

Classification of magmatic rocks

- Modal – chemical – normative – cationic
- Some common descriptive terms:
 - felsic/mafic
 - leucocratic/melanocratic
 - silicic, alkaline, etc.
 - acid - intermediate – basic – ultrabasic (66 / 52 / 45 wt% SiO₂)

I. The IUGS system

(International Union of Geological Sciences)

The only "official" one, to be preferred if possible.

A. For plutonic rocks

Modal classification based on

Q' - Quartz

A' – Alkali feldspar

P' – Plagioclase feldspar (An% > 5)

F' – Feldspatoids (leucite, nepheline)

M' – mafics (everything else !)

1. M' < 90 %

- QAP

or

- QAF

NB: Problem near P-apex

- Gabbro/diorite (An% > 50 – but also M' > 35 %, pyroxene rather than amphibole, color, SiO₂ > 52 % (as for volcanics))

Diagram for gabbroic rocks

- Tonalites/Trondhjemites

2. M' > 90 %

Cpx-Opx-Ol classification

3. Modifiers

Chemical (alkali...) or mineralogical (muscovite (bearing) - ...)

B. For volcanic rocks

1. If possible, use a similar modal diagram

QAP/F (volcanic version)

NB: be careful of possible differences between phenocrysts and groundmass!

NB: same problem on P apex. Basalt/andesite (SiO₂ > 52 %, see other criteria above)

2. If not, use a chemical diagram

TAS = Total Alkali vs. Silica

(SiO₂ vs. Na₂O + K₂O)

II. Other systems

Why?

- Old classifications (should be forgotten)
- Difficulties to use the IUGS system
- Classifications that allow to refine the terminology for some rocks
- Classifications with genetic implications (largely with traces, sometimes with majors)

Most have a very specific scope, should not be used otherwise!

A. Classification based on modal mineralogy

Name	Volcanic /Plutonic	Description	Comment
Lamprophyres nomenclature	V	Feldspars and foids	Useful for lampros.
Charnockite nomenclature	P	Adaptation of QAP	Commonly used for granulites

B. Classifications based on major elements

Name	Volcanic /Plutonic	Plot description	Comment
AFM	VP	Na ₂ O + K ₂ O – FeO - MgO	Supposedly separating different magmatic series. Semi-deprecated.
TAS (Cox version)	V	SO ₂ vs K ₂ O + Na ₂ O	Deprecated. Use the IUGS version instead.
TAS (Middlemost)	P	Adaptation of above	Potentially useful but using the “old” TAS. The IUGS TAS is sometimes adapted to plutonic rocks...
Hi-Mg classification	V	Adaptation of TAS	Useful for hi-Mg lavas
SiO ₂ – K ₂ O	V	SiO ₂ vs K ₂ O	Useful for sub-alkaline lavas

C. Classifications based on normative compositions

Name	Volcanic/ Plutonic	Plot description	Comment
Basalt terminology	V	3 CIPW-normative triangles	For basalts & mafic lavas
Streckeisen & Le Maître	P	Adaptation of QAP with norms	Potentially useful when no modal data available. Uncommon.
O'Connor	P	Ab-An-Or triangle	Commonly used for Na-rich plutons (Archaean)

D. Classifications based on cationic compositions

Name	Volcanic/ Plutonic	Plot description	Comment
A/CNK vs. A/NK	VP	Cationic ratios Al/Ca+Na+K, Al/Na+K	Historical. Not really used but the notions of peraluminous etc. are still of wide use.
R1-R2	VP	Use complicated sets of parameters (principal components, more or less)	Once popular, now largely deprecated. Useful to compare with mineral compositions.
P-Q	P		
A-B	P		
Batchelor-Bowden	P	Adapted R1-R2	Supposedly differentiating tectonic settings
Jensen cation plot	V	Al – Mg – Fe+Ti triangle	Of marginal use; elements insensitive to alteration or metamorphism.

E. Classifications based on trace elements

Name	Volcanic/ Plutonic	Plot description	Comment
Pearce diagrams	V and P (different sets)	Logs of Y, Nb, Rb, Ta...	Supposedly differentiating geodynamic settings
Wood diagrams	V	Triangles, Th Hf Nb Ta Zr	Supposedly differentiating geodynamic settings

Far too many tentative discriminant diagrams. Some will be reviewed in the relevant lectures.