DNIPRO UNIVERSITY of TECHNOLOGY 1899

TU BERGAKADEMIE FREIBERG

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Seit 1765.

TECHNOLOGICAL MINERAGRAPHY

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Technological mineralography is a part of ore microscopy that studies the properties of ores in relation to the process of their enrichment

Information about the diagnostic properties of ore minerals and their textural and structural relationships allows you to choose the optimal ore enrichment process. When studying the source minerals, you can assess the influence of the specific gravity, magnetic and electrical properties of minerals on the process of their separation.

Fine-grained mixtures of ore minerals with higher density and non-ore minerals can lead to the loss of valuable components or to the dilution of the concentrate. Similar problems can arise if the ore contains fine-grained mixtures of magnetic and non-magnetic minerals.

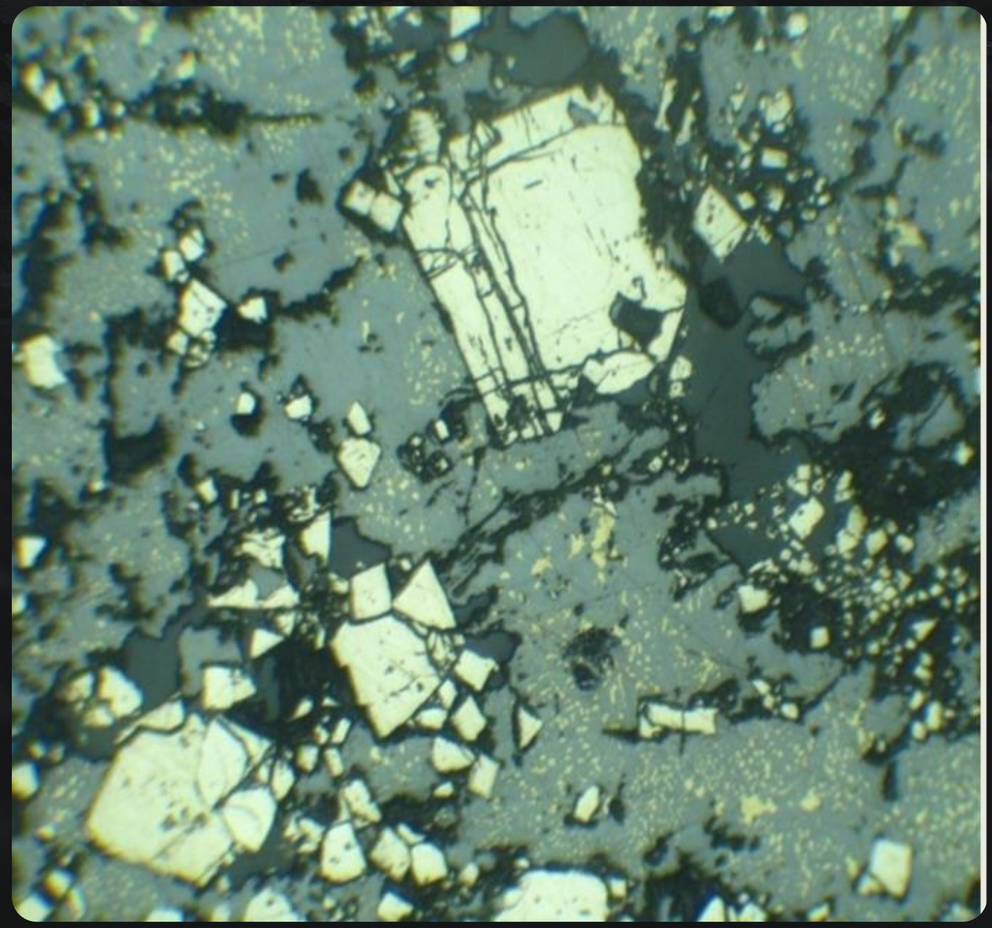
Microstructures and microtextures of ore

Ore structure

is the structure of a mineral aggregate determined by the shape, size and manner of intergrowth of mineral grains in the aggregate.
The morphological unit of the structure is a mineral grain.

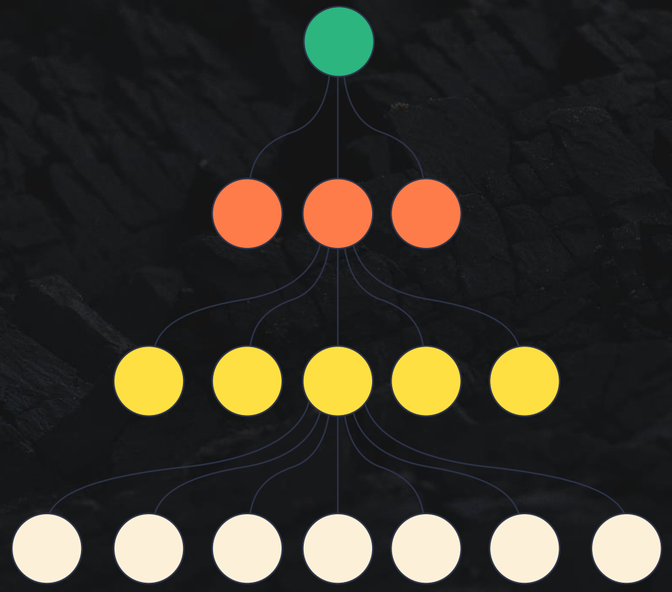
Texture

is the structure of ore determined by the shape, size and manner of intergrowth of mineral aggregates.
The morphological unit of texture is a mineral aggregate.



CLASSIFICATION OF ORE STRUCTURES

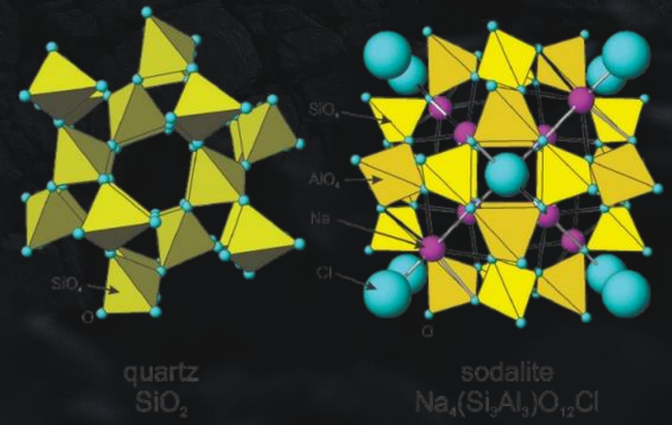
5 genetic groups of structures



1. Crystallisation structures from liquid melts and solutions;
2. Decomposition structures of solid solutions;
3. Structures of recrystallisation and decrystallisation of a substance in the solid state;
4. Cataclastic structures;
5. Structures of sedimentary ores.

CRYSTALLISATION STRUCTURES

This genetic group of structures is characterised by the granular structure of mineral aggregates, which is clearly visible both macroscopically and under a microscope.
Concealed crystalline forms of mineral discharge are practically not found.



https://opengeology.org/Mineralogy/13-crystal-structures

The main morphological types of structures of this group are:

