Atlas of Igneous Rocks and Their Textures

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LOW-PRICED EDITION

ELBS

Part 3: Crystal shapes

- Two kinds of term used to describe crystal shapes:

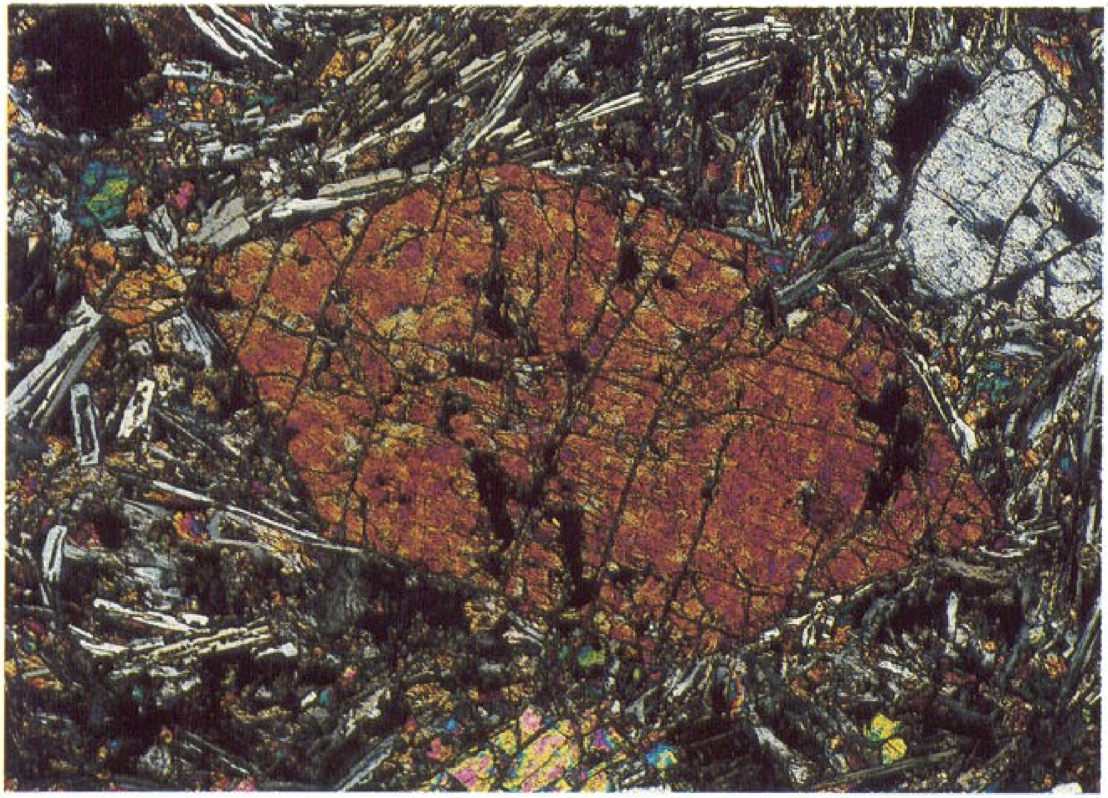
1. Those relating to the quality of the development of faces on crystals
2. Those specifying the three-dimensional shapes of individual crystals

1. Terms indicating the quality of the development of faces on crystals

- Unfortunately, three sets of words are in use to describe the same ideas, the most commonly used set being that in the first column of the following table.

Preferred terms	Synonymous terms	Synonymous terms	Meaning
Euhedral	Idiomorphyc	Automorphic	Crystal completely bounded by its characteristic faces.
Subhedral	Hypidiomorphic	Hypautomorphic	Crystal bounded by only some of its characteristic faces.
Anhedral	Allotriomorphic	Xenomorphic	Crystal lacks any of its characteristic faces.

Euhedral olivine in olivine basalt



23 Euhedral olivine in olivine basalt

The photograph shows the characteristic six-sided euhedral shape of olivine in sections through the prism and dome faces. Note the slight enclosure of matrix material by one of the prism faces.

Olivine basalt from Ubekendt Ejland, West Greenland; magnification × 40, XPL.

Subhedral olivine in picritic basalt

24 Subhedral olivine in picritic basalt

Some of the faces on this equidimensional olivine crystal are flat, planar ones, whereas others are curved and embayed.

