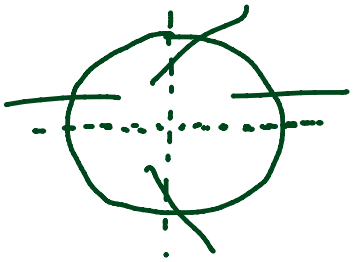
Geology - Mineralogy

31 October 2023 16:02

Symmetry + crystal classes

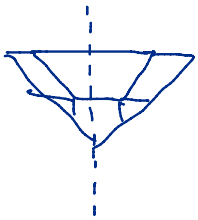


crystal symmetry.

- light refracting
- electrical properties.

6 elements of crystal symmetry :-

- Centre of symmetry.
- Axis of symmetry.



- Plane of symmetry.
- Axis of rotatory inversion.
- Screw axis of symmetry.
- Glide plane of symmetry.

Classification :-

Cubic

spinel
Cubic

Pyrite
cubic.

* Tetragonal

* Orthorhombic

* Hexagonal

* Monoclinic

* Triclinic

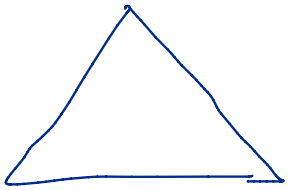
Cubic → cube, octahedron, dodecahedron, rhombododecagon, trapezohedron, hextocahedron.

- symmetry (highest)
- 4 axes
- 3 planes of symmetry
- a center of symmetry
- Ex. → diamond, galena, pyrite, halite, fluorite.

Tetragonal

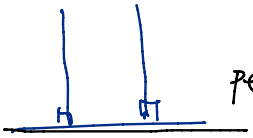
- 1 axis of symmetry. is longer than the other two axes.
- 4 planes of symmetry.

- prism, pyramid [tetragonal], pinacoid, dipyramid



- Examples :- Zircon, rutile, cassiterite, anatase, scheelite

Orthorhombic



unequal + perpendicular

- 3 axes of symmetry.
- 3 planes.
- prism, pyramid, pinacoid.
- Ex. → Olivine, topaz, barite, gypsum, sulfur.

↳ 3 types

1) Body centred orthorhombic
2) Base centred orthorhombic
3) Face centred orthorhombic.

Monoclinic

- 1 axis of symmetry longer than the other 2 axes.
- 1 plane of symmetry.

- prism, pyramid, pinacoid.

Eg - Pyroxene, amphibole, mica, gypsum, orthoclase.

Triclinic - • lowest degree of symmetry.
• No axes of symmetry.
• No planes of symmetry
• prism, pyramid, pinacoid.

Eg — Plagioclase feldspar, kaolinite, aquamarine.

Hexagonal - 1 axis of symmetry longer than the other two axes.

6 planes of symmetry.

prism, pyramid, pinacoid., basal, rhombohedron.

E.g. - Quartz, calcite, corundum, apatite, beryl.

Trigonal

- 1 axis of symmetry longer than the other two axes.

- 3 planes of symmetry.
- Forms :- basal pinacoid, rhomohedron, prism.
- Egs - Tourmaline, hematite, ilmenite, corundum, calcite.

Chemical

Physical properties of minerals.

↳ Colour -

↳ Lustre -

↳ Hardness -

Mohs Scale.

Diamond 10.

Corundum 9.

Topaz

Quartz.

Talc. 1.

Cleavage. smooth, flat surface.

Fracture conchoidal, uneven or hackly.

Streak.

Diaphaneity. - transperant, translucent, opaque.

Density measure of the mass of a mineral per unit volume.

Magnetism. - E.g. magnetite, pyrrhotite.

Taste - salty. [halite] chalky [gypsum]

Odor - sulfer ; (rotten eggs)
arsenopyrite ; (garlic)

Effervescence - 

calcite acid
(hydrochloric acid)

forms bubbles.

