Igneous petrology EOSC 321
Laboratory 5:
Modal and normative compositions of granites

Learning Goals. After this Lab, you should be able:

- Classify phaneritic rocks based on their modal mineral abundance
- Classify igneous rocks based on their normative compositions
- Compare and contrast the modal and normative compositions of igneous rocks and consider why there are differences
- Identify the key rock-forming minerals in felsic rocks
- Name felsic rocks based on their textures and mineral modes using triangle diagrams

Duration and organization: This lab should be completed by the next week Lab period. The assignment is for **groups of 2 students**.

The first 30 minutes of the lab will be an assessment on felsic rocks. You will be given an unknown felsic rock thin section to describe and categorize.

Material Needed: a) Lab 5 Manual printed off the course website; b) Polished stained and unstained hand specimens

Introduction: This lab emphasizes the skills of rock classification of macro-specimens based on modal and normative compositions. Ideally, a normative composition, i.e. abundances of imaginary, normative minerals should be used for a more accurate classification of a rock. Rock norm is not always similar to modes of real minerals present in the rock. Learn how to calculate rock norms using the specialized petrological software and compare the norms with mineral modes.

Note that macrospecimens have been stained to make K-feldspar turn yellow. Learn to recognize Ksp in stained and unstained natural samples.

Background Info: The Lab samples have been collected from the Endako batholith (central Canadian Cordillera), a composite batholith that consists of many intrusive phases. The batholith had a protracted emplacement history, covering approximately 75 m.y., with clear evidence for periods of magmatic quiescence. The oldest magmatic suite of the Endako batholith, the Stern Creek suite, is dated at approximately 220 Ma. Plutons of the Stag Lake suite range in age from 180 Ma to 161 Ma. The Francois Lake suite is divided into two subsuites: the Glenannan subsuite dated at 157 Ma to approximately 155 Ma and the 149 to 145 Ma Endako subsuite that hosts the Endako molybdenite deposit. Intrusion of the Casey phase occurred at 145.1 Ma. Eocene intrusion of the high-level, miarolitic Sam Ross Creek phase happened last. The Endako batholith hosts Jurassic molybdenite deposit, which is the oldest economic Mo deposit in the Cordillera of North America. Pulsed magmatism, evident even within individual magmatic suites, may play a major role in concentrating and ultimately depositing molybdenite in this porphyry system.

Assignment:

1. Examine the hand samples in the Lab found in the tray labeled "Endako batholith". For each sample, estimate modes of mafic minerals, quartz, plagioclase and K-feldspar using the attached reference fields of view. Plot the estimates on the QAP ternary diagram and name each rock using the IUGS classification triangle for felsic and intermediate plutonic rocks (all attached).

2. Trace the evolution of the bulk composition and modal mineralogy of the Endako magma based on the relative ages of the magmatic phases given in the background Info. How would you describe the temporal evolution of the melt?

3. Bulk chemical analyses of all Endako phases are given in the attached Table. Calculate their normative compositions on a CIPW Norm calculator you downloaded from the course website. Remember to normalize the analyses to 100% without volatiles (H_2O, CO_2, Loss on Ignition (LOI)). Sulfur (S) in the analyses is given in ppm, just ignore it. For comparison with mineral modes, you need to calculate VOLUME % of normative minerals.

