

Atlas of Igneous Rocks and Their Textures

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ELBS

LOW-PRICED EDITION

Part 2: Granularity

- This property embraces three different concepts:
 1. what the aided and unaided eye can or cannot see
 2. absolute crystal size
 3. relative crystal sizes

1. Terms referring to what the aided and unaided eye can or cannot see

-*Phanerocrystalline (phanerictic taxture)* – all crystals of the principal minerals can be distinguished by the naked eye¹

- *Aphanitic* – all crystals, other than any phenocrysts present, cannot be distinguished by the naked eye². Two sub-types exist:

(a) *Microcrystalline* – crystals can be identified in thin section with petrographic microscope. Crystals only just large enough to show polarization colours (less than 0.01mm) are called *microlites*.

(b) *Cryptocrystalline*³ – crystals are too small to be identified even with the microscope. Globular, red-like and hiar-like crystals which are too small to show polarization colours are known as *crystallites*.

¹ Pegmatitic texture is a variety of phanerocrystalline in which the crystals are strikingly large, bigger than 1-2cm, and in rare instances up to many meters.

² The term aphyric is sometimes used for aphanitic rocks which lack phenocrysts.

³ Felsitic texture is sometimes applied to siliceous rocks with illdefined, almost cryptocrystalline, grey-polarizing areas composed of more or less equigranular aggregates of quartz and alkali feldspar. The name felsite is often applied to such rocks, although this is more commonly a field term for fine-grained acid material of uncertain mode of occurrence.

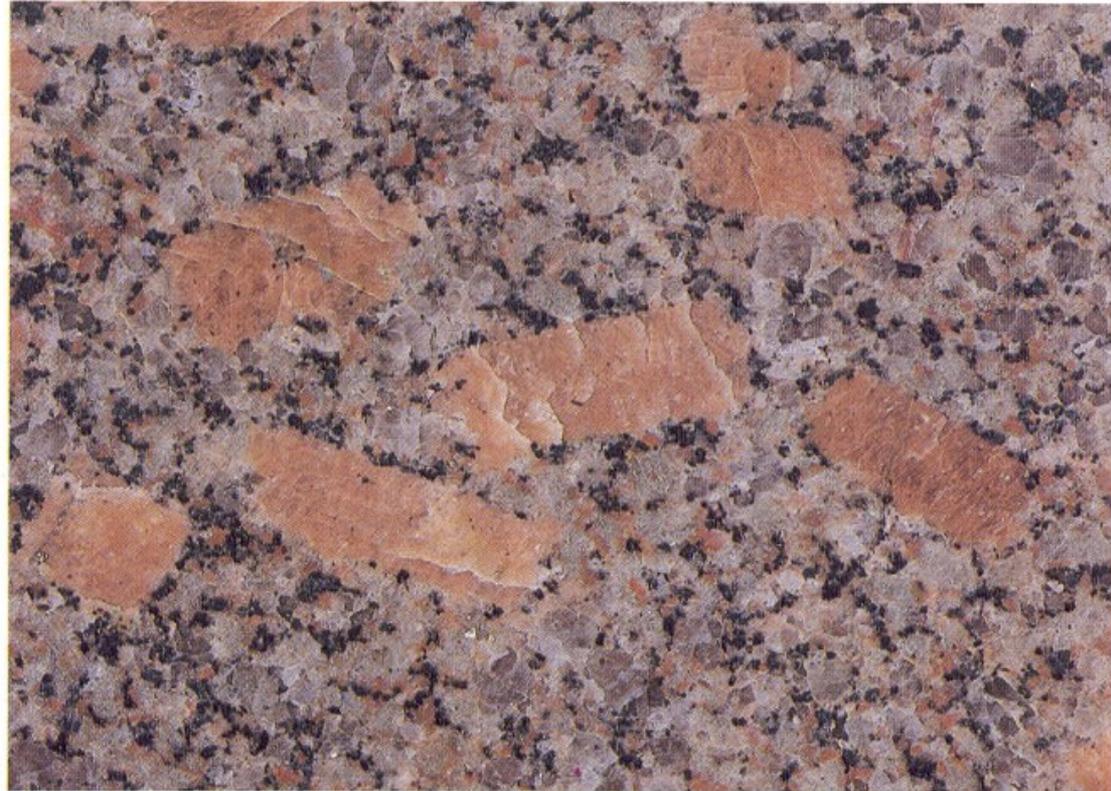
Phanerocrystalline granites

10 Phanerocrystalline granites

The crystals in the two granites, illustrated here in hand specimen, are clearly visible to the naked eye. Although the rocks contain the same minerals (alkali feldspar, plagioclase feldspar, quartz and biotite) the proportions of the minerals are not the same, and this influences the rock textures. Thus the Shap granite contains two distinct sizes of potassium feldspar crystals (pink), whereas the Eagle Red Granite has only one.

Granite from Shap, England (opposite) and 'Eagle Red' granite, South Africa (next page); both magnifications $\times 1$.