Fluroscence - (glow)

scheelite (yellow)
willemite (green)

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Mineralogy

Symmetry and forms in common crystal classes

Crystal symmetry is the arrangement of the atoms in a crystal in a regular, repeating pattern. This symmetry is reflected in the external form of the crystal, as well as in its other properties, such as its light-refracting and electrical properties.

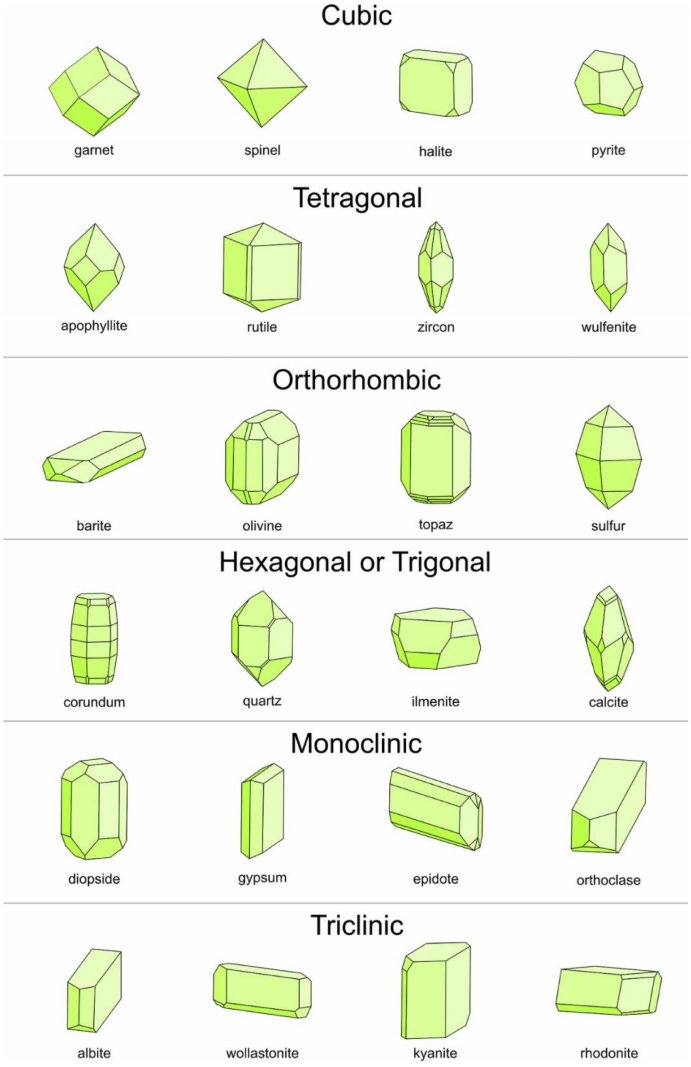
There are six elements of crystal symmetry:

- Center of symmetry: A center of symmetry is a point in the crystal such that every atom or group of atoms has an identical counterpart on the opposite side of the center.
- Axis of symmetry: An axis of symmetry is an imaginary line passing through the crystal such that a rotation of the crystal around the axis by a certain angle brings it into coincidence with itself.
- Plane of symmetry: A plane of symmetry is an imaginary plane passing through the crystal such that a reflection of the crystal across the plane brings it into coincidence with itself.
- Axis of rotatory inversion: An axis of rotatory inversion is an imaginary line passing through the crystal such that a rotation of the crystal around the axis by a certain angle followed by an inversion of the crystal brings it into coincidence with itself.
- Screw axis of symmetry: A screw axis of symmetry is an imaginary line passing through the crystal such that a translation of the crystal along the axis by a certain distance followed by a rotation of the crystal around the axis by a certain angle brings it into coincidence with itself.
- Glide plane of symmetry: A glide plane of symmetry is an imaginary plane passing through the crystal such that a reflection of the crystal across the plane followed by a translation of the crystal along the plane by a certain distance brings it into coincidence with itself.

The presence or absence of these elements of symmetry determines the crystal class to which a crystal belongs. There are 32 crystal classes in total.