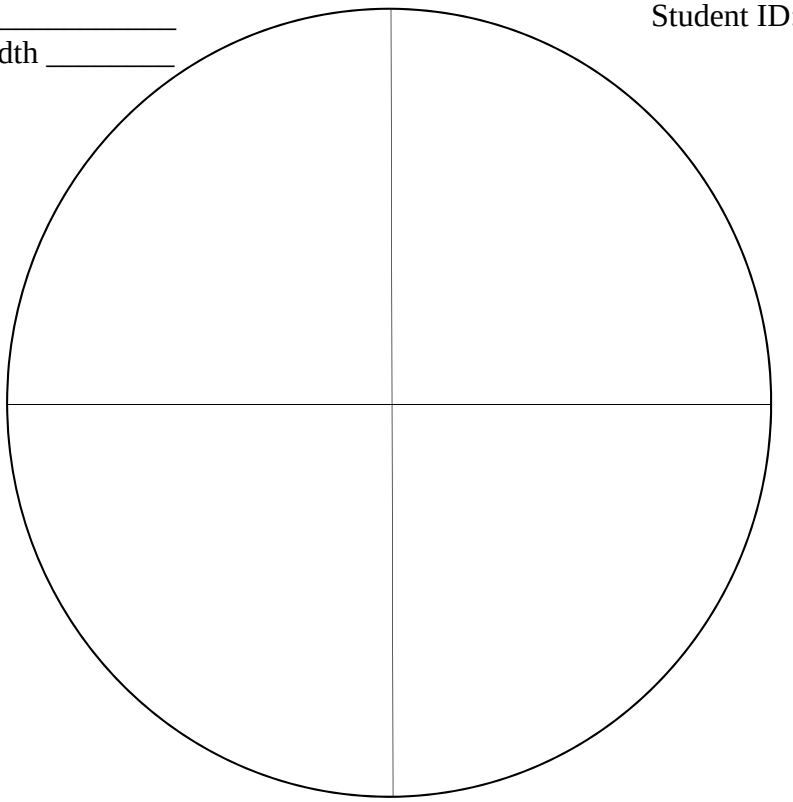
4. Use the norms for classification of the Endako rocks on the second empty classification triangle. Count Q as % normative quartz, P- as % normative anorthite, A – as % normative Ksp. Plot each rock on the QAP ternary diagram and name the rock accordingly.

5. Compare names and positions of points in the triangles assigned to each rock based on the modes and the norms. Comment on possible discrepancies. Hint: What are mafic minerals present in the rocks and how do they contribute to the discrepancies?

TEST 3 Felsic Rocks
30 minutes

Thin section _____
Magnification_____
Field of view width _____

Your Name:_____
Student ID:_____



Description:

Rock name:

Igneous petrology EOSC 321

Laboratory 5:

