

27 EKİM 2014

Bazı kristeller neden hep aynı şekildeki yüzeylerden oluşurlar?

Açı sabitliđi yasası nedir?

Kristal sistemleri nasıl kurgulanır?

Bravais kafesleri(uzay kafesleri) nasıl kurgulanır?

Weiss and Miller indislenmesi nasıl yapılır ve farkları nelerdir?

Zon ekseni nedir? Kristal eksenleri ve simetri eksenlerinden farkı nedir?

İki yüzeye ait zon ve iki zon arasındaki yüzeyi hesaplama Determinant alma(vektörel çarpım)

iki yüzeye ait zon eksenini

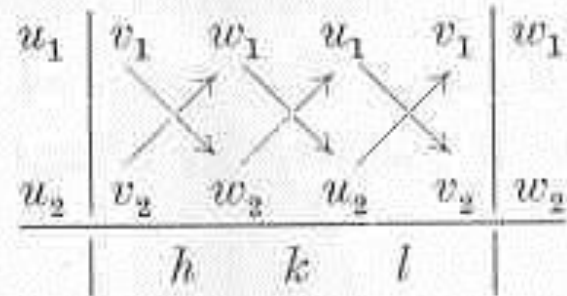
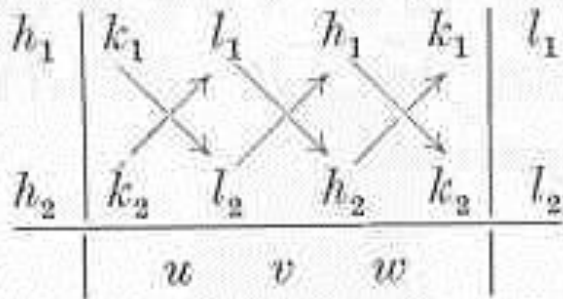
$$h_1 u + k_1 v + l_1 w = 0$$

$$h_2 u + k_2 v + l_2 w = 0$$

iki zona ait yüzey

$$h \cdot u_1 + k \cdot v_1 + l \cdot w_1 = 0$$

$$h \cdot u_2 + k \cdot v_2 + l \cdot w_2 = 0$$



$$u = k_1 \cdot l_2 - k_2 \cdot l_1$$

$$v = l_1 \cdot h_2 - l_2 \cdot h_1 \quad \} [u \ v \ w]$$

$$w = h_1 \cdot k_2 - h_2 \cdot k_1$$

$$h = v_1 \cdot w_2 - v_2 \cdot w_1$$

$$k = w_1 \cdot u_2 - w_2 \cdot u_1 \quad \} (h \ k \ l)$$

$$l = u_1 \cdot v_2 - u_2 \cdot v_1$$

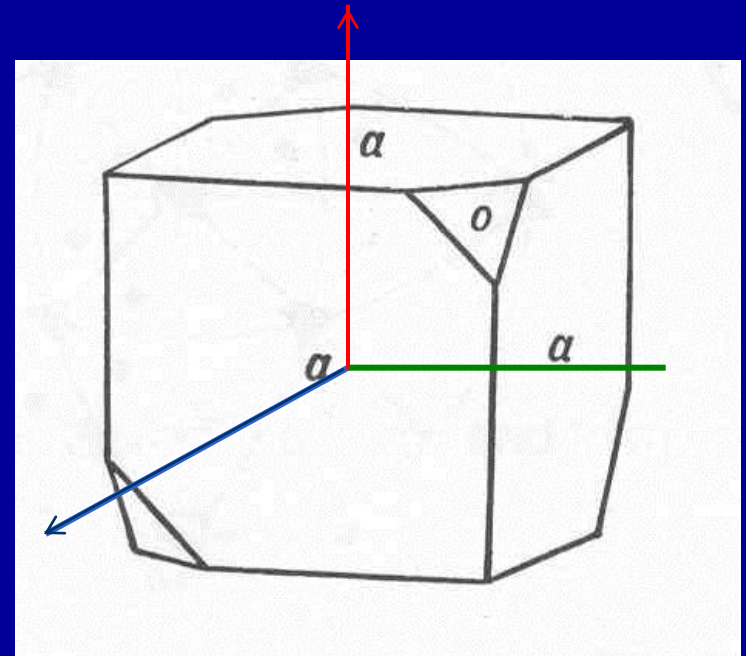
İki yüzey arasındaki yüzeyin indisini hesaplama

Toplama kuralı(skaler çarpım);

Aynı zonda yer alan iki yüzeyin arakesitinde yer alan bir yüzeyi bulmak için Vektörlerin skaler çarpımı yani bileşen katsayılarını toplama kuralı uygulanır. Örneğin, $(h_1 k_1 l_1)$ ve $(h_2 k_2 l_2)$ yüzeyleri arasındaki yüzey; $(h_3 k_3 l_3)$ yüzeyi ise

$$\begin{array}{r} h_1 \quad k_1 \quad l_1 \\ + \quad h_2 \quad k_2 \quad l_2 \\ \hline \end{array}$$

$$(h_3 k_3 l_3) = h_1 + h_2, \quad k_1 + k_2, \quad l_1 + l_2$$
$$(h_1 + h_2 \quad k_1 + k_2 \quad l_1 + l_2)$$



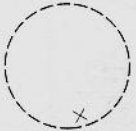


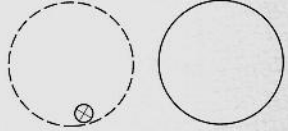

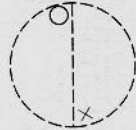
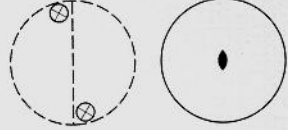
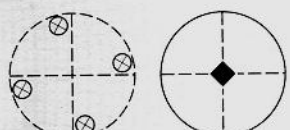
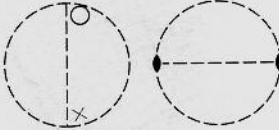
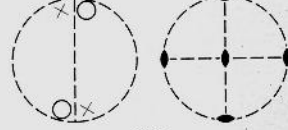

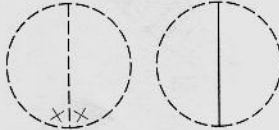
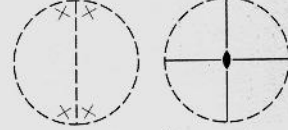
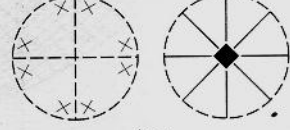
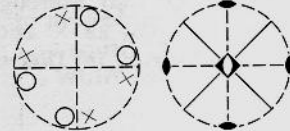
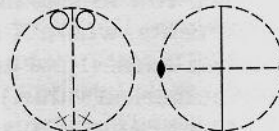
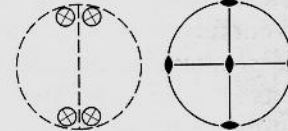
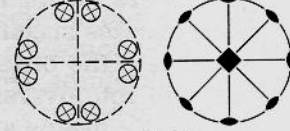
BÖLÜM III
KRİSTAL SINIFLARININ
(NOKTA GRUPLARININ)
KRİSTAL
SİSTEMLERİNE DAĞILIMLARI
VE UZAY GRUPLARI

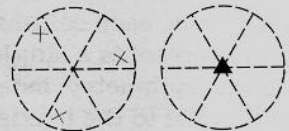
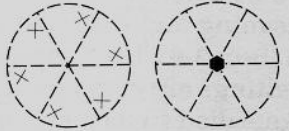
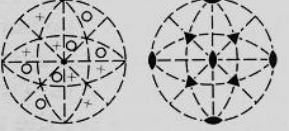
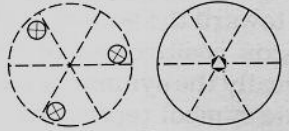
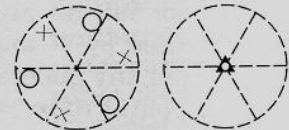
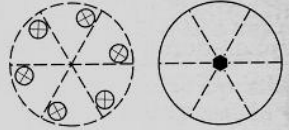
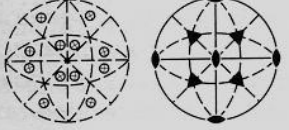
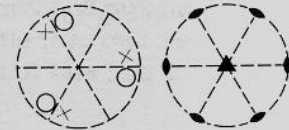
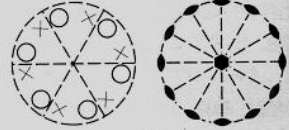
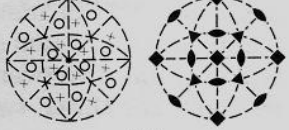
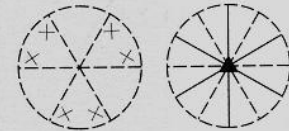
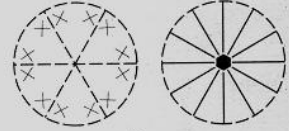
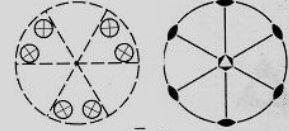
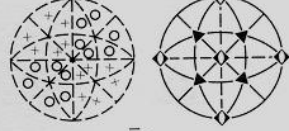
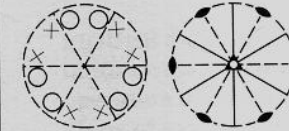
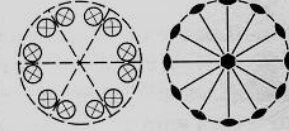
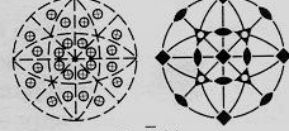
Simetri elemanları ve onların kombinasyonundan oluşan nokta grupları (kristal sınıfları) Hermann –Mauguin sembolleri ile gösterilir(1, 222, 432, 6/m mmm, 32, 4/m-32/m gibi).

Bunlar 6 kristal sistemi içerisinde yer alırlar. Bütün kristaller bu kristal sistemlerinin yanı sıra, bu sistemde yer alan bir kristal sınıfında (nokta grubunda) yer almak zorundadır.

