UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2009/2010

April/May 2010

EBS 242/3 – Petrography & Ore Microscopy
[Petrografi & Mikroskopi Bijih]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains ELEVEN printed pages and THREE pages APPENDIX before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS muka surat yang bercetak dan TIGA muka surat LAMPIRAN sebelum anda memulakan peperiksaan ini.]

This paper consists of TWO questions from PART A and FOUR questions from PART B.
[Kertas soalan ini mengandungi DUA soalan dari BAHAGIAN A dan EMPAT soalan dari BAHAGIAN B.]

Instruction: Answer **TWO** questions from PART A and **THREE** questions from PART B. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **DUA** soalan dari BAHAGIAN A dan **TIGA** soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies, the English version must be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

PART A / *BAHAGIAN A*

1. Please define or describe the following:

   (i) Pyroclastic and Porphyritic (igneous rock).

   (ii) Detrital and Lithification (sedimentary rock).

   (iii) Metamorphic aureole (metamorphic rock).

   (iv) Reflectance and Bireflectance (ore microscopy).

   (v) Birefringence and Becke Lines (optical mineralogy).

   Takrif atau terangkan mengenai perkara-perkara berikut:

   (i) Piroklas dan forfiritik (batuan igneous).

   (ii) Endapan berklas dan pembatuan (batuan sedimen).

   (iii) Aureol metamorf (batuan metamorf).

   (iv) Balikan dan Dwibalikan (mikroskopi bijih).

   (v) Dwirefringens dan garis Becke (mineralogi optik).

   (20 marks/*markah*)

2. Given Figure 1(a) and 1(b) shows the classification charts or diagrams of the two common rock classes or categories (Rock A and Rock B) in the earth crust. Discuss and elaborate about their classification schemes.

   Carta atau Rajah 1(a) dan 1(b) yang diberikan menunjukkan skema pengelasan dua kategori utama batuan pembentukan kerak bumi (Batuan A dan Batuan B). Bincang dan perjelaskan skema-skema pengelasan ini.

(i) Rock A.

Batuan A.

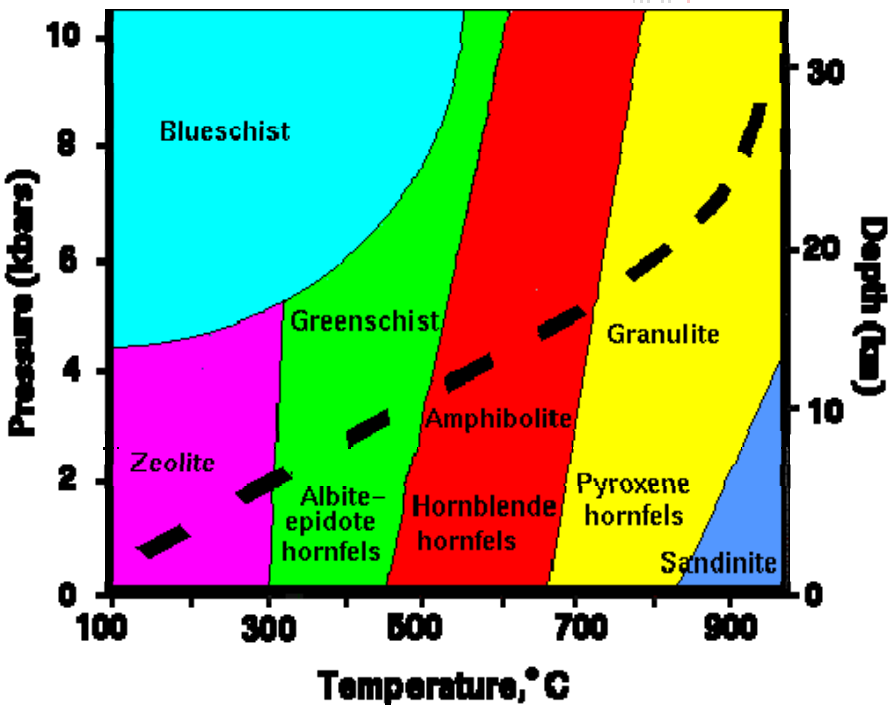

Figure 1(a) / *Rajah 1(a)*

(ii) Rock B.