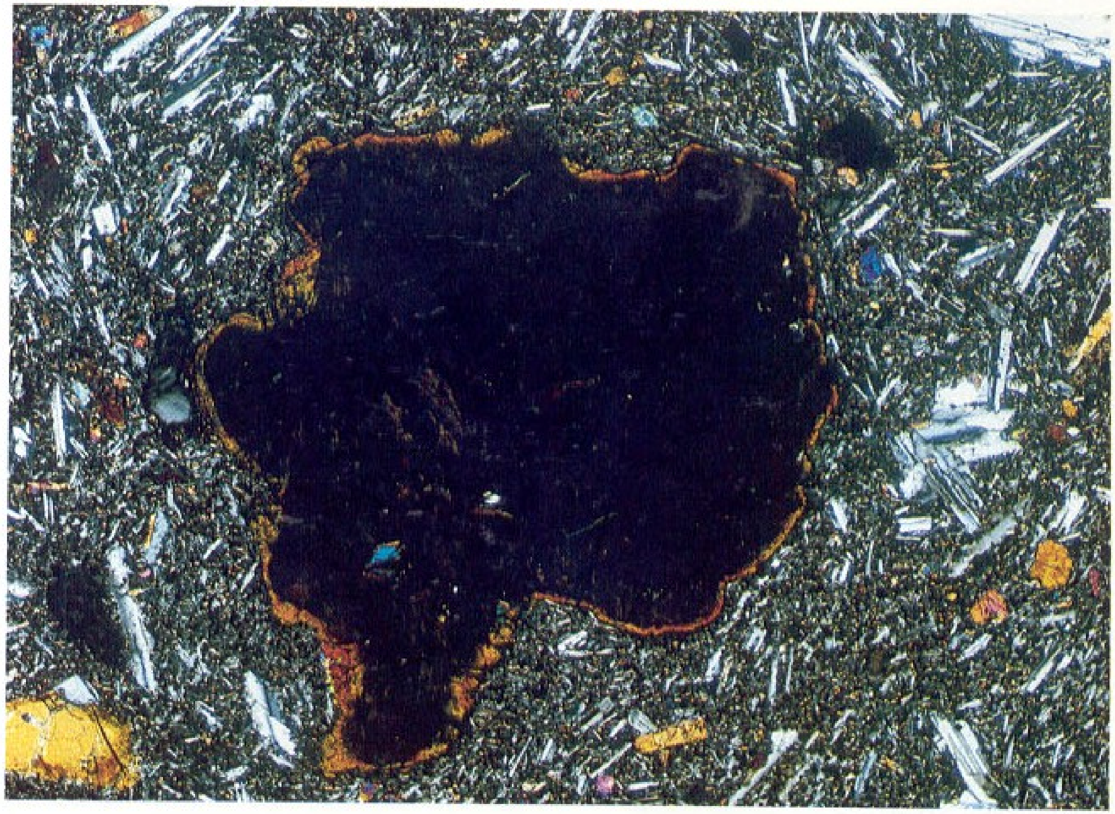
Picritic basalt from Ubekendt Ejland, West Greenland; magnification × 72, XPL.

Anhedral olivine phenocryst in basalt

25 Anhedral olivine phenocryst in basalt

The entire perimeter of the large olivine crystal, at extinction in this picture, has an irregular outline and no planar faces are present. (The narrow brown rim on the crystal is 'iddingsite' formed by hydration and oxidation of the olivine.)

Olivine basalt from Mauritius, Indian Ocean; magnification × 32, XPL.



2. Terms indicating three-dimensional crystal shape

In hand specimens of coarse-grained rocks is often possible to see the three-dimensional shape of a crystal on a broken surface. For finer-grained rocks, however, the crystals have to be examined in thin section and two-dimensional shapes of several crystals of different oriantations used to deduce the tree-dimensional shapes of the crystals in general.

General tree-dimensional terms:

- The shape either be an *equidimensional* (syn. *equant*) or an *inequidimensional* one, as illustrated in figs. A and B where the names applied to the various shapes are shown.

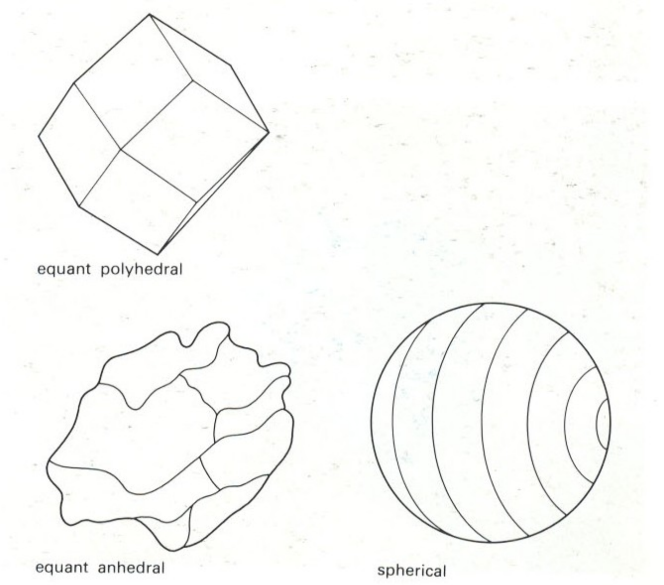


Fig. A Examples of equidimensional crystal shapes:

The words *grain* and *granule* are often used for equidimensional crystals, and *drop* and *bleb* for particularly small examples.

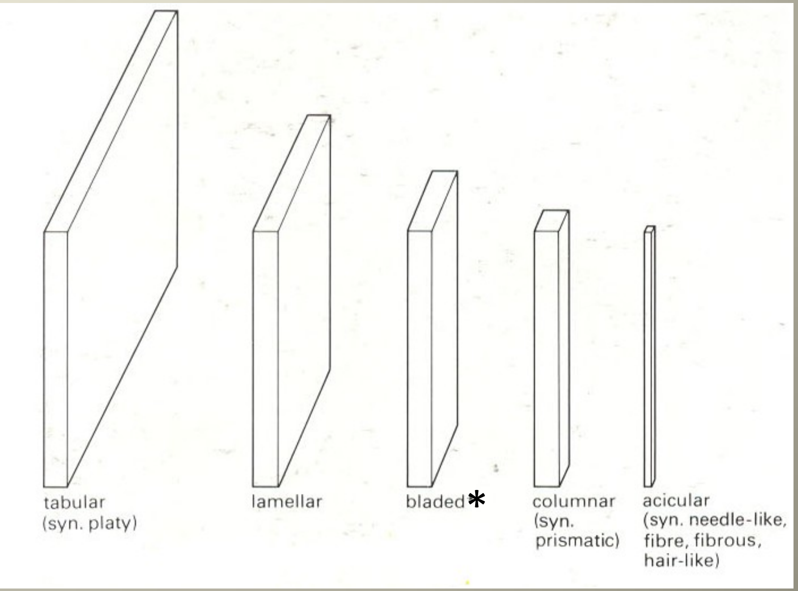


Fig. B Examples of inequidimensional shapes:

Although these are euhedral examples, they could besubhedral or anhedral.

