# CHAPITER : V

## I- CLASSIFICATION OF IGNEOUS ROCKS

### I.1- Classification based on mineralogical composition

The Streckeisen Double Triangle Classification is used to classify all igneous rocks, excluding ultrabasic rocks. However, it is more suitable for acidic and intermediate igneous rocks, i.e. rather leucocratic (=light) rocks.

Indeed, it is based on the proportion of the three families of minerals (leucocratic) essential in these rocks. These are the feldspars: A, the alkali feldspar (Na: albite and K: orthoclase) and P, the calc-sodic feldspar (plagioclase); Q, quartz for rocks oversaturated in silica or F, the feldspathoid (abbreviated "foid" in the triangle below) for rocks undersaturated in silica.

Ferromagnesian minerals are, in general, in low proportion (a few tens of %). The proportion of these generally colored minerals allows to define the Coloration Index (CI). In theory, it is advisable not to use this classification when the CI>90%. In practice, as I noted above, this classification is no longer very suitable for rocks with a CI >50-60%. We will take for example, the "anorthosite, diorite, gabbro" box which contains rocks whose coloring index is very variable. A classification more suitable for gabbro (- anorthosite) is also proposed.

they added plagiogranite to the "tonalite" box, a term used for the rare granites of the oceanic lithosphere. This term is synonymous with trondhjemite and leucotonalite.

The 2 triangles are joined by the A-P line (alkali feldspars - plagioclase). Quartz (Q) and felspathoid (F) are positioned at the 2 opposite vertices, so no rock can contain the Q-F association.

The relative proportion of A - P - Q or F leucocratic minerals in the rock is calculated. It is the modal mineralogical composition.

Two versions of the triangle are proposed: the one above for plutonic rocks; another for volcanic equivalents (**See figure 2**).

**TURLAN** offers a handy little program that lets you place a rock whose modal composition is known in the double triangle (**See figure 3**). .