Common crystal classes and their forms

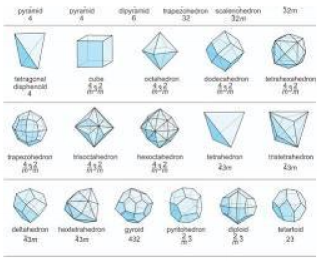
The following are some of the most common crystal classes and their associated forms:


Cubic
garnet
spinel
halite
pyrite
Tetragonal
apophyllite
rutile
zircon
wulfenite
Orthorhombic
barite
olivine
topaz
sulfur
Hexagonal or Trigonal
corundum
quartz
ilmenite
calcite
Monoclinic
diopside
gypsum
epidote
orthoclase
Triclinic
albite
wollastonite
kyanite
rhodonite

Cubic

Cubic crystals have the highest degree of symmetry. They have four axes of symmetry, three planes of symmetry, and a center of symmetry. Common cubic crystal forms include the cube, octahedron, dodecahedron, rhombododecahedron, trapezohedron, and hexoctahedron.

- Forms: Cube, octahedron, dodecahedron, rhombododecahedron, trapezohedron, hexoctahedron
- Examples: Diamond, galena, pyrite, halite, fluorite



Tetragonal

Tetragonal crystals have one axis of symmetry that is longer than the other two axes. They also have four planes of symmetry. Common tetragonal crystal forms include the prism, dipyramid, tetragonal pyramid, and pinacoid.

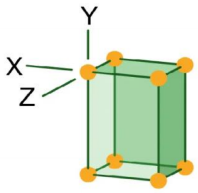
- Forms: Prism, dipyramid, tetragonal pyramid, pinacoid
- Examples: Zircon, rutile, cassiterite, anatase, scheelite

Orthorhombic

Orthorhombic crystals have three axes of symmetry that are all perpendicular to each other. They also have three planes of symmetry. Common orthorhombic crystal forms include the prism, pyramid, and pinacoid.

- Forms: Prism, pyramid, pinacoid
- Examples: Olivine, topaz, barite, gypsum, sulfur

Orthorhombic crystal system



All three axes are unequal in length, and all are perpendicular to one another.

Its three variants are:

Body-centred orthorhombic
lattice point in the middle of the unit cell

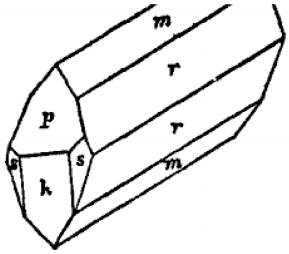
Base-centred orthorhombic
lattice points in the middle of each of the two ends

Face-centred orthorhombic
lattice points in the middle of each side

Monoclinic

Monoclinic crystals have one axis of symmetry that is longer than the other two axes. They also have one plane of symmetry. Common monoclinic crystal forms include the prism, pyramid, and pinacoid.

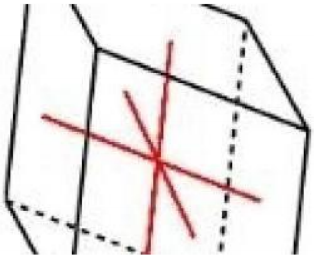
- Forms: Prism, pyramid, pinacoid
- Examples: Pyroxene, amphibole, mica, gypsum, orthoclase



Triclinic

Triclinic crystals have the lowest degree of symmetry. They have no axes of symmetry and no planes of symmetry. Common triclinic crystal forms include the prism, pyramid, and pinacoid.

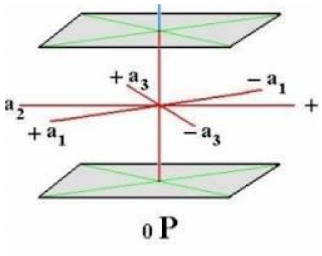
- Forms: Prism, pyramid, pinacoid
- Examples: Plagioclase feldspar, kaolinite, aquamarine



Hexagonal

Hexagonal crystals have one axis of symmetry that is longer than the other two axes. They also have six planes of symmetry. Common hexagonal crystal forms include the prism, dipyramid, rhombohedron, and basal pinacoid.