- **idiomorphic-grained,**
- **hypidiomorphic-grained,**

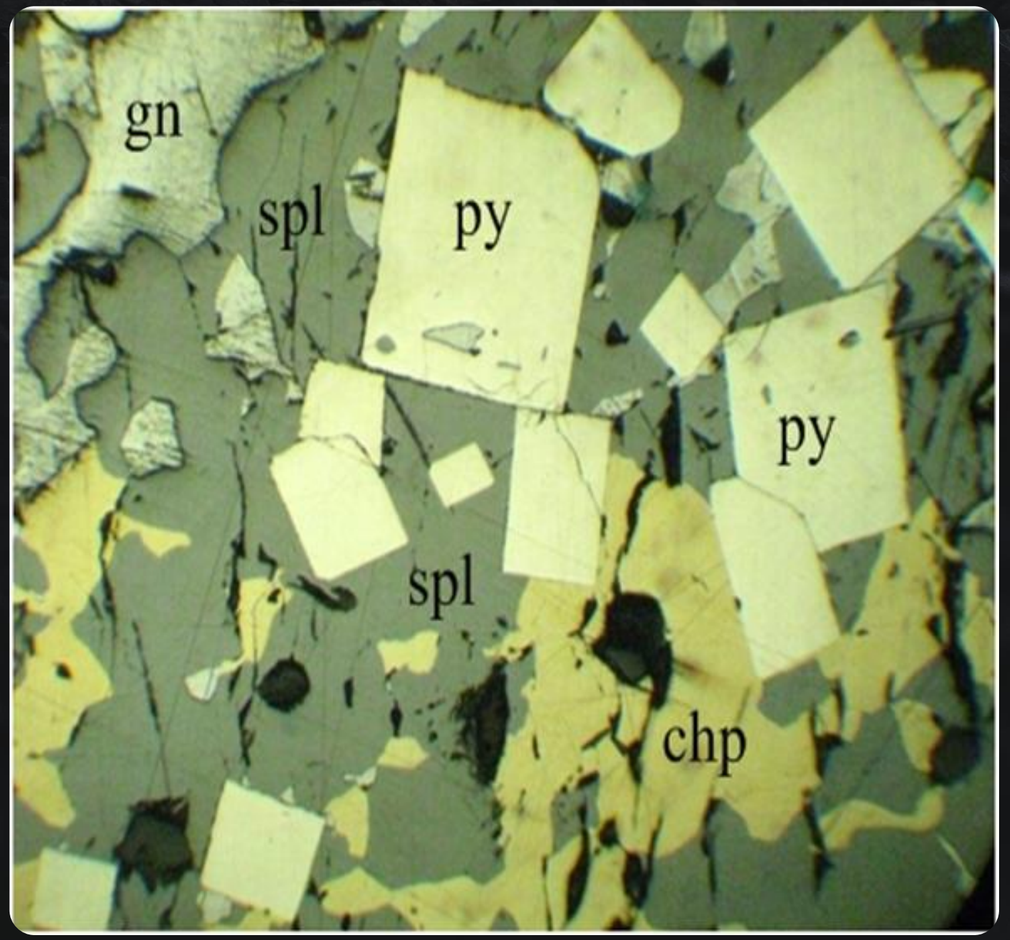
- **allotriomorphic-grained,**
- **graphic**

- **subgraphic,**
- **sideronitic,**

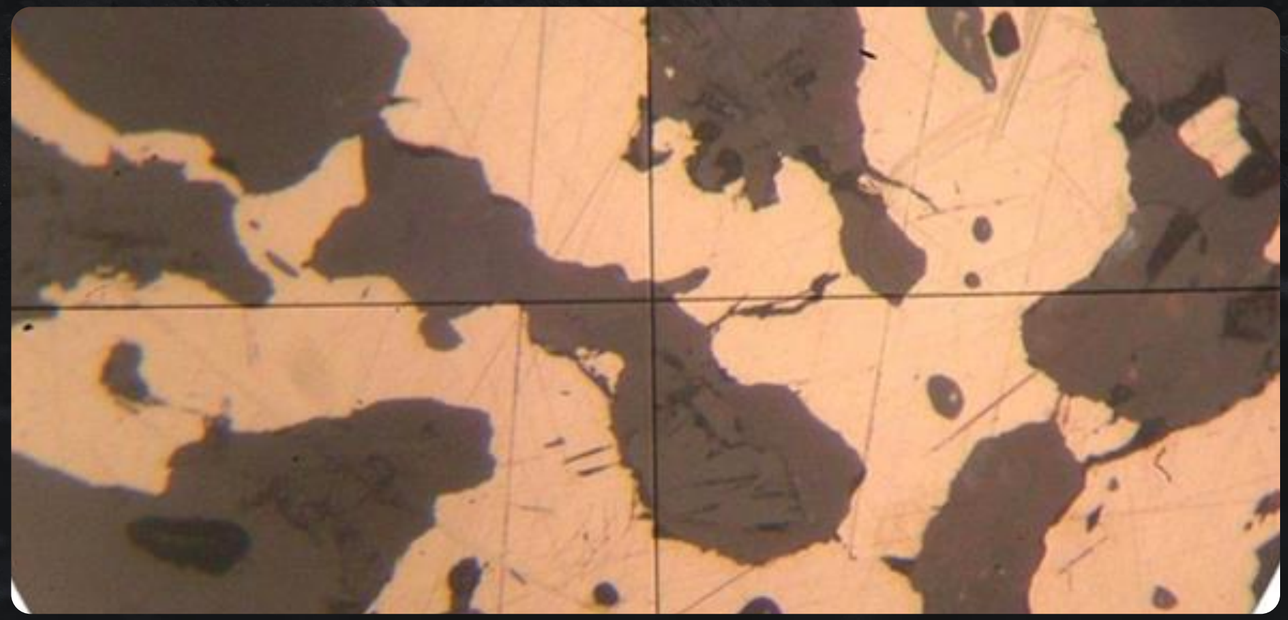
- **porphyritic,**
- **poikilitic**

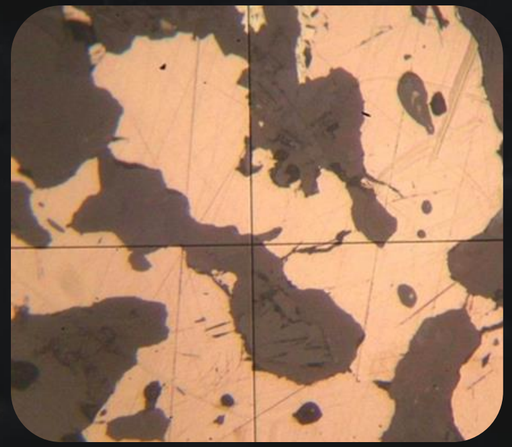
IDIOMORPHIC GRAIN STRUCTURE (PANIDIOMORPHIC GRAIN STRUCTURE)

- idiomorphic-grained,
- hypidiomorphic-grained,
- allotriomorphic-grained,
- graphic,
- subgraphic,
- sideronitic,
- porphyritic,
- poikilitic.



Sideronite structure



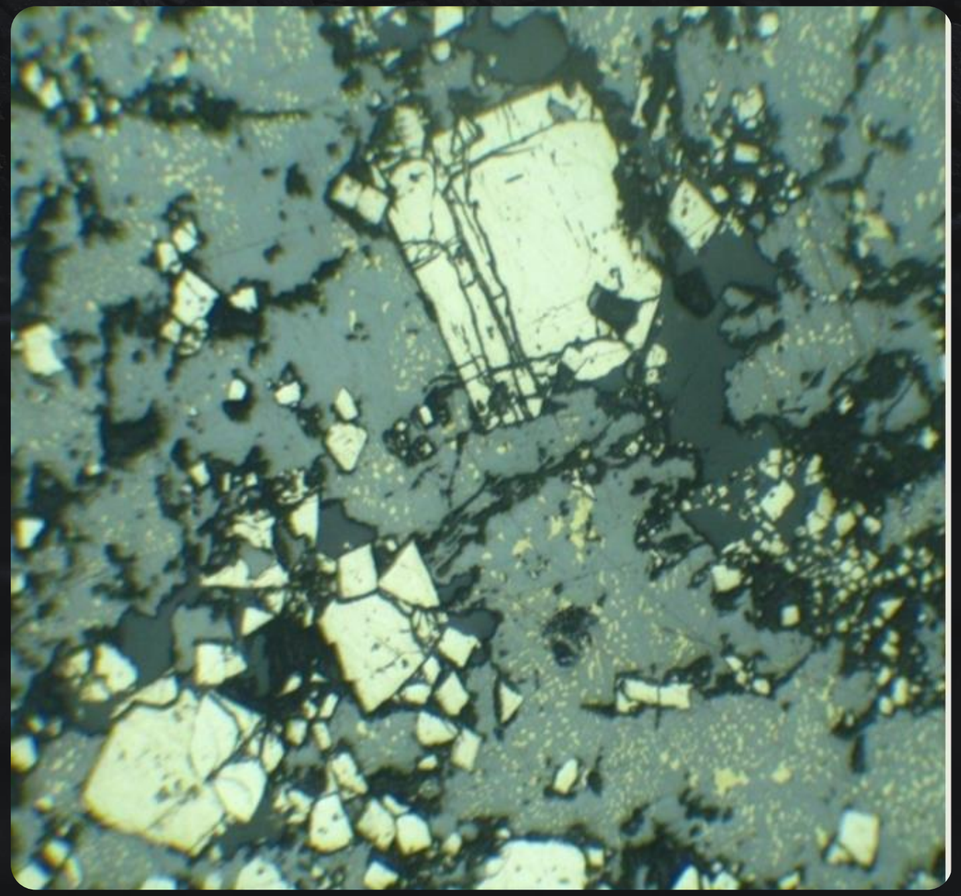


A sideronite structure is a mineral structure in which ore minerals fill the spaces between silicate mineral grains, cementing them together.

