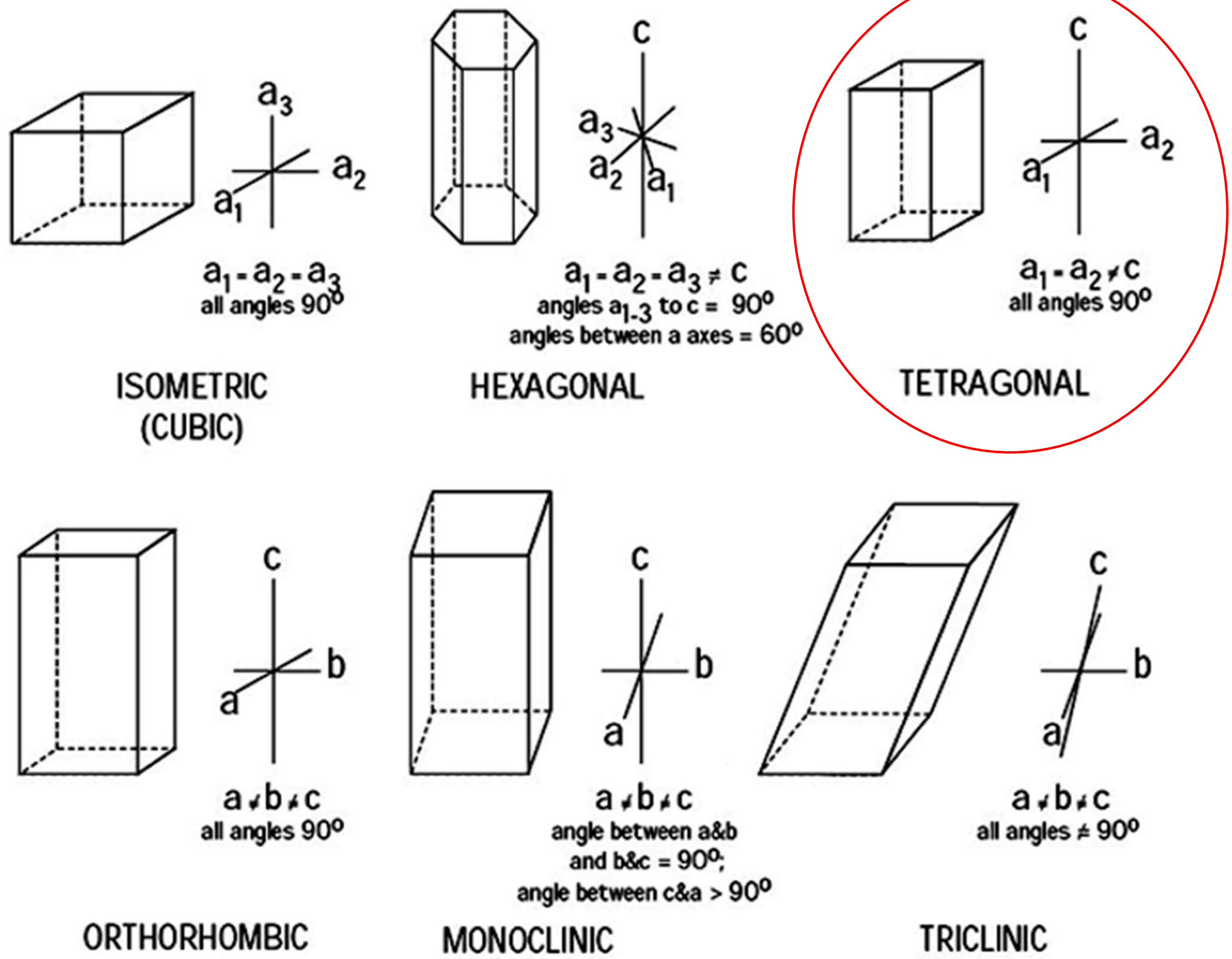
