6.5.1 Symplectitic intergrowths

Symplectite is the name used for an intimate intergrowth texture involving two minerals of different type. One mineral occurs as beeps or vermicular (worm-shaped) or lamellar inclusions in the other mineral, the latter is said to act as a host to the first. The term symplectite should be used purely as a descriptive term, it gives no genetic implication. In fact, several mechanisms can account for the development of a symplectitic intergrowth, of which the most important are:

(i) Eutectic crystallization. In Chapter 3 we have seen that the final stage of crystallization of many melts is represented by the eutectic crystallization of two or three minerals at the same time. An example of the resulting texture can be seen in Figure 6-5a, which is the most common example in igneous rocks, the granophyric or micrographic intergrowth, characterized by regularly shaped and orientated quartz inclusions in alkali feldspar. This texture is the result of eutectic crystallization of S¡O2 polymorph (later to become quartz) and alkali feldspar, as is illustrated in Figure 6-6. **graphic intergrowth**. The name of the texture is derived from the Egyptian script which it resembles.

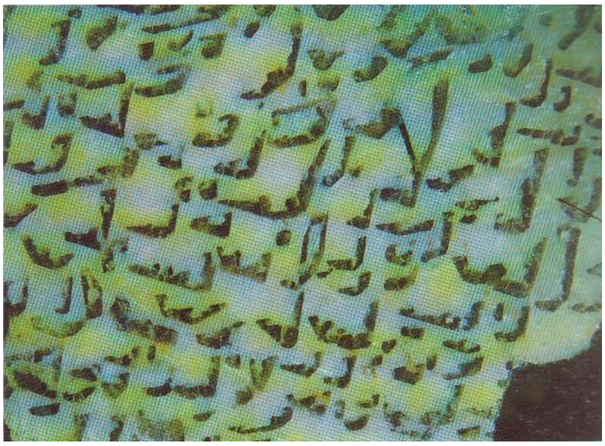

Fig. 16 Graphic granite

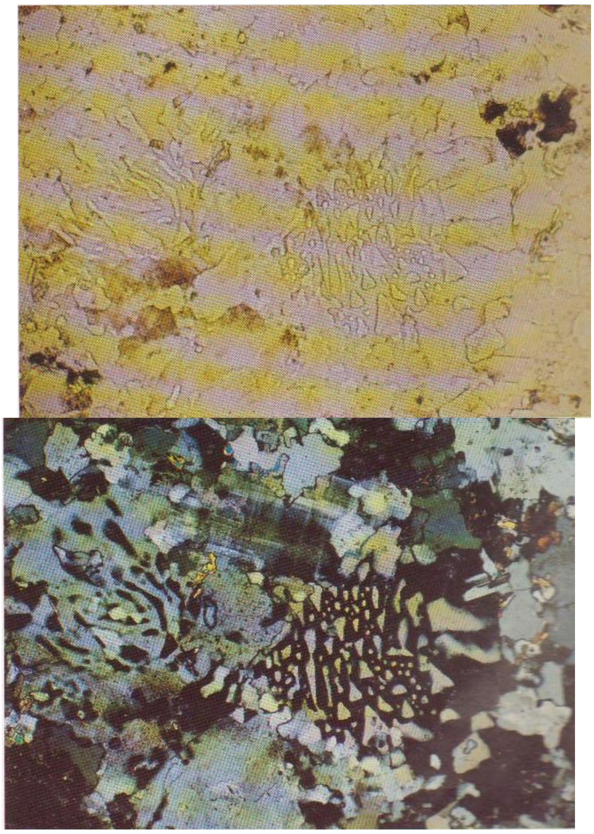

Fig. 17 Micrographic texture in aplite

(ii) Replacement. When a mineral is unstable under the prevailing T and P conditions, it may be replaced by one or more other minerals that are stable. This may lead to symplectitic intergrowths, especially common in high-grade metamorphic rocks (See Figure 6-5b). In igneous rocks one common example of this replacement texture is known: **myrmekitic intergrowth**. It is characterized by vermicular quartz inclusions in plagioclase crystals. It is thought to form due to replacement of alkali feldspar by plagioclase, whereby excess S¡O2 from the replacement reaction accounts for the origin of the quartz inclusions (See Figure 6-5d).'

