



## Mafic minerals most likely associated with certain felsic combinations in igneous rocks

Feldspar Combinations	Typical mafic and non-feldspar associations
Anorthite	Olivine
Anorthite + Bytownite/Labradorite	Olivine, minor Pyroxene
Bytownite/Labradorite	Olivine, + Pyroxene, minor Hornblende
Bytownite/Labradorite + Andesine (minor to no Sanidine)	Hornblende, Olivine + Pyroxene, minor Na-Ca Amphiboles
Andesine + Oligoclase (none to some Sanidine)	Hornblende + Na-Ca Amphiboles, Olivine + Pyroxene, minor Biotite
Oligoclase/Albite, (none to a lot of Sanidine)	Hornblende + Na-Ca Amphiboles, Olivine + Pyroxene, Biotite
Oligoclase + Albite, minor Anorthoclase (none to a lot of Sanidine)	Hornblende + Na-Ca Amphiboles + Biotite, Olivine + Pyroxene, minor Muscovite
Anorthoclase + Orthoclase, (none to a lot of Sanidine), minor plagioclases	Na-Ca Amphiboles + Biotite, Hornblende, Olivine + Pyroxene, Muscovite
Orthoclase/Microcline, (none to a lot of Sanidine)	Na-Ca Amphiboles + Biotite, Muscovite, minor Hornblende, minor Olivine + Pyroxene

Blue = plagioclase

Red = K-spar

Green = Residual

The above chart has lists from most to least abundant as reading from left to right.

Quartz is not on this graph because its formation is dependent on melt saturation. Even though it only forms at the lowest temperatures, if the melt is over saturated you could have it as a major component even with anorthite. If it is undersaturated you could have no quartz at low temperatures and have feldspathoids (foids) instead.

Orthoclase is in the residual phase of Bowen's but it is a K-spar and treated as such herein.

Amphiboles and feldspars like to form together, and are similar in other ways. They are both formed at similar melt temperatures. Both have varying amounts of Na and Ca. Its just feldspars will also form with K, and amphiboles will form with Fe/Mg. Amphiboles are also hydroxide (OH<sup>-</sup>) friendly as where feldspars are not. Both of them like to form in two crystal systems. Amphibole is either monoclinic or orthorhombic. Feldspars are either monoclinic or triclinic.

Common Na-Ca amphiboles are Pargasite, Winchite, and Edenite

The mafic minerals change rank not because they change into other minerals as a melt cools like the feldspars. Others become more numerous than the earlier forming mafic minerals.