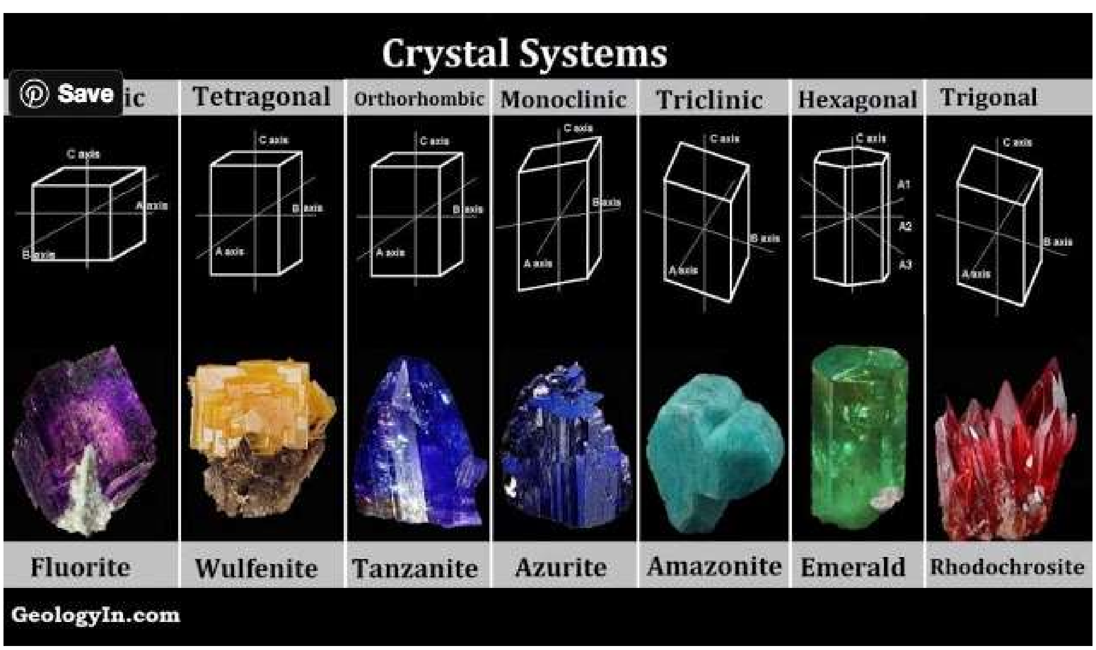
TETRAGONAL (Rectangular) MINERALS

