The Grand Geochemical Cycle: Residence time

Let's consider:

The average time that a substance remains dissolved in seawater
We call this the "residence time" of an element or substance

$$\text{Residence Time (yrs.)} = \frac{\text{Total amount in seawater (kg)}}{\text{Input rate (kg/yr)}}$$

where Input rate= average concentration in rivers (kg/km^3) x river discharge (km^3/yr)

We will see how this works: first for water, then for total salt, and, finally, for some individual elements. These calculations give us insights into how the system works

How long does it take to cycle ocean water through rivers and back again?

Residence time of water in the ocean

Volume = 1.4×10^9 km^3

River Influx = 3.7×10^5 km^3 /yr

t = Volume / Influx

$$t = \frac{1.4 \times 10^9 \text{ km}^3}{3.7 \times 10^5 \text{ km}^3}$$

t = 4000 years

The Grand Geochemical Cycle

- How much time to make the ocean salty?

- about 5×10^{22} grams of dissolved solids in ocean
- rivers bring in about 2.5×10^{15} gm dissolved solids per year

--think about it!

- Should only take about 2×10^{7} years (20 million yrs.) to bring oceans to present salinity

Assuming:

- rivers have kept approx. same input through time
- oceans have kept approx. same composition through time

--but we know oceans are 3.8 billion yrs. old

- This confirms that there must be output of material from ocean!!