PRIDERITE

Indicator mineral for finding diamond

CHEMICAL FORMULA : $(K,Ba)(Ti,Fe)_8O_{16}$

As you see priderite is a Oxide mineral which is similar to rutile(TiO_2) in its properties.(*1)