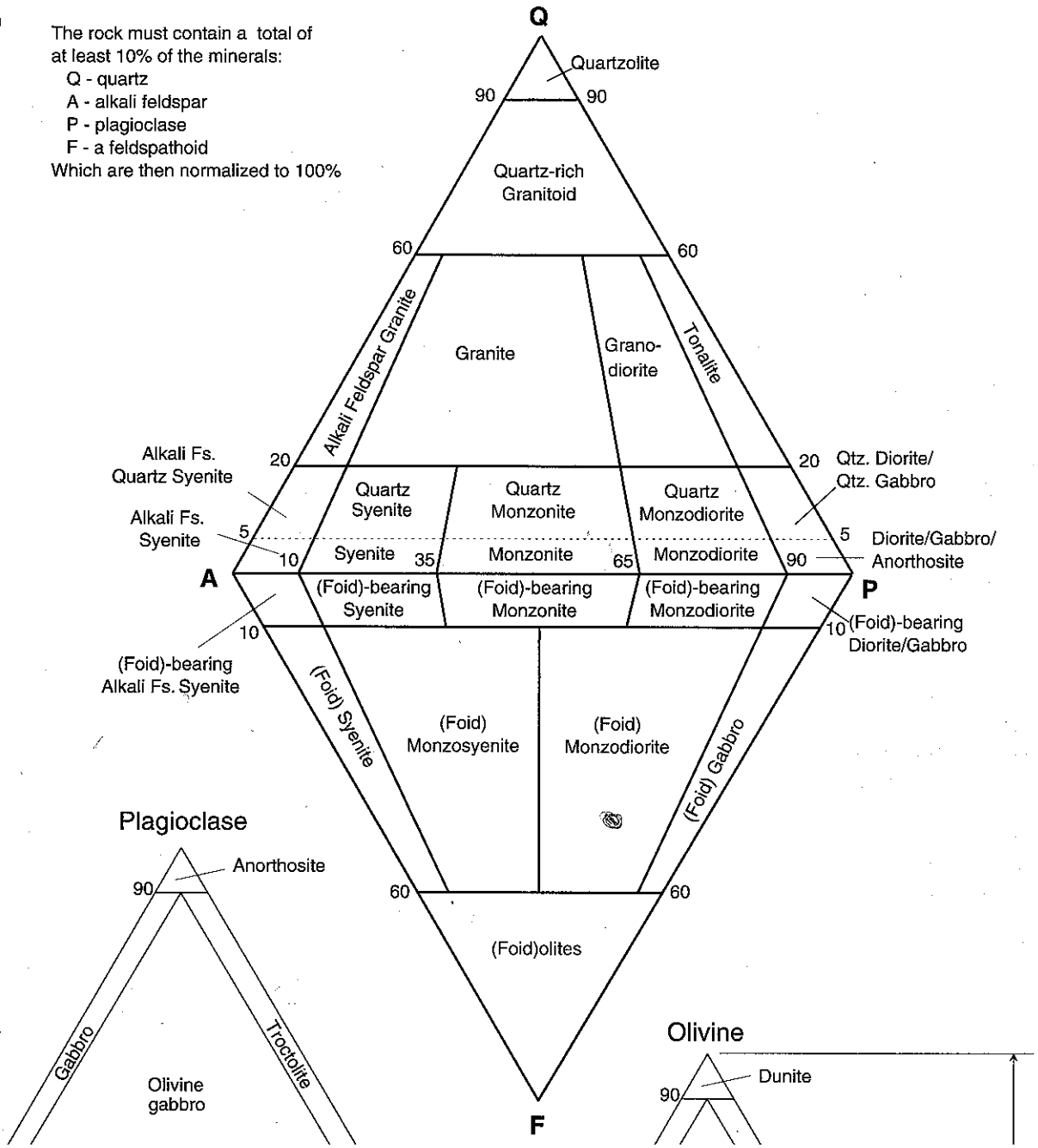
Granitoids

Sample	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	CO_2T	P_2O_5	S	LOI
Fraser suite	**66.7**	**0.63**	**15.9**	**1.1**	**2.5**	**0.1**	**0.99**	**2.17**	**4.8**	**3.91**			**0.2**	**60**	**0.7**
Casey phase (type area)	77.0	0.10	12.4	0.1	0.4	0.06	0.15	0.20	3.8	4.58	0.5	0.0	0	0	
Francois sub-phase	**70.2**	**0.39**	**14.8**	**1.2**	**1.0**	**0.1**	**0.70**	**1.66**	**4.4**	**4.20**			**0.2**	**74**	**0.9**
Endako phase	67.0	0.43	14.4	0.9	1.7	0.1	1.23	2.64	3.0	4.28			0.2	638	3.4
Glenannan phase	**72.2**	**0.29**	**13.5**	**1.5**	**0.8**	**0.1**	**0.82**	**1.71**	**3.5**	**3.86**			**0.1**	**29**	**0.6**
Nithi phase	75.0	0.17	13.1	0.3	0.7	0.06	0.29	0.89	3.9	4.09	0.5	0.2	0	0	
Copley Lake phase	**70.6**	**0.30**	**14.9**	**1.1**	**1.2**	**0.06**	**0.66**	**1.93**	**4.0**	**4.22**	**0.6**	**0.3**	**0**	**0**	
Caledonia phase	61.6	0.52	16.5	2.6	2.4	0.19	2.50	2.43	4.4	3.15	2.2	1.1	0	0	
Leg Lake phase	**70.6**	**0.30**	**14.9**	**1.1**	**1.2**	**0.06**	**0.66**	**1.93**	**4.0**	**4.22**	**0.6**	**0.3**	**0.11**	**0**	
Sugarloaf phase	57.20	0.74	17.40	3.0	4.3	0.15	3.07	6.50	3.7	2.30			0.29	199	0.6
Limit Lake intermed. pha	**68.8**	**0.42**	**15.3**	**1.1**	**2.0**	**0.07**	**1.45**	**3.21**	**3.7**	**3.02**	**0.7**	**0.0**	**0**	**0**	
Stag. Lake mafic phase	49.4	1.02	17.4	4.8	5.8	0.19	5.55	10.37	2.7	0.94	1.4	0.0	0	300	
Stern Creek Suite	**63.9**	**0.51**	**16.3**	**1.5**	**2.5**	**0.1**	**2.26**	**4.52**	**4.4**	**1.99**			**0.2**	**49**	**1.2**

(a)

