

your name _____

Petrology 2006 – Exam #3

1. Define the following terms:

migmatite

pelite

hornfels

protolith

2. Define and explain how do each of the following form/occur? Be specific enough so I know you know the answer:

foliation

greenschist

retrograde metamorphism

contact metamorphism

3. Consider a "typical" marble that starts off life (before it is metamorphosed) containing calcite, dolomite, quartz, water and carbon dioxide. When it is metamorphosed, it develops new metamorphic minerals, including talc, tremolite, forsterite, diopside, periclase, and wollastonite (Box A). Add these to the original things present – that's a lot of possible minerals and assemblages.

A. Under normal conditions, how many minerals would you expect to coexist stably in "typical" marble? Why?

B. Write and balance a reaction involving talc, periclase, quartz and water. Useful

Box A

phase	formula
calcite	CaCO_3
dolomite	$\text{CaMg}(\text{CO}_3)_2$
quartz	SiO_2
talc	$\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$
tremolite	$\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$
forsterite	Mg_2SiO_4
periclase	MgO
wollastonite	CaSiO_3
diopside	$\text{CaMgSi}_2\text{O}_6$
water	H_2O

formulas are in Box A. Which side of the reaction do you expect to be the high temperature side? Why?

C. Write and balance a reaction involving periclase, forsterite and quartz? Which side of the reaction do you expect to be the high-temperature side? Why?

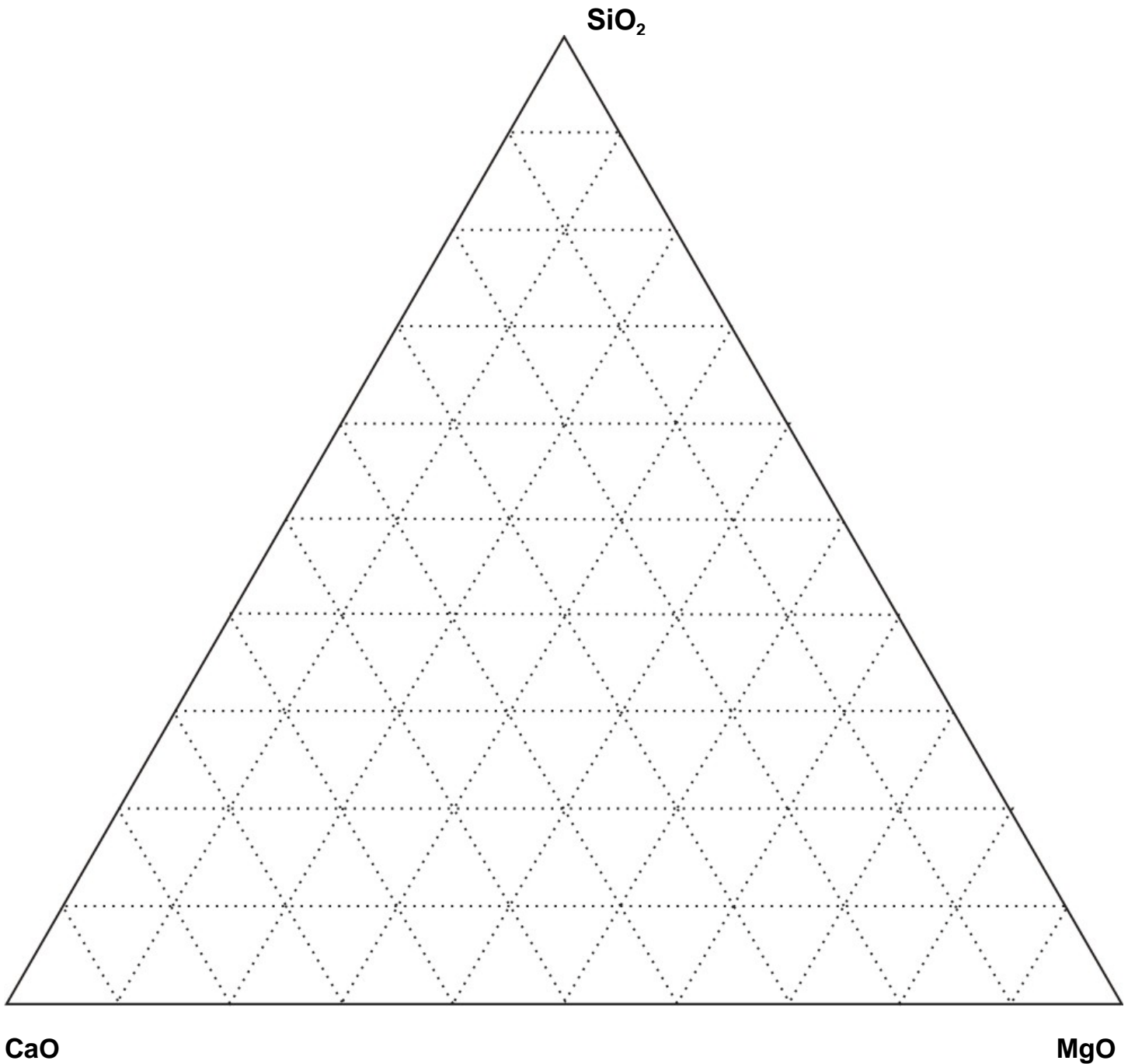
D. Write a balance a decarbonation reaction that involves some or all of the minerals in Box A. Which side of the reaction do you expect to be the high temperature side? Why?

E. Hold on there, Jack! The reaction from part B above has 1 more mineral in it than the one from part C. How can this be? Are we violating the phase rule? If we are, how is it justified. If not, explain what's up.