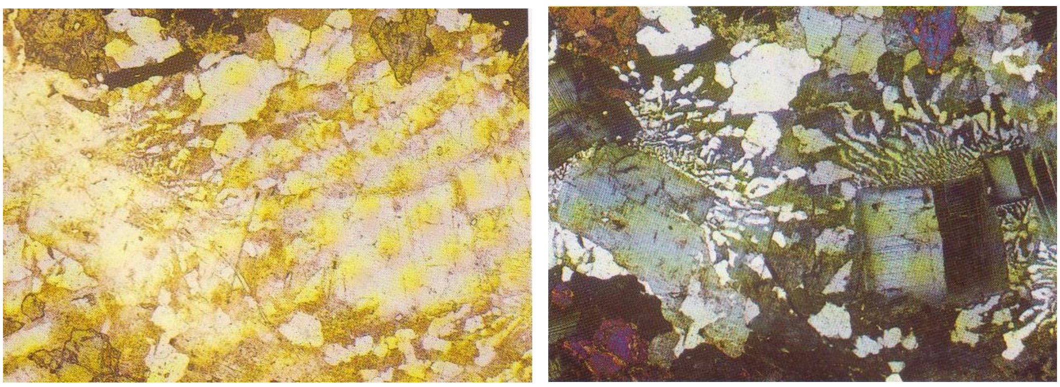

Fig. 18 (a) Granophyric texture

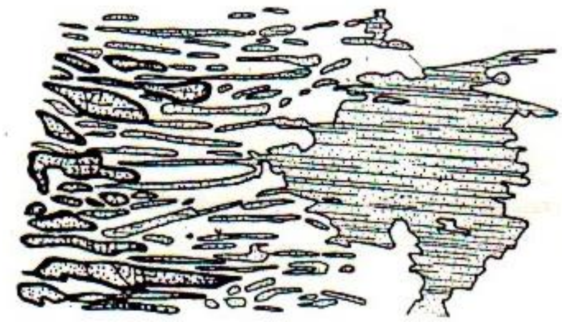

Fig. 18 (b) Replacement symplectite in high grade metamorphic rock

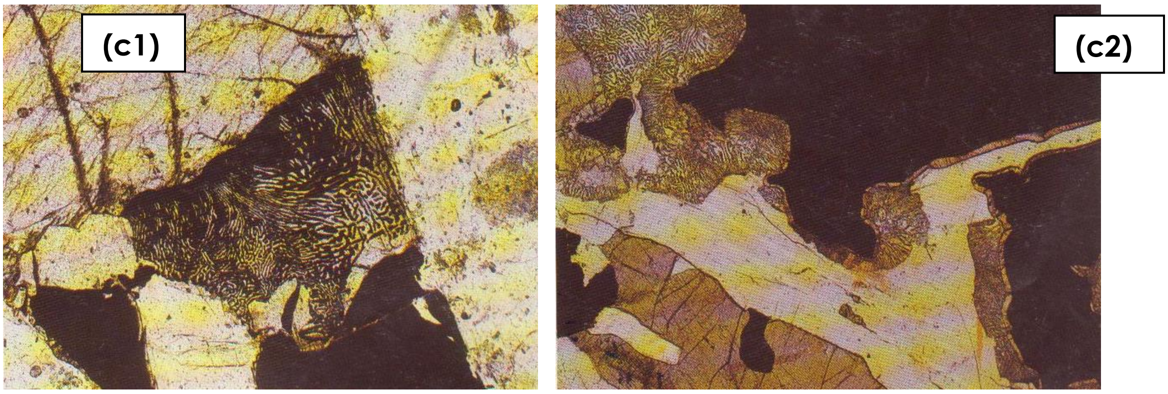

Fig. 18 (c1) Symplectite of iron ore and orthopyroxene; (c2) Fayalite-quartz symplectite