Kristal Sistemleri ve bunlara kristal sınıflarının(nokta grupları) dağılımı:

Kristal sınıfı	Kristal Sistemi	Karakteristik simetri	Hermann-Mauguin Simgesi
1, $\bar{1}$	Triklinik	Tek dönümlü eksen	Kristalografik Kısıtlama yok
2, m, 2/m	Monoklinik	2 dönümlü eksen ve ayna	2-dönümlü eks. b eksen
222, $mm2$, $2/m2/m2/m$	Ortorombik	Üç birbirine dik doğ.	2-dönümlü eksenler
4, -4 , 4/m, 422, $4mm$, $4/m2/m2/m$	Tetragonal		Bir 4 dönümlü eksen 4-dönümlü eksen c
6, -6 , 6/m, 622, $6mm$, $-6m2$, $6/m2/m2/m2/m$	Hekzagonal	Bir 6-dönümlü eksen	İlk sayı c eksen, iki, üç ve dört sırasıyla a_1 , a_2 , a_3 eksenlerle çakışık
3, -3 , 32, $3m$, $-32/m$	Trigonal	Bir 3-dönümlü eksen	İlk sayı c eksen, iki, üç ve dört sırasıyla a_1 , a_2 , a_3 eksenlerle çakışık
23, $2/m-3$, 432, $-43m$, $4/m-32/m$	Kübik	Dört 3-dönümlü eksen kristalografik eksenlerle $54^{\circ}44'$ açı yapar.	İlk sayı a, b, c; ikinci sayı diyagon; üçüncü sayı kenarı gösterir.

	Triclinic	Monoclinic (1st setting)	Tetragonal
X	 1	 2	 4
\bar{X} (even)	—	 $m (=2)$	 $\bar{4}$
X (even) plus center and \bar{X} (odd)	 $\bar{1}$	 $2/m$	 $4/m$
	Monoclinic (2nd setting)	Orthorhombic	
X2	 2	 222	 422
Xm	 m	 $mm2$	 $4mm$
$\bar{X}2$ (even) or $\bar{X}m$ (even)	—	—	 $\bar{4}2m$
X2 or Xm plus center and $\bar{X}m$ (odd)	 $2/m$	 $2/m 2/m 2/m$	 $4/m 2/m 2/m$

Trigonal	Hexagonal	Cubic	
 <p>3</p>	 <p>6</p>	 <p>23</p>	X
—	 <p>$\bar{6}$</p>	—	\bar{X} (even)
 <p>$\bar{3}$</p>	 <p>6/m</p>	 <p>2/m 3</p>	X (even) plus center and \bar{X} (odd)
 <p>32</p>	 <p>622</p>	 <p>432</p>	X2
 <p>3m</p>	 <p>6mm</p>	—	Xm
—	 <p>$\bar{6}m2$</p>	 <p>$\bar{4}3m$</p>	$\bar{X}2$ (even) or $\bar{X}m$ (even)
 <p>$\bar{3}2/m$</p>	 <p>6/m 2/m 2/m</p>	 <p>4/m $\bar{3}2/m$</p>	X2 or Xm plus center and $\bar{X}m$ (odd)

Kristal sınıflarının (nokta gruplarının) kristal sistemlerine dağılımı

1- TRIKLİNİK SİSTEM(2)

Triklirik Pedial sınıf

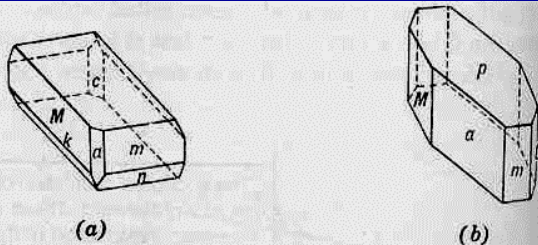
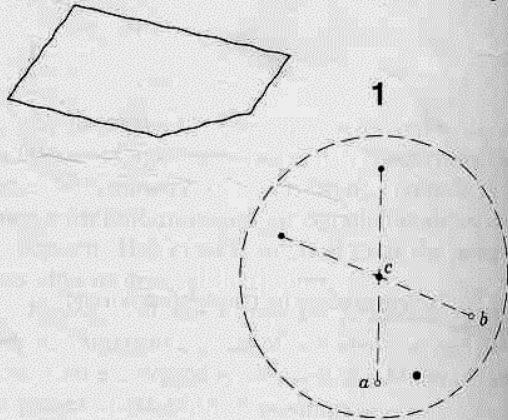
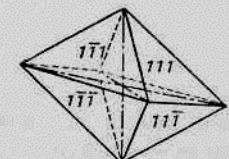
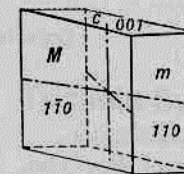
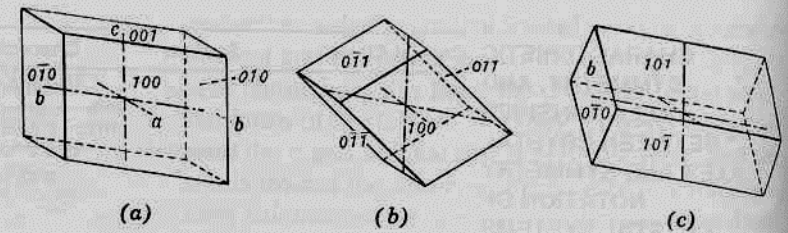
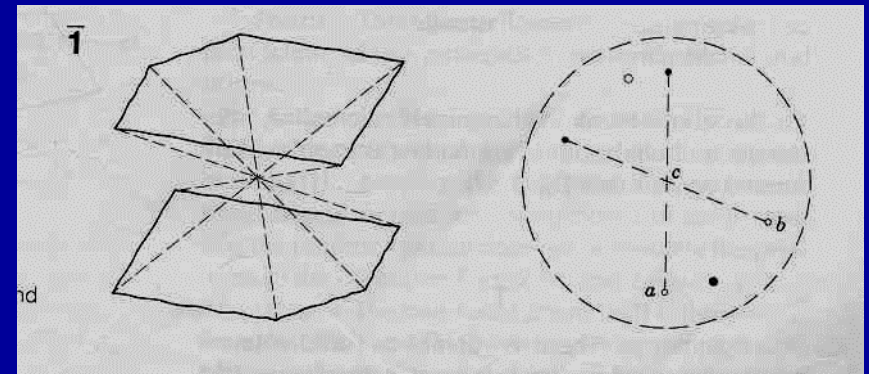


FIG. 2.57. Triclinic crystals. (a) Rhodonite. (b) Chalcantite.

FIG. 2.58. Triclinic pedion (or monohedron) and stereogram.



Triklirik pinakoidal sınıf

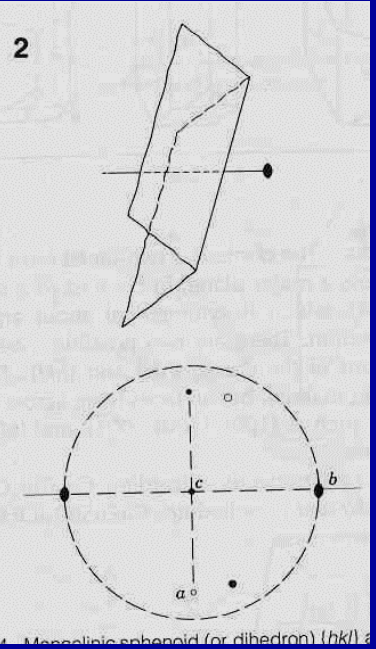


(d)

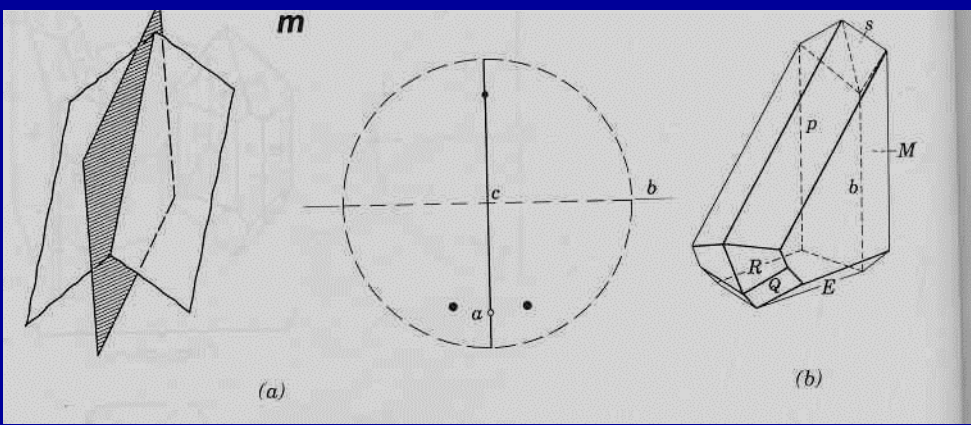
(e)

2-MONOKLINİK SİSTEM (3)

Monoklinik domatik sınıf

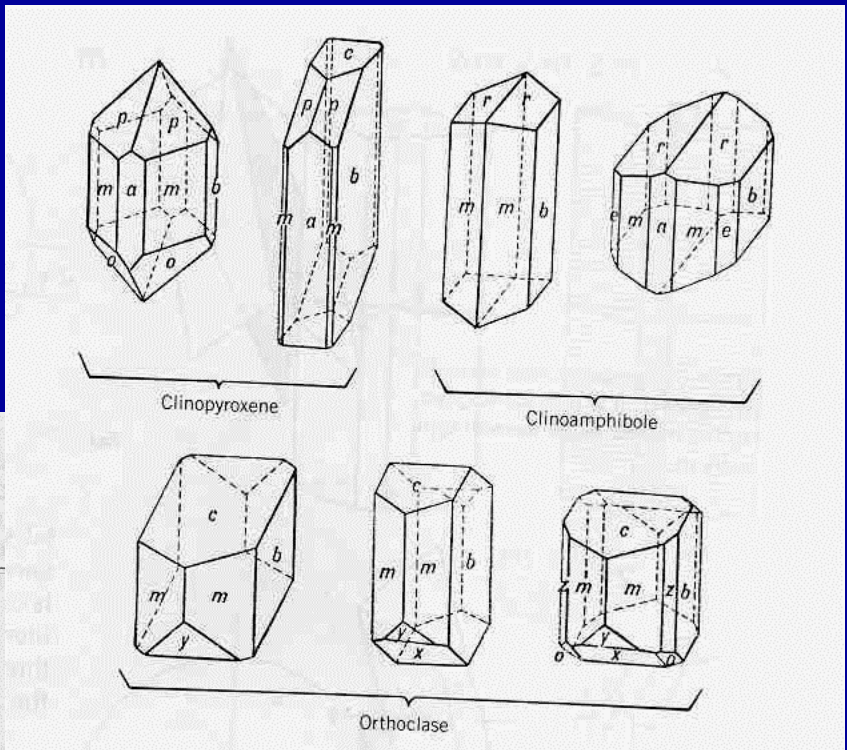
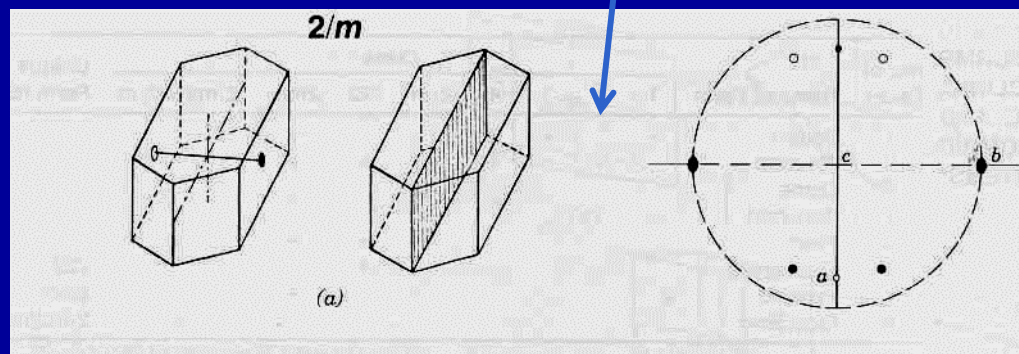