*Bleded feldspars crystals by common usage are frequently described as lath-shaped or as laths of feldspar , in allusion to the slats (laths) in a Venetian blind.

Specific three-dimensional terms:

Skeletal, dendritic and embayed crystals:

Skeletal crystals are those which have hollows and gaps, possibly regularly developed, and usually with particular crystallographic orientations. In thin section these spaces appear as embayments[1] and holes in the crystal, filled with groundmass crystals or glass. *Dendritic crystals* consist of a regular array of fibres sharing a common optical orientation (i.e. all part of a single crystal) and having braching pattern resembling that of a tree or veins in a leaf or a feather. In practice, many crystals can be described as either skeletal or dendritic because they have characteristics of both.

[1] A common mistake among petrologists is the terms embayment and embayed imply resorption of crystal by reaction with liquid. While this may be true of some crystals (see below fig. 29), others (see fig. 26,27) have embayments which probably formed during growth.

Skeletal olivines in picritic basalt

26 Skeletal olivines in picritic basalt

All the large crystals in this rock are olivines and each shows a different shape in section; some are complex skeletal crystals (e.g. elongate yellow crystal on the left), others are relatively simple skeletons (e.g. equant orange crystal, middle right) and yet others have only small embayments.

Picritic basalt from Ubekendt Ejland, West Greenland; magnification × 40, XPL.

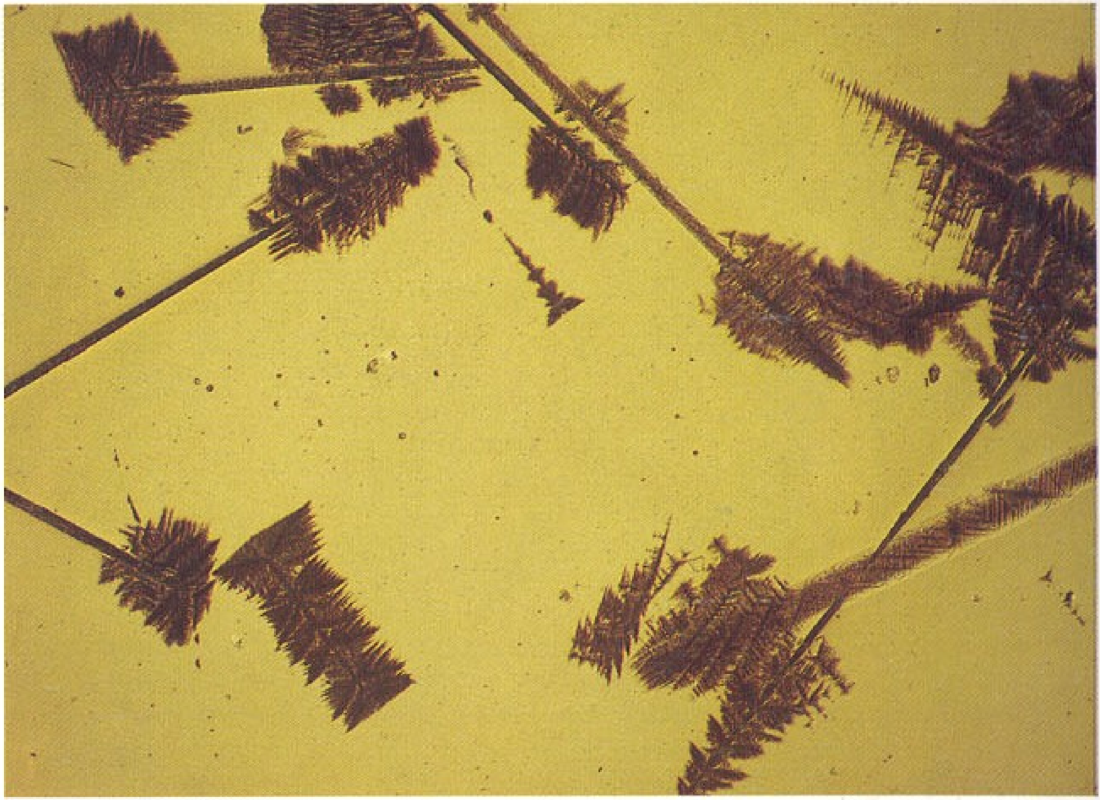
Skeletal olivine

27 Skeletal olivine

While superficially resembling the euhedral outline of the olivine in **23**, the crystal occupying the bulk of this picture has a complex interior form and incomplete prism and dome faces.

Picritic basalt from Ubekendt Ejland, West Greenland; magnification × 15, PPL.

Dendritic olivines



28 Dendritic olivines

All the delicate, dendritic crystals in this photograph are olivines which formed during exceedingly rapid solidification of the basalt melt, part of which became the yellow glass.