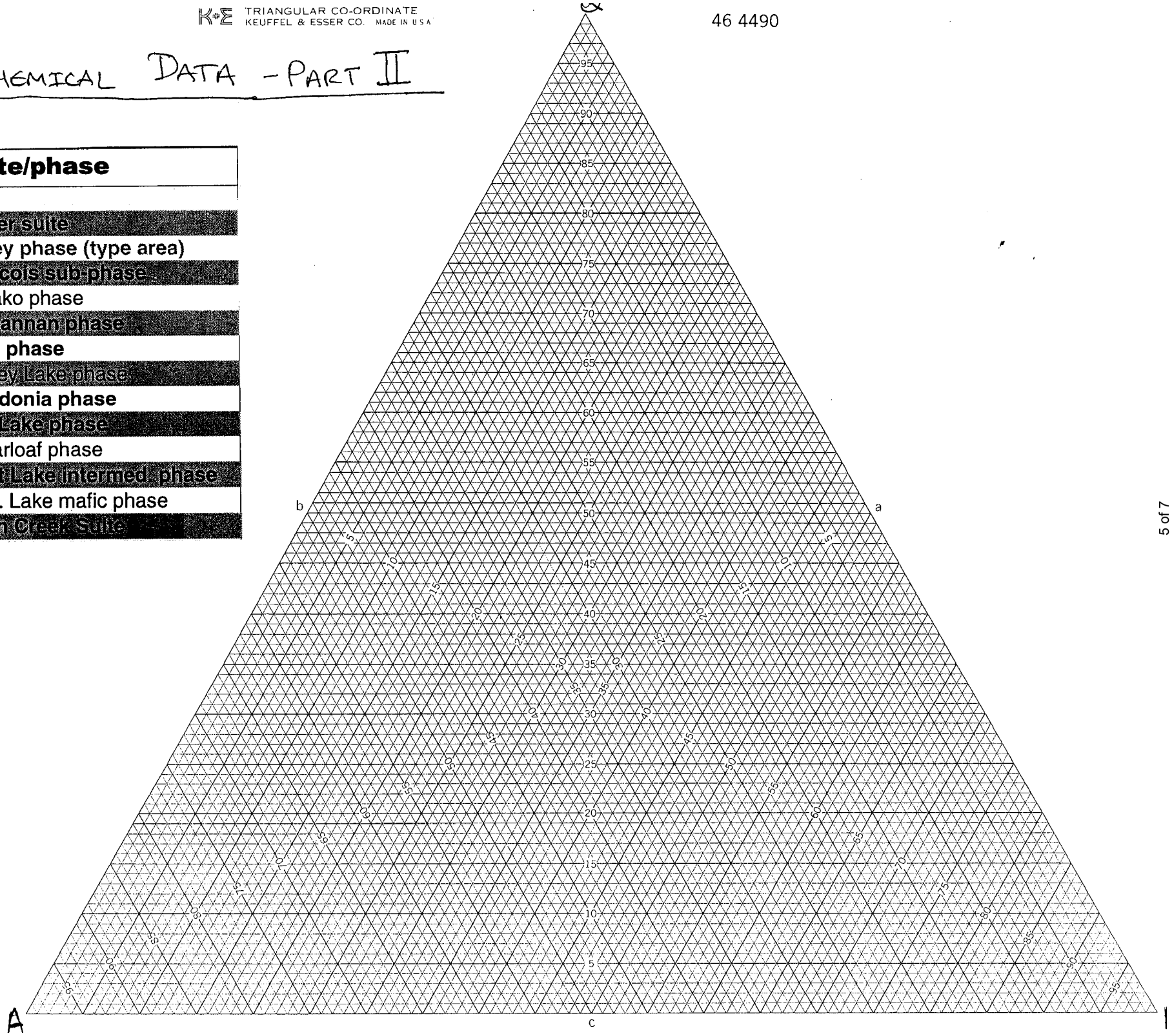
The rock must contain a total of at least 10% of the minerals:
- Q - quartz
- A - alkali feldspar
- P - plagioclase
- F - a feldspathoid