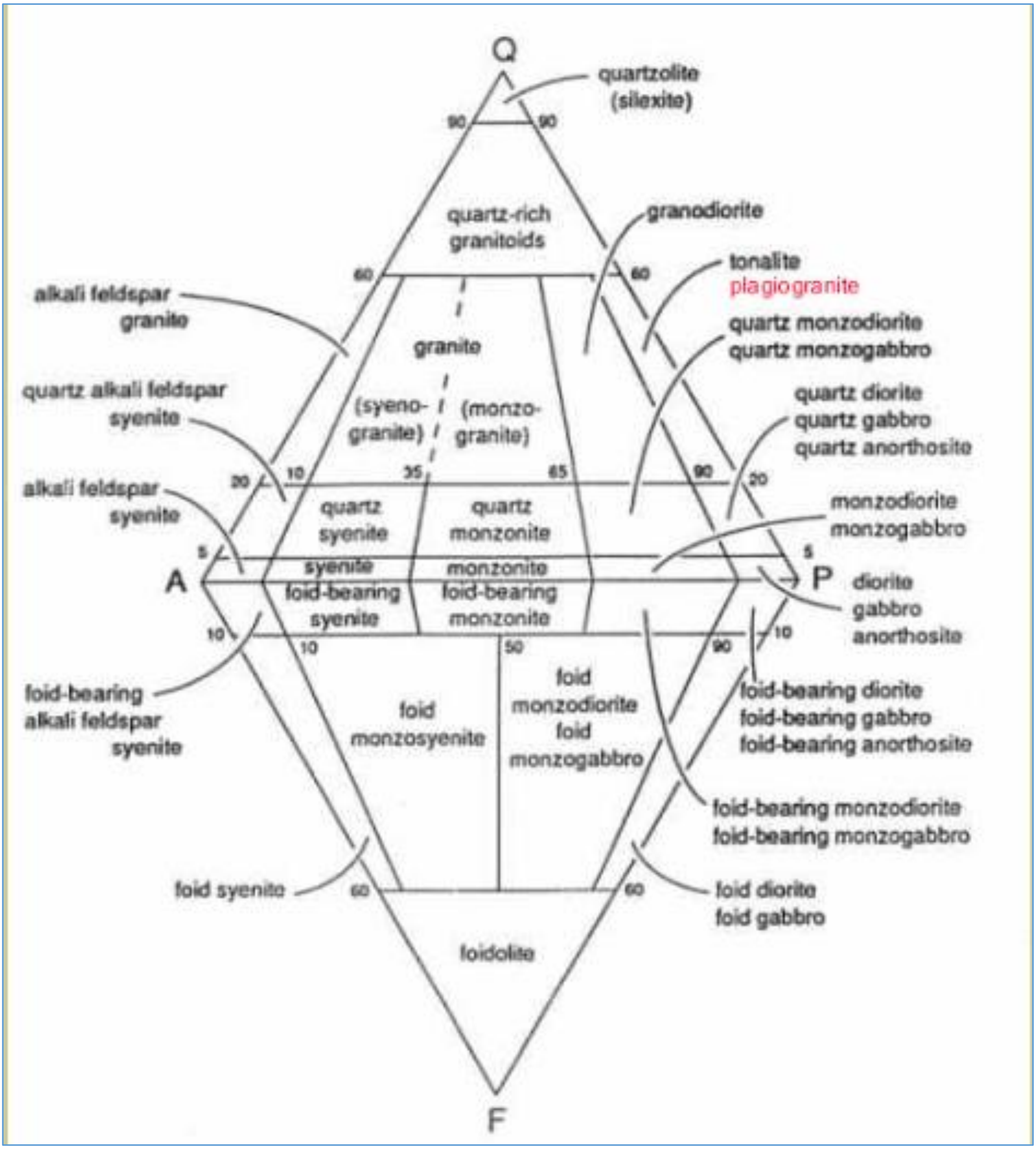


***Figure 1 : Streckeisen** classification and nomenclature of plutonic igneous rocks based on their modal mineralogical assemblage. (Recommendations of the International Union of Geological Sciences)*