This structure is characteristic of magmatic ores and is caused by the later formation of ore minerals relative to silicate minerals. At the same time, silicate minerals that were formed earlier show the presence of corrosion boundaries.

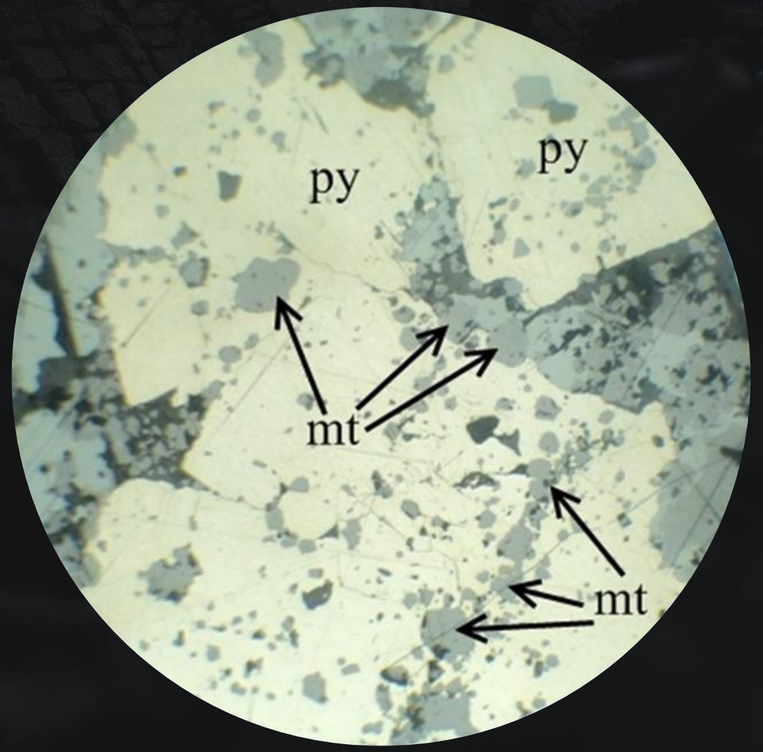
PORPHYRITIC STRUCTURE

A porphyritic structure characterises a mineral aggregate in which the minerals that crystallised earlier are significantly larger in size than those that crystallised later. At the same time, minerals early in crystallisation have corrosion limitations.



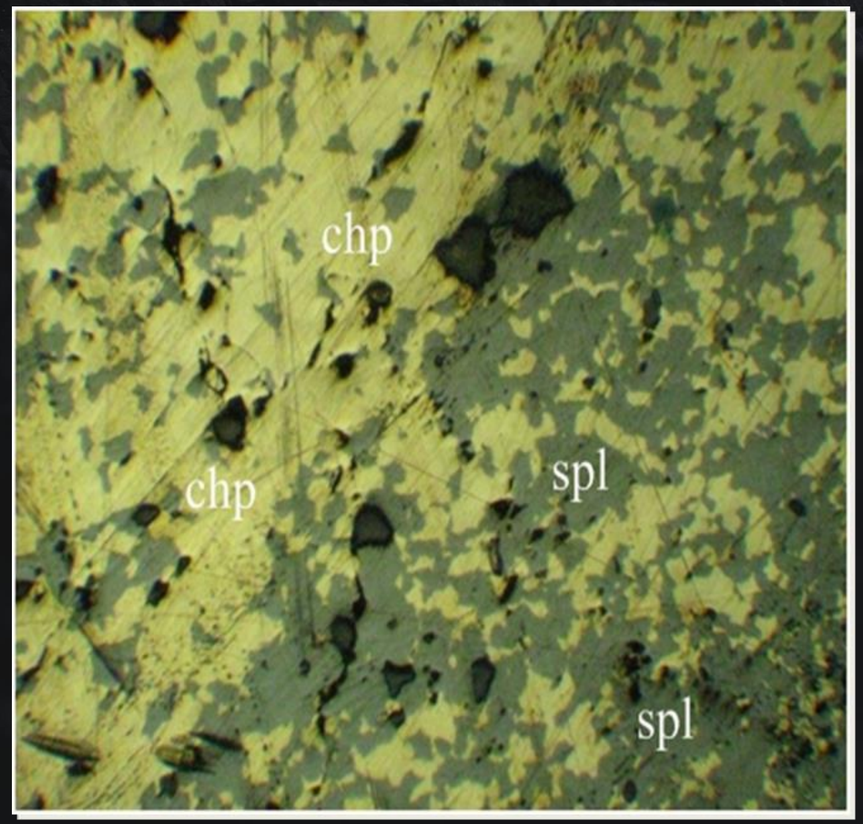
POIKILITIC STRUCTURE

The poikilitic structure is characterised by a disorderly arrangement (germination) of small grains of one ore mineral in larger grains of another ore mineral.



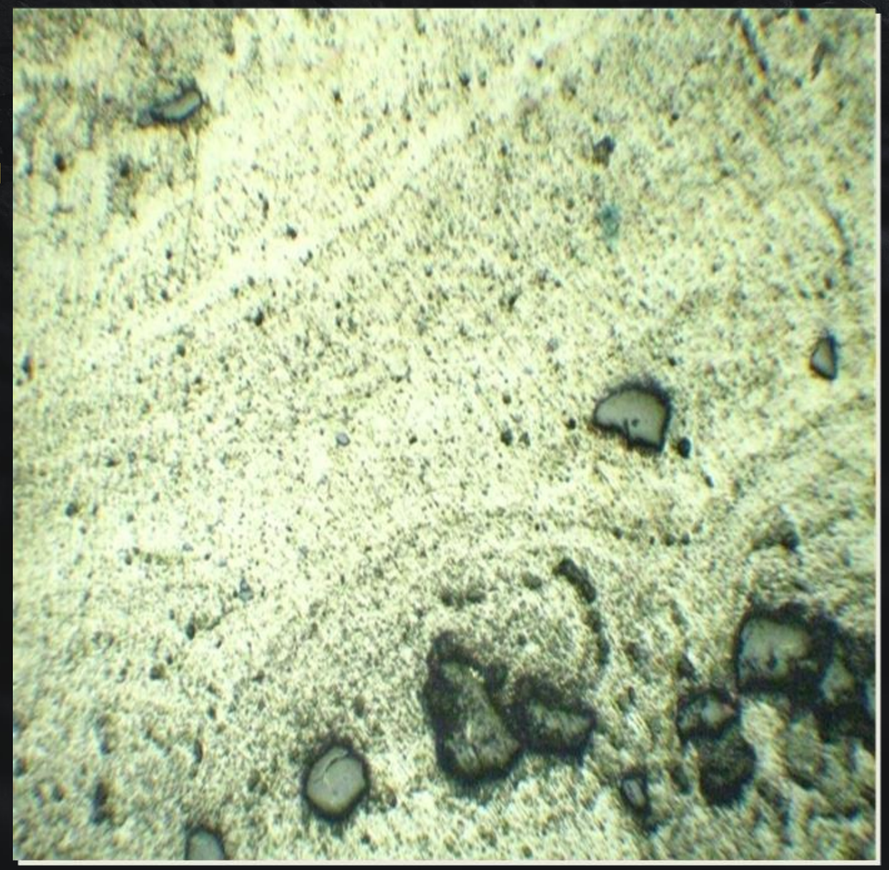
ALOTRIOMORPHIC GRANULAR STRUCTURE

An allotriomorphic granular structure is the structure of a mineral aggregate in which the grains are irregular in shape and intertwined, forming winding boundaries between the grains. This structure indicates the simultaneous formation of minerals.