Which are then normalized to 100%



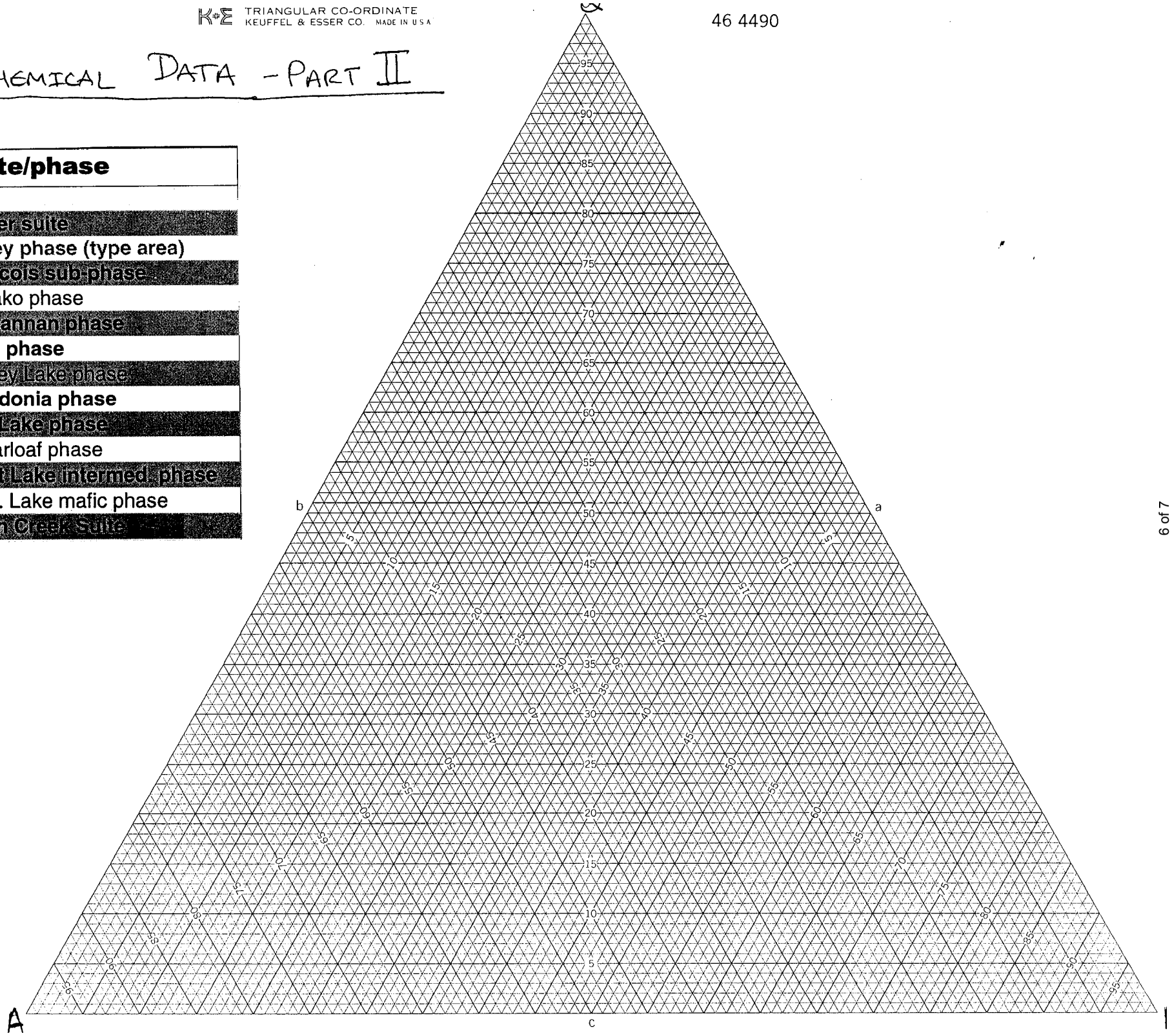
GEOCHEMICAL DATA - PART II

	Suite/phase
1.	Fraser suite
2.	Casey phase (type area)
3.	Francois sub-phase
4.	Endako phase
5.	Glenannan phase
6.	Nithi phase
7.	Copley Lake phase
8.	Caledonia phase
9.	Leg Lake phase
10.	Sugarloaf phase
11.	Limit Lake intermed. phase
12.	Stag. Lake mafic phase
13.	Stern Creek Suite