Ejirin: $\text{NaFe}^{3+} [\text{Si}_2\text{O}_6]$



Monoklinik sfenoidik sınıf

Monoklinik prizmatik sınıf

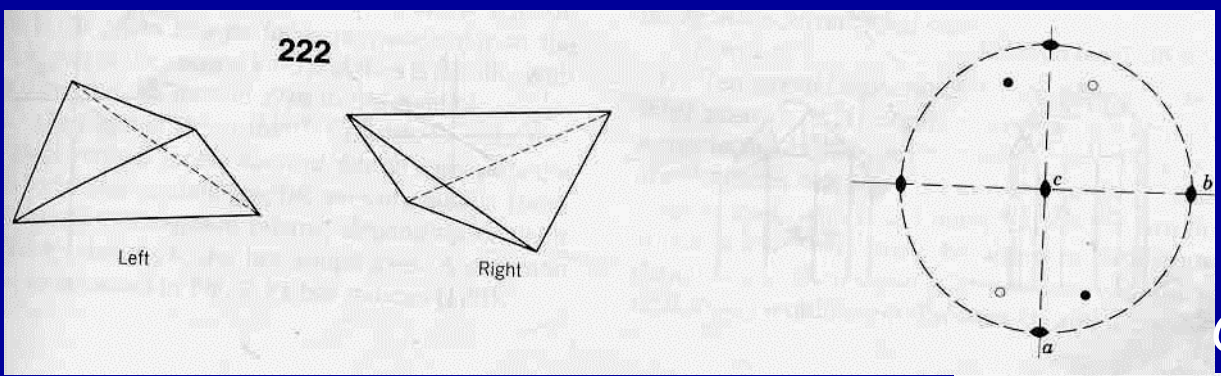


3. ORTOROMBİK SİSTEM (3)

Ortorombik disfenoidik sınıf

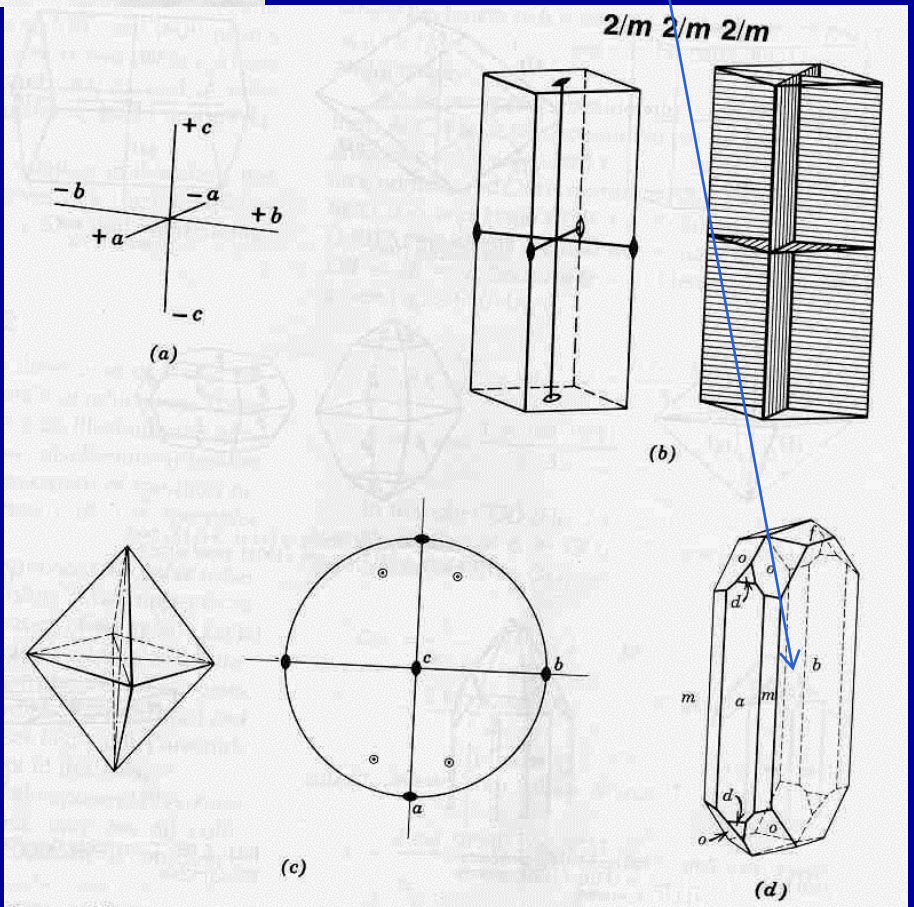
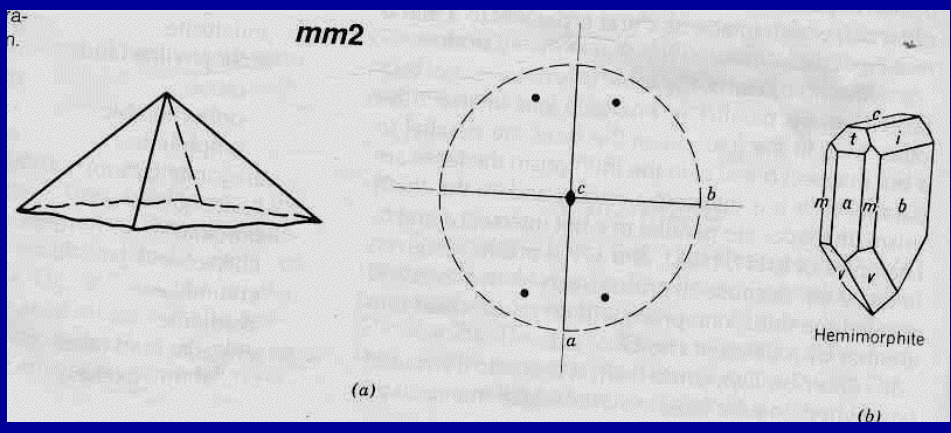


Enstatite



Ortorombik dipramidal sınıf

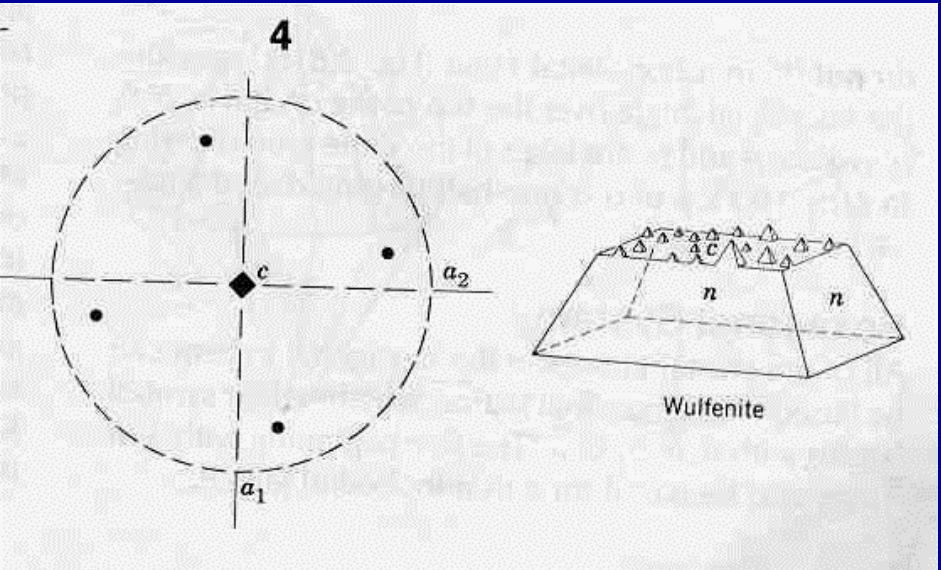
Ortorombik piramidal sınıf



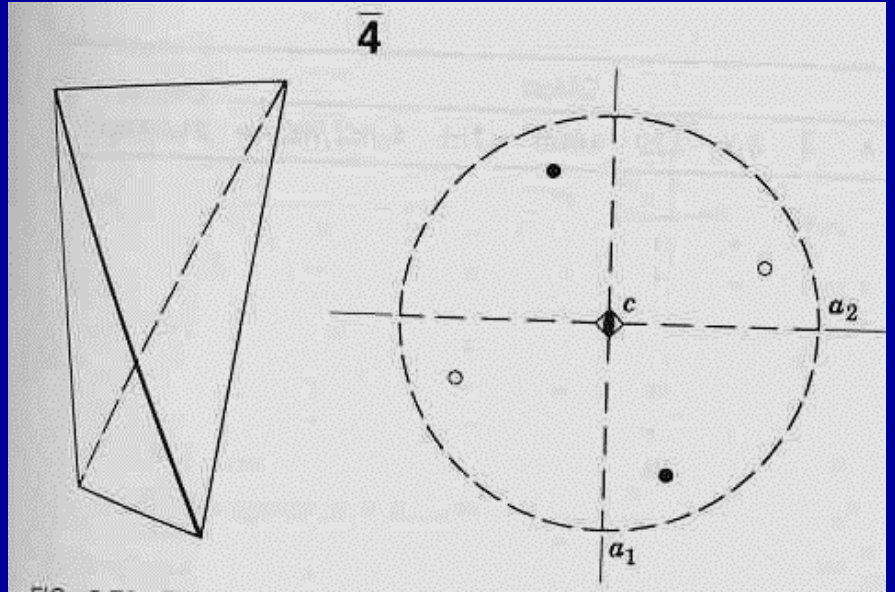
types of forms in this class

4-TETRAGONAL SISTEM (7)