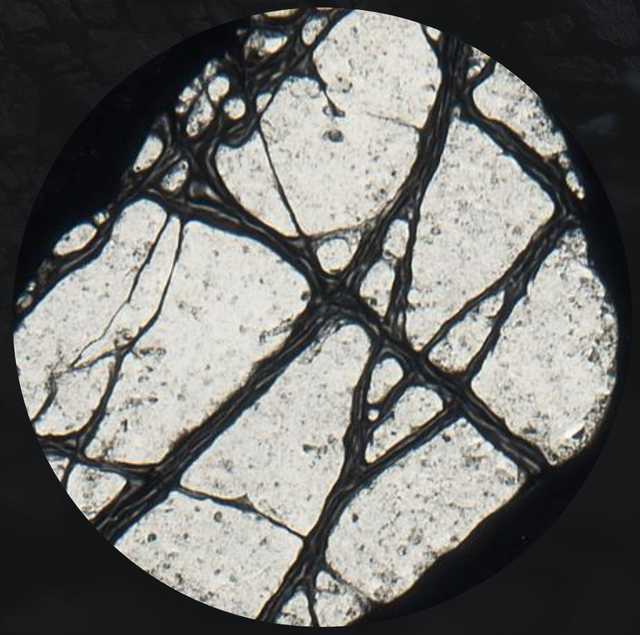
HIDDEN CRYSTAL STRUCTURE

- The covert crystalline (gel) structure is formed when ore-bearing solutions are sharply supercooled or supersaturated, from which covert crystalline and colloidal masses are formed.
- During metamorphism, colloids undergo recrystallisation, so they are rarely observed in ores.

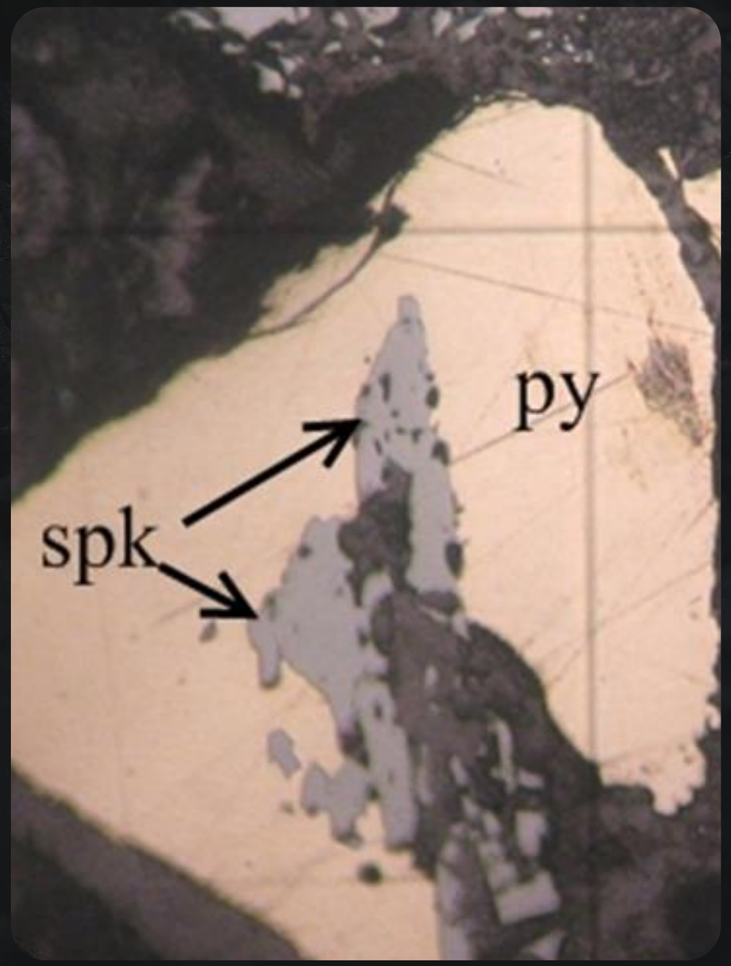


REPLACEMENT STRUCTURES (CORROSION)

The structures of this group are widespread in ores of endogenous and exogenous deposits. The study of replacement structures is of great importance for determining the genesis of ores, as it allows one to determine the stages of ore deposition and to establish the sequence of ore and vien mineral separation.

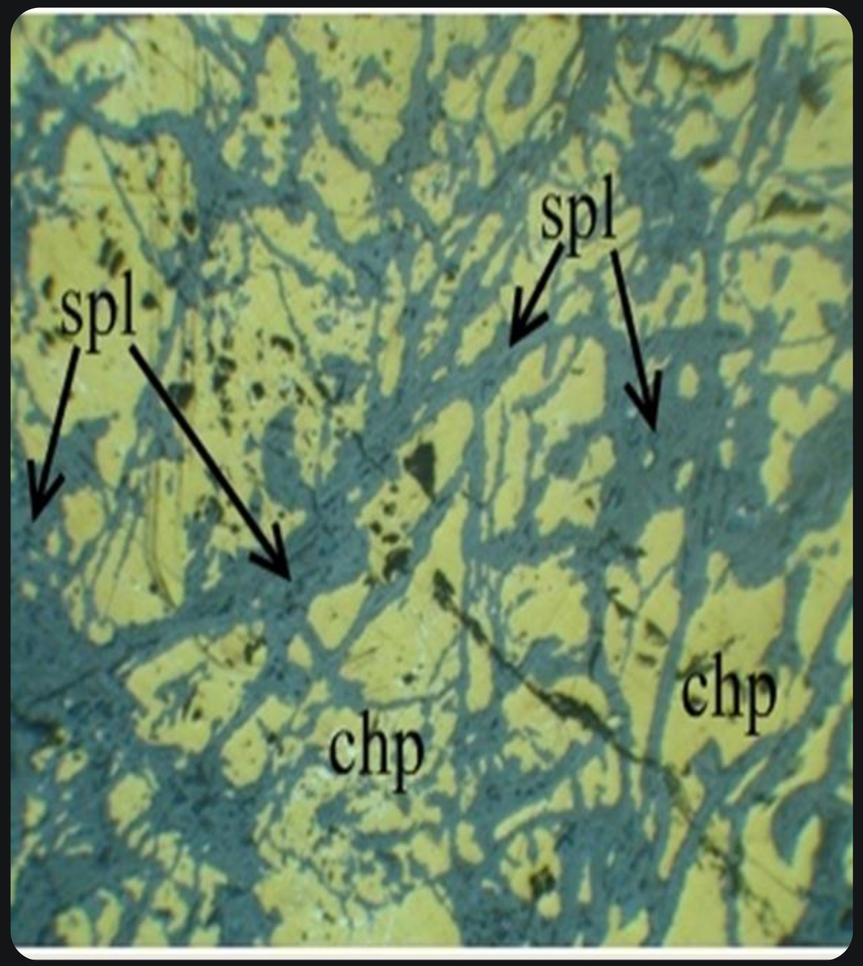


Polished section of polymetallic(Al)



CORROSION STRUCTURE

The corrosion structure characterises the structure of mineral aggregates in which one mineral penetrates another, resulting in the replacing mineral acquiring irregular shapes with uneven, jagged edges and bay-like walls.