- Forms: Prism, dipyramid, rhombohedron, basal pinacoid
- Examples: Quartz, calcite, corundum, apatite, beryl



Trigonal

Trigonal crystals have one axis of symmetry that is longer than the other two axes. They also have three planes of symmetry. Common trigonal crystal forms include the prism, rhombohedron, and basal pinacoid.

- Forms: Prism, rhombohedron, basal pinacoid
- Examples: Tourmaline, hematite, ilmenite, corundum, calcite

It is important to note that not all crystals of a given class will exhibit all of the possible forms for that class. The specific forms that a crystal develops will depend on the conditions under which it formed.

Crystal symmetry is a powerful tool for identifying and classifying minerals. It is also important for understanding the physical properties of minerals. By studying the symmetry of a crystal, we can gain insights into its internal structure and how it will interact with light, electricity, and other forces.

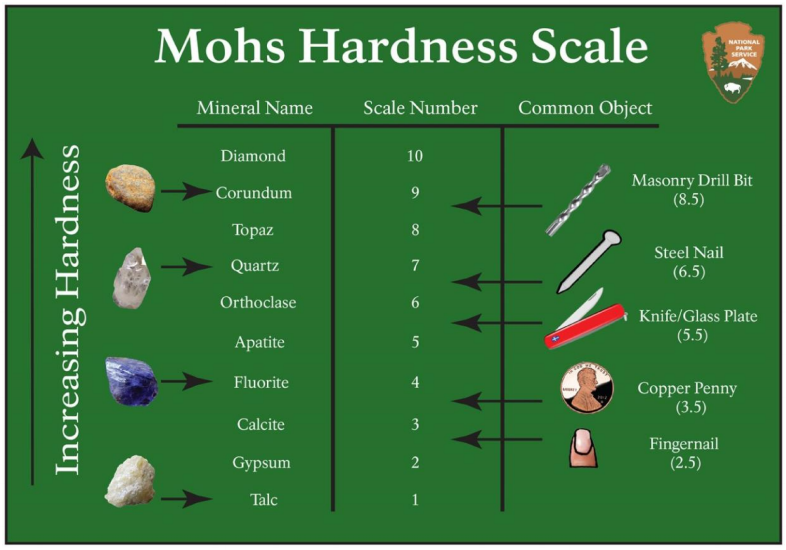
Physical properties of minerals are those properties that can be observed and measured without changing the chemical composition of the mineral. These properties are useful for identifying and classifying minerals.

Some of the most important physical properties of minerals include:

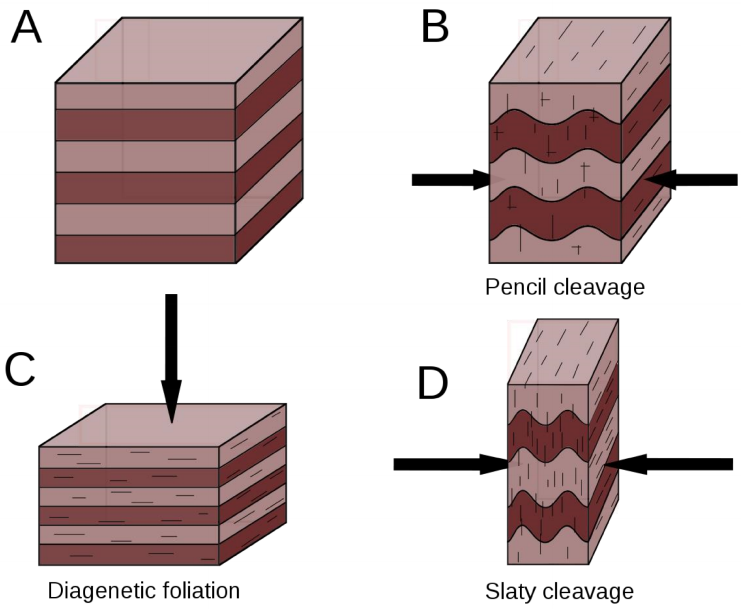
- Color: The color of a mineral is one of the first properties that people notice. However, color is not a reliable property for mineral identification because it can vary depending on the mineral's impurities and the way it formed.