*A thin section view of the Shap granite is shown in **144***

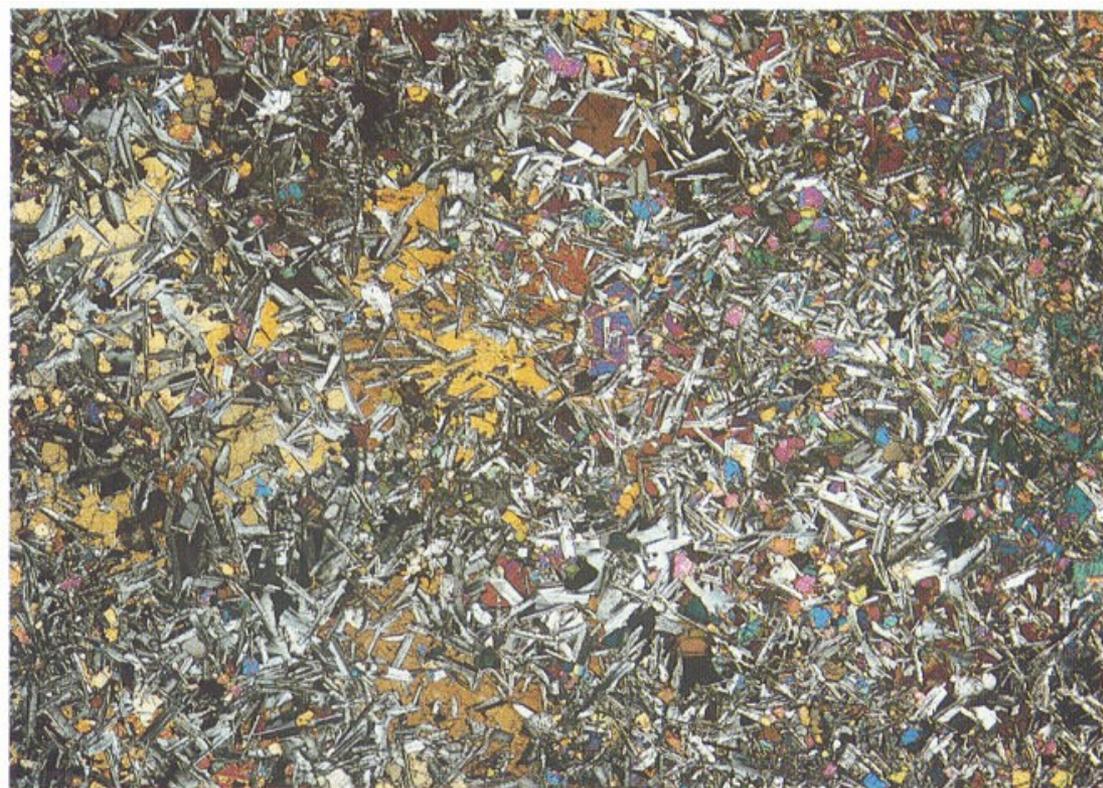


Phanerocrystalline granites



Phanerocrystalline granites (continued)

Microcrystalline olivine basalt

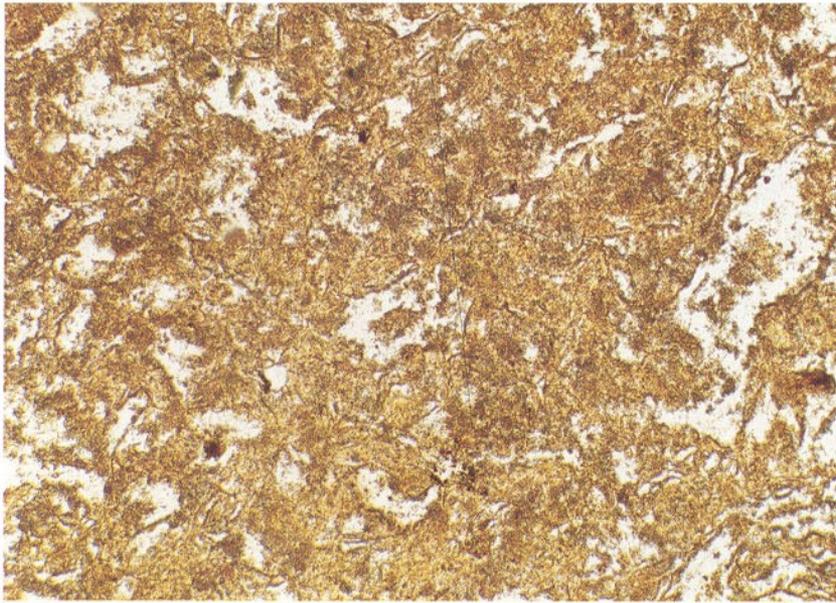


11 Microcrystalline olivine basalt

This rock consists mainly of plagioclase feldspar, augite and olivine but, without the aid of the microscope, individual crystals would not have been distinguishable. In parts of the photograph the randomly arranged rectangular plagioclases are enclosed by areas showing uniform yellowish interference colours, these are augite crystals.

Olivine basalt from North-west Skye, Scotland; magnification $\times 11$, PPL.