Introduction

There are 6 geometry systems which every mineral in the world will fall into. Although daunting at first, learning these systems and being able to visualize the common variants will enable you to identify well developed minerals on sight or at least the mineral family (eg- carbonates all look the same)



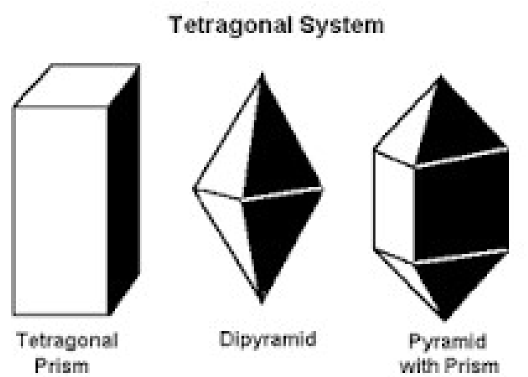


Tetragonal (Greek: tetra = four, denotes crystals with 4 sides and 4 angles)

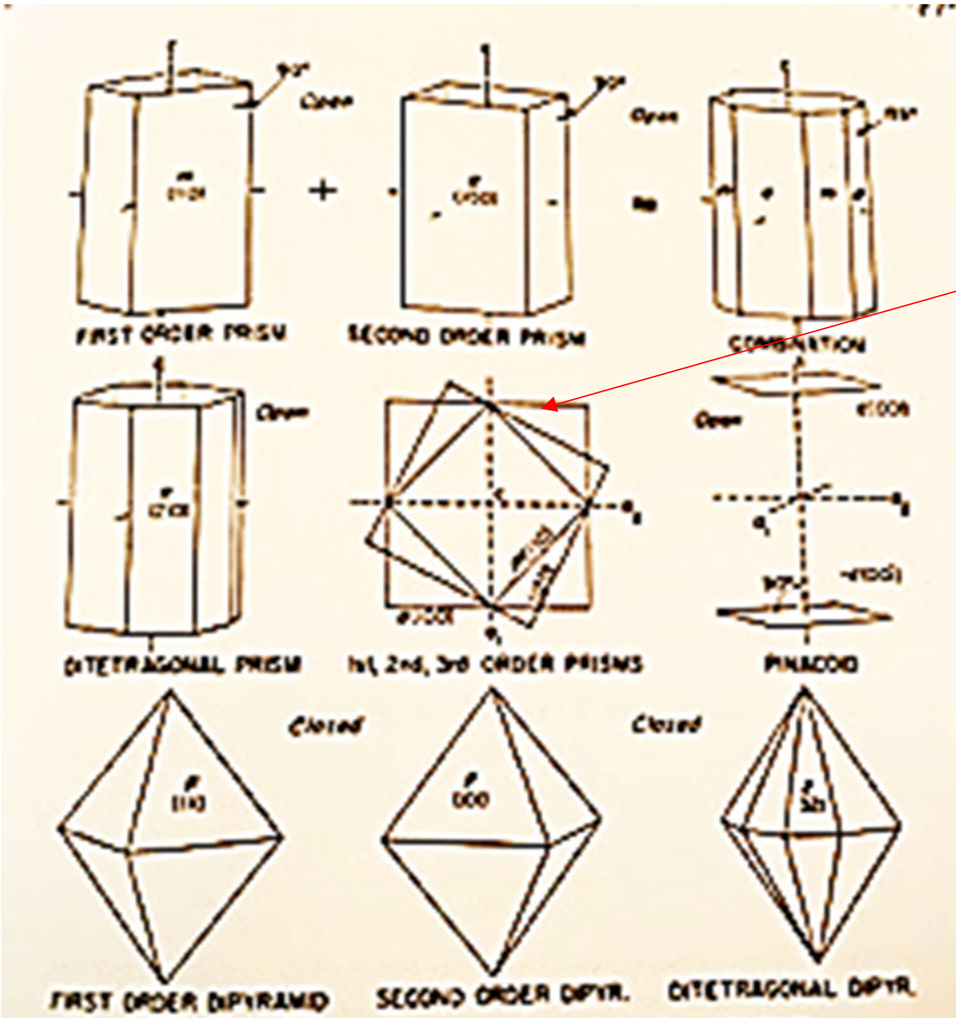
Crystal Growth

- Crystals grow from cooling and solidifying molten melts or precipitation of hot vapors
- They start as tiny blocks and grow (typically) in all directions at the same time – think of Russian nesting dolls or a growing insect- the outer growth completely surrounds the inner 3D shape
- The starting block is the **unit cell** which is the smallest distinct group of atoms which has all the essential parts of the mineral including its chemical, physical, and geometric properties. In tetragonal minerals this is a parallelepiped with 90-degree angles (a rectangle.) (There are different unit cell shapes for other mineral forms – recall that it is a cube for isometric minerals.) These unit cells will begin to stack as the crystal forms.
- The outer form will reflect the unit cell which will stack over a trillion trillion times in even the smallest visible crystal. A cubic or rectangular unit cell will never form a hexagonal crystal.
- Crystal growth occurs as a unit cell attaches to another and so on. Where it attaches depends on several factors. It may be the area that is most exposed, an area not hidden by other crystals, or the area with strongest attraction chemically or electromagnetically. Therefore, different areas on a crystal can grow at different rates leading to classic variations which allow us to identify certain minerals on sight.