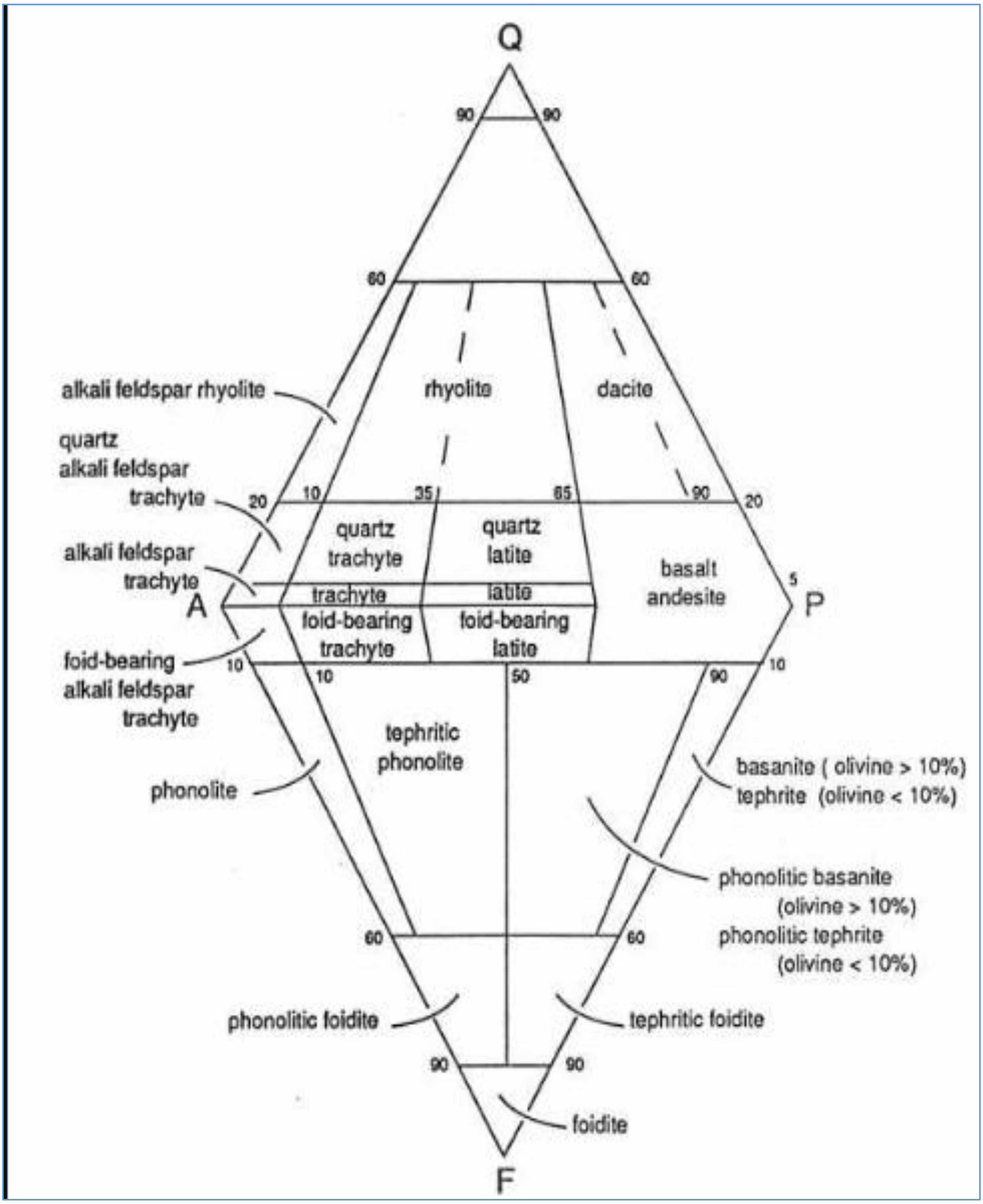


***Figure 2 : Streckeisen** classification and nomenclature of plutonic igneous rocks based on their modal mineralogical assemblage. (Recommendations of the International Union of Geological Sciences)*