Cryptocrystalline rock

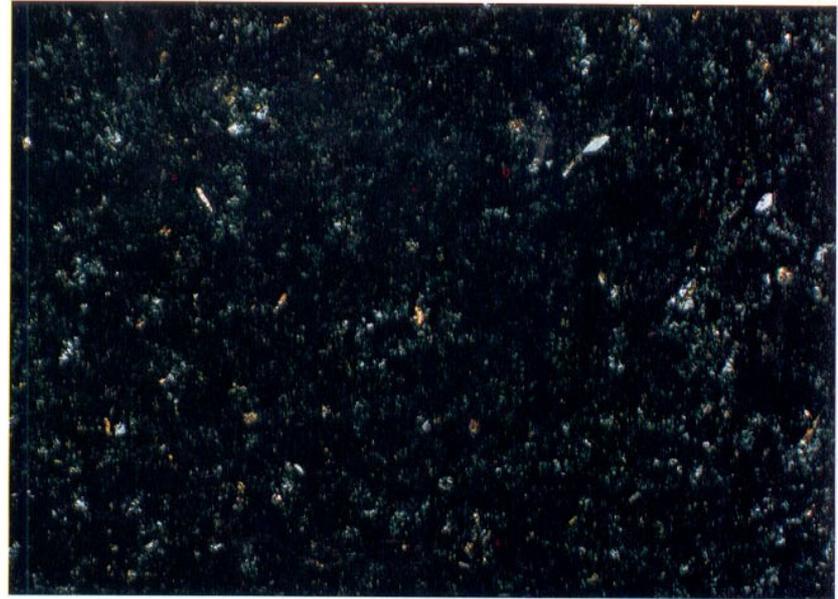


Cryptocrystalline rock (continued)

12 Cryptocrystalline rock

Comparison of these two photographs shows that the brown material in the PPL view is birefringent but that the individual crystals are of submicroscopic size. The clear areas in the PPL view are slightly more coarsely crystalline, as can be seen in the XPL view.

Rhyolite from Island of Pantelleria, Italy; magnification $\times 72$, PPL and XPL.

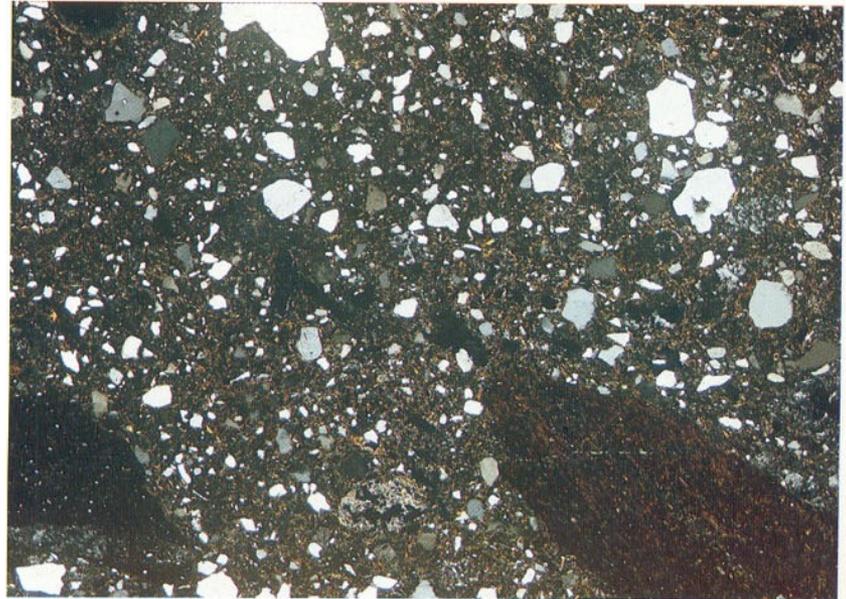
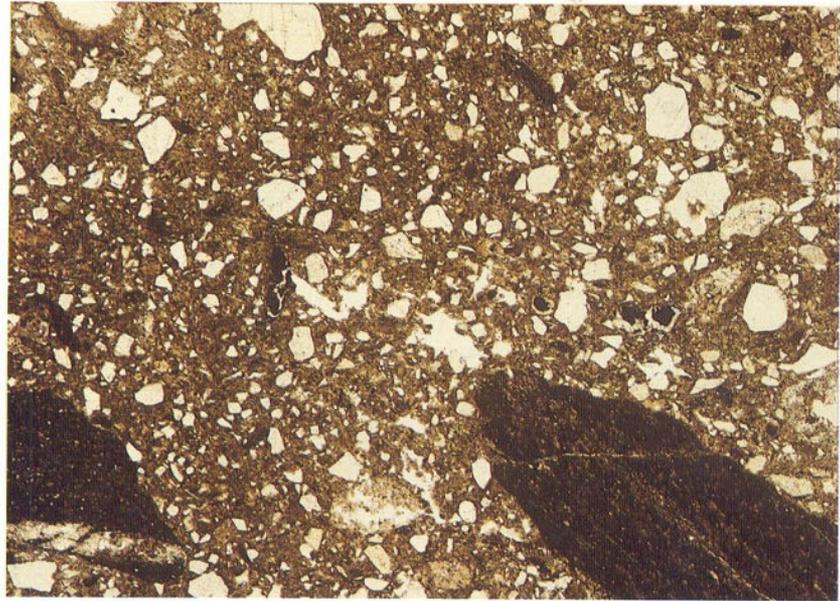


