Rock Classification

Chapter 2, pp. 17-26

Basis for Classification

- Minerals present in the rock
  - Best for coarse-grained rocks
  - Useful for field work
- Chemical Composition
  - Works for fine-grained rock
  - Expensive and takes time

Mineralogical Classification

- Color Index = % of dark minerals
- Felsic < 35% mafic minerals
- Mafic = 35% – 90% mafic minerals
- Ultramafic > 90% mafic mineral

Monominalic Rocks

- Plagioclase Anorthosite
- Olivine Dunite
- Augite Clinopyroxenite
- Hypersthene Orthopyroxenite

QAPF Diagram

- Useful for most Common rocks
- Recalculate the minerals to 100% QAP or FAP

Chemical Classification

- CIPW norm
  - Calculated minerals from chemical analysis
- Saturation concept
  - Si saturation
    - Acid to basic
  - Al saturation
- Harker-Peacock index
  - Alkalies vs calcium
**Silica Saturation**

<table>
<thead>
<tr>
<th>Acid</th>
<th>SiO$_2$ &gt; 66 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate</td>
<td>SiO$_2$ 52 to 66 %</td>
</tr>
<tr>
<td>Basic</td>
<td>SiO$_2$ 45 to 52 %</td>
</tr>
<tr>
<td>Ultrabasic</td>
<td>SiO$_2$ &lt; 52 %</td>
</tr>
</tbody>
</table>

**Aluminum Saturation**

Based on the feldspar ratio 1:1:3 (NaAlSi$_3$O$_8$)

- Peraluminous   $\text{Al}_2\text{O}_3 > (\text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O})$
- Peralkaline    $(\text{Na}_2\text{O} + \text{K}_2\text{O}) > \text{Al}_2\text{O}_3$

**Classification of Igneous Rocks**

*Figure 2-1a: Method #1 for plotting a point with the components 70% X, 20% Y, and 10% Z on triangular diagrams. An Introduction to Igneous and Metamorphic Petrology, John Winter, Prentice Hall.*

*Figure 2-1b: Method #2 for plotting a point with the components 70% X, 20% Y, and 10% Z on triangular diagrams. An Introduction to Igneous and Metamorphic Petrology, John Winter, Prentice Hall.*

**Feldspar Classification**

**Pyroxene Classification**
Basalt Classification

Phases:
- Augite (Cpx)
- Hypersthene (Hy)
- Olivine (Oliv)
- Plagioclase (Plag)
- Nepheline (Ne)

Classification of Igneous Rocks

Figure 2-2: A classification of the phaneritic igneous rocks. a. Phaneritic rocks. b. Gabbroic rocks. c. Ultramafic rocks. After IUGS.

(a) The rock must contain a total of at least 15% of the minerals below. Renormalize to 100%

Phaneritic rocks with more than 10% (quartz + feldspar + feldspathoids). After IUGS.

(b) The rock must contain a total of at least 15% of the minerals below. Renormalize to 100%

Quartz-rich Granitoid
- 90 Quartz
- 60 Alkali Fs.
- 20 Monzonite
- 20 Monzodiorite

Quartz Syenite
- 90 Quartz
- 60 Alkali Fs.
- 20 Monzonite
- 20 Monzodiorite (Foid)-bearing

Syenite
- 90 Alkali Fs.
- 10 quartz
- 10 (Foid) Monzosyenite
- 10 (Foid) Alkali Fs. Syenite
- 10 (Foid) Monzodiorite
- 10 (Foid) Gabbro

Diorite/Gabbro
- 90 Diorite/Gabbro
- 10 (Foid)olites

(rhodonite)

Classification of Volcanic Rocks

Figure 2-3: A classification and nomenclature of volcanic rocks. After IUGS.

Rhyolite/Dacite/Trachyte
- 90 Rhyolite/Dacite
- 60 60 Rhyolite/Dacite
- 35 65 Rhyolite/Dacite
- 20 20 Rhyolite/Dacite

Andesite/Basalt
- 90 Andesite/Basalt
- 60 60 Andesite/Basalt
- 35 65 Andesite/Basalt
- 20 20 Andesite/Basalt

Classification of Basalt Trends

Basalt Discriminator

Basalt Trends
Classification of Igneous Rocks

Figure 2.4: A chemical classification of volcanics based on total alkalis vs. silica. After Le Bas et al. (1986) J. Petrol., 27, 745-750. Oxford University Press.

Si Activity

- $\alpha_{SiO_2}$
- Based on a set of reactions
- Limits three main magma series