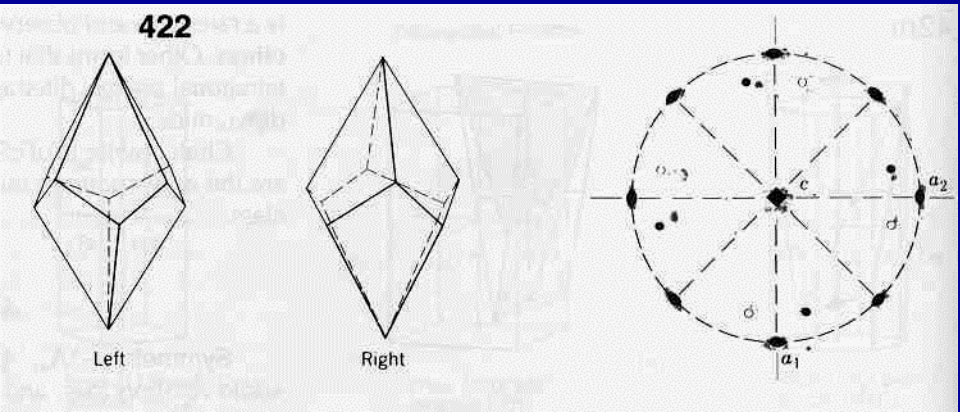
Tetragonal piramidal sınıf



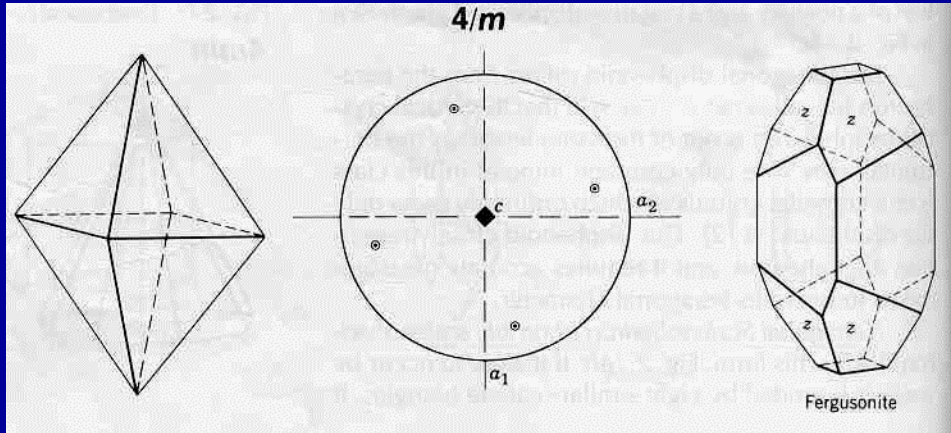
Tetragonal disfenoidik sınıf



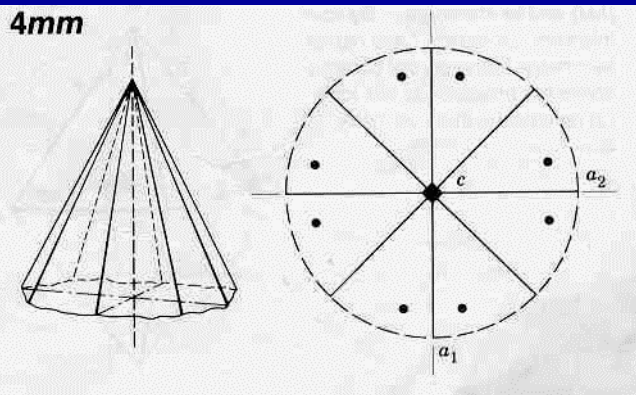
Tetragonal trapezoedrik sınıf



Tetragonal dipiramidal sınıf

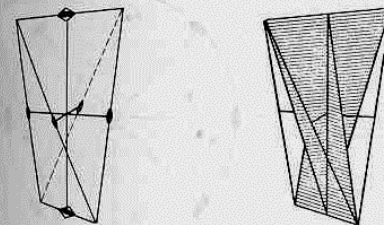


Ditetragonal piramidal sınıf

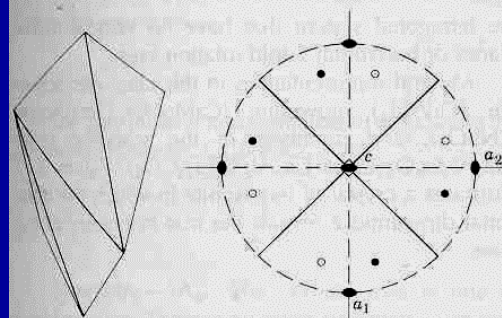


Tetragonal skalenoeedrik sınıf

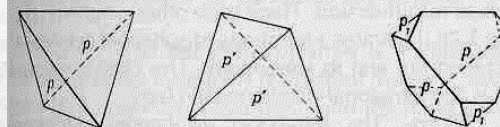
42m



(a)



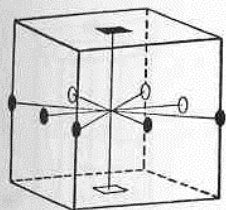
(b)



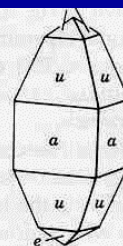
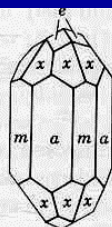
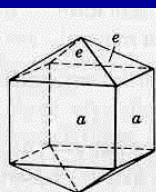
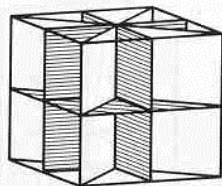
(c)

4/m 2/m 2/m

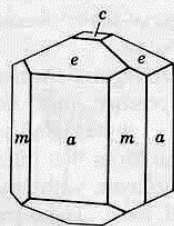
Ditetragonal dipiramidal sınıf



(a)



Zircon



Vesuvianite



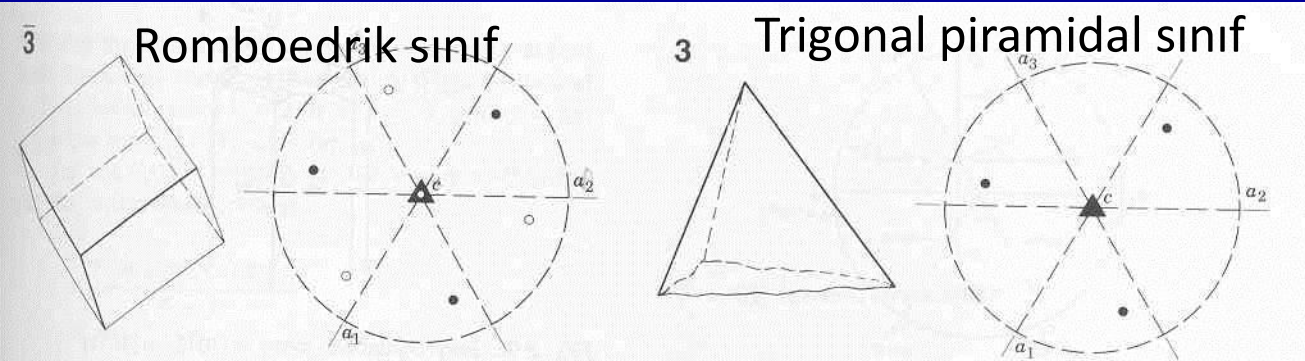
Apophyllite



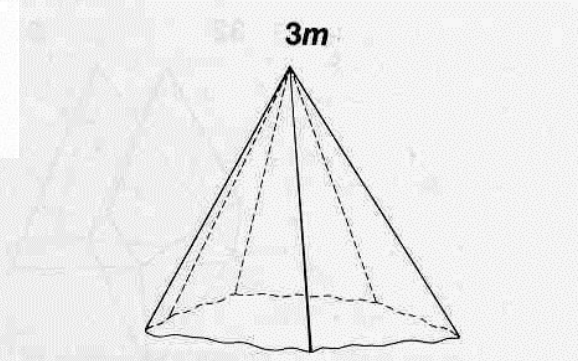
Anatas: TiO_2

5-HEKZAGONAL SİSTEM ()

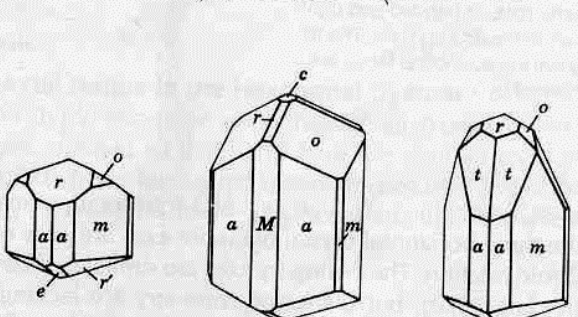
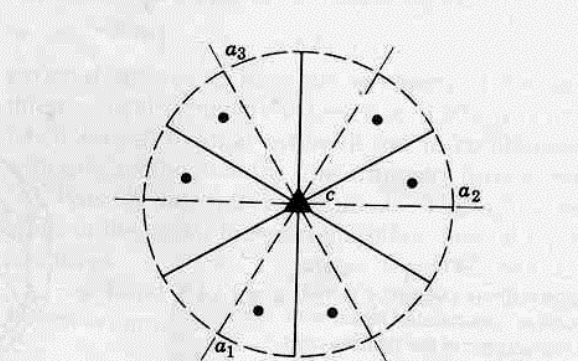
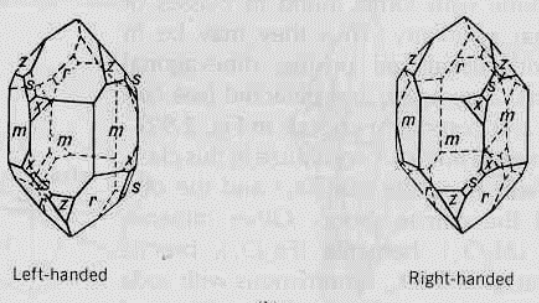
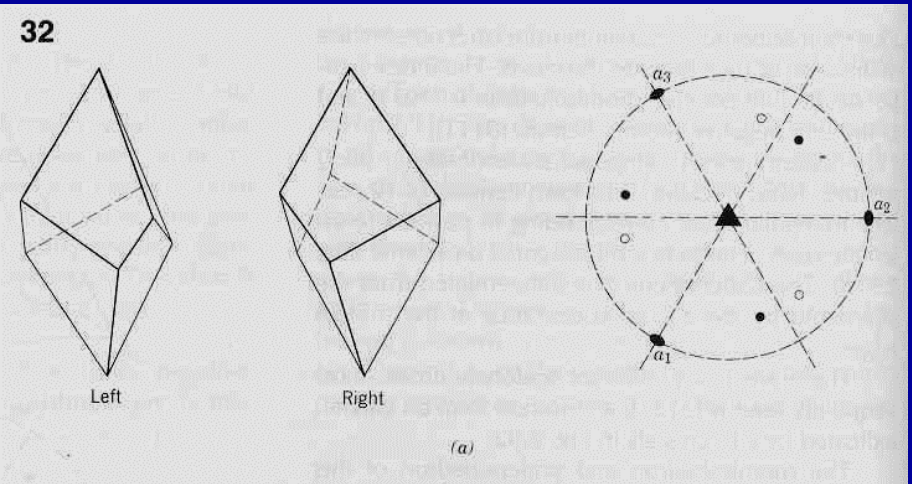
C eksenine paralel simetri eksenini 3 dönümlü (5).