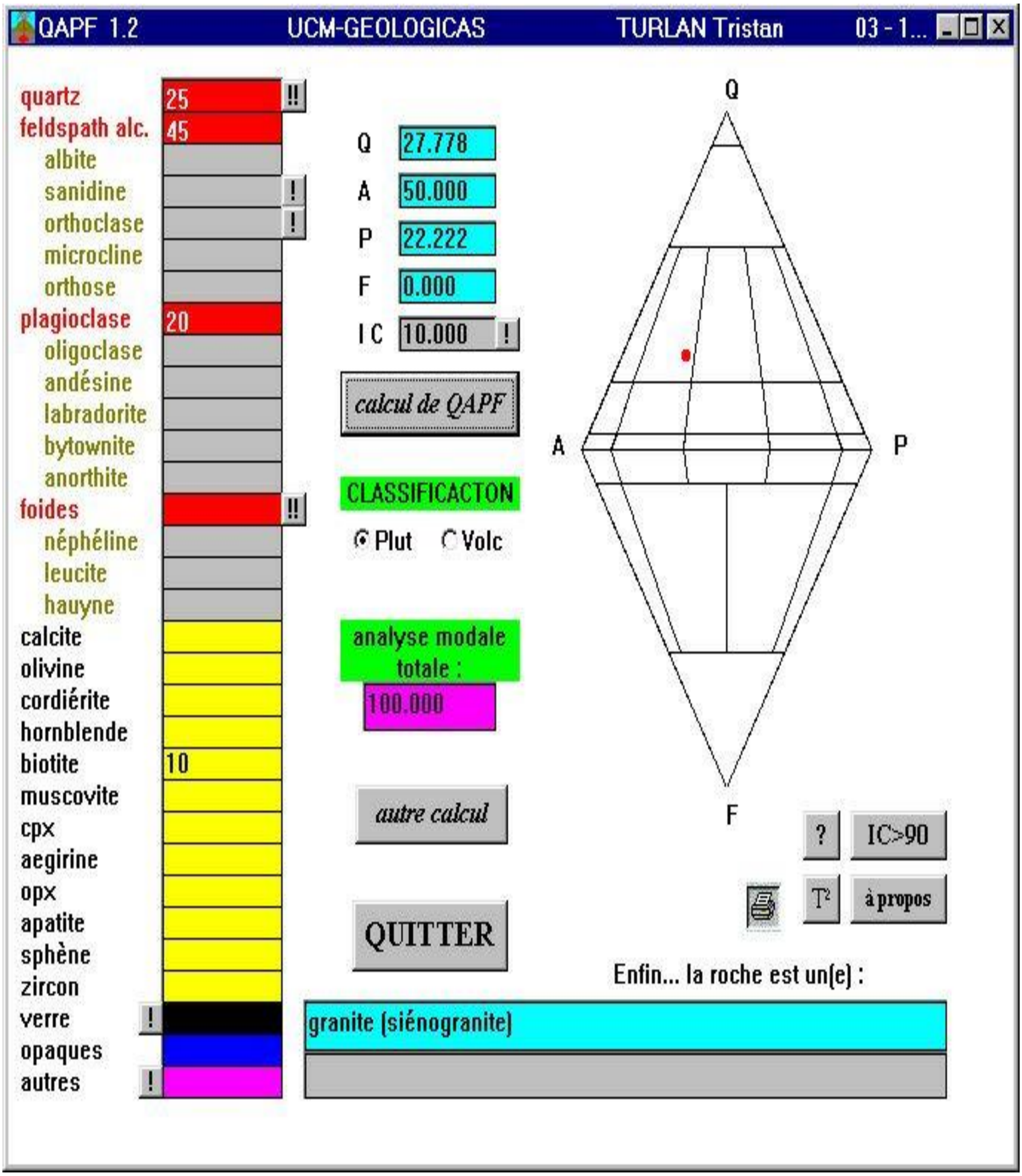


Figure 3 : Program of Tristan TURLAN

Download the [program of Tristan TURLAN.]() ; (485Ko)

## I.2- Classification based on chemical composition

chemical composition requires partial or complete analyses. A number of chemical classifications of igneous rocks have been devised. Few are listed below:

- Silica percentage
- Silica saturation
- Alumina saturation
- Alkali lime index
- Total Alkali Silica (TAS)

### I.2.1- Silica percentage

**Igneous rock classification based on silica percentage.**

| SiO2 (in wt%) | Rock types | Examples |
|---|---|---|
| 75-66 | Acidic/ felsic | granite, rhyolite |
| 52-66 | Intermediate | granodiorite, andesite |
| 45-52 | Mafic/basic | diorite, gabbro, basalt |
| <44 | Ultrabasic/ultramafic | peridotite, dunite |

### I.2.1. Silica saturation

Shand in 1913 and Holmes in 1917 classified igneous rocks on the basis of free silica into three groups:

- **Silica oversaturated rocks** contain more than 66% SiO2, i.e. free quartz mineral is found. Such rocks are also known as acidic or felsic rocks.
- **Silica saturated rocks** are typically those which have sufficient silica to form stable silicate mineral but seldom free quartz occur. They contain more than 52 - 66% SiO2.
- **Silica undersaturated rocks** contain insufficient silica and silica deficient minerals like olivine, nepheline, leucite and are devoid of quartz mineral.

### I.2.2. Silica saturation

On the basis of alumina, the rocks have been divided into three subtypes:

1. **Peraluminous**: This group contains excess of alumina than required for formation of feldspars, which can be chemically expressed as: $Al_2O_3 > (CaO + Na_2O + K_2O)$

$$A/CNK > 1$$

Minerals like muscovite, corundum, kyanite should be present.

2. **Metaaluminous**: Molecular percentage of this category is expressed in the form:

$Al_2O_3$<($CaO$+$Na_2O$+$K_2O$) and $Al_2O_3$>($Na_2O$+$K_2O$)
A/CNK<1 and A/NK<1
This group does not contain alumina rich minerals and also lack alkali pyroxene and amphibole. This group is quite common in igneous rocks.

3. **Peralkaline**: This group is alumina poor and oversaturated with a On a molecular basis will be expressed as: $Al_2O_3$<($Na_2O$+$K_2O$)
A/NK<1

### I.2.3. Alkali Lime Index

In 1931 a petrologist by name Peacock examined suites of rocks throughout the world. He used this classification for a related series of igneous rocks using $SiO_2$, $Na_2O$, $K_2O$ and $CaO$ data. Heplotted $CaO$ vs $SiO_2$ and ($Na_2O$+$K_2O$) vs $SiO_2$.
Commonly $CaO$ decreases and $Na_2O$ + $K_2O$ increases with respect to $SiO_2$. Peacock noted that the two curves intersect at different values of $SiO_2$ for different suites. He used the value of $SiO_2$, where the two curves intersect known as the **Peacock Index** or **Alkali Lime Index**, to divide the rock suites into following:

| Name of Suite | Peacock Index |
|---|---|
| Alkalic | <51 |
| Alkali-Calcic | 51-56 |
| Calcic-Alkalic | 56-61 |
| Calcic | >61 |