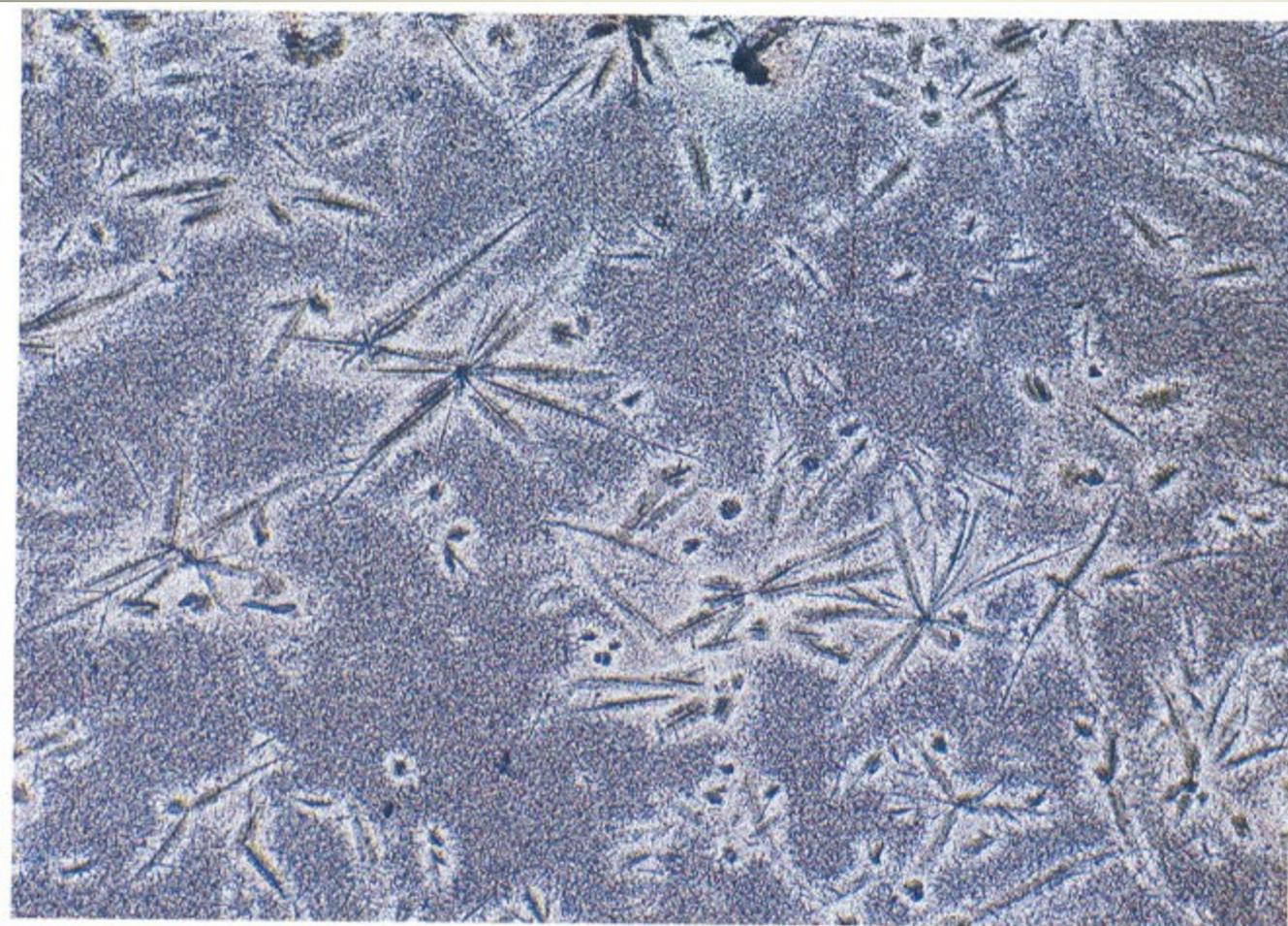
Cryptocrystalline matrix in a tuff

13 Cryptocrystalline matrix in a tuff

Cryptocrystalline texture is common in tuffs (i.e. consolidated ash), as in the matrix of this rock. Here the matrix encloses fragments of shale and quartz crystals. (See also 8 and 9.)

Tuff from unknown locality; magnification $\times 16$, PPL and XPL.





14 Pitchstone containing crystallites of various sizes

Radiate clusters of crystallites are characteristic of the bulk of the glass contains even smaller crystallites, the grey colour, whereas adjacent to the larger ones the smaller ones are absent. This is a typical view of the rock illustrated in 5.