Ditrigonal piramidal sınıf



Trigonal trapezoedrik sınıf





Kalsit

Ditrigonal skalenoedrik sınıf

$\bar{3}2/m$

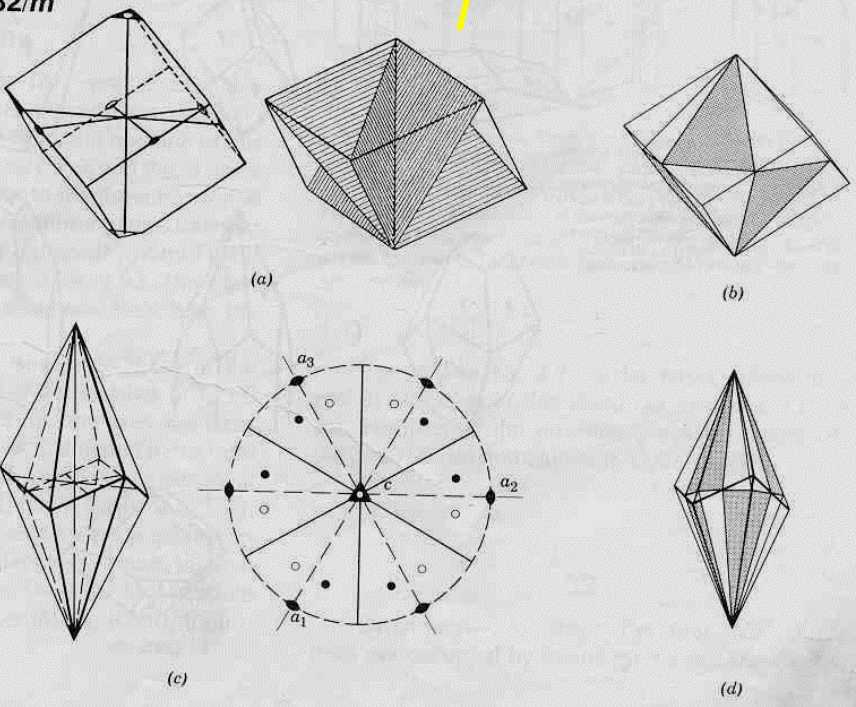
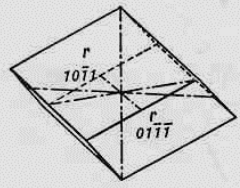
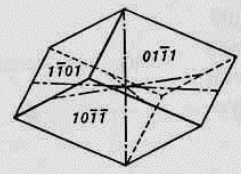


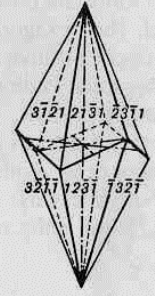
FIG. 2.92. Commonly developed forms and form combinations in $\bar{3}2/m$.



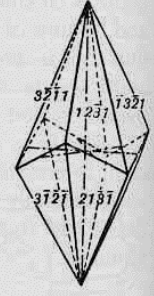
Rhombohedron $\{10\bar{1}1\}$, positive



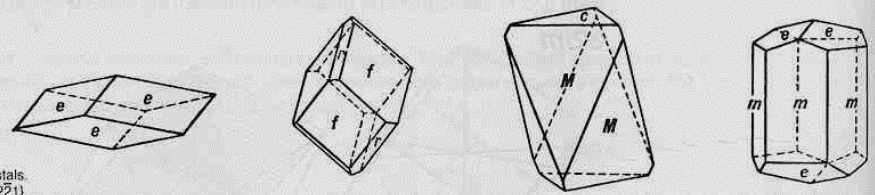
Rhombohedron $\{01\bar{1}\bar{1}\}$, negative



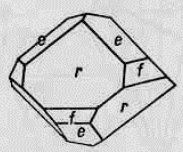
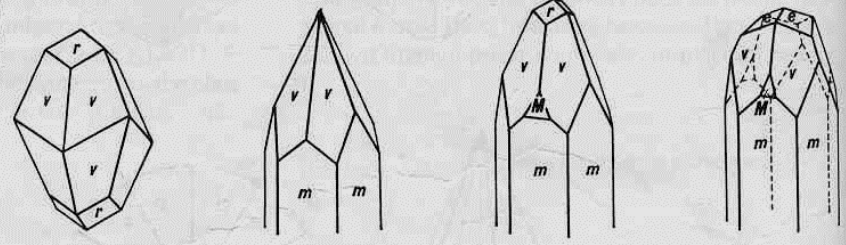
Scalenohedron $\{2131\}$, positive



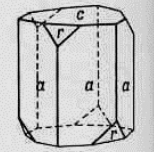
Scalenohedron $\{1231\}$, negative



Calcite crystals.
Forms: $e \{01\bar{1}2\}$ and $f \{02\bar{2}1\}$,
negative rhombohedrons,
 $r \{10\bar{1}1\}$ and $M \{4041\}$
positive rhombohedrons, m
 $\{10\bar{1}0\}$, prism, c
 $\{10\bar{1}0\}$ pinacoid, v
scalenohedron.

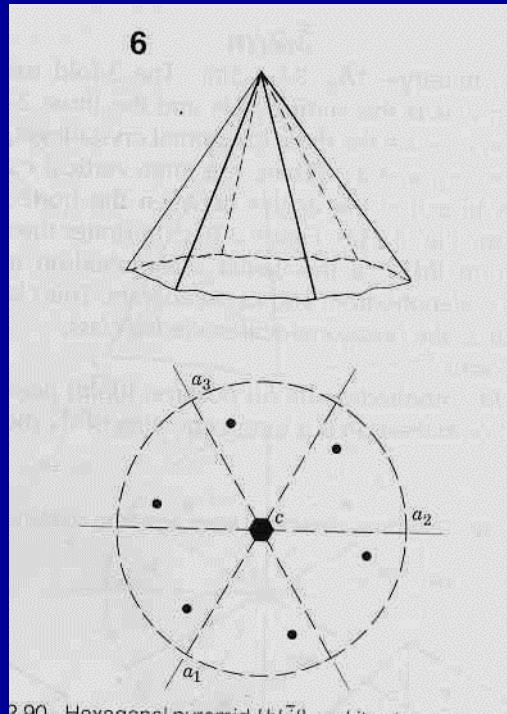


Chabazite.



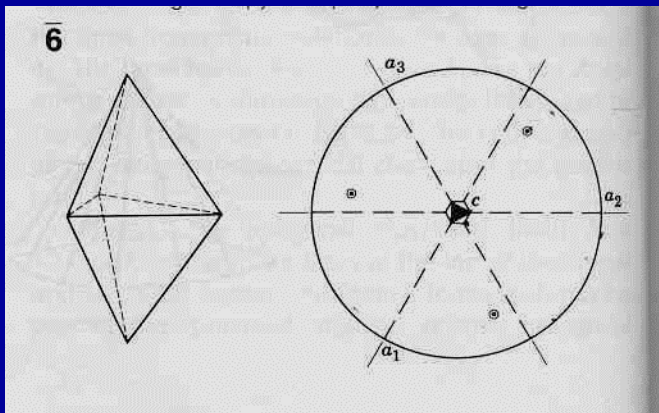
Corundum.

C eksenine paralel dönme eksenini 6 dönümlü (7)

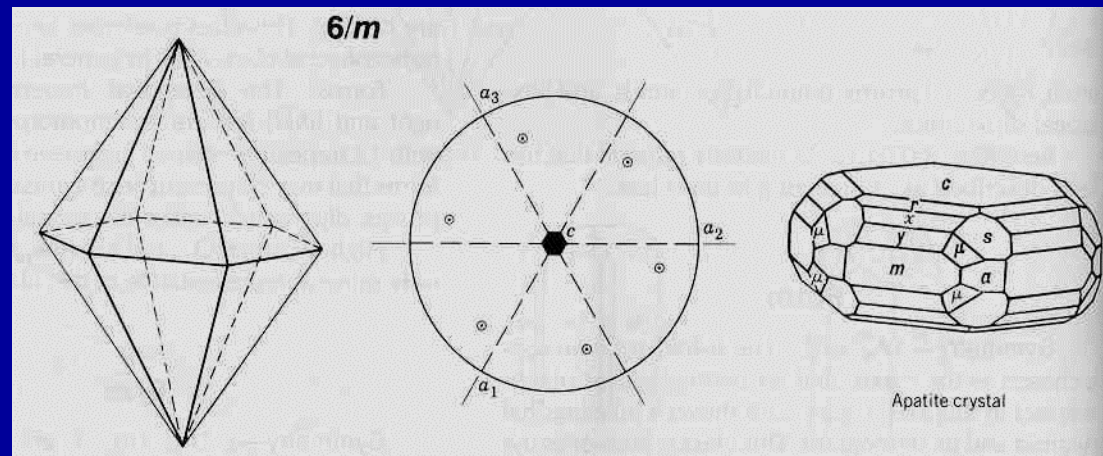


Heksagonal piramidal sınıf

Trigonal dipiramidal sınıf



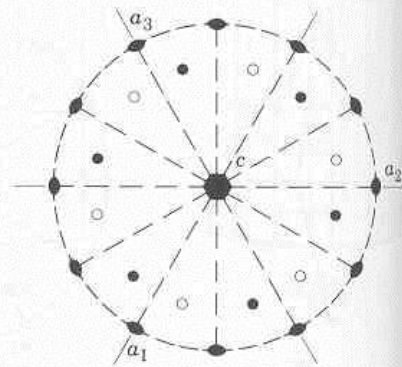
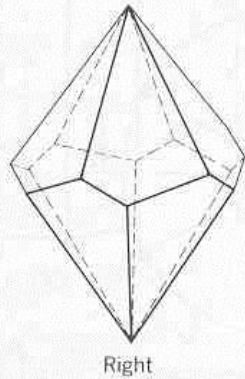
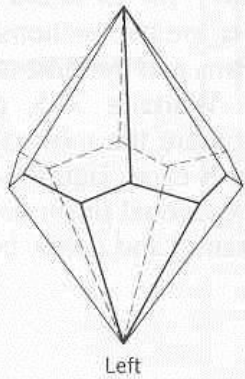
Heksagonal dipiramidal sınıf



Apatite crystal

622

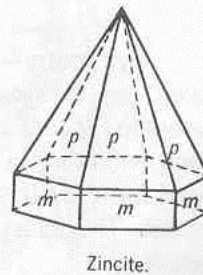
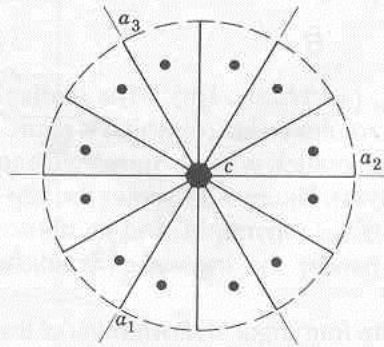
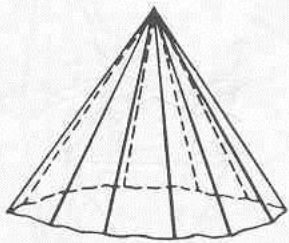
Heksagonal trapezoedrik sınıf