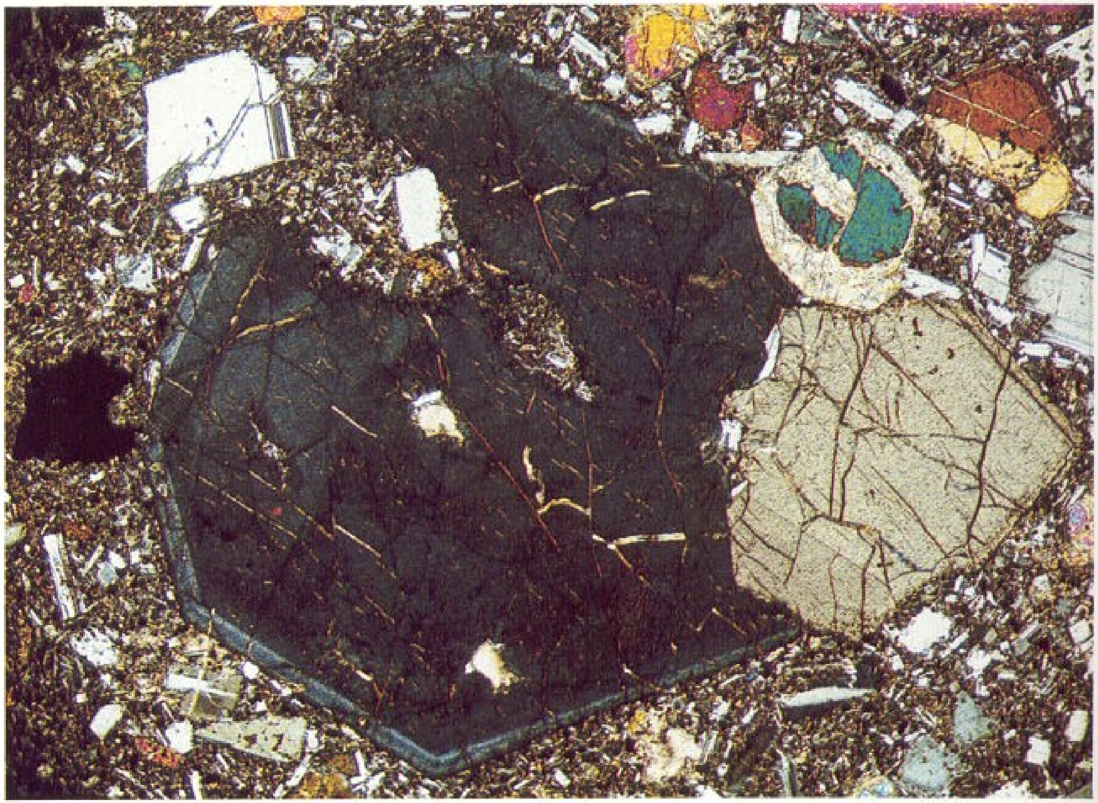
Specimen of olivine basalt melted and then cooled at 1400°/hr in the laboratory; magnification × 40, PPL.

Embayment in augite phenocryst

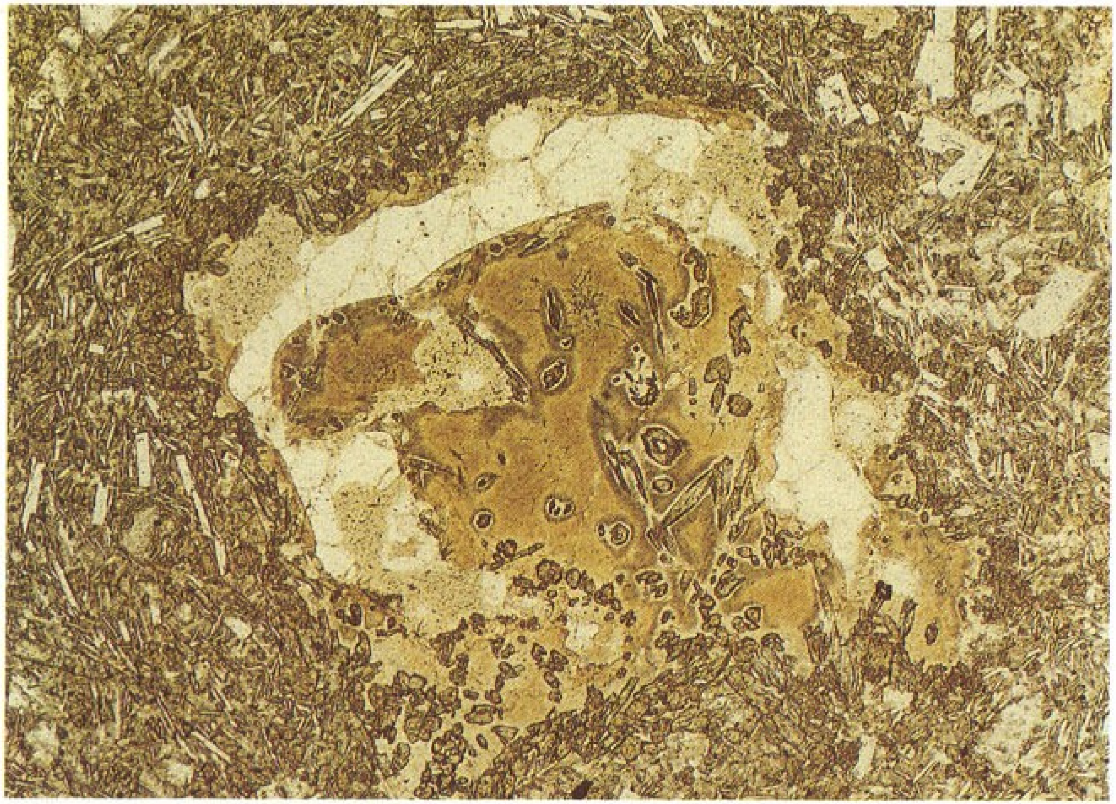
29 Embayment in augite phenocryst

The large augite crystal in this photograph contains a deep embayment filled with the basaltic groundmass. The irregular outline of this embayment distinguishes it from the embayments in the skeletal crystals in **27**. Note also the distinct marginal zoning and the delicate 'patchy zoning' within the crystal.

