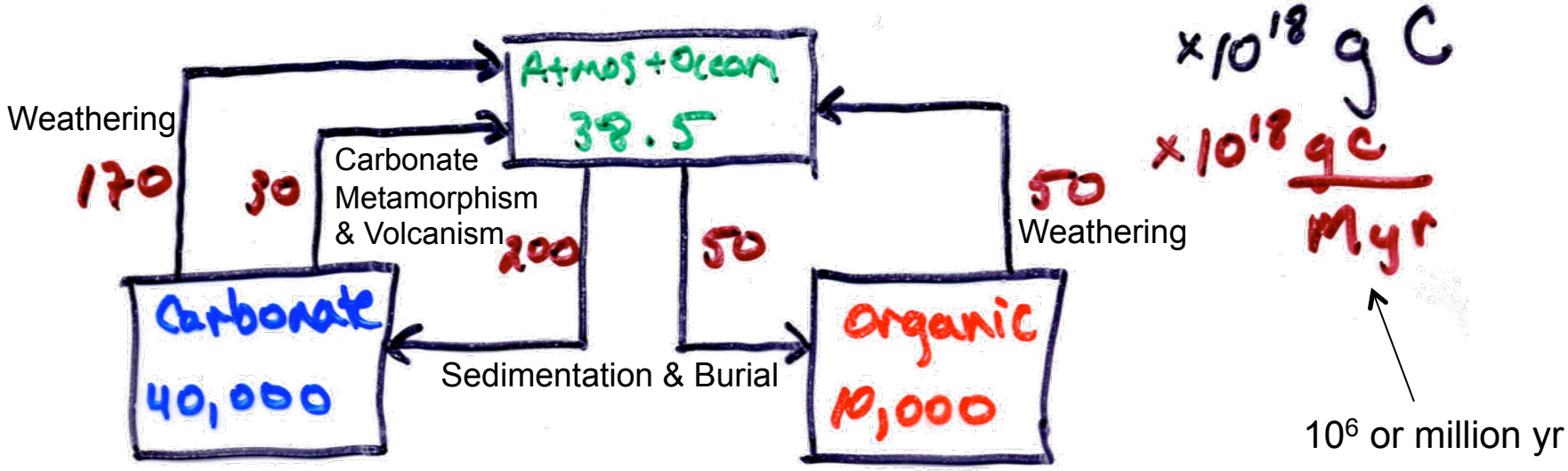
Clarification to Thurs 1/29 Lecture Notes

Long-Term Carbon Cycle: Rock Weathering and Mineral Precipitation Reactions

Carbon Reservoirs & Fluxes – The Long-Term View

- Most carbon in Earth's crust occurs in carbonate rocks (~1000x more than in ocean + atmosphere) & as organic material (kerogen) in rocks (~250x more than in ocean + atmosphere)
- Ocean + atmosphere C reservoir is small w.r.t. rock reservoir & the transfer rates between those reservoirs
- Transfer of C between rocks & ocean + atmosphere (>10^6 yr) can strongly perturb the CO_2 greenhouse effect



(units are 1000x larger than in previous figures!)

Amended 1/30/09

Net reaction of Rock Weathering on Land & (Biogenic) Mineral Precipitation in the Ocean

Carbonate Weathering: $CaCO_3 + H_2CO_3 \rightarrow Ca^{2+} + 2HCO_3^-$

Carbonate Precipitation: $Ca^{2+} + 2HCO_3^- \rightarrow CaCO_3 + H_2CO_3$

0

Note: Both reactions occur at Earth surface conditions

Calcium-Silicate Weathering:

$CaSiO_3 + 2H_2CO_3 \rightarrow Ca^{2+} + 2HCO_3^- + SiO_2(aq) + H_2O$

Note: Silicate minerals do not re-form at Earth surface conditions

Carbonate Precipitation: $Ca^{2+} + 2HCO_3^- \rightarrow CaCO_3 + H_2CO_3$

Opal (Biogenic Silica) Precipitation: $SiO_2(aq) \rightarrow SiO_2(s)$

Ocean-atmosphere CO_2 exchange: $CO_2 + H_2O \rightarrow H_2CO_3$

$CaSiO_3 + CO_2 \rightarrow CaCO_3 + SiO_2$

- Ca^{2+} liberated from silicate weathering leaves ocean as $CaCO_3$
- 2 mol H_2CO_3 req'd to weather $CaSiO_3$ *but* only 1 mol H_2CO_3 liberated during $CaCO_3$ precipitation