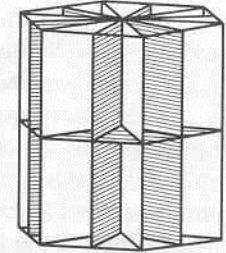
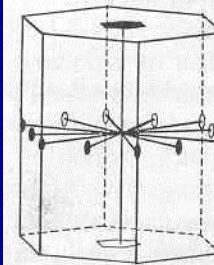
Diheksagonal piramidal sınıf

Diheksagonal dipiramidal sınıf

6mm



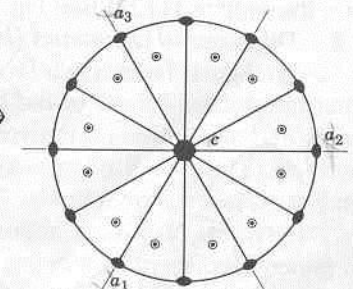
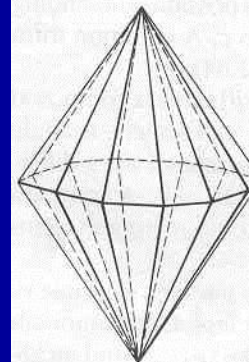
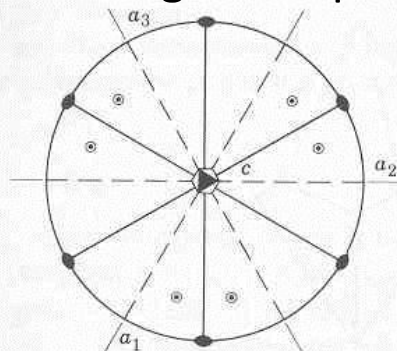
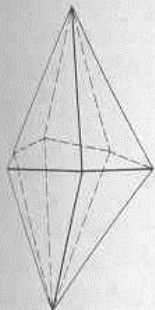
6/m 2/m 2/m



(a)

$\bar{6}m2$

Ditrigonal dipiramidal sınıf

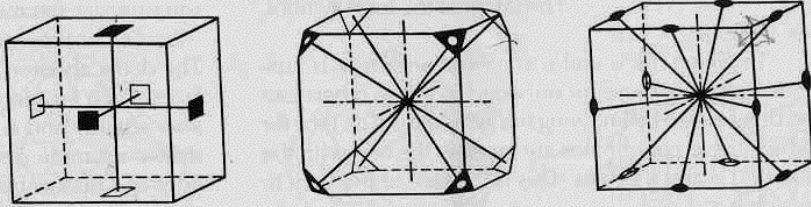


(b)

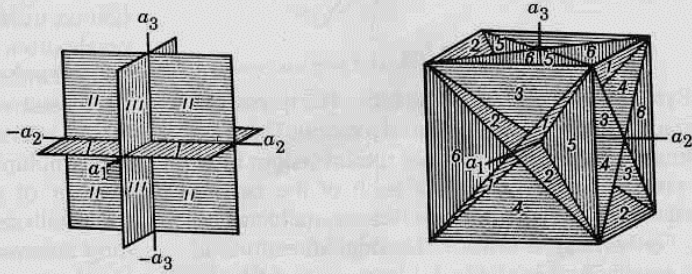
6- KÜBİK SİSTEM

Heksakisoktaedrik sınıf

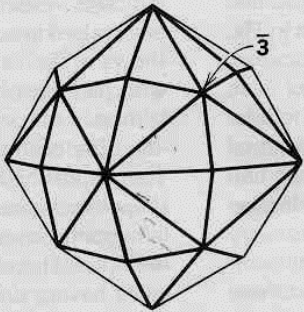
$4/m\bar{3}2/m$



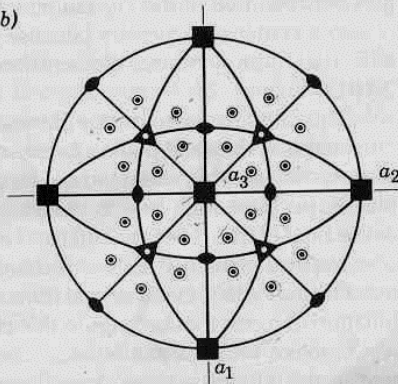
(a)



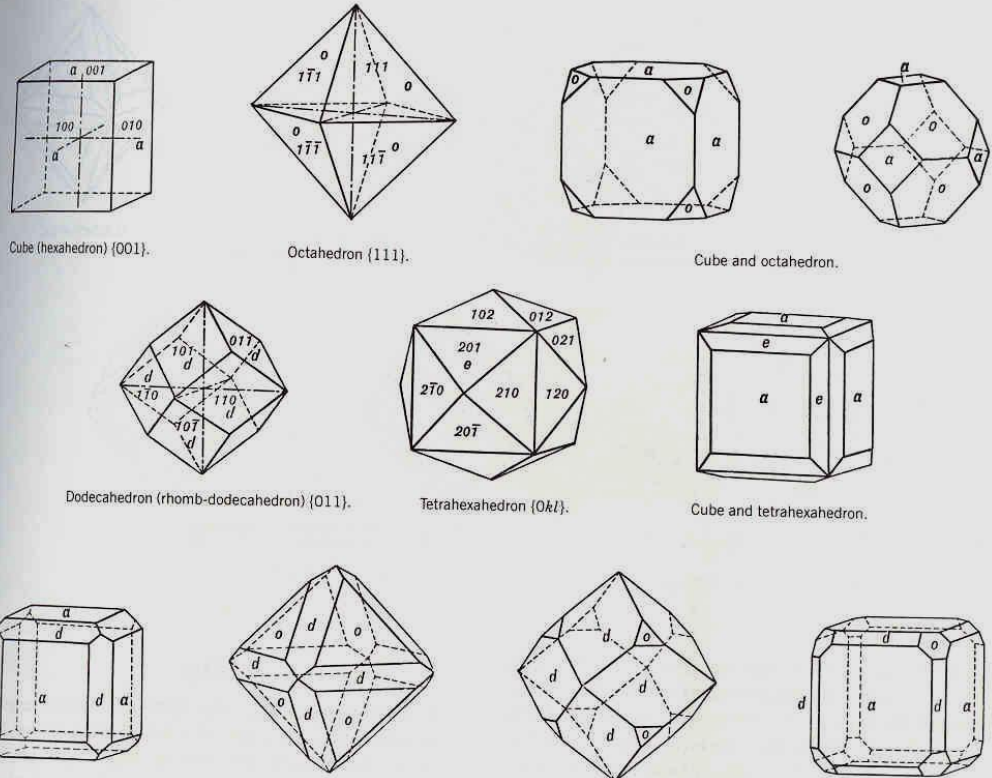
(b)



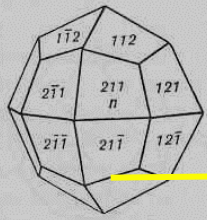
(c)



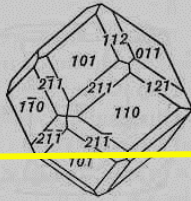
Florit: CaF_2



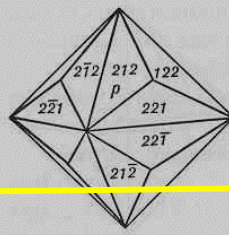
Combinations of cube and dodecahedron, octahedron and dodecahedron, and cube, octahedron, and dodecahedron.



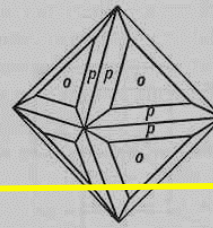
Trapezohedron (tetragon-trioctahedron) $\{hhl\}$.



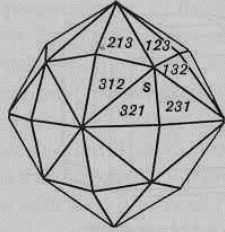
Dodecahedron and trapezohedron in garnet.



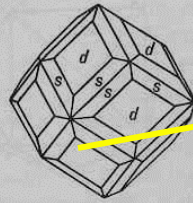
Trisoctahedron (trigon-trioctahedron) $\{hll\}$.



Octahedron and trisoctahedron in diamond.



Hexoctahedron (hexaoctahedron) $\{hkl\}$.



Dodecahedron and hexoctahedron. Dodecahedron, trapezohedron, and hexoctahedron. Both represent garnet.

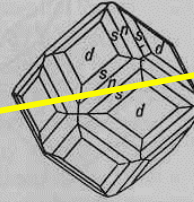
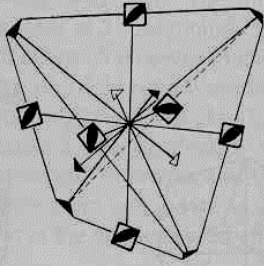
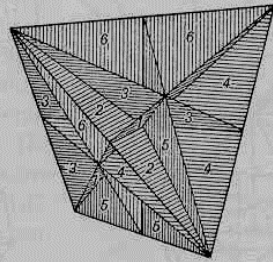


FIG. 2.102. Additional commonly developed forms and form combinations in $4/m\bar{3}2/m$ (see also

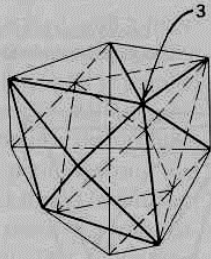
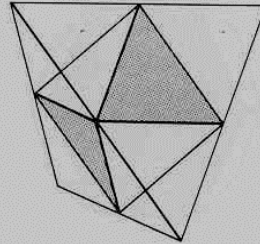
$\bar{4}3m$ Heksakistetraedrik sınıf



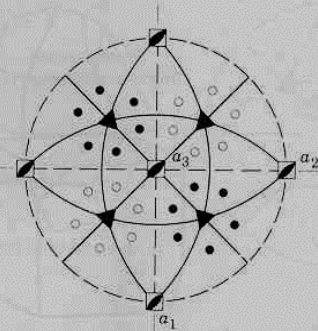
(a)



(b)

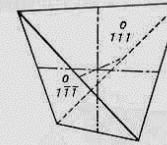


(c)

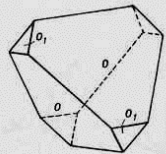
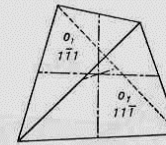


Lösit

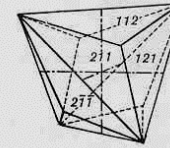
Granat



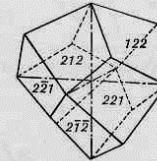
Tetrahedrons Positive $\{111\}$ and negative $\{1\bar{1}\bar{1}\}$.