Olivine basalt from Arthur's Seat, Edinburgh, Scotland; magnification × 23, XPL.



Embayment quartz



30 Embayed quartz

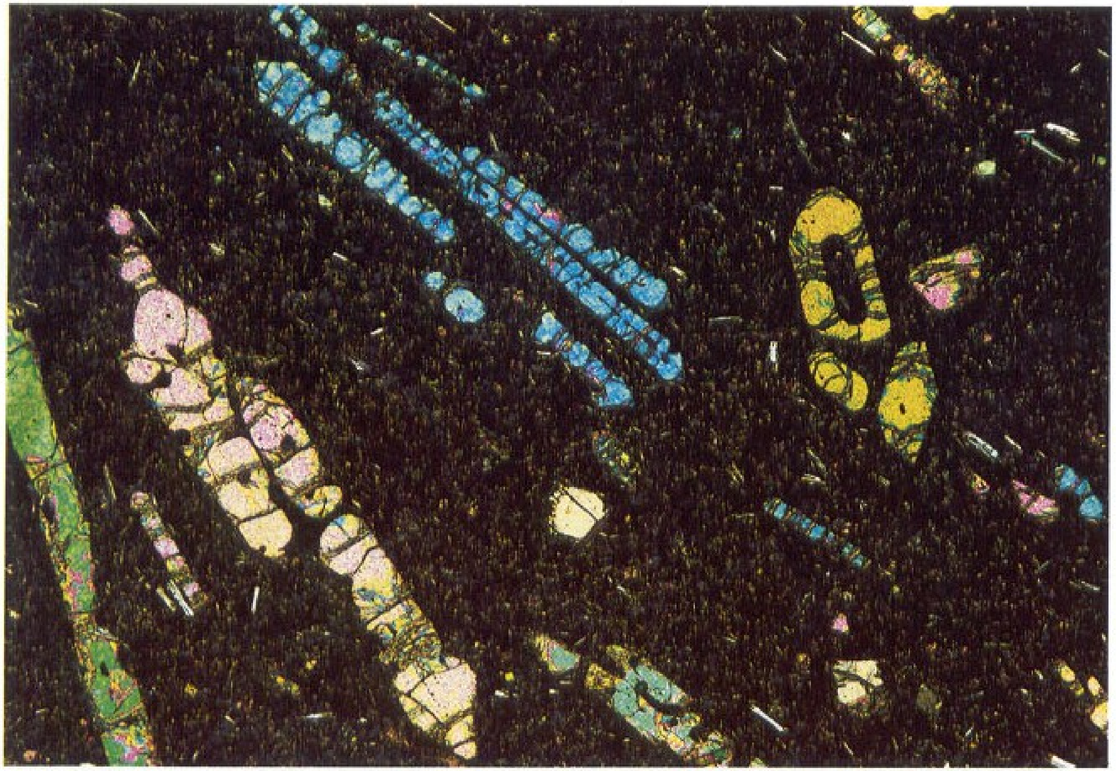
The deeply embayed quartz crystal in this olivine basalt contains brown glass and small, columnar, skeletal pyroxenes. It is also surrounded by a film of the glass and an aggregate of equant granular augite crystals which separate it from the basaltic groundmass.

Olivine basalt from Lassen Park, USA; magnification × 42, PPL.

Parallel-growth crystals:

The term is applied to an aggregate of elongate crystals of the same mineral whose crystalographic axes are mutually parallel, or almost so. Although in thin section the individual parts of the aggregate may be isolated from one another, in the third dimension they are probably conected. A parallel-growth crystals is therefore a single, incomplete crystal formed by a particular style of skeletal growth.

Olivine parallel growth



31 Olivine parallel growth

The elongate olivines near the middle of the photograph and showing blue interference colour all have the same crystallographic orientation, and hence represent a single, parallel-growth crystal. The crystal with yellowish-green interference colour shows how the parallel-growth crystal *might* appear, if sectioned at right angles.

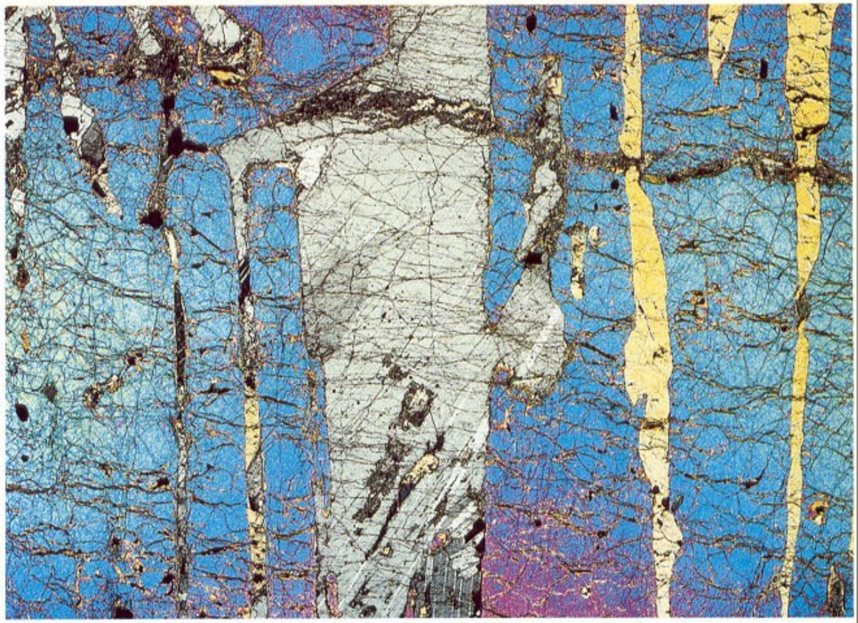
Picritic basalt from Ubekendt Ejland, West Greenland; magnification × 23, XPL.