Pitchstone from Arran, Scotland; magnified 100x

2. Terms indicating absolute ranges of grain size

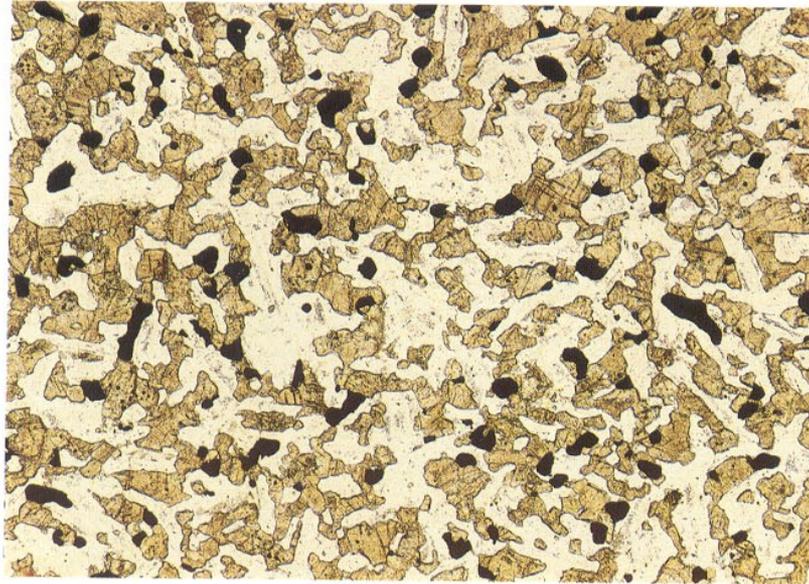
Coarse-grained – crystal diameters $> 5\text{mm}$

Medium-grained – crystal diameters $1\text{-}5\text{ mm}$

Fine-grained – crystal diameters $< 1\text{ mm}$ (or very fine-grained $< 0.05\text{ mm}$)

The next six photographs were all taken at the same magnification (x27) to indicate how grain size relates to the number of crystals seen in a given field of view (4.2x3.1 mm), and hence the extent of the texture visible at that magnification. While the overall texture is recognizable in the fine-grained rock, it is not so in the coarse one and low-power objective lens would be necessary to examine it adequately. Petrographic microscopes rarely have a sufficiently low-power objective lens for examining the textures of coarse-grained rocks; a hand lens should be used for these, with two sheets of polaroid, if available.

Fine-grained gabbro



15 Fine-grained gabbro

This rock contains plagioclase, orthopyroxene, augite and magnetite; some of the orthopyroxene crystals (low birefringent mafic mineral) contain narrow lamellae of augite. Although the rock is fine grained, it is called a 'gabbro' because it is from a large intrusion; the fine grain size results from quick cooling at the intrusion margin. Another term that could be used for this rock is *microgabbro* (see p. 78).

Gabbro from chilled margin of the Skaergaard intrusion, East Greenland; magnification $\times 27$, PPL and XPL.

Fine-grained gabbro (continued)