Luster: Luster is the way that a mineral reflects light. It can be described as metallic, nonmetallic, glassy, greasy, or pearly.

Hardness: Hardness is a measure of how resistant a mineral is to scratching. It is determined by comparing the mineral to a set of standard minerals called the Mohs scale.



Cleavage: Cleavage is the tendency of a mineral to break along smooth, flat surfaces. Cleavage is determined by the arrangement of atoms in the mineral's crystal structure.



Fracture: Fracture is the way that a mineral breaks when there is no cleavage. It can be described as conchoidal, uneven, or hackly.

Streak: Streak is the color of the powder that a mineral leaves when it is rubbed on a white unglazed porcelain plate. Streak is a more reliable property for mineral identification than color because it is not affected by impurities.

Diaphaneity: Diaphaneity is the ability of a mineral to transmit light. It can be described as transparent, translucent, or opaque.

Density: Density is a measure of how much mass a mineral has per unit volume. It can be determined by weighing the mineral and then measuring its volume.

Mineral Compositions	Classification	I
Quartz	/	
Potassium Feldspar	/	
Plagioclase	/	
Calcite	/	
Dolomite	/	
Pyrite	/	
Analcite	/	
Clinoptilolite	/	
Clay Minerals	Kaolinite	
	Chlorite	
	Illite	
	Montmorillonite	

Magnetism: Magnetism is the ability of a mineral to be attracted to a magnet. It is a property of only a few minerals, such as magnetite and pyrrhotite.

Other physical properties of minerals include:

- Taste: Some minerals have a distinctive taste, such as halite (salty) and gypsum (chalky).
- Odor: Some minerals have a distinctive odor, such as sulfur (rotten eggs) and arsenopyrite (garlic).
- Effervescence: Some minerals effervesce (bubble) when they are reacted with an acid, such as calcite (reacts with hydrochloric acid).
- Fluorescence: Some minerals fluoresce (glow) when they are exposed to ultraviolet light, such as scheelite (yellow) and willemite (green).

1. What is the most abundant mineral in the Earth's crust?
   a) Quartz
   b) Feldspar
   c) Mica
   d) Calcite

2. Which mineral is often referred to as "fool's gold" due to its metallic appearance?
   a) Hematite
   b) Pyrite
   c) Galena
   d) Magnetite

3. What is the hardest naturally occurring mineral on the Mohs scale of mineral hardness?
   a) Quartz
   b) Talc
   c) Diamond
   d) Gypsum

4. Which mineral is commonly used in the production of aluminum?
   a) Bauxite
   b) Hematite
   c) Magnetite
   d) Halite

5. Which mineral is a major component of limestone and marble?
   a) Feldspar
   b) Gypsum
   c) Calcite
   d) Pyroxene

6. What is the chemical formula of the mineral known as "common salt" or "table salt"?
   a) Na_2CO_3
   b) NaCl
   c) K_2SO_4
   d) $CaCO_3$

7. Which mineral group includes garnet and olivine?
   a) Silicates
   b) Sulfides
   c) Oxides

d) Carbonates

8. What mineral exhibits a phenomenon known as "twinning," where two crystals are oriented in a specific way?
a) Quartz
b) Calcite
c) Halite
d) Gypsum

9. Which mineral is often used in the manufacturing of electrical insulators and spark plugs?
a) Gypsum
b) Quartz
c) Feldspar
d) Porcelain

10. Which of the following minerals is used in the production of talcum powder?
a) Quartz
b) Feldspar
c) Gypsum
d) Talc