4. Why do we go to all the work to combine some components and project from others when we make diagrams such as AFM or ACF diagrams? What is the point? What does it gain us?

When combining components (e.g., K_2O and Na_2O) how should we decide which ones to combine? For example, why not combine MgO and SiO_2 – we never do this?

How should we decide which components to project from in a chemographic diagram?



5. Plot the minerals listed in Box A on this diagram. Ignore (project from) H_2O and CO_2 .

6. A bright young geologist named Dan was studying some rocks in Montana and found the following assemblages in three different marbles from the same outcrop:

- quartz-diopside-tremolite
- calcite-forsterite-wollastonite
- quartz-forsterite
- wollastonite (yes, it is pure wollastonite)

Given this information, draw appropriate tie-lines on the triangular diagram above. Be careful, things are a bit tricky – I did not give you the simplest of problems and maybe tried to mess with you a bit.

7. Refer to the AFM diagrams on the next page.

a. Why do some minerals plot as points and some as lines and some as black areas?

b. What is the maximum value for $Fe/(Fe+Mg)$ possible for chlorite (Chl), according to the diagrams?

c. Where (use letters to refer to zones or reactions) are the following assemblages stable (assume that muscovite and quartz are present in all of them):

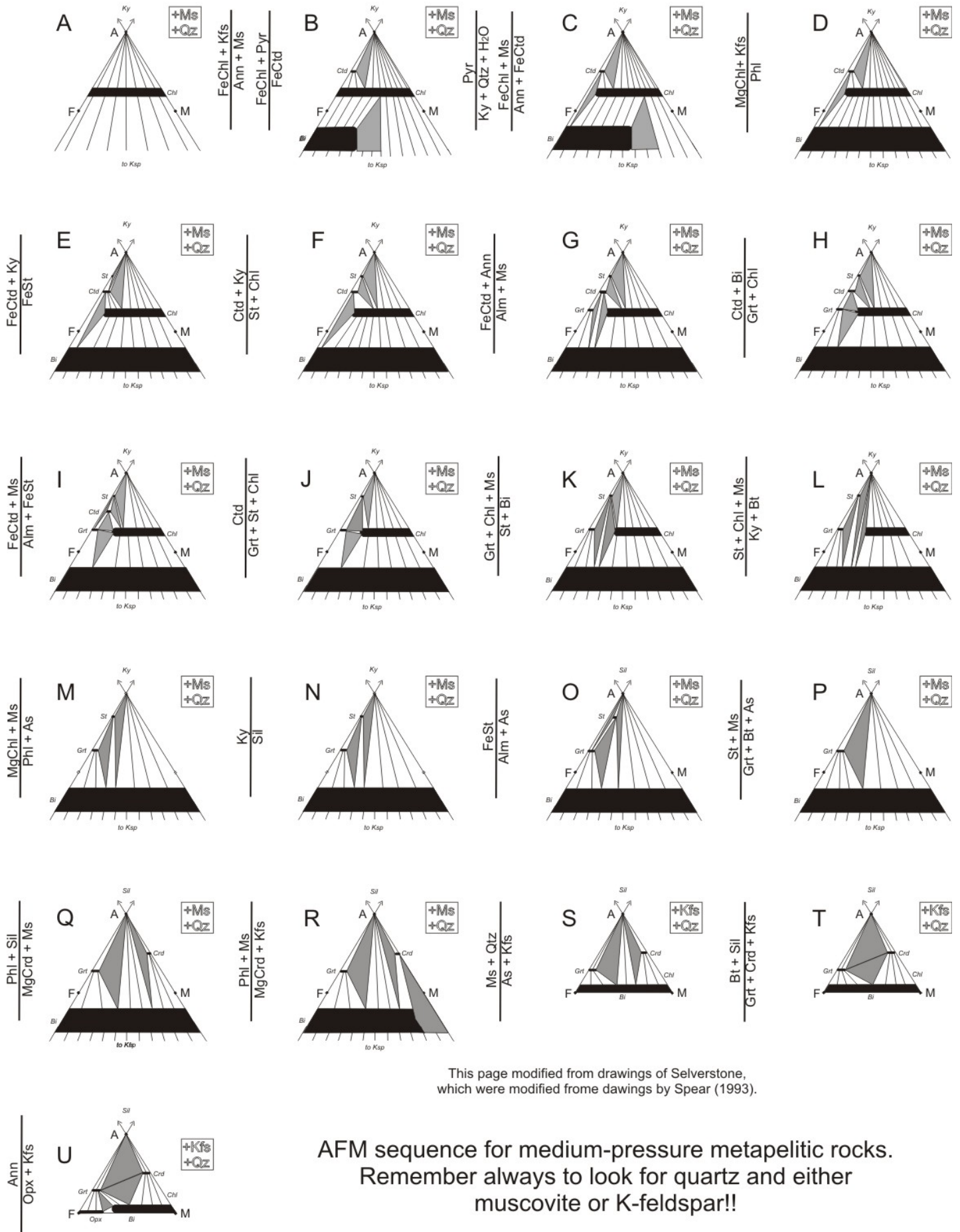
garnet (Grt) - chlorite (Chl) - biotite (Bi)

garnet (Grt) - cordierite (Crd)

chloritoid (Ctd) - garnet (Grt) - chlorite (Chl) - biotite (Bi)

d. Consider diagram P (next page). For a composition that plots in the gray triangle, what will be the mineral assemblage and what will be the compositions of the phases present?

AFM Compatibility Diagrams



This page modified from drawings of Selverstone, which were modified from drawings by Spear (1993).

AFM sequence for medium-pressure metapelitic rocks.
 Remember always to look for quartz and either muscovite or K-feldspar!!