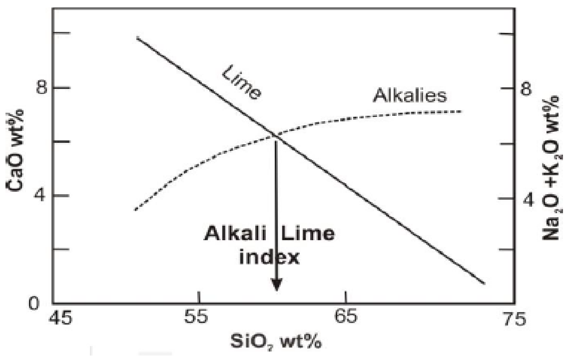


**Figure 3:** ***Silica versus lime and alkali plot***

### I.2.3. Total Alkali Silica (TAS)

The most popular chemical classification scheme is total alkali silica contents based (TAS) diagram was given by Le Bas and others in 1986 (**Figure 4**).

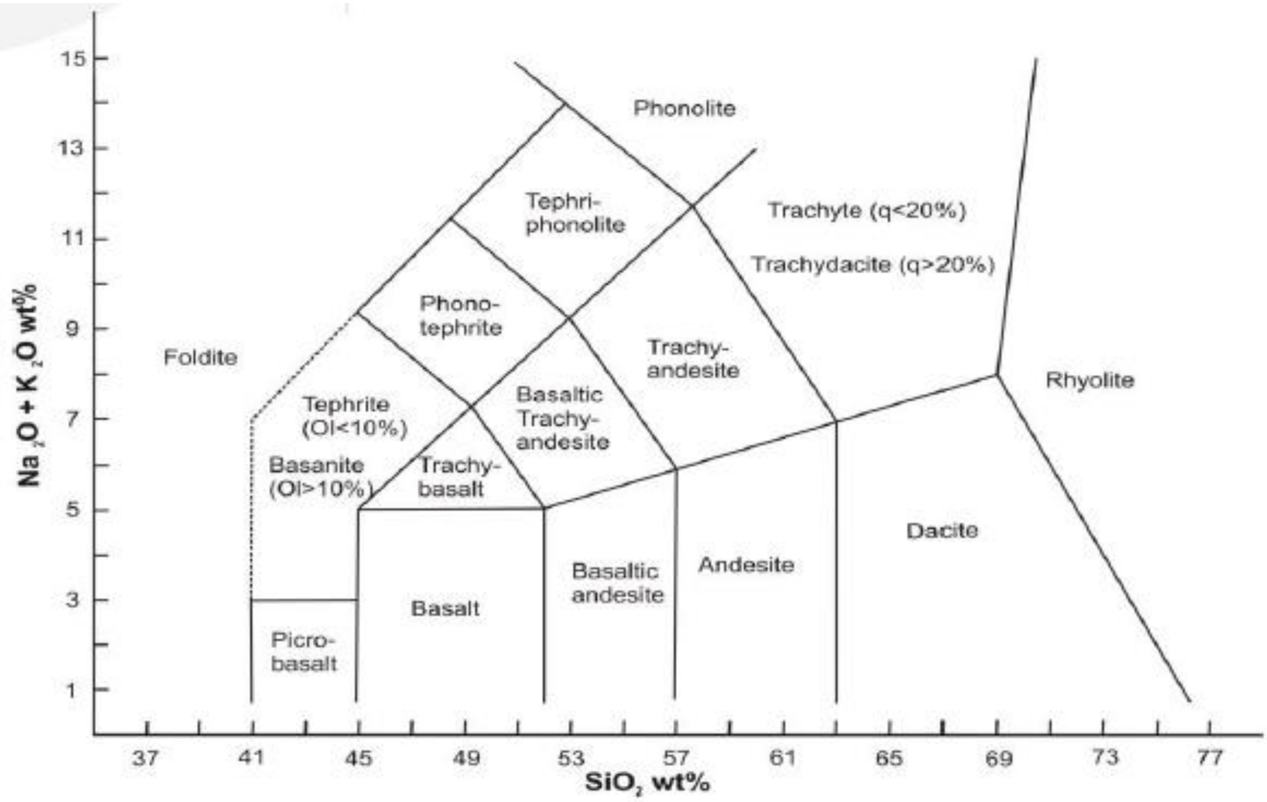


**Fig. 3.4: Total Alkali silica (TAS) diagram.**