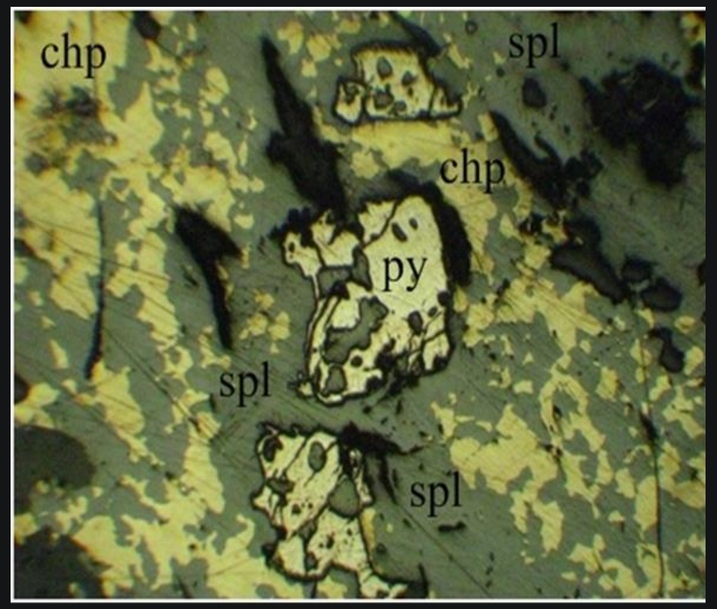
CROSSING STRUCTURE

Characterised by the presence of veins of the replacing mineral in the replaced mineral. The veins are usually ‘branched’, sinuous and non-parallel to each other.

STRUCTURE OF REMAINS REPLACEMENT

The structure of substitution remains characterises the structure of a mineral aggregate in which ‘corroded’ grains of substituted minerals are observed with preserved relics of the original minerals, usually concentrated in the centre of the grain. At the same time, the general orientation of the relics is preserved.

SKELETAL STRUCTURE

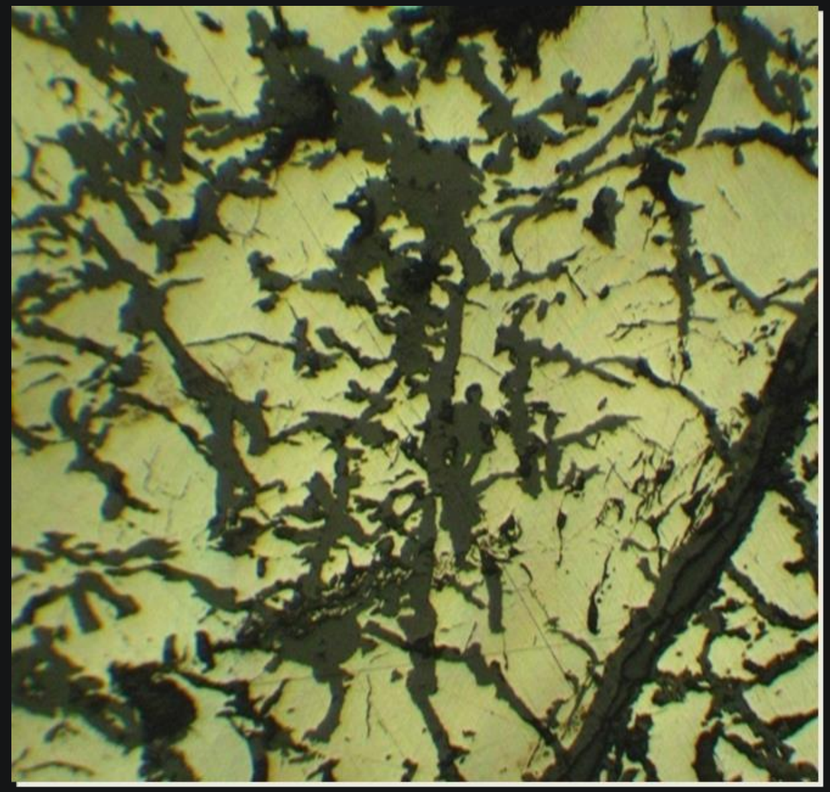


The skeletal structure is formed when the mineral replacement process proceeds from the centre to the periphery.

In this case, the outer edges are preserved, forming the crystal skeleton of the grain

GRID STRUCTURE

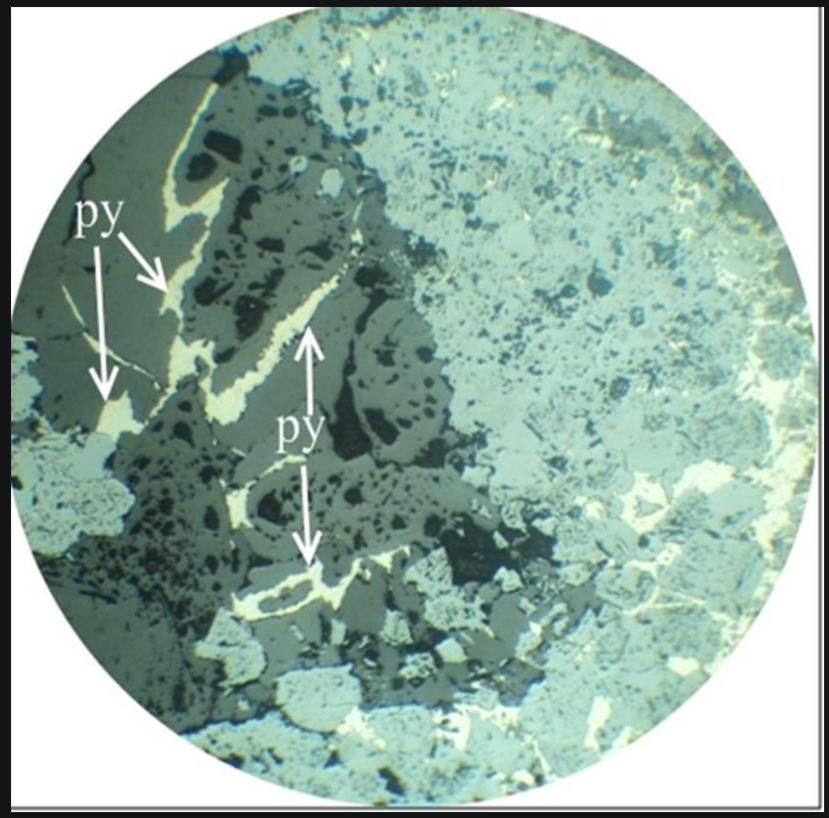
A grid structure is characteristic of mineral aggregates in which the penetration of the mineralised replacement solution occurred along the intersecting directions of the cleavage of the original mineral.



LOOP STRUCTURE

The loop structure is characterised by the localisation of one mineral around the boundaries of grains of another mineral.

For this example, the loop allocation of pyrite among non-metallic minerals.



LOOP STRUCTURE

Metasomatic replacement is opposed to the secretory method of mineral deposition when filling open cavities. As a rule, both methods are combined. Metasomatic processes occur under the influence of solutions – liquid and gaseous. The paths of solution movement in the rock are small pores, contacts between grains, etc.