Parallel growth in very coarse-grained rock

32 Parallel growth in a very coarse-grained rock

Here the parallel growth is of a very large olivine crystal. The actual width of the field of view is 1.7 cm and this shows only a small part of the parallel growth, whose total width is 50 cm and height is 150 cm. The whole comprises several hundred parallel units like the ones shown here. Plagioclase and augite occupy the 'channels' between the parallel growths. In the XPL picture the polars have been rotated so that the olivine is not in extinction. The slight differences in birefringence of the olivine at the top and bottom of the picture are caused by the section being thinner there. This rock has the special textural name *harrisite*.

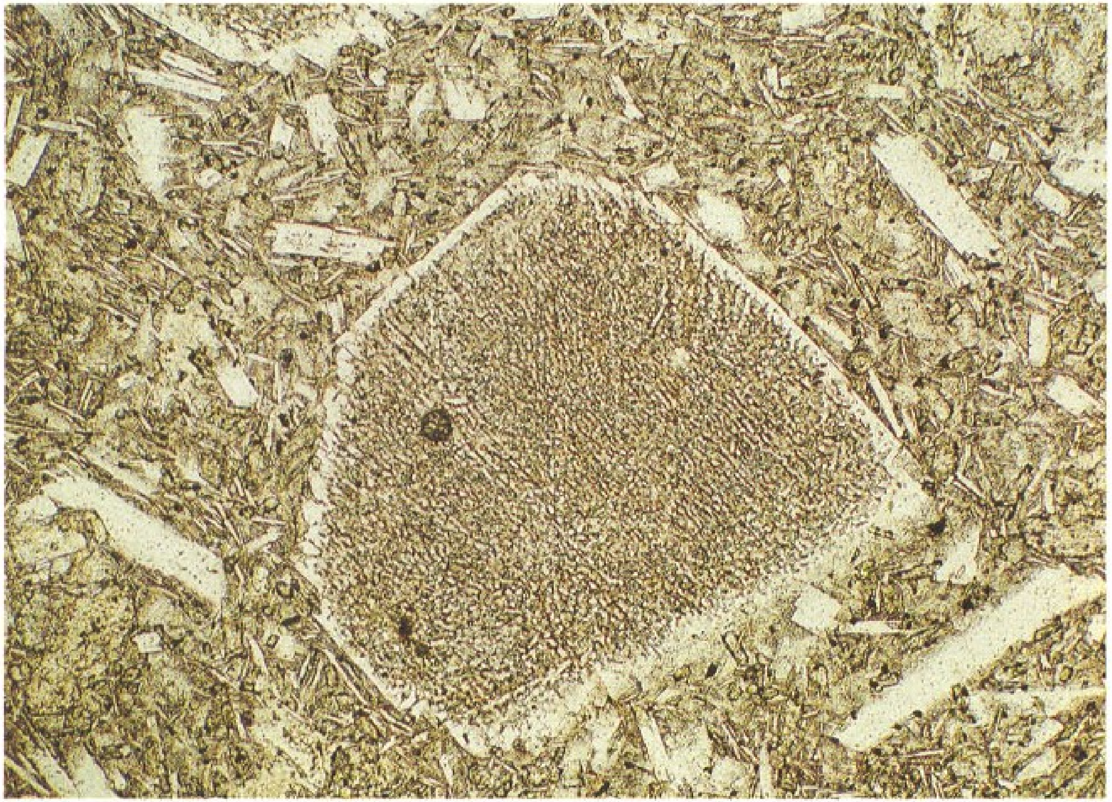
Feldspathic peridotite from Rhum, Scotland; magnification ×7, PPL and XPL.



Sieve-textured crystals:

These contain abundant, small, interconnected, box-shaped glass inclusion, giving the crystals a spongy, or porous, appearance.