Batuan B.

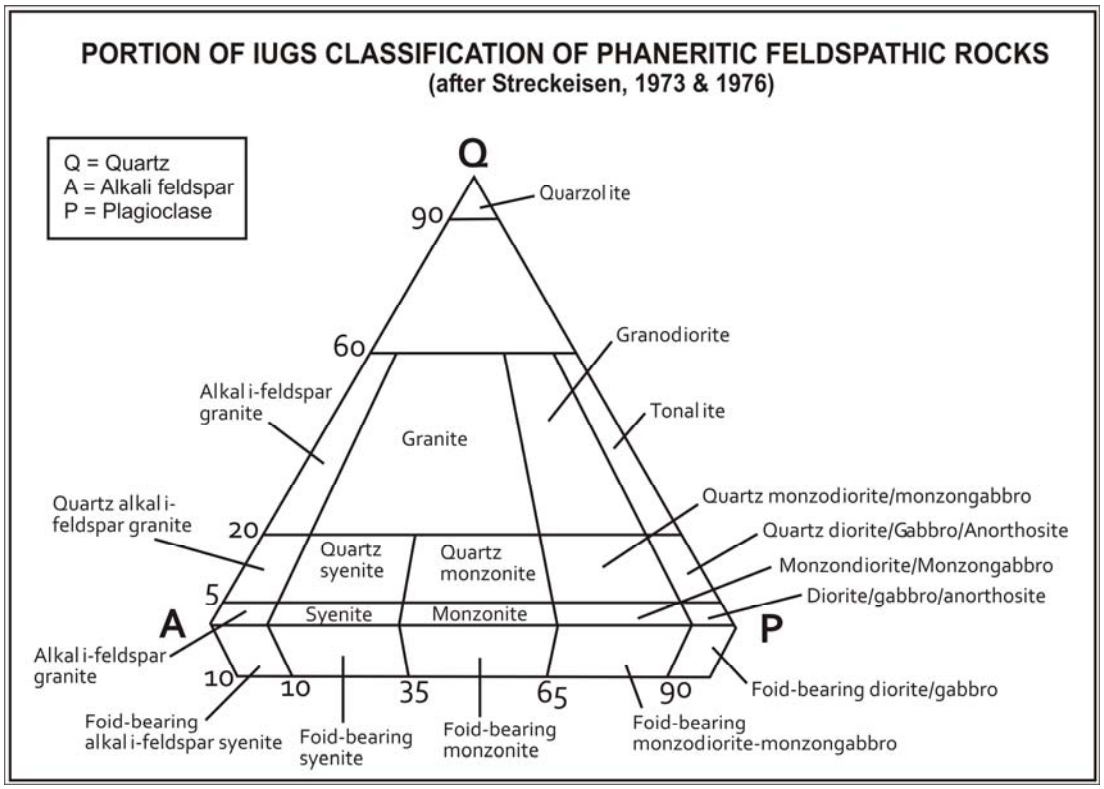

Figure 1(b) / *Rajah 1(b)*

(20 marks/*markah*)

PART B / *BAHAGIAN B*

3. Answer the following question:

(i) Based on the QAPF classification system (APPENDIX 1), determine the class/type and the name of these igneous rocks according to their respective composition and textures as given in the following Table A.

Jawab soalan-soalan berikut:

(i) Berdasarkan kepada sistem pengelasan QAPF (LAMPIRAN 1), tentukan kelas/jenis serta nama batuan-batuan igneus yang mempunyai tekstur dan komposisi seperti berikut sebagaimana diberikan dalam Jadual A.