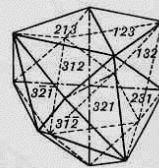
Combination (+) and (-).



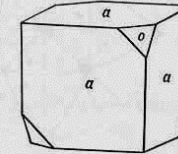
Tristrahedron. (trigon-tritrahedron) $\{hhl\}$.



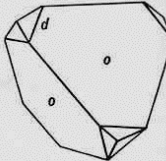
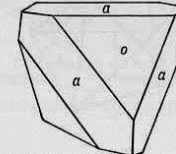
Deltoid dodecahedron (tetragon-tritrahedron) $\{hll\}$.



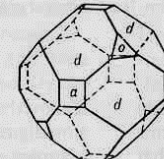
Positive hextetrahedron (hexatetrahedron) $\{hkl\}$.



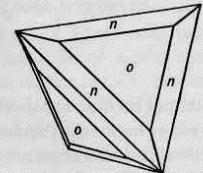
Combinations of cube and tetrahedron.



Tetrahedron and dodecahedron.



Dodecahedron, cube, and tetrahedron.



Tetrahedron and tristrahedron.

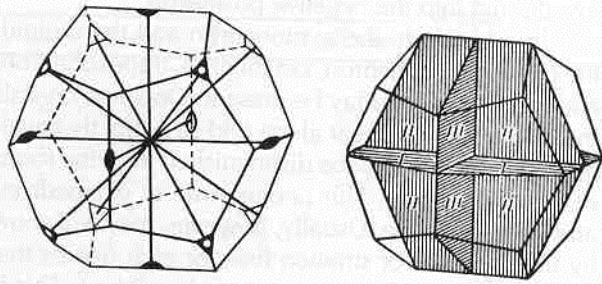
by devel-
combina-

$2/m\bar{3}$

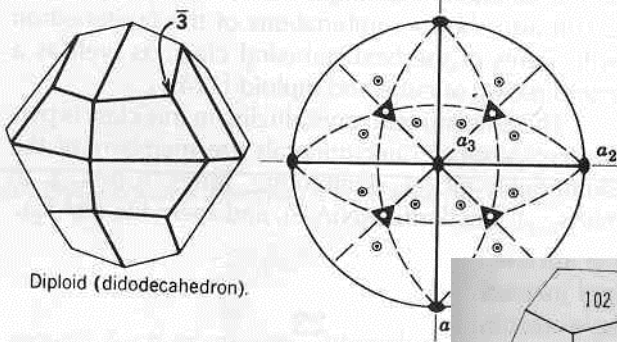
Disdodekaedrik sınıf



Pirit: FeS_2

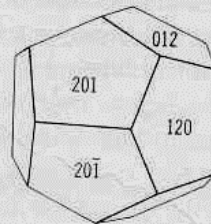
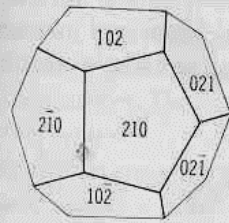


(a)

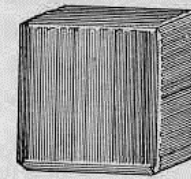


Diploid (didodecahedron).

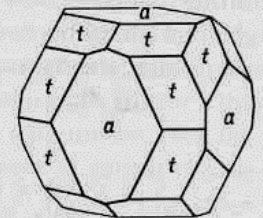
(b)



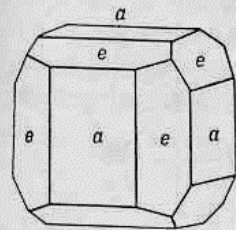
Pyritohedrons (dihexahedrons).
Positive $\{h0l\}$ and negative $\{0kl\}$.



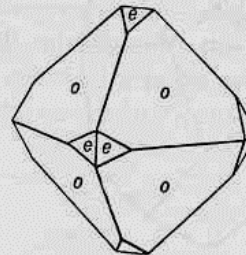
Striated pyrite cube.



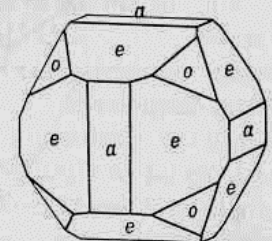
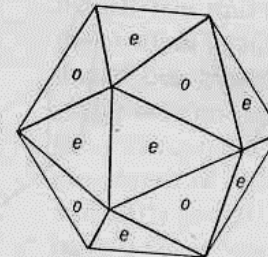
Diploid and cube.



Cube and pyritohedron.

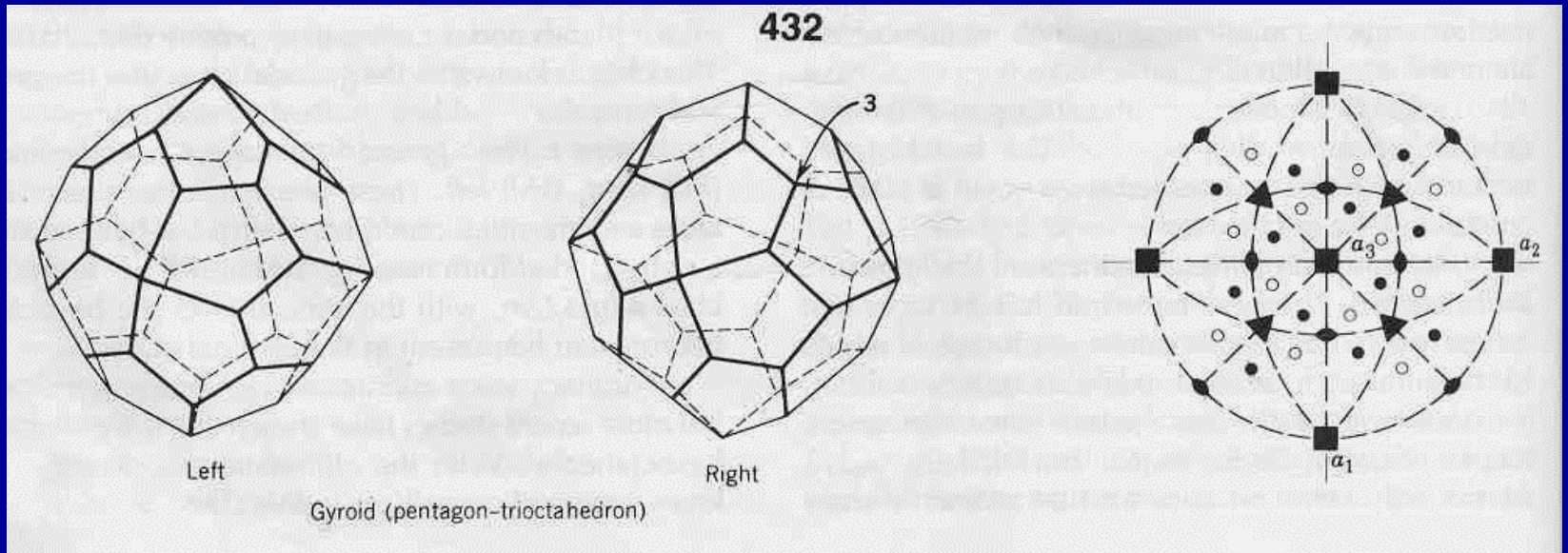


Octahedron and pyritohedron.

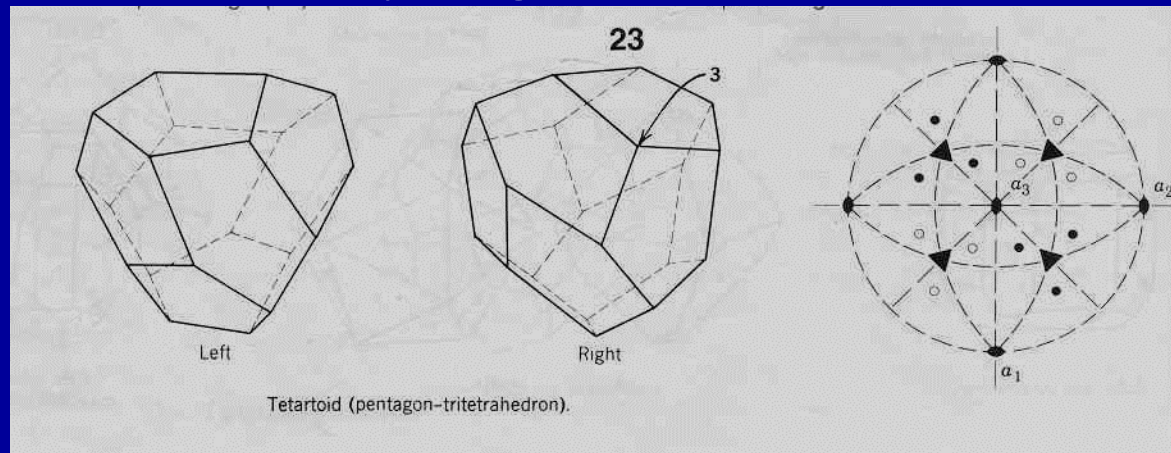


Pyritohedron,
cube, and octahedron.

Pentagonositetraedrik sınıf



Tetraedrik pentagondodekaedrik sınıf.



İÇ YAPIDAKİ SİMETRİ İŞLEMLERİ VE ELAMANLARI

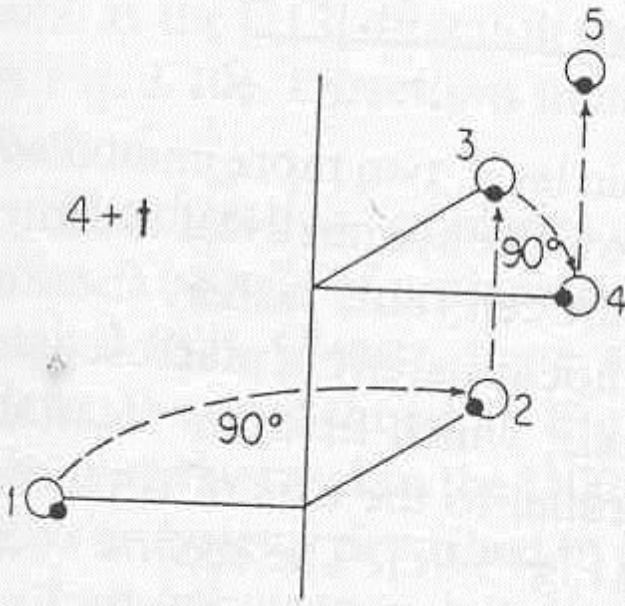
Bir mineral veya kristalin iç yapısında(atomik ve moleküler) bütün simetri işlemleri yer alır. Morfolojidekilere ek olarak öteleme ve işlemleri ve diğerleri ile olan kombinasyonlarda vardır.

