GG325 -- PRINCIPLES OF GEOCHEMISTRY
Spring 2009 - Final Exam Project

Your Final Exam is a take home project on the comparative geochemistry of 2 elements during the sequence of events from the birth of our solar nebula to the formation of the earth, to the formation of a typical Hawaiian basalt, to the subsequent weathering of this rock via interaction with water. Each of you has picked an element, and I would like you to compare the geochemistry of that element to the geochemistry of Sr. Essentially, you should track your element and Sr along their path from the condensation sequence to the ocean. Your final project

a. should report both abundances and abundance ratio at each of the steps along the way detailed below.
b. explain why/how things changed from the preceding step.

The elements you have picked are:

Student	Element
Matt M	Mo
Nantana	C
Chris	Te
Matt D	Co
Lindsey	U
Kyle	?

I hope you will have fun finding stuff out about your elements!! Feel free to discuss your ongoing research with your fellow students or with me (this can be an interactive project in the sense that you can come to me as questions arise). Feel free to work together on finding out information for Rb or your other elements, but please submit your report in your own words.

I've also I suggest first making an outline and work schedule, and then doing things a topic at a time (e.g., melting the mantle, then crystallization, then chemical break down of your rock, then transport in a river, etc..)

Due Date: You have until the end of finals week to complete the assignment. I prefer electronic submissions (i.e., send it to me by email). But if you prefer, you can instead turn it in to Alison (VGP secretary in room 606A) by noon on Fri 14 Dec (no exceptions, unless you plan to file for an incomplete with a valid excuse). Grades need to be turned in the following Monday.

Project Description
This is mainly an exercise in finding out information, making relevant calculation, and interpreting the results. The main project is described on the next page. I will put an example paper out with the reading for you to look at.

Other notes:

- The project grade will be mostly based on content (see page 3) but please apply your best writing skills as well as you write up your report.
- Be as quantitative as possible when you describe each step in the sequence noted on the next page.
- Please use as much geochemical/geological knowledge as you have at your disposal to rationalize your observations and write a report with the following sections:
  1. Introduction
  2. data/calculations
  3. discussions
  4. references.
  5. Overall Summary and Conclusions (This is an important section)

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Please report and explain abundances of your element (in g/g) and ratios to Sr in these ***"steps"***

1. Solar Abundances (consider how the elements were formed)
2. Condensation sequence (consider important phases).
3. planetary differentiation to make the primitive mantle
4. formation of the depleted mantle
5. formation of a Hawaiian lava: for simplicity, make the following assumptions: a. it is made 10% and 5% modal batch melting of solids from 50% depleted mantle and 50% primitive mantle, respectively. Mix the melts formed from the two solids b. mantle solids are 20% garnet, 20% cpx, 20% opx, 40% olivine (in both sources). c. fractional crystallization of 15% olivine and 5% plagioclase.
6. weathering your lava. (is your element soluble, insoluble, involved in biological interactions, etc..). Consider Hawaii's climate when making these calculations.
7. River transport through an estuary (i.e., how much by dissolved and suspended load?)
8. final destination: the ocean (consider residence time)

Project guidelines:

a) your paper *should be ≤8* double-space laser-printed or typed pages, written in the form of a scientific paper (please, no hand written text) (any illustrations you may wish to include can be computer generated or drawn by hand, as long as they are legible). There is no minimum length requirement. It is up to you to decide how thorough you do or don't want to be. Keep in mind that this project will reflect a large part of your grade; as such, it should cover each essential topic in a manner that leaves out no major facts or explanations.
b) include references for all data cited in a bibliography and cited in the text in one of these style: footnote[1,2], bracket[1,2] or abbreviated author (Smith et al., 1995).
c) provide a summary that encapsulates your findings and compares how your elements' abundances and their ratio change at each step.
d) use results of your own quantitative calculations as much as possible. If you have to make approximations, explain and justify them.
e) make every attempt to compare and contrast your elements' similarities and differences in each step along the way, rather than just describing their individual behaviors.
f) be creative. If you have a hypothesis about something, tell it to me, but use all of your collective geochemical and geological knowledge to justify your suggestion.
g) include graphical items (figures, plots, etc..) when necessary to illustrate a point but please don't load up your document with unnecessary display items.
i) I will grade mostly on content but please use proper grammar and an organized layout.
j) Remember to consider things like oxidation state, ionic size, electronegativity, bonding behavior, chemical abundance, distribution coefficients, aqueous solubility, residence times, ion complexation, pH, pE, etc... for this assignment. You may find the Geochemical Earth Reference Model website (http://earthref.org/GERM/main.htm) useful for finding distribution coefficients and elemental abundances in various earth reservoirs (see links on the main page). You must properly cite all data sources you use.

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I will attach this sheet to each graded project, so you know ahead of time what various sections are worth:

Grade Sheet for _____ (student name)

Topic	**Total Possible Points**	**Your Score**
	Points for the calculations and reasoning about what your found :	
1. Solar Abundances	5	
2. Condensation sequence.	5	
3. planetary differentiation to make the primitive mantle	10	
4. formation of the depleted mantle	10	
5. formation of a Hawaiian lava	21 (3 points for each set of K_ds, 5 points for melt calcs, 5 points for crystal calcs 5 points for discussion)	
6. weathering	5	
7. River transport through an estuary	5	
8. the ocean	5	
	Other Points	
Overall Summary and Conclusions	20	
logistical (i.e., organization, presentation, references)	14	
TOTAL	**100**	