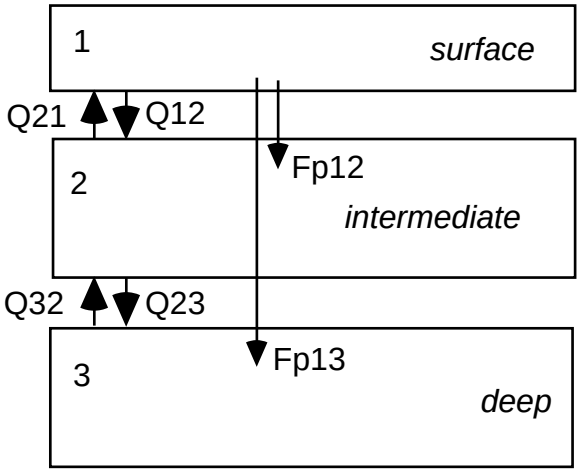
Problem Set 3: Introduction to Ocean Box Modeling

1. Write the steady-state matrix equation for phosphorus for the 3-box model shown below (you do not have to solve the equations):



Where Q signifies flux of water and F_p signifies a particulate flux. Note your units!

2. Explore the "Harvardton Bears" 3-box ocean model. You are given two Microsoft Excel 5.0 files which contain models for S, P, Alk, CO2, C13, and C14. The goal is to explore the model a little by changing some parameters.

The model is best viewed on a color monitor. Color coding helps you identify the uses of cells: **Things you can change are marked in boldface dark blue.** These include water fluxes between boxes (subject to the conditions that water fluxes must be balanced and certain "forbidden" outcomes are avoided - you will be warned when these aconditions are violated), phosphorus concentrations in the boxes, the Redfield Ratios, and the gas exchange piston velocity.

The model is arranged by modules in a vertical sense, so that any changes in a module affect modules below but not those above. (The exception to this is the oxygen model at the bottom, which only depends on the phosphorus and salinity modules.

Water fluxes are given in Sverdrups (10^6 m^3/sec). Concentrations are in µmol/kg (except for ^{14}C and salinity) .

Important model outputs are shown in magenta.

Other color codes indicate different types of fluxes: e.g., water fluxes are shown in cyan (light blue) and particle fluxes are shown in green.

Temperature and salinity are not explicitly changable in the model, although one of the files assumes warmer and fresher conditions and the other assumes saltier and cooler conditions.

Each time you make a set of changes, you must press Command-Option-g (goal seek) to solve the CO2-system (CO2, C13, C14) equations. All other calculations occur immediately.

Your goal here is to explore the sensitivity of the model to small changes in conditions such as surface phosphorus and water fluxes, and to report your findings in the context of the ocean carbon system. I am only expecting a couple of pages for this report.