as U, Th, & K have unstable energy
- Atoms disintegrate spontaneously, which release radioactive particles & energy
- The Energy heats the Earth's interior, eventually causes volcanism



Write a detailed proposal to study the anthropogenic influence on the sediment at the Zhoushan area

Hint:

- 1. Pollution history, dating
- 2. Human impact: heavy metals, POPs
- 3. Sediment cores
- 4. Determination of sampling locations, background?