EPS 287: Role of the biological pump in the carbon cycle

Prof. Ann Pearson

G13 Hoffman (617-384-8392)

pearson@eps.harvard.edu

Asst. Prof. Dave Johnston

302 Hoffman (617-496-5024)

johnston@eps.harvard.edu

Office Hours: by appointment

Schedule: Fridays and/or Wednesdays, 1:00 – 4:00; Location, Geo Museum 204

Assignments, classes 1-10:

1) Each week you will be responsible for reading each of the assigned papers and be prepared to discuss them (generally ~4 papers).

2) For one of the assigned papers, you will (a) prepare a 1 page synopsis of the major points, type of argument (model, data, …), and strengths/weaknesses, as well as (b) lead a 20 minute discussion on your paper (using some combination of PowerPoint and/or chalk talk). The papers will be chosen/assigned during the prior week's class. Generally this will be done in pairs (2 people will present 1 paper jointly.)

Class 11, onward - Term project:

We will divide into groups to work on "Superproblems" in class #11. This will be an active (tutorial) class in which we help you get started on your term project.

In a break with tradition, the course assignment will not be a term paper, but rather a term project. This will be some kind of model or other quantitative exercise, in which you will take steps to resolve an outstanding question. You will turn in a team final report, with figures and data output (and code, if necessary) and your team will give a presentation. Think of this as the equivalent of one very large problem set with a short report.

Assessment:

55% Leading and participation in discussion.

10% Write-ups associated with discussion.

35% Final project

Schedule for the semester:

Jan 27 (F): Carbon system: review, isotope systematics, history of long-term trends; box model basics. Case studies with focus on the Paleozoic to present-day.

Feb 1 (W): Systematics of fractionation in algae and how to understand ε_p. Paleobarometry. Alternative metabolisms and effects on ε.

Feb 3 (F): Export production from a modern perspective. Now that we have a sense of f_{org}, its stability, and/or the uncertainty in how it's determined from C isotopes… what do we really know about how C is exported?

Feb 15 (W): Export production in the past: Proterozoic, P/T, and other interesting times.

Feb 17 (F): PProd and the Redfield ratio. What if the other end of the stick is the thing that is wiggling? We assume stable denominator (P) but what if C, N, and P can all change?

Feb 24 (F): So…what is the size of the biosphere, anyway? Oxygen and oxygen isotopes.

March 7 (W): Falkowski revisited: could nitrogen control export production after all? Nitrogen cycle processes and feedbacks; ocean deoxygenation.

March 16: SPRING BREAK

March 21 (W): Processes controlling carbon burial. How much is driven by production vs. burial conditions?

March 30 (F): Microbial C degradation and methane cycle. What controls the terminal preservation of carbon from a biological perspective, and does biology even matter?

April 6 (F): History of the carbon cycle on land. Terrigenous carbon production, storage, and export. Is there anything special about terrigenous carbon?

April 13 (F): Projects day; start projects in class, with help

April 20: Ann and Dave both gone, no class this week.

April 27 (F): Final presentations.

May 3: ***Projects due, Last day of reading period***#