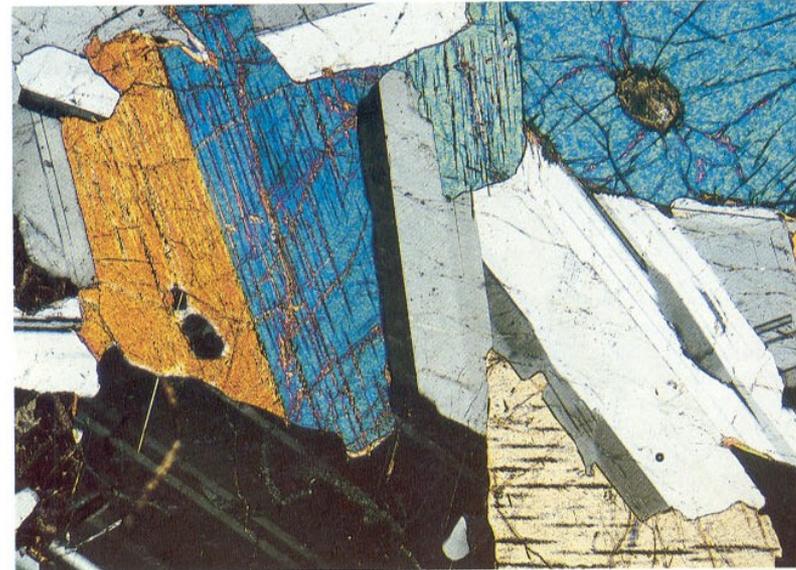


Medium-grained olivine gabbro

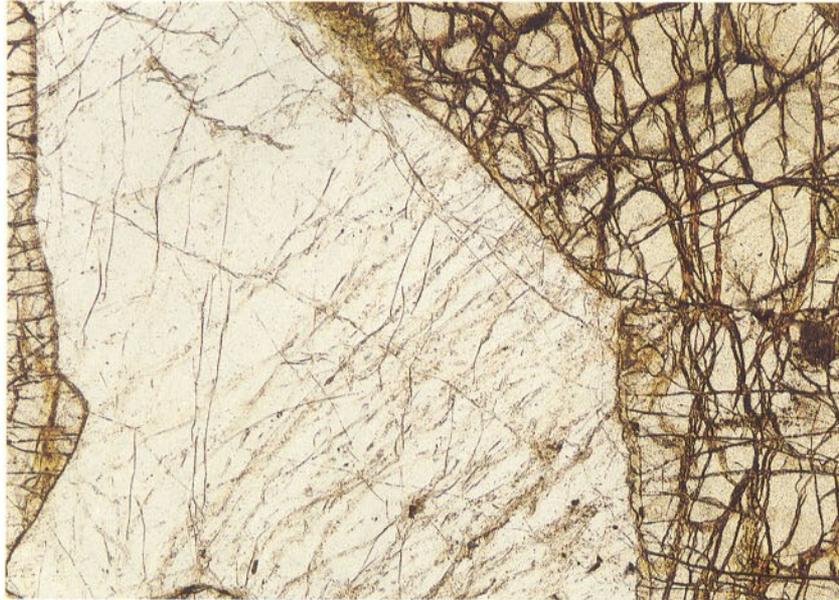
16 Medium-grained olivine gabbro

The spaces between the tabular crystals of plagioclase in this rock are occupied by augite and ilmenite. At the top right of the picture the plagioclase abuts onto an olivine crystal. The augite crystals contain lamellae of orthopyroxene.

Gabbro from Lower Zone b of the Skaergaard intrusion, East Greenland; magnification $\times 27$, PPL and XPL.



Coarse-grained olivine gabbro



17 Coarse-grained olivine gabbro

At this magnification only parts of three large olivines and one plagioclase are visible, such that textural relations are not determinable in this single view.

Gabbro from Rhum, Scotland; magnification $\times 27$, PPL and XPL.



3. Terms indicating relative size of crystals

Equigranular – all crystals are of approximately the same size.

Inequigranular – crystals differ substantially in size. A common variety, *porphyritic texture*, involves relatively large crystals (*phenocrysts*¹) embedded in fine-grained groundmass (so the same mineral may be present as both phenocrysts and groundmass). In naming a rock with porphyritic texture the minerals present as phenocrysts should be listed and followed by the suffix –phyric, e.g. ‘hornblende-pigeonite-phyric andesite’.

However, if the groundmass is glassy, the term ‘*vitro-phyre*’ is used, e.g. ‘olivine vityrophyre’. *Seriate texture* involves a continuous range in size of crystals of the principal minerals; if the crystals show a broken series of sizes, the intergranular texture is said to be *hiatal*. Caution is necessary in thin section depend on the attitude of the intersection of the crystal in three dimensions.

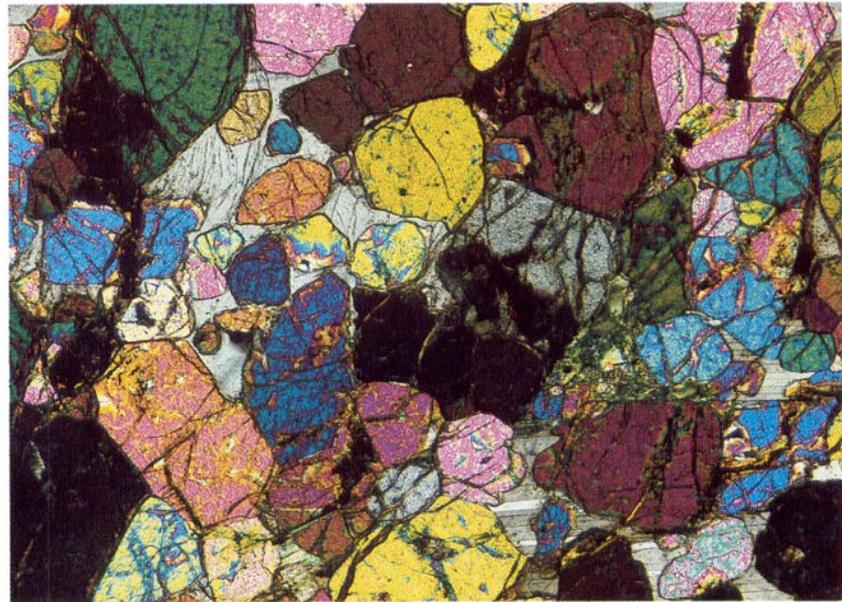
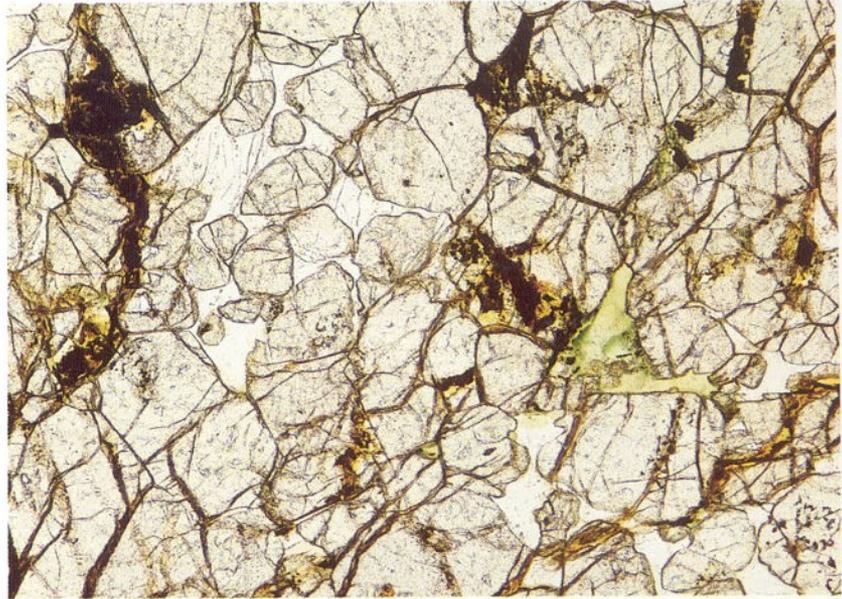
¹ The prefix micro- may be added to phenocrysts which have diameters between 0.05 and 0.5 mm (e.g. ‘Olivine microphenocrysts’).