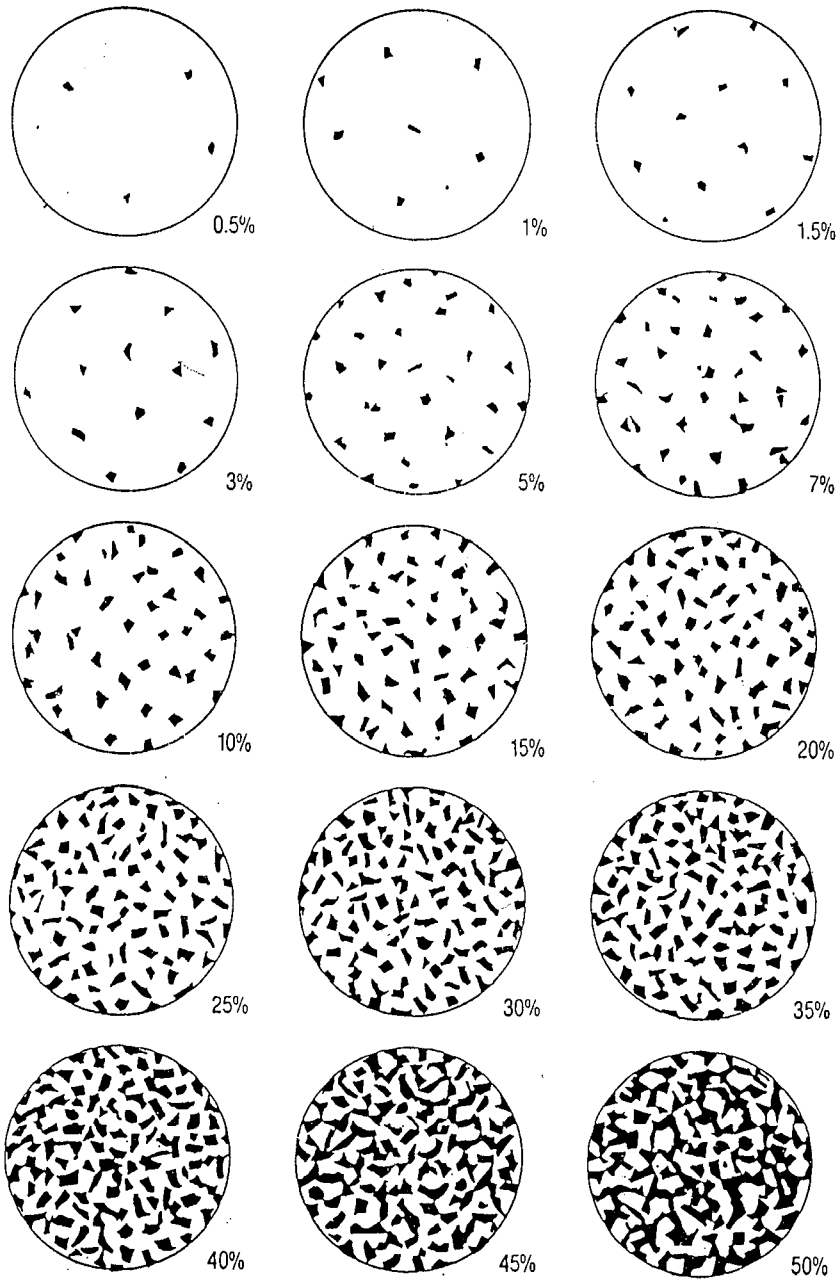


GEOCHEMICAL DATA - PART II

	Suite/phase
1.	Fraser suite
2.	Casey phase (type area)
3.	Francois sub-phase
4.	Endako phase
5.	Glenannan phase
6.	Nithi phase
7.	Copley Lake phase
8.	Caledonia phase
9.	Leg Lake phase
10.	Sugarloaf phase
11.	Limit Lake intermed. phase
12.	Stag. Lake mafic phase
13.	Stern Creek Suite



APPENDIX 3. Percentage Diagrams For Estimating Compositon By Volume*



*To convert the results to weight percentages, multiply each volume percentage by the specific gravity of that mineral and recalculate the resulting numbers so that they sum to 100.