Sieve-textured feldspar



33 Sieve-textured feldspar

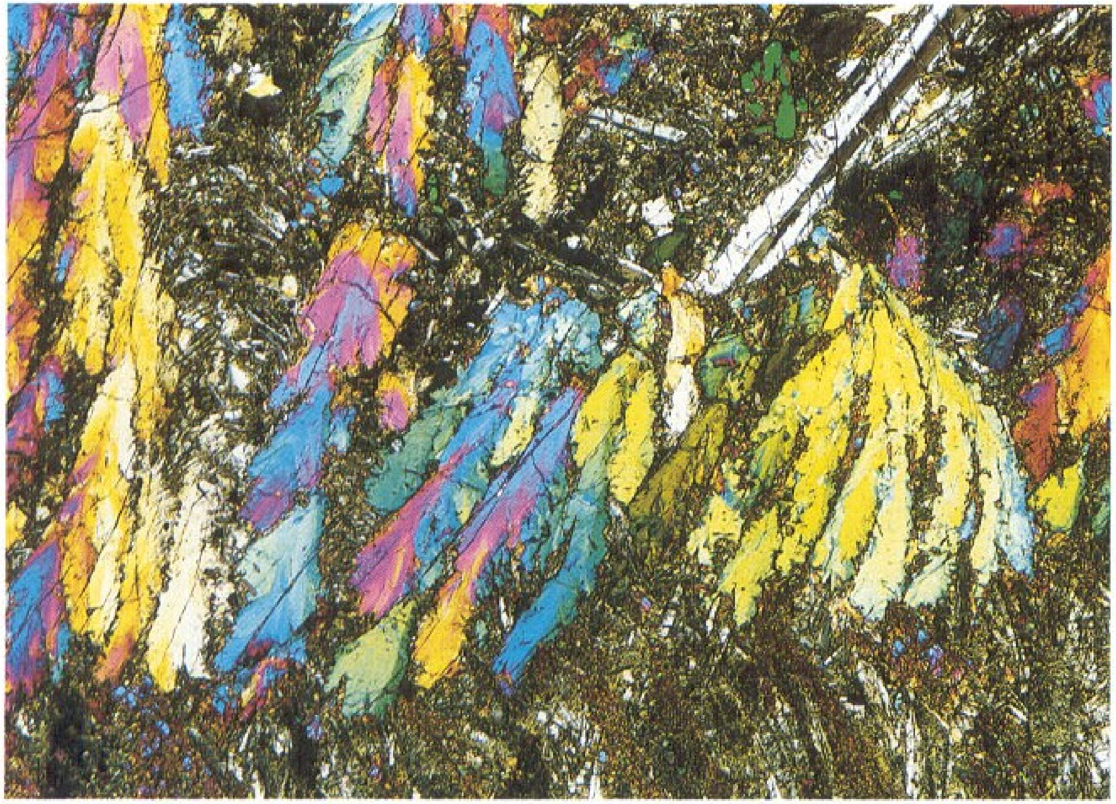
The core of this xenocryst consists of glass and alkali feldspar in a fine-mesh-like arrangement; the narrow rim is an overgrowth of plagioclase.

Olivine basalt from Lassen Park, USA; magnification ×62, PPL.

Elongate, curved, branching crystals:

These are rarely genuinely bent, rather the curveture is caused by development of branches along the length of the crystals, each branch having a slightly different crystallographic orientation to its neighbours (Fig. 34-36).

Curved branching augite



34 Curved branching augite

The highly coloured crystals in this photograph are complex, branching crystals of augite in subparallel alignment. They form part of a pyroxene-rich band in a differentiated dyke. (See also **71**.)

Dolerite from North Skye, Scotland; magnification × 21, XPL.

Branching augite in lamprophyre dyke

35 Branching augite in lamprophyre dyke

The acicular, aligned phenocrysts in this photograph are all of augite, forming composite, radiating, curved and branching groups. Individual needles can be seen to consist of several straight portions offset slightly from one another, and having very slightly different orientations; this gives each 'needle' its curved appearance. The margin of the dyke lay to the left. (See also **70**.)

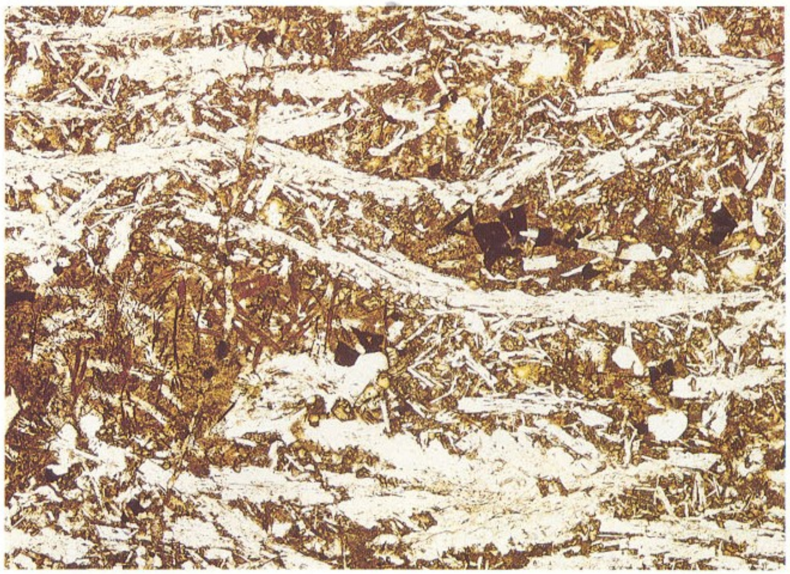
Fourchite from Fiskaenesset area, South-west Greenland; magnification × 20, XPL.

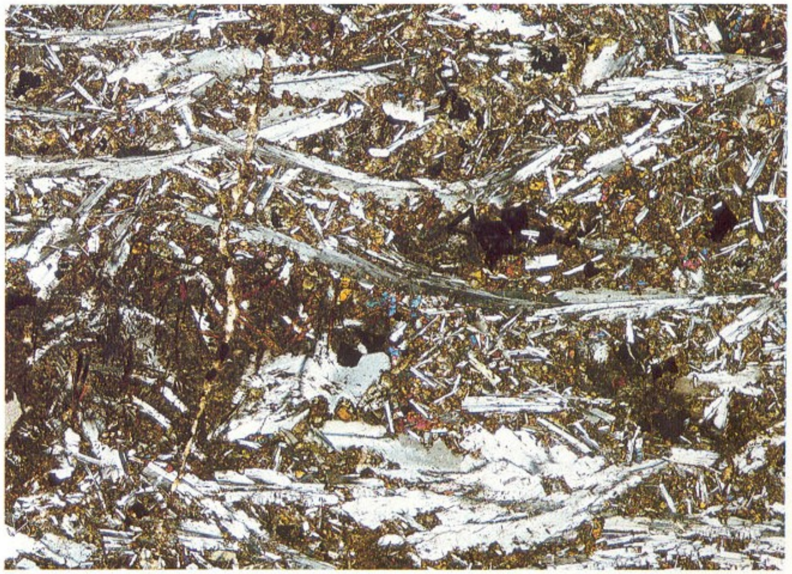
Curved and branching plagioclase crystals in dolerite