Equigranular peridotite

18 Equigranular peridotite

Uniformly-sized olivine crystals, some of them in clots, form the bulk of this rock, with plagioclase filling the interstices. The black material is microcrystalline haematite formed by oxidation of olivines and the green material is a clay mineral.

Peridotite from the Skaergaard intrusion, East Greenland; magnification $\times 27$, PPL and XPL.
Additional views of equigranular rocks are shown in 43, 113, 117, 125, 130 (first photo), 134, 140 (third photo), 168.

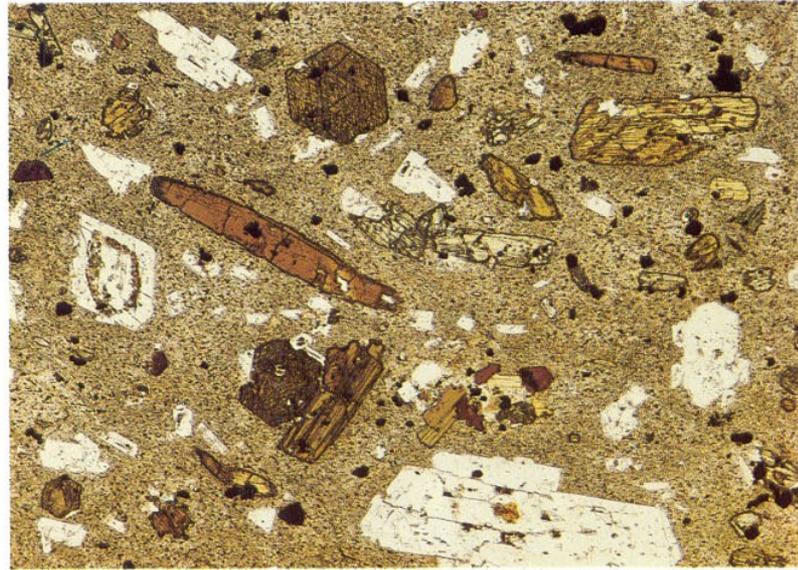


Porphyritic andesite

19 Porphyritic andesite

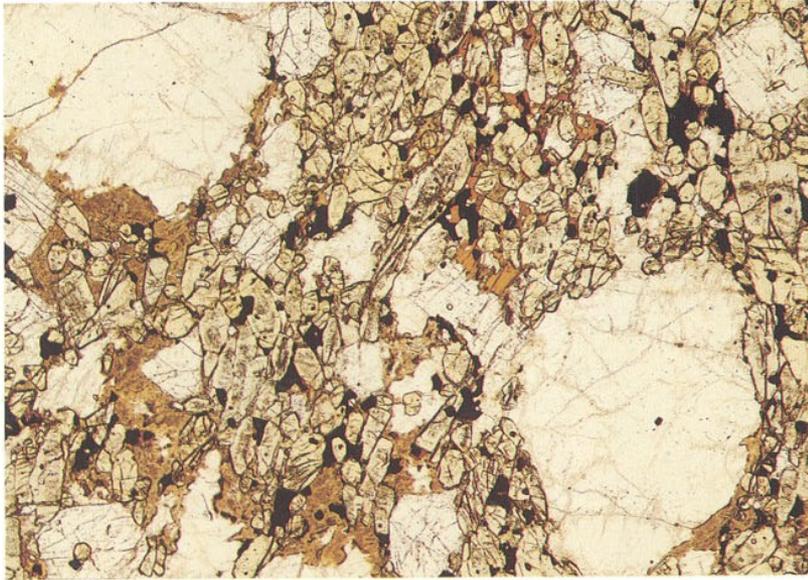
In this rock the phenocrysts (some of them in clots) of plagioclase, hornblende (khaki colour in PPL), augite (pale green in PPL) and magnetite, are surrounded by fine-grained groundmass of plagioclase, magnetite and glass.

Andesite from Siebengebirge, Germany; magnification $\times 23$, PPL and XPL.