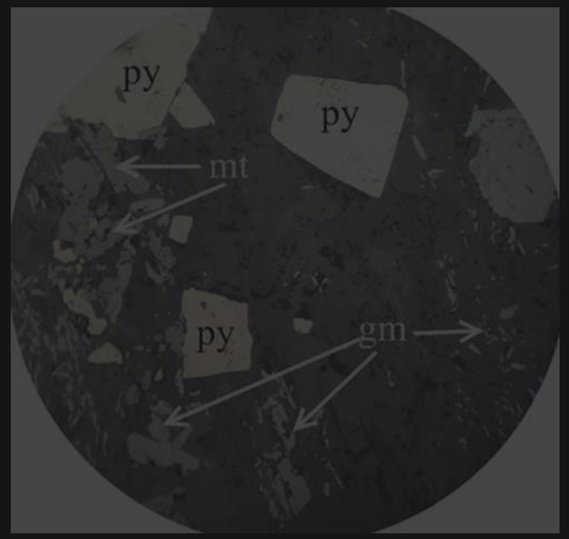


Fig. 3.1

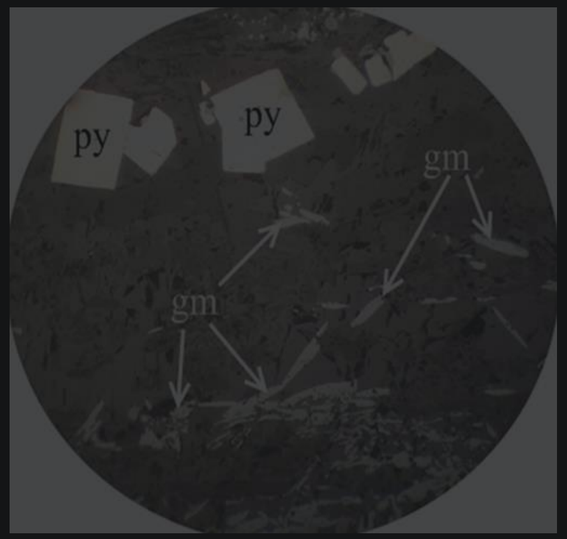


Fig. 3.2

Fig. 3.3

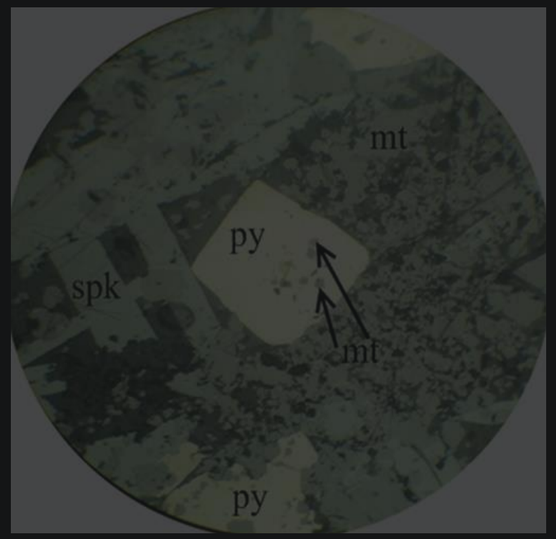
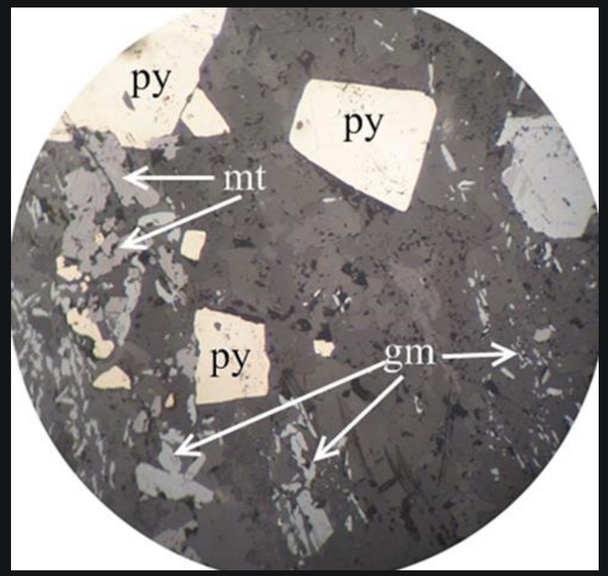


Fig. 3.4



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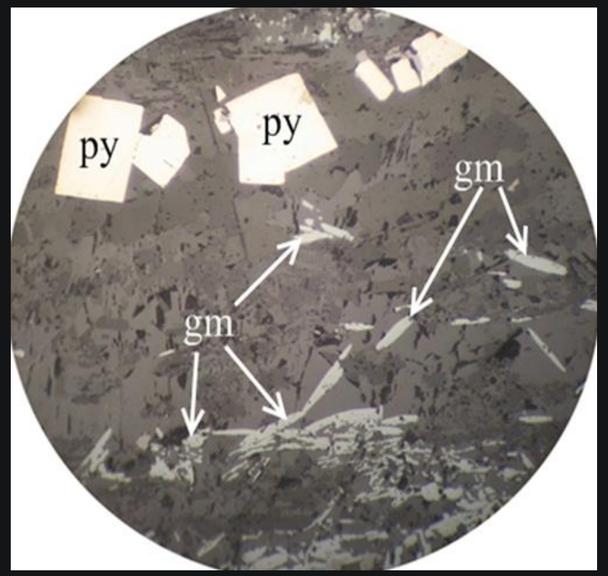


Fig. 3.2

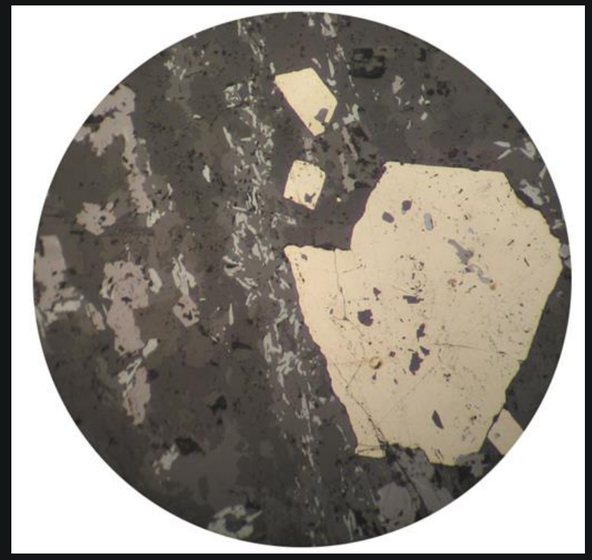


Fig. 3.3

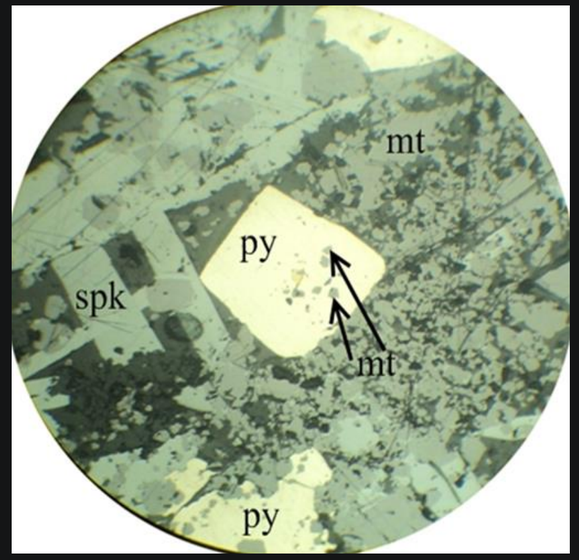
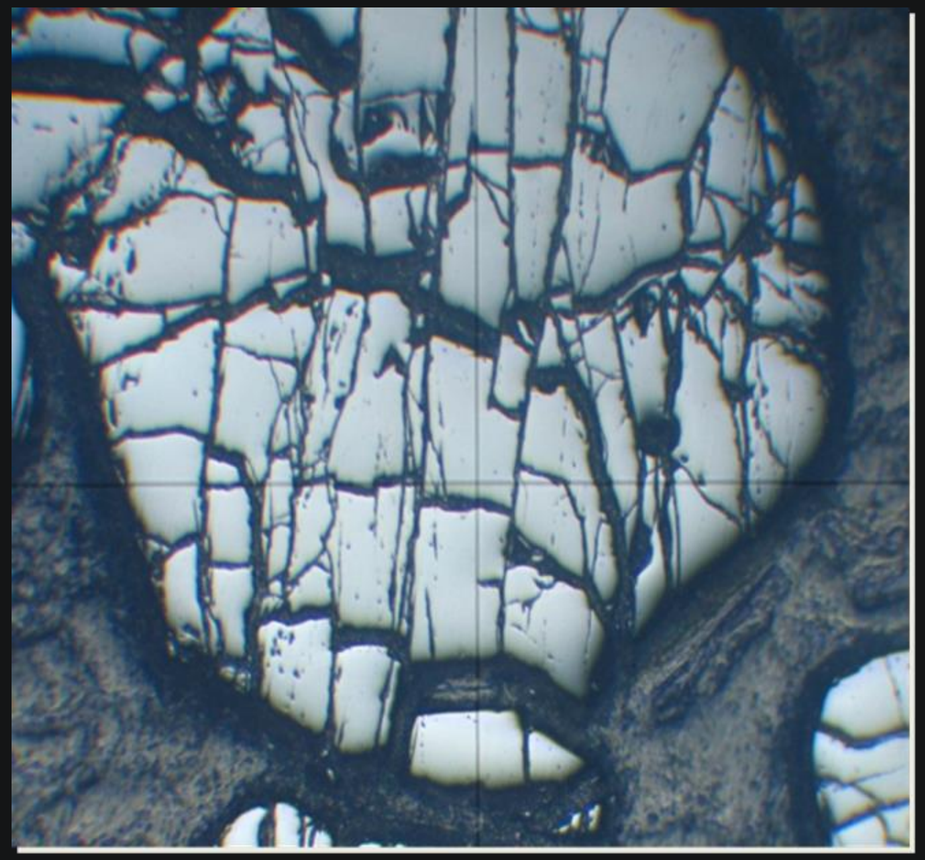