Döngülü Eksenler(Screw Axes) ve Kayma Düzlemleri(Glide planes)

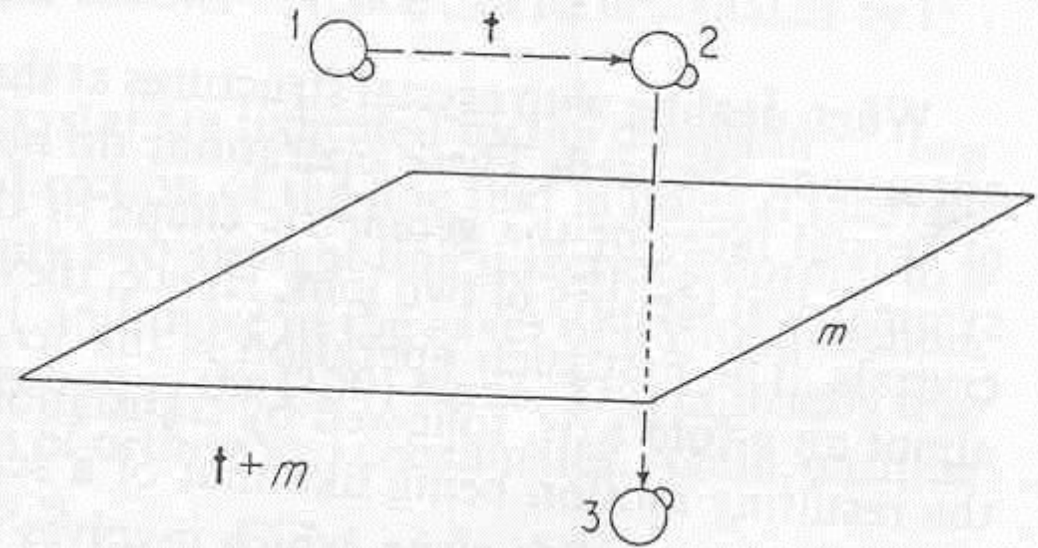
Daha önce Simetri işlemlerine ötelemeyi katmadan simetri işlemlerinden türeyen simetri elemanlarını ve bunların kombinasyonları söz konusuydu (yani dönme, yansıma, evirme ve dönmeli evirme). Bunlar kristalin yüzeyinde ortaya çıkar. Ancak iç yapıda atom ve atom gruplarının tekrarlanmasında öteleme işlemi ile döndürme ve yansıma ile birlikte bunların kombinasyonları, ayrıca bütün bu elemanların ötelemeyle olan kombinasyonları da vardır.

Döndürme(veya yansıma) +Öteleme kombinasyonu

(c) Screw axis



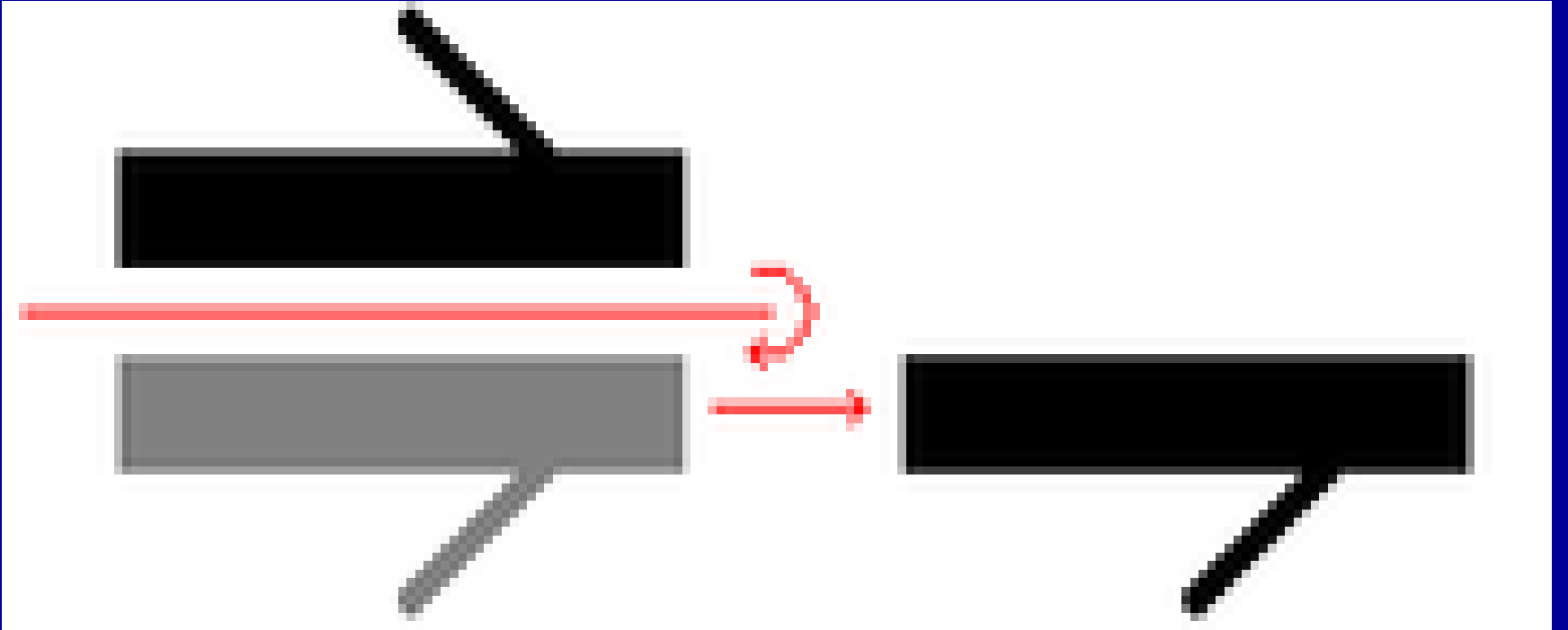
(d) Glide plane



a) Vida eksenini
(screw axis)
(Döndürme +Öteleme)

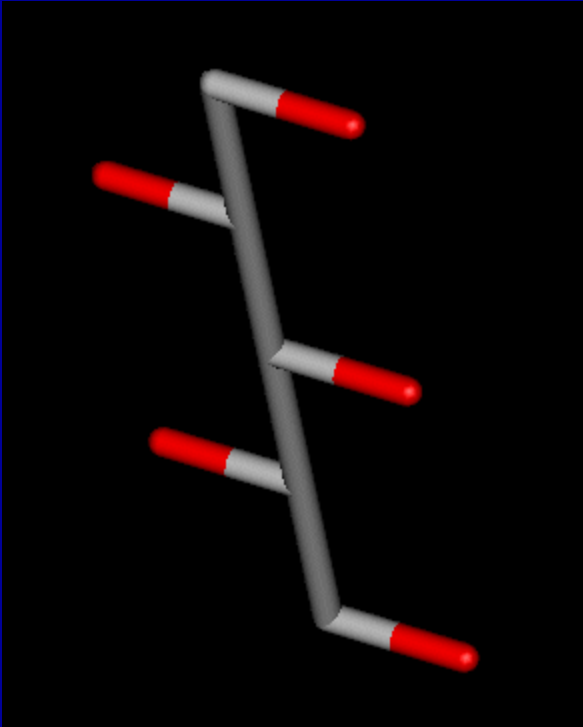
b) Kayma düzlemi
(glide plane)
(Yansıma +Öteleme)

Yansıma işlemi + Öteleme işlemi = Kayma düzlemi



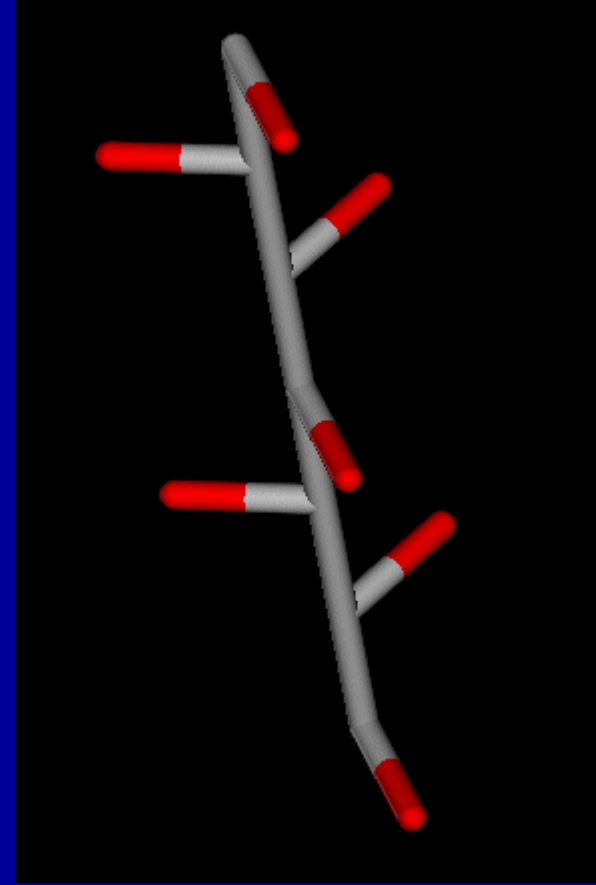
-Döndürme işlemi +Öteleme işlemi=döngülü eksen(vida ekseni)

2- dönümlü işlemi öteleme işlemi takip ediyor.



2_1

3- dönümlü döndürme işlemi öteleme işlemi takip ediyor.



3_1

- Kristal sistemleri(6):**

Bir kristaldeki kenarlara paralel çizilerek elde edilen koordinat eksen takımlarıdır. 6 adet eksen takımı vardır. Bunlara kristal eksenleri de denir. Kenarlar ve bunların birbirleri ile yaptığı açılar ve de eksenlerin boyutları bu kristal eksenlerini belirler.

- Uzay kafesleri(14):**

Kristal eksenleri + **atom yerleşimlerinin (basit, hacmi merkezlenmiş, tabanları mekez., yüzeyi merkz. ve rombohedral) kombinasyonundan türer** 6 kristal sistemi içinde yer alan birim hücrelerdeki atomların yerlerini gösterir.

Nokta Grupları veya Kristal sınıfları(32):

Simetri işlemleri(döndürme, yansıtma ve evirme) ve bunların kombinasyonlarından türer. Doğrudan yüzey morfolojisini verir. Bunlar kristal sistemlerinin içinde yer alırlar. Kristalin morfolojisini tanımlar.

Uzay Grupları(230):

Simetri işlemlerinin tümünün birbirleri ile kombinasyonlarından türer(öteleme+döndürme+yansıtma+evirme + kombinasyonlarının tümü). Bütün iç ve dış yapıyı tanımlar.