Porphyritic andesite (continued)

Leucite-phyric micro-ijolite

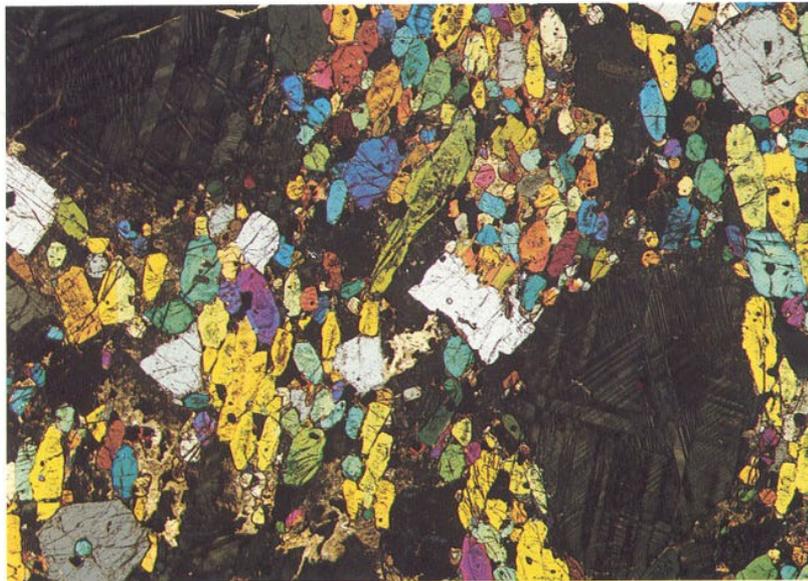


20 Leucite-phyric micro-ijolite

Two, large, shapeless crystals of leucite (very dark and showing multiple twinning in XPL photograph) are here surrounded by an equigranular groundmass consisting of crystals of elongate augite (bright interference colours), equant nepheline (grey in XPL) and interstitial biotite, leucite and magnetite. The amorphous material in the PPL view is a clay mineral.

Micro-ijolite from the Batsberg intrusion, East Greenland; magnification $\times 11$, PPL and XPL.

Many other examples of porphyritic rocks can be seen by leafing through the book.

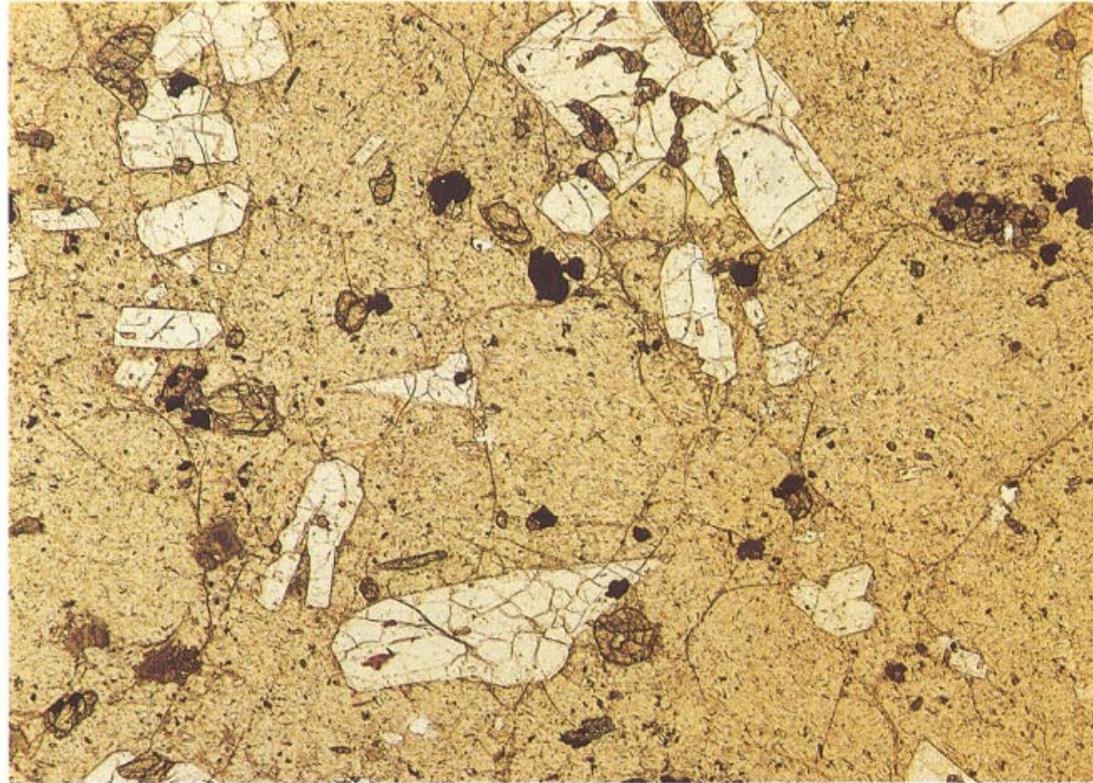


Plagioclase-augite-magnetite vitrophyre

21 Plagioclase-augite-magnetite vitrophyre

Phenocrysts of the three minerals plagioclase, augite and magnetite, some of them in clots, are set in glass which contains crystallites of plagioclase.

*Basalt from Arran, Scotland; magnification $\times 20$, PPL.
See 132 for another example of vitrophyre.*



Seriate-textured olivine basalt

22 Seriate-textured olivine basalt

The crystals of olivine, augite and plagioclase in this basalt all show a wide range of grain size from as small as 0.01 mm up to 4 mm. Note the abundance of groundmass inclusions in some of the crystals, giving them a sponge-like appearance.

Olivine basalt from Arthur's Seat, Edinburgh, Scotland; magnification $\times 11$, PPL and XPL.
See 44 and 137 for other examples of this texture.