Fig. 3.4

CRUSHING STRUCTURE (CATACLASTIC)

•The crushing structure is characteristic of mineral aggregates containing fragile and hard minerals broken into separate fragments (clasts) by a system of microcracks.

•The granoclast structure is characterised by fragments of equal size in the mineral aggregate.

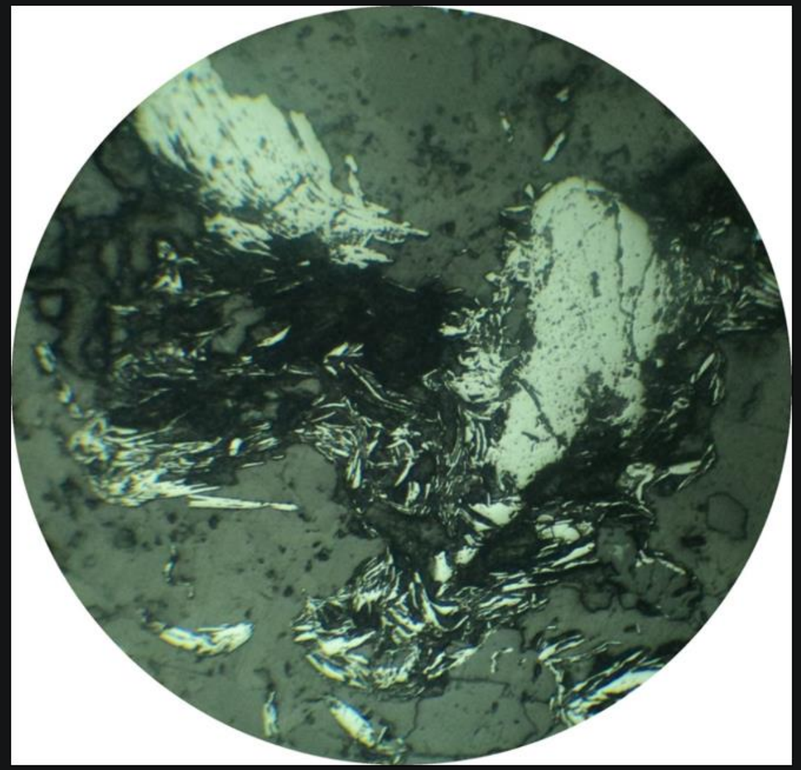


DEFORMATION STRUCTURE (CRUSHING)

•The crushing structure is formed under the influence of pressure on soft and ductile minerals, which, as a result of dynamometamorphism, undergo plastic deformation in the form of crushing and cracking of mineral grains.

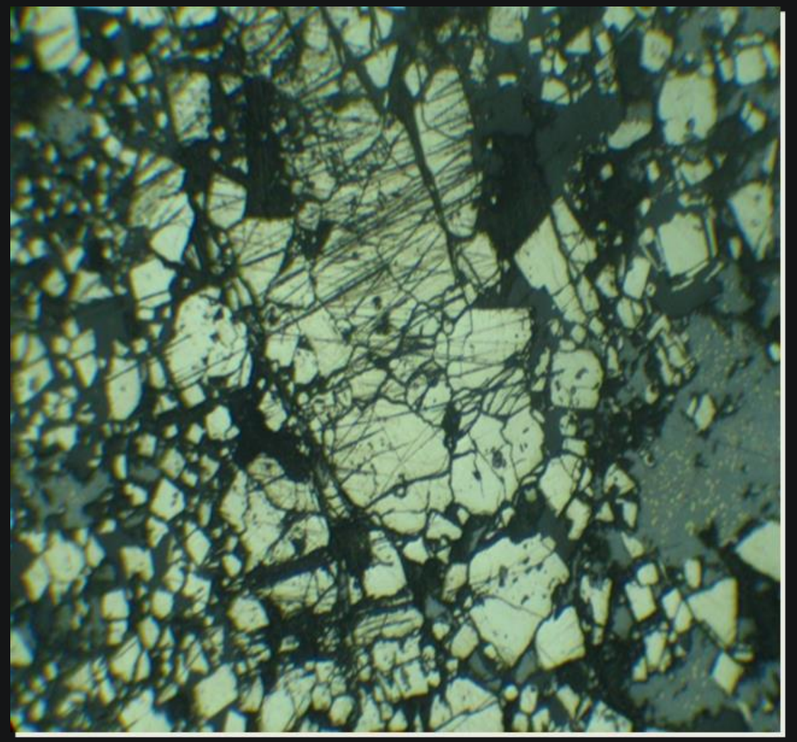
•Such structures in polarised light with crossed nicols are observed in molybdenite and antimony, and can be detected in chalcopyrite and sphalerite using structural etching.

•In galenite, the structure of the crushing is easily recognised by the arrangement of the triangular scratches.



HETEROCLASTIC STRUCTURE

The most common type of crushing structure is heteroclastic, which is characterised by a combination of fragments of different sizes in a mineral aggregate.



SOLID SOLUTION DECOMPOSITION STRUCTURES

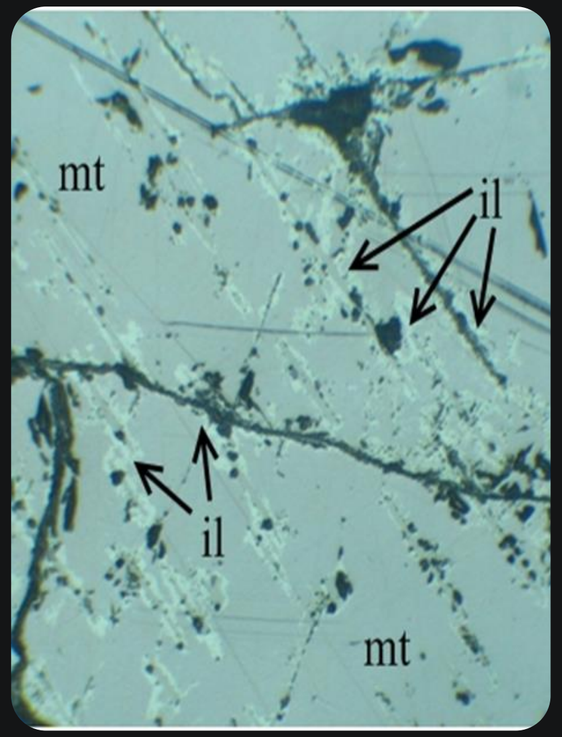
•The formation of solid solution decomposition structures occurs as a result of changes in the physical and chemical conditions that existed at the time of ore formation. Under new conditions, early complex mineral compounds become unstable and decompose into simpler minerals.