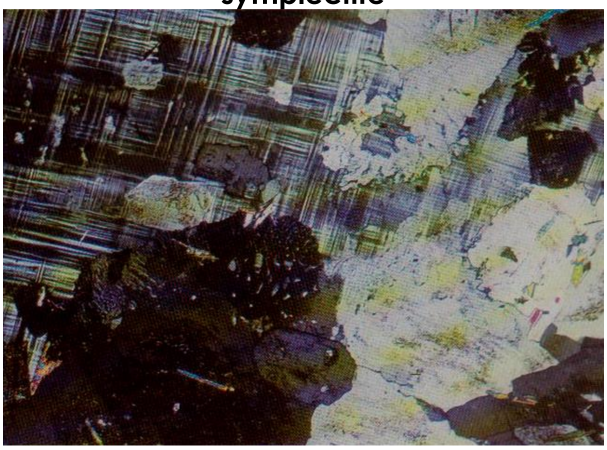

Fig. 18 (d) Myrmekitic texture in granite

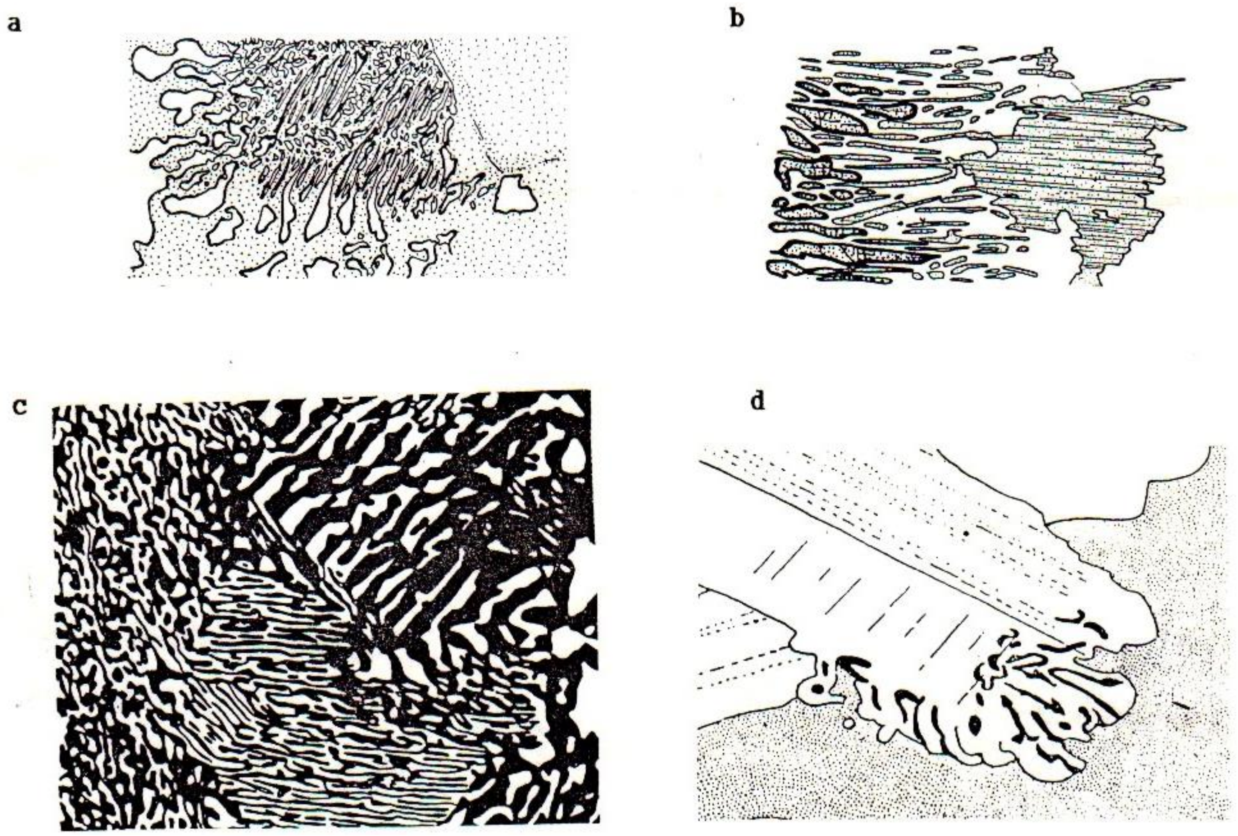

Fig. 19 Different types of symplectitic intergrowths. (a) granophyric intergrowth, a symplectite caused by eutectic crystallization of quartz and alkali feldspar; (b) replacement symplectite in high grade metamorphic rock, representing the reaction biotite + quartz --→ hypersthene + H2O, (c) symplectite as a result of exsolution of chalcopyrite (white) from bornite (black) (d) myrmekite, a symplectitic intergrowth of plagioclase (white) and quartz (black) replacing microcline (stippled). (from Bard, 1986 and Hatch, Wells and Wells, 1972).

(iii) Exsolution. When temperatures drop below that of the solvus of solid solution minerals, these minerals will start to expel the components that cannot be accommodated stably in their crystal lattice any longer. This process is called exsolution, and it produces symplectitic intergrowths between the host mineral and the exsolved mineral. The most common example of exsolution intergrowth in igneous rocks is that shown by feldspars in granites and syenites, and by pyroxenes in gabbroic rocks. Also important is exsolution in the spinel group (for example, Ti-bearing magnetite may exsolve bleeps of Fe2TiO4, ulvospinel) and in many ore minerals (for example, bornite, Cu5FeS4, is often seen to exsolve lamellae of chalcopyrite, CuFeS2, See Figure 6-5c).

The exsolution processes taking place in feldspars have already been discussed in Section 3.3.5. Alkali feldspar exsolving albite is called perthite and plagioclase exsolving alkali feldspar is called antiperthite. The different forms that the perthitic intergrowths may obtain are shown in Figure 6-7.

