

EESC 4701: Igneous and Metamorphic Petrology
MODELING CRYSTALLIZATION
LAB 6
Due April 5

NAME:

Purpose: *In this lab you will explore PELE, a program that models crystallization. We'll specifically consider the effect of pressure and H₂O on phase equilibria.*

Outline

- Perform four experiments that are detailed below
- Save the text output, "Mass Solids", and "AFM Plot" for each
- Make a series of Harker diagrams (instructions below)
- Answer the questions at the end of the lab

Instructions for using Pele

- Enter the starting melt composition
 - Save the starting composition (so you can easily load it in subsequent experiments)
- Enter the H₂O of the given experiment
- Enter the appropriate Oxygen Buffer
- Click "Compute Redox"
- Normalize melt composition
- Enter the pressure of the experiment
- Find the liquidus
- Enter in the correct stop temperature and proper increment
- Click execute
- When the experiment is complete
 - Take a screen shot of both the "Mass Solids" and "AFM Plot" tabs
 - Save the text output (File>Save last execution as...)

Starting composition

SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MgO	CaO	Na ₂ O	K ₂ O	MnO	P ₂ O ₅
50.2	0.9	14	10	10.8	11	3	1	0.2	0.8

Run conditions

You will perform four experiments using the following conditions.

All experiments

Oxygen buffer: QFM +1

Stop temperature: After you have found the melt liquidus (see above), use the lowest multiple 50 that is above 800 C.

Inc: -50 C

All experiment should be isobaric.

All experiment should be fractional crystallization.

Experiment 1

Pressure: 8 kbar

H₂O initial: 4 wt.%

Experiment 2

Pressure: 1 kbar

H₂O initial: 4 wt.%

Experiment 3

Pressure: 8 kbar

H₂O initial: 0.5 wt.%

Experiment 4

Pressure: 1 kbar

H₂O initial: 0.5 wt.%

Harker diagrams

Make 6 Harker diagrams following the instructions below:

- Plots should be scatter plots that are made in Excel
 - Each scatter plot should also have a line connecting points
- All plots should have SiO₂ on the x-axis
- The y-axis variables are: MgO, FeO, CaO, Na₂O, K₂O, P₂O₅
- Each plot should have 4 data series (each of the four experiments)
- Each plot should have a legend
- On the CaO and FeO plots, for each of the 3 experiments, indicate where the following phases begin crystallizing (this can be done in Excel – or it can be done by hand with print outs)
 - Olivine
 - Pyroxene
 - Plagioclase

Questions

Answer the following questions using complete sentences.

1. Compare the liquidus temperatures of the different experiments. Which melt has the highest liquidus temperature? Which plot has the lowest liquidus temperature? Why?
2. For each experiment, list the phases crystallized in the order in which they occur (doesn't have to be in full sentences).
3. Look at the FeO vs. SiO₂ figure. What is different about each experiment? How can you explain this?
4. Which of your experiments best fits mid ocean ridge basalt evolution? Which fits arc basalt evolution? In these two settings, does your modeled evolutionary trends generally fit with the observations?

Turn in

- Harker diagram
- All 4 "Mass Solids" plots
- All 4 "AFM Plot" plots
- Answers to the questions above