•In this way, some of the components that make up the primary ore minerals in the form of a solid solution or isomorphic additions separate into independent compounds when the temperature drops.

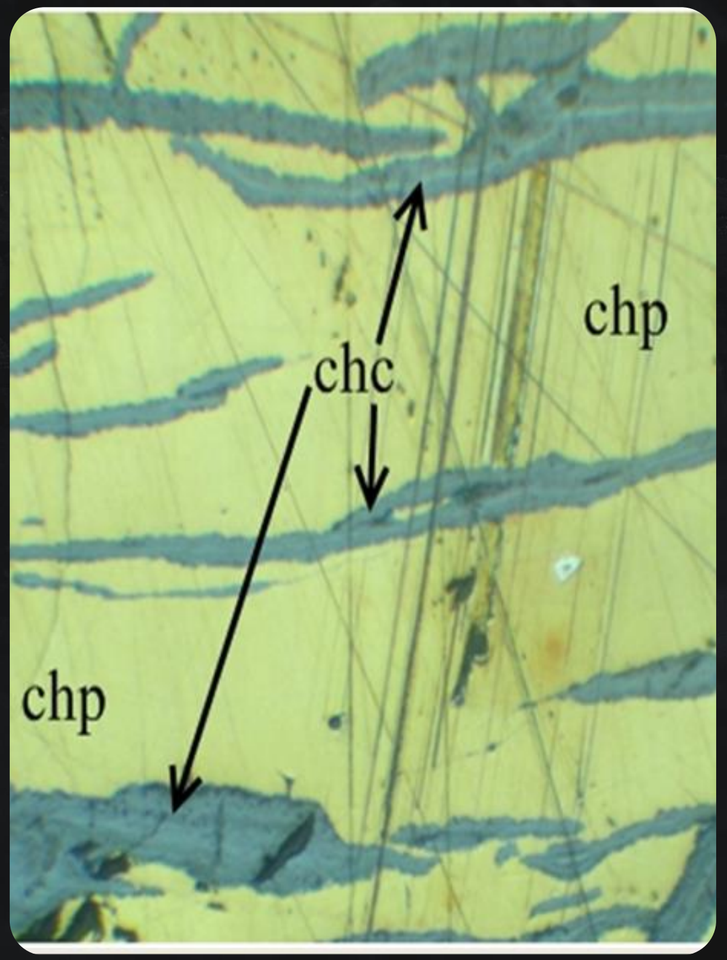
EMULSION STRUCTURE

•The emulsion structure is characterised by the separation of small dot-like grains of one mineral in the main mass of another. This structure is formed when the temperature drops sharply. It is most characteristic of the following mineral pairs: chalcopyrite in sphalerite, pyrite in sphalerite, chalcopyrite in stannite, etc.

LAMELLAR STRUCTURE OF SOLID SOLUTION DECOMPOSITION



The lamellar structure is characterised by the oriented arrangement of lamellar inclusions of one mineral in another. At the same time, the lamellar separations of one mineral are confined to the cleavage directions of the other mineral. The boundaries between minerals are smooth, with no traces of corrosion. This is characteristic of the following pairs of minerals: pyrite + pentlandite, kubanite + chalcopyrite, ilmenite + magnetite.

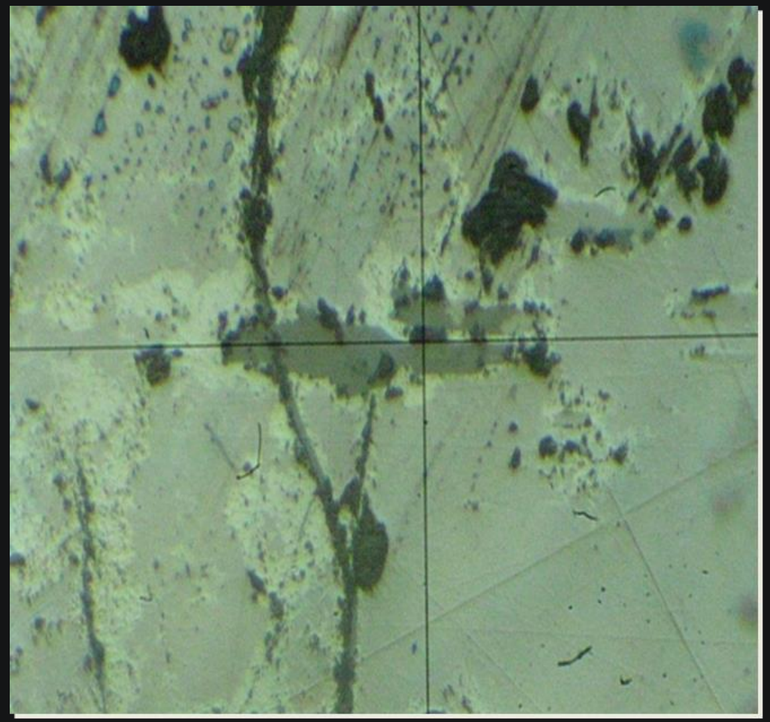


GRID STRUCTURE OF SOLID SOLUTION DECOMPOSITION

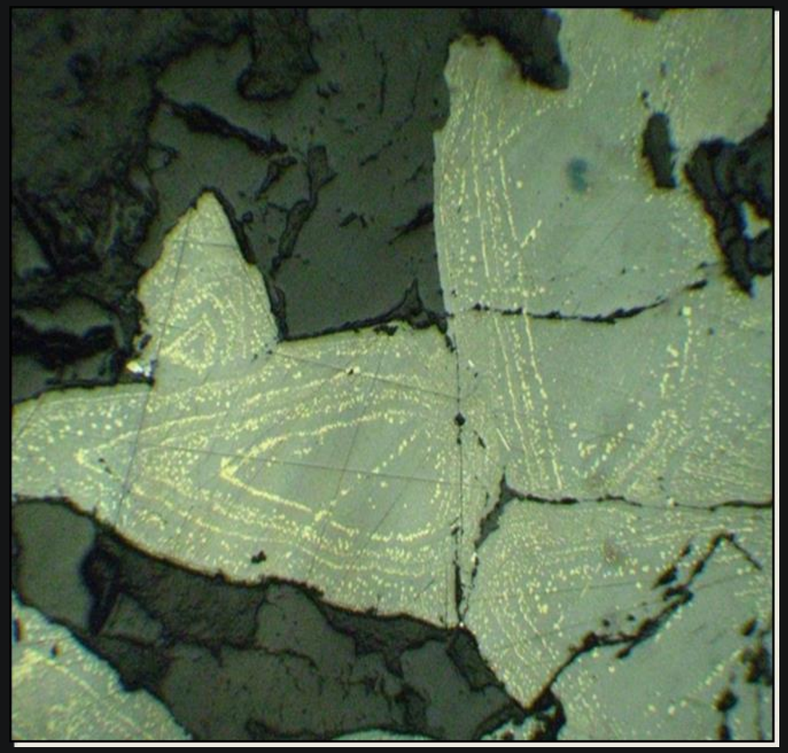
•A grid structure of solid solution decomposition is formed when lamellar precipitates of one mineral are located in two mutually perpendicular directions of cleavage of another mineral. At the same time, the thickness of the plates narrows at their intersection points. This feature allows grid structures of solid solution decomposition to be distinguished from grid substitution structures. This structure is characteristic of the following pairs of minerals: ilmenite + hematite, chalcopyrite + bornite, etc.

LOOP STRUCTURE OF SOLID SOLUTION DECOMPOSITION

•The looped structure of solid solution decomposition is formed as a result of the separation of one mineral from the periphery of another in the form of curved veins. This structure is most characteristic of the pentlandite + pyrite pair.



ZONAL STRUCTURE OF SOLID SOLUTION DECOMPOSITION



•The zonal structure of solid solution decomposition is formed when one of the minerals formed during the decomposition of a solid solution is located in concentric zones determined by the structure of the primary mineral.

• This structure is typical for the following pairs of minerals: magnetite + hematite, pyrite + cobalt pyrite, bravoite + pyrite.

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