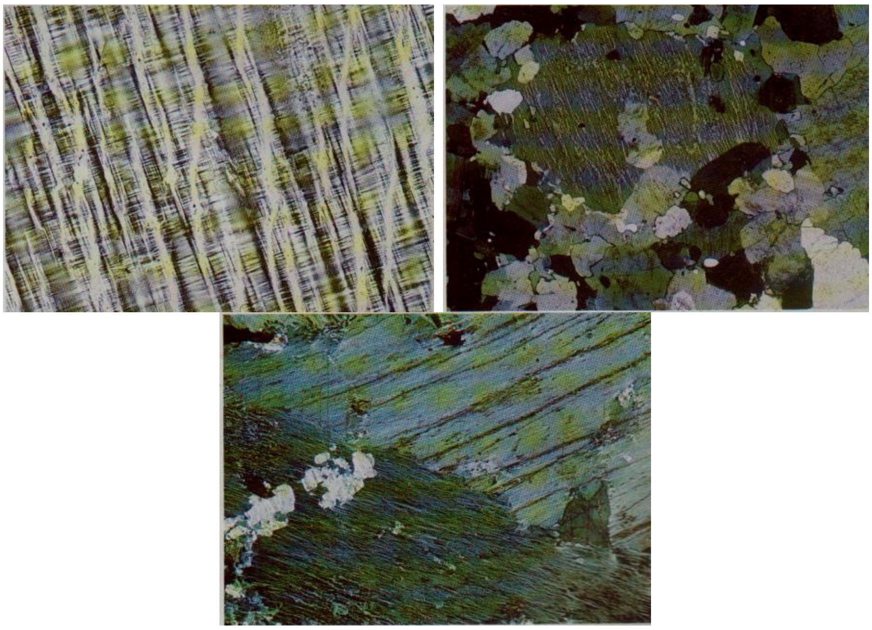

Fig. 20 Microperthitic textures

Fig. 21 Microperthitic textures

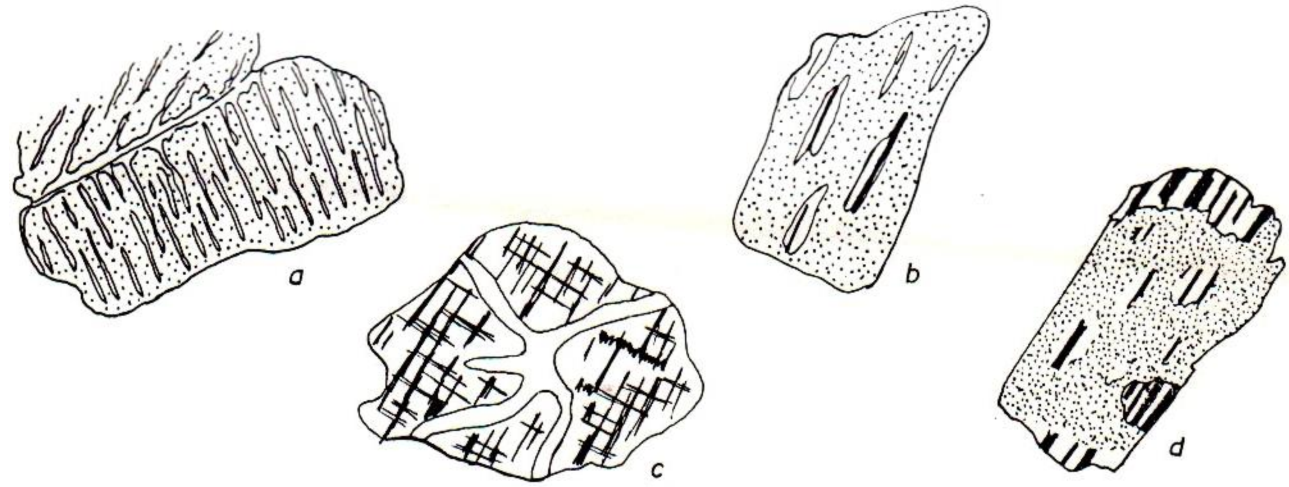

Fig. 22 Perthite textures. (a) string perthite: thin lamellae of albite in orthoclase, (b) rod perthite: albite as thin leaves in orthoclase, (c) vein perthite: albite veins in microcline, (d) patch perthite: patches of twinned albite replacing orthoclase.

When clinopyroxene crystallizes from a melt the first crystal to form is rich in magnesium. With falling temperature the composition shows progressive iron enrichment. This Fe-enrichment is accompanied by Ca-enrichment, as can be observed in the simplified crystallization diagram of pyroxenes (See Figure 3-14). Subsolvus reactions involve the unmixing of orthopyroxene from clinopyroxene, thereby relatively enriching the clinopyroxene in calcium, and the usually form lamellae or bleps parallel to the (100) or (001) planes of the crystals, i.e. parallel to the twin planes of the clinopyroxene. A special texture which may evolve in a twinned clinopyroxene is called herringbone texture (a herring is a fish); it can be seen when the pyroxene is twinned according to (100) and shows exsolution lamellae of orthopyroxene parallel to (001), as is illustrated in Figure 6-8a.

The above described exsolution processes and textures in pyroxenes may be superimposed by another symplectitic texture, called Schiller structure, caused by the exsolution of iron from pyroxenes. The Schiller texture is characterized by tiny, hair-like rodlets of magnetite or ilmenite (when Ti is expelled from the pyroxene as well), which are usually orientated parallel to the Z-axis of pyroxene (See Figure 6-8b). Schiller texture is common in igneous pyroxenes, but it is also rarely observed in other minerals such as plagioclase.

Figure 6-8 (a) Herringbone texture in clinopyroxene, (b) Schiller texture in clino-or orthopyroxene.