Tetragonal Basic Forms



- In the tetragonal crystal system, we will begin to see crystals that have rise or tallness. This is the **c-axis**, and it can be very helpful to orient this upright (like a skyscraper.) This is the side that is unequal compared to the other two sides, which often are shorter (but not always, as we will discuss later.)
- Because the remaining two sides are the same length, we continue to call them both a, as they are equivalent. In the orthorhombic crystal system (which we will cover next) all three sides have a different length. So, if we orient our crystal as a skyscraper, a_1 will be facing us and a_2 will be facing to our right and c will be up and down.
- Although the tetragonal dipyramid does exist, it is rare in collectible species. It is commonly seen as a topper on the top or bottom of the prism (or body) of the crystal. This is referred to as the termination or double termination if both the top and bottom are present and well formed. A complete (and undamaged!) termination often adds value to a mineral specimen. Also note that while these triangle shapes often point up like a pyramid, they can also bevel down onto the prism. A flat termination is called the pedion.
- As noted before, the c axis is ONLY DIFFERENT from the other two sides. Therefore, sometimes this can be SHORTER. These crystals are commonly called “Tabular” or “tabbies.” Wulfenite is commonly seen as tabular as well as barite which is in the orthorhombic system.
- A good tip for the tetragonal system (and orthorhombic) is to count the sides. Either of these will have 4 or 8 sides (count even thin bevels as a side.) Quartz and calcite are in the hexagonal system and will have 6 sides (or 12.) This is a great way to tell apophyllite from quartz. Apophyllite is tetragonal and will have 4 sides. The quartz is hexagonal and will have 6 sides. I think that the easiest way to count the sides is on the prism or the elongated side, but others prefer to look top down (like an airplane above your skyscraper) and count the profile.
- In practice, unless you have a nice and big, well-formed crystal, it can be hard to tell tetragonal from orthorhombic.



TETRAGONAL FORMS & COMBINATIONS
FIG. 48.

Notes:

The difference between a first, second, or third ordered prism is only its orientation to the axes. Two can occur in the same crystal.

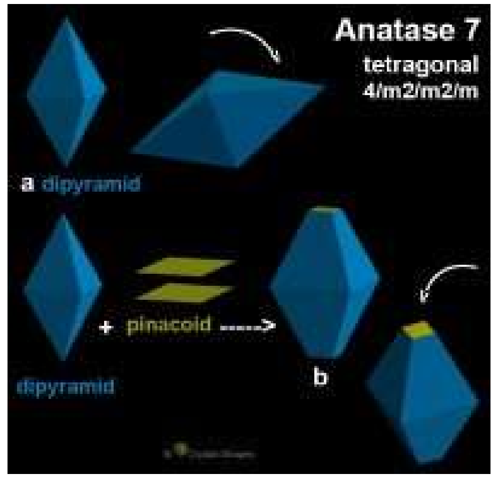
Dipyramids often occur on top of prisms. Sometimes the triangular faces form bevels down onto the prism.

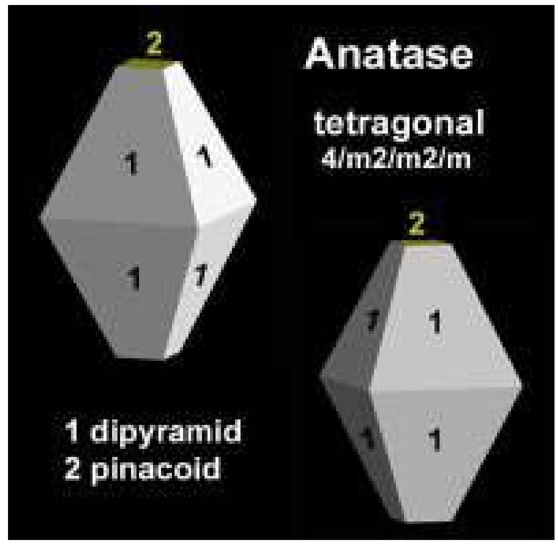
As light approaches a cube from any side, it "sees" different molecular arrangements. Viewing from the top, it will "see" a diamond or square, but from the side it will be a rectangle. Therefore, tetragonal minerals will have the following findings in tests:

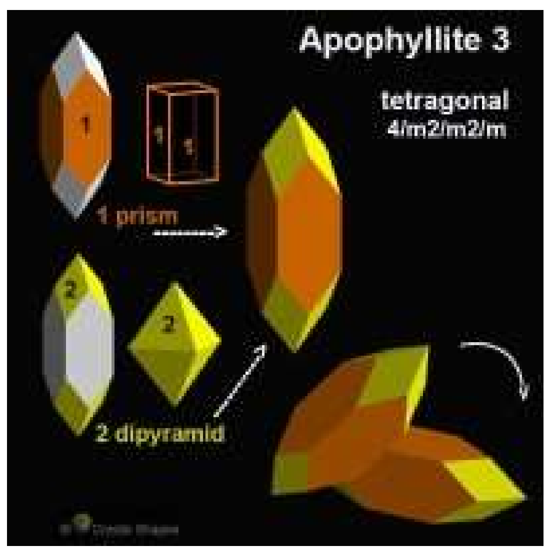
- Alternates dark and light in polariscope or polarized light- **anisotropic**
- Will have two lines in the refractometer, reflecting each of the different speeds of light (because the light "sees" different sides)
- The difference between the two lines is called the birefringence and is calculated by subtracting one from the other. This can help determine the stone's identity
- Will be two colors in the dichroscope- **dichroic**

Collectable Cubic Minerals:

Anatase
Apophyllite
Cassiterite
(Chalcopyrite) – very hard to see tetragonal shapes due to twinning and pseudo shapes being common
Diaboleite
Phosgenite
Rutile
Scapolite
Scheelite
Stolzite
Torbernite
Vesuvianite (old name: Idiocrase)
Wardite
Xenotime
Zircon





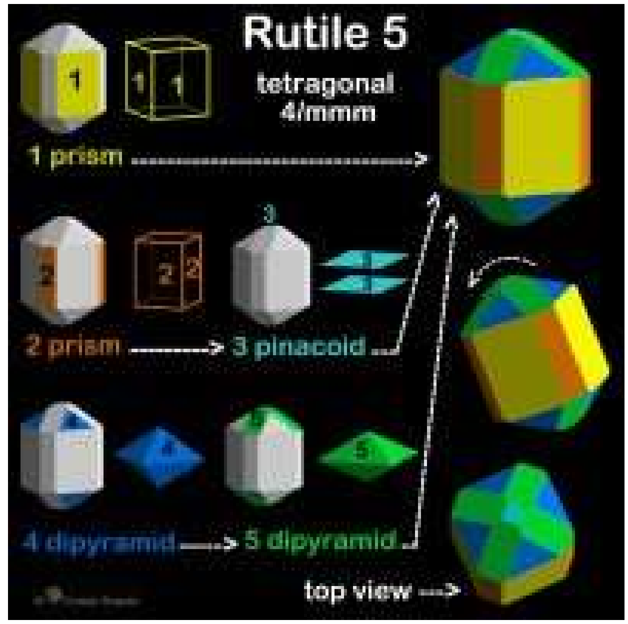


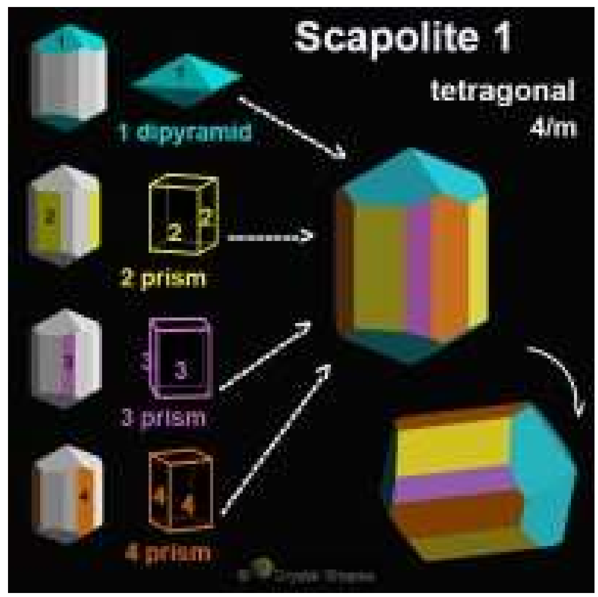
Apophyllite vs Quartz:

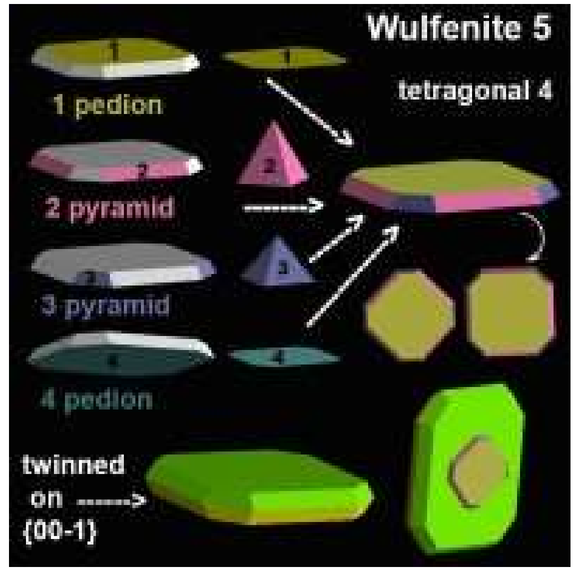
-Apophyllite has 4 sides (or 8) while Quartz has 6, therefore top down apophyllite will look square or diamond shaped while quartz will look like a hexagon

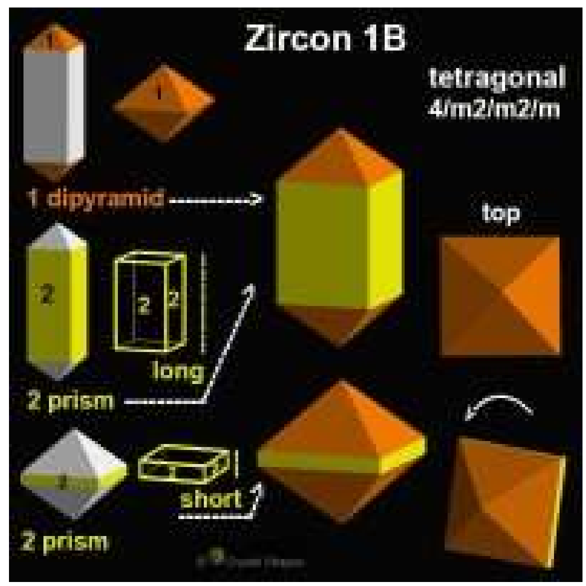
-Apophyllite cleaves easily perpendicular to the c axis and quartz does not have cleavage

-Apophyllite most commonly occurs with zeolites (India minerals) so almost always these are not quartz, but apophyllites


Rutile 5
tetragonal
4/mmm
1 prism
2 prism
3 pinacoid
4 dipyramid
5 dipyramid
top view


Scapolite 1
tetragonal
4/m
1 dipyramid
2 prism
3 prism
4 prism





Chalcopyrite**

A word of caution: although chalcopyrite is tetragonal, it typically forms a very complicated crystal in real life. It has very complex twinning which gives it pseudo shapes- meaning that it can look like other crystal systems.

I find that the easiest way to differentiate it from similar minerals is by color:

-Pyrite = native gold color, usually forms simple cubic shapes (the cube, octahedrons, and pyritohedrons)
-Chalcopyrite = bronze to brassy color due to the copper element. It easily takes patina so if there is iridescence or browning, that is usually chalcopyrite. It forms complicated crystals that can look like little weird spheres. This is usually what is on the fluorites from Illinois and other areas. (We saw lots of this on fluorite cubes last year.)
-Arsenopyrite = gray, black, or silver

References / Resources

Smorf.nl
Mineralogy by John Sinkankas
Webmineral.com
Mindat.com