36 Curved and branching plagioclase crystals in dolerite

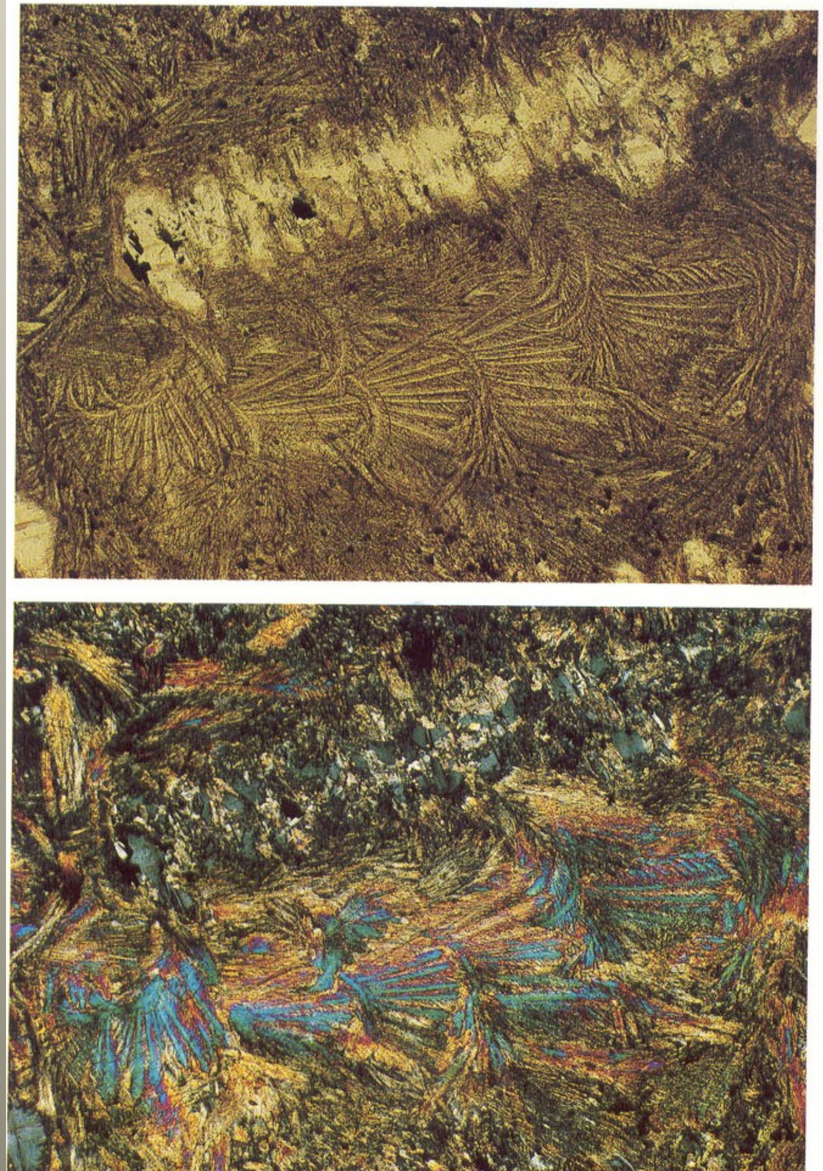
The large composite plagioclase crystals in this rock are elongate parallel to the *c* crystallographic axis and flattened parallel to (010). From the direction in which they branch, and from that in which the crystal at the bottom widens, it can be deduced that the crystals grew from right to left. The matrix consists of fine-grained plagioclase, olivine, pyroxene, amphibole, devitrified glass and clay minerals.

Feldspathic dolerite, Ubekendt Ejland, West Greenland; magnification × 16, PPL and XPL.





Composite branching augite crystal



37 Composite branching augite crystal

These photographs illustrate a particularly intriguing shape of branching augite crystal: it consists of groups of slightly diverging needles, subparallel to the length of the crystal, which apparently have grown from curved branching needles oriented approximately at right angles to the crystal length. Despite the uniform interference colour of many of the needles, a sweeping style of extinction occurs when the microscope stage is rotated under crossed polars, indicating that the needles are not all of the same crystallographic orientation.

Peridotitic komatiite from Munro Township, Ontario, Canada; magnification × 52, PPL and XPL.

Pseudomorphs:

It may be found that crystals in thin section, althoug having the characteristic shape of a particular mineral, prove to be of another mineral, or an aggregate of crystals of another mineral. The name *pseudomorph* is used for such a crystal. If the pseudomorph has the same composition as the original mineral (e.g. quartz in place of tridymite) it is known as a *paramorph*.

Carbinate pseudomorphs after olivine

38 Carbonate pseudomorphs after olivine

The phenocrysts in this altered basalt show typical sections of skeletal olivine, with inclusions of groundmass in the embayments. However the photograph shows the phenocrysts to be occupied by finely crystallized carbonate, indicating that replacement of olivine has occurred.

Altered basalt from Castleton, Derbyshire, England; magnification × 27, XPL.

*Another example of pseudomorphs is shown in **149**.*