Table A / *Jadual A*

Features / *Fetur*	**Igneous A / *Igneus A***	**Igneous B / *Igneus B***	**Igneous C / *Igneus C***
Composition / *Komposisi*	Q: > 23% AP: < 9% Plg: > 66% Acc: Muscovite / *Muscovit* (< 2%)	Q: 10% AP: 15% Plg: 70% Acc: Biotite, olivine / *Biotit, olivin* (> 5%)	Q: 22% AP: < 12% Plg: > 65% Acc: Augite / *Augit* (> 2%)
Texture / *Tekstur*	Medium to coarse grained / *Berbutir sederhana hingga kasar*	Aphanetic / *Berbutir halus*	Medium to coarse grained / *Berbutir sederhana hingga kasar*
Distinguished features / *Fetur-fetur unggul*	Granular / *Berbutir*	Euhedral, plagioclase normally andesine as phenocryst, Porphyritic / *Euhedron, Fenokris Plagioklas adalah andesin sebagai fenokris Porfiritik*	Granular / *Berbutir*

Notes: Q: Quartz; AP: Alkali feldspar; Plg: Plagioclase and Acc: Accessory mineral

Nota: Q: Kuarza; AP: Alkali feldspar; Plg: Plagioklas dan Acc: Mineral aksesori

(ii) State and describe the optical properties between the following minerals:

- Biotite and Plagioclase (transparent minerals).
- Molybdenite and pyrite (opaque minerals).
- Calcite and cassiterite.

Nyata dan terangkan mengenai sifat-sifat optik di antara kedua-dua pasangan mineral berikut:

- *Biotit dan plagioklas (mineral lutsinar).*
- *Molibdenit dan pirit (mineral legap).*
- *Kalsit dan kasiterit.*

(20 marks/*markah*)

4. Please answer the following questions:

Sila jawab soalan-soalan berikut:

[a] Genetically, metamorphic rocks are classified into a few main classes or categories. Please state and describe these classes with appropriate (rock types) examples.

Secara genetik, batuan metamorf boleh dikelaskan kepada beberapa kategori utama. Sila nyatakan dan terangkan kelas-kelas ini berserta dengan contoh-contoh batuan yang bersesuaian.

(10 marks/*markah*)

[b] Minerals are grouped into three different optical classes depending on the crystal system to which they belong. Please state the classes and briefly describe how to distinguish the minerals under the polarised microscope with appropriate examples for each crystal class?

Mineral adalah dikelaskan kepada tiga kelas optikal berdasarkan sistem kristal. Sila nyatakan sistem kelas tersebut dan takrifkan secara umum bagaimana sifat ini boleh ditentukan di bawah mikroskop pengutub berserta contoh?

(10 marks/*markah*)

5. Please answer any <u>two (2)</u> of the following questions:

Sila jawab mana-mana <u>dua (2)</u> soalan berikut:

[a] Refractive index, RI of a material is the ratio of the speed of light in a vacuum to the speed of light in a material through which it passes. Briefly describe the way of measuring the index of refraction of an unknown mineral using the Becke Line method.

Index biasan, I.B. bagi suatu bahan adalah hubungan di antara halaju cahaya dalam vakum dengan halaju cahaya tersebut bergerak dalam sesuatu medium. Sila nyatakan cara mengukur indeks biasan bagi mineral yang tidak dikenalpasti menggunakan kaedah Garis Becke.

(10 marks/*markah*)

[b] What determines the retardation of mineral crystal and its governing factors? Please determine the birefringence of mineral augite with R.I. values for n_s = 1.724 and n_f = 1.700 respectively for standard thin section.

Apakah yang menentukan nilai pembantutan hablur mineral dan faktor kebergantungannya? Sila tentukan nilai dwibalikan mineral augit yang mempunyai I.B. masing-masing n_s = 1.724 dan n_f = 1.700 untuk keratan nipis piawai.

(10 marks/*markah*)

[c] Briefly define or describe the following:

(i) Phaneritic and Aphanitic textures (igneous rock).

(ii) Metasomatism and Metamorphic facies (metamorphic rock).

(iii) Anisotropy and Polarization colour (ore microscopy).

Secara ringkas berikan tarifan atau keterangan mengenai perkara berikut:

(i) Tekstur forforitik dan Aphanitik (batuan igneus).

(ii) Metasomatisma dan Metamorf fasis (batuan metamorf).

(iii) Anisotropi dan warna pengutuban (mikroskopi bijih).

(10 marks/*markah*)

6. Please answer any <u>two (2)</u> of the following questions:

Sila jawab mana-mana <u>dua (2)</u> soalan berikut:

[a] Please describe the extinction phenomenon in optical mineralogy and the method used to study this property under the polarised microscope with appropriate example of minerals.

Sila terangkan padaman fenomena di dalam mineralogi optik dan kaedah yang digunakan untuk mengkaji sifat ini menggunakan mikroskop pengutub berserta contoh mineral yang bersesuaian.

(10 marks/*markah*)

[b] What are “unpolarized” and “polarized” lights?

Apakah itu cahaya “tak terkutub” dan “terkutub”?

(10 marks/*markah*)

[c] Briefly discuss the differences and similarities between the properties of the following rocks (composition, texture, grain size and other distinguished features):

(i) Dolomite and limestone.

(ii) Rhyollite and granite.

(iii) Conglomerate and sandstone.

(iv) Basalt and gabbro.

Secara ringkas, bincangkan sifat-sifat perbezaan dan persamaan utama di antara pasangan batuan berikut (komposisi, tekstur, saiz butiran dan fetur-fetur unggul lain):

(i) Dolomit dan batu kapur.

(ii) Riolit dan granit.

(iii) Konglomerat dan batu pasir.

(iv) Basalt dan gabro.

(10 marks/*markah*)

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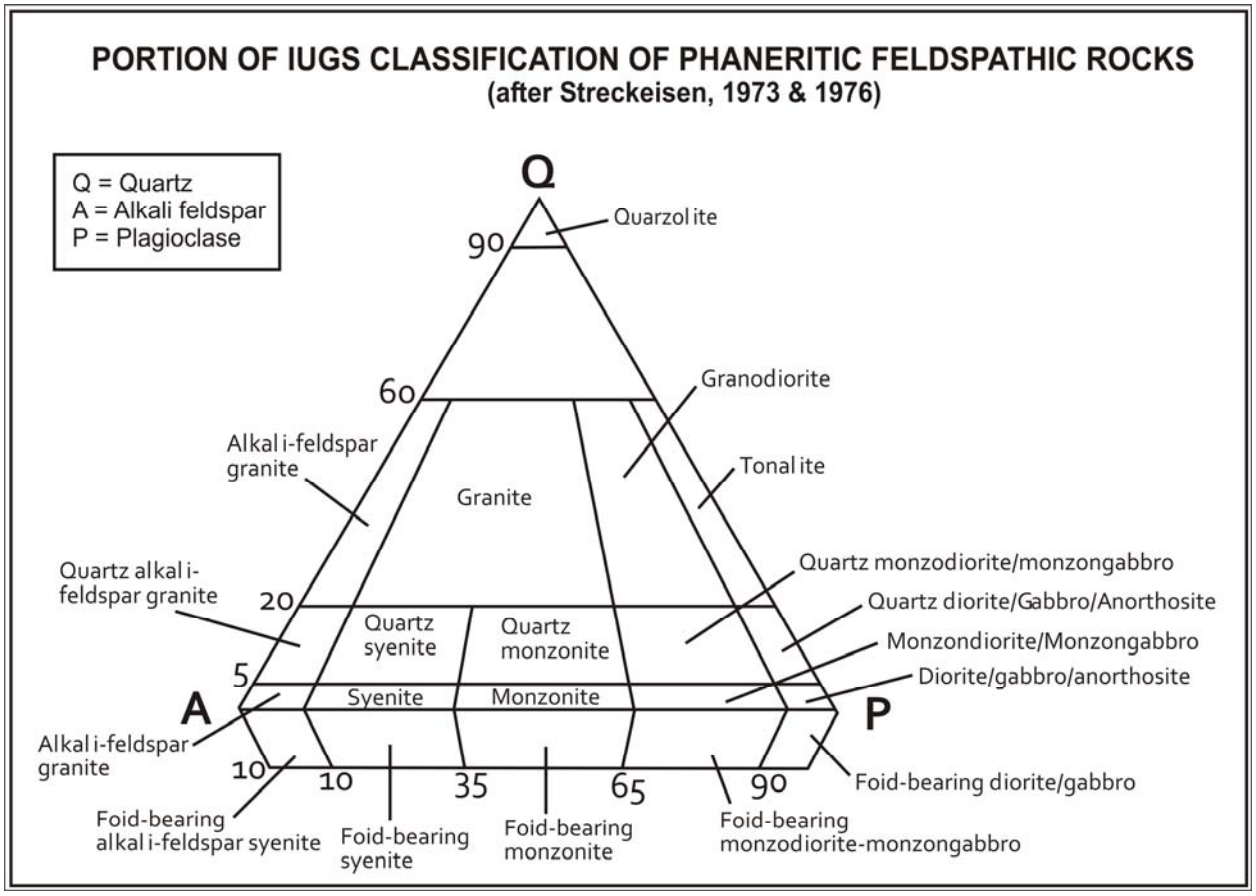
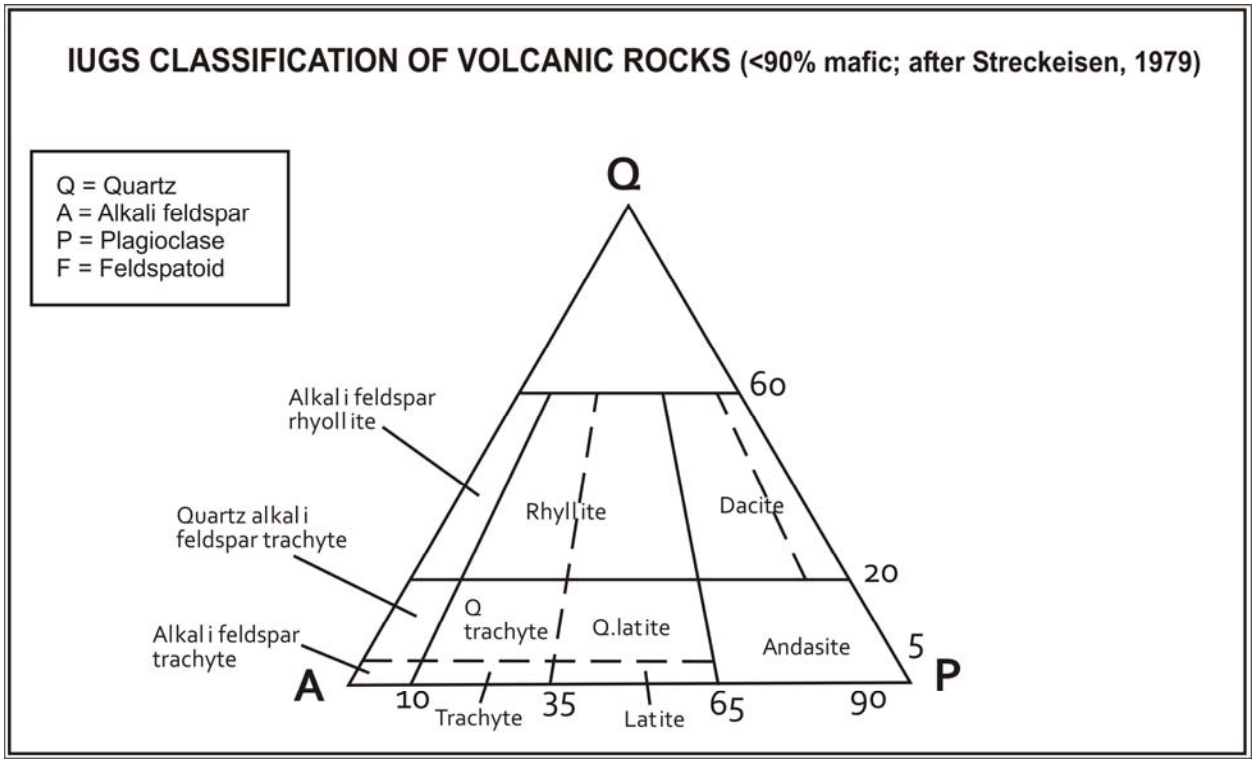
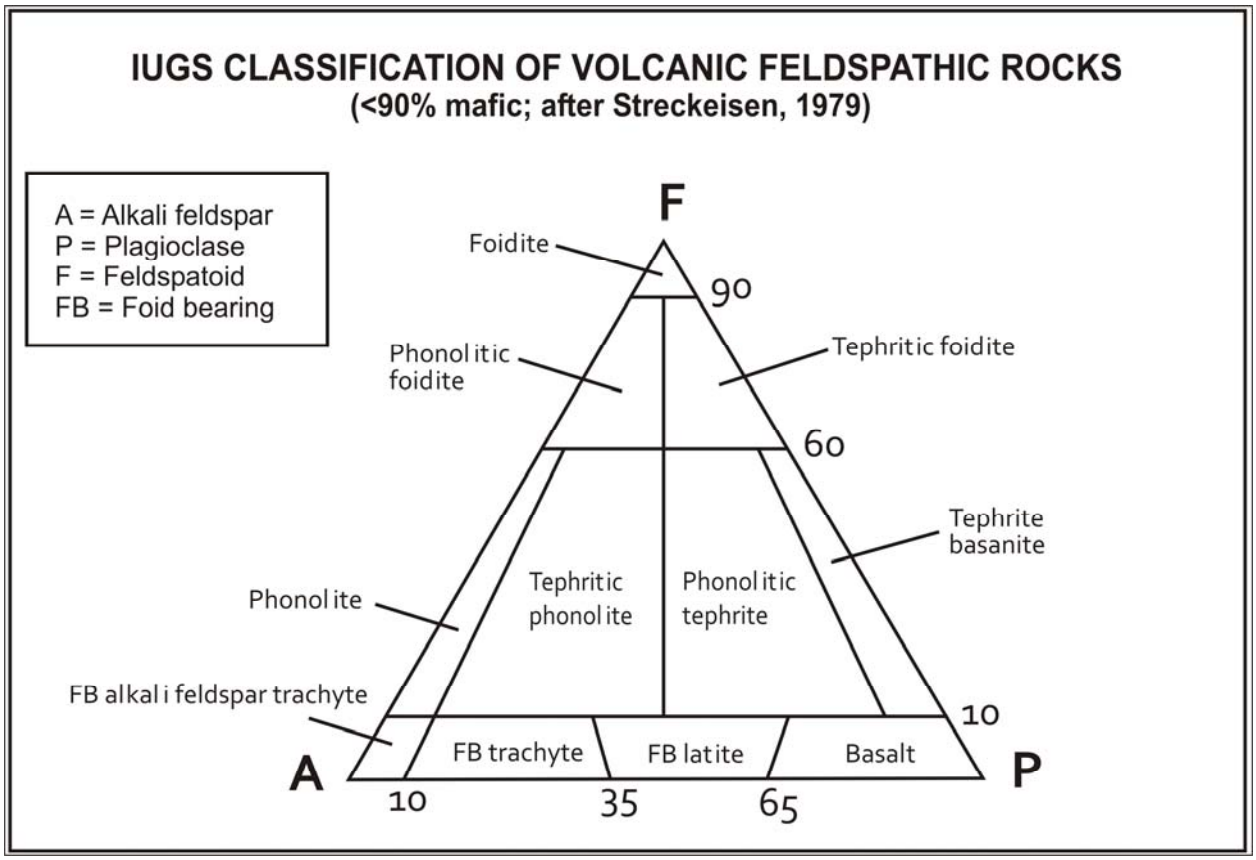
APPENDIX 1 / ***LAMPIRAN 1***




IUGS CLASSIFICATION OF VOLCANIC ROCKS (<90% mafic; after Streckeisen, 1979)
Q = Quartz
A = Alkali feldspar
P = Plagioclase
F = Feldspatoid
Q
60
20
5
A
P
10
35
65
90
Alkali feldspar rhyolite
Quartz alkali feldspar trachyte
Alkali feldspar trachyte
Rhyllite
Dacite
Q trachyte
Q.latite
Andasite
Trachyte
Latite


IUGS CLASSIFICATION OF VOLCANIC FELDSPATHIC ROCKS
(<90% mafic; after Streckeisen, 1979)
A = Alkali feldspar
P = Plagioclase
F = Feldspatoid
FB = Foid bearing
F
Foidite
90
Phonolitic foidite
Tephritic foidite
60
Tephrite basanite
Phonolite
Tephritic phonolite
Phonolitic tephrite
FB alkali feldspar trachyte
10
FB trachyte
FB latite
Basalt
A
P
10
35
65