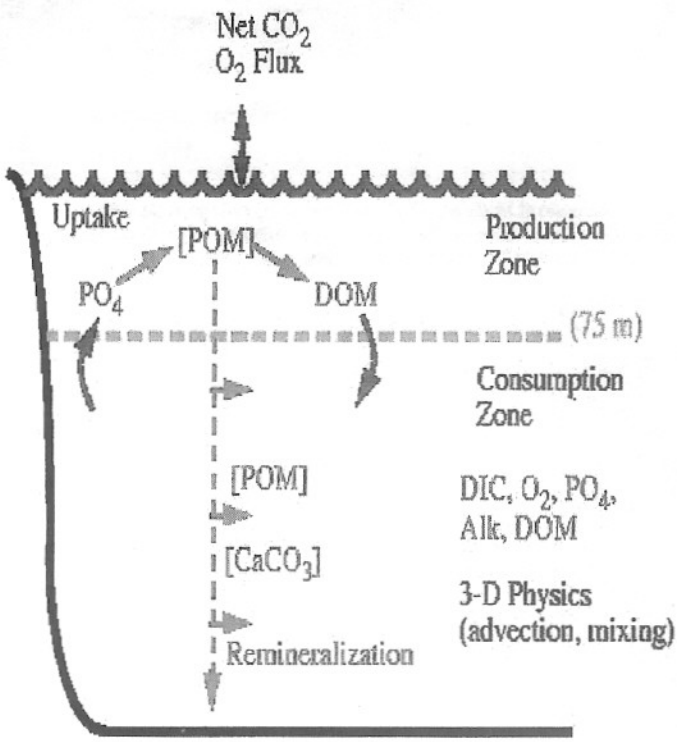
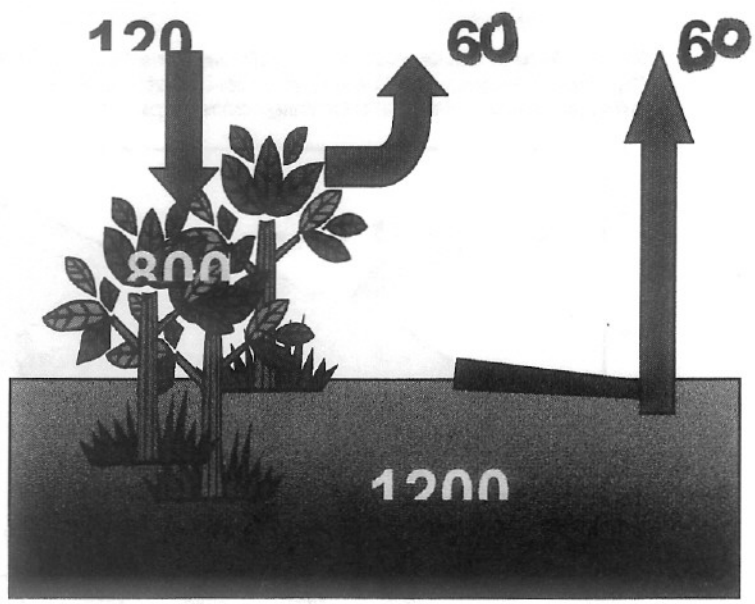
ES10 March 10 2003 **Inez Fung**

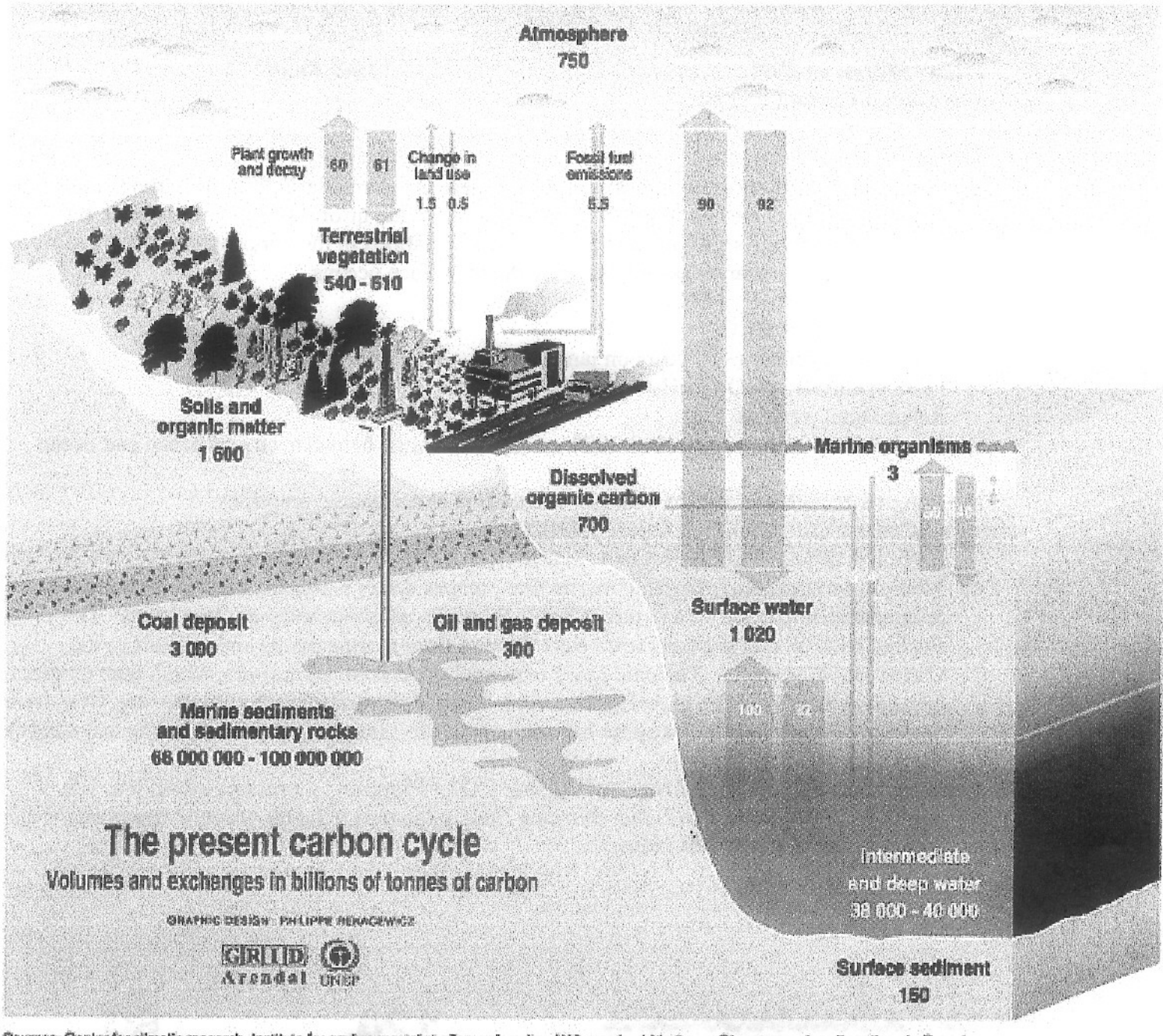
The Global Carbon Cycle

Topics

1. Inventory, fluxes, turnover times: the atmosphere is the smallest of all the carbon reservoirs. Turnover times of carbon in the other reservoirs provide information about the time scale at which the reservoir's CO_2 exchange dominates variations in the atmosphere.
2. Fast cycling (~1 year) – gas exchange with the surface oceans
   $CO_2 + H_2O \leftrightarrow H^+ + HCO_3^-$
   $CO_3^= + H^+ \leftrightarrow HCO_3^-$
3. Short-term cycling (~10 years on land)
   Photosynthesis: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$
   Respiration: reverse
4. Intermediate-term cycling (100-1000 years) – exchange between surface ocean and ocean interior.
5. Long-term cycling (million years) - weathering and volcanic eruptions
   $CaCO_3 + CO_2 + H_2O \leftrightarrow Ca^{++} + 2HCO_3^-$
   $CaSiO_3 + 2CO_2 + H_2O \leftrightarrow Ca^{++} + 2HCO_3^- + SiO_2$
6. Medium-term cycling: Organic matter that escapes decay is transformed by pressure and temperature into coal, oil and gas. Coal is found in paleo-swampy environments. The Persian Gulf oil and gas reservoirs were formed from marine plants and animals in the Cretaceous-Cenozoic. Tectonic uplift exposes buried coal, oil and gas, which then oxidizes.
7. Natural variations in the global carbon cycle are tied to variations in climate – e.g. CO_2 varied between 180 ppmv and 280 ppmv between glacial and interglacial periods of the last 420,000 years.
8. Human perturbations – current atmospheric CO2 >350ppmv, increasing steadily at 1.5 ppmv/y. Concentration is higher than any time in the past 420,000 years; increase rate is also fastest in the past 420,000 years.







Sources: Center for climatic research, Institute for environmental studies, university of Wisconsin at Madison; Okanagan university college in Canada, Department of geography; World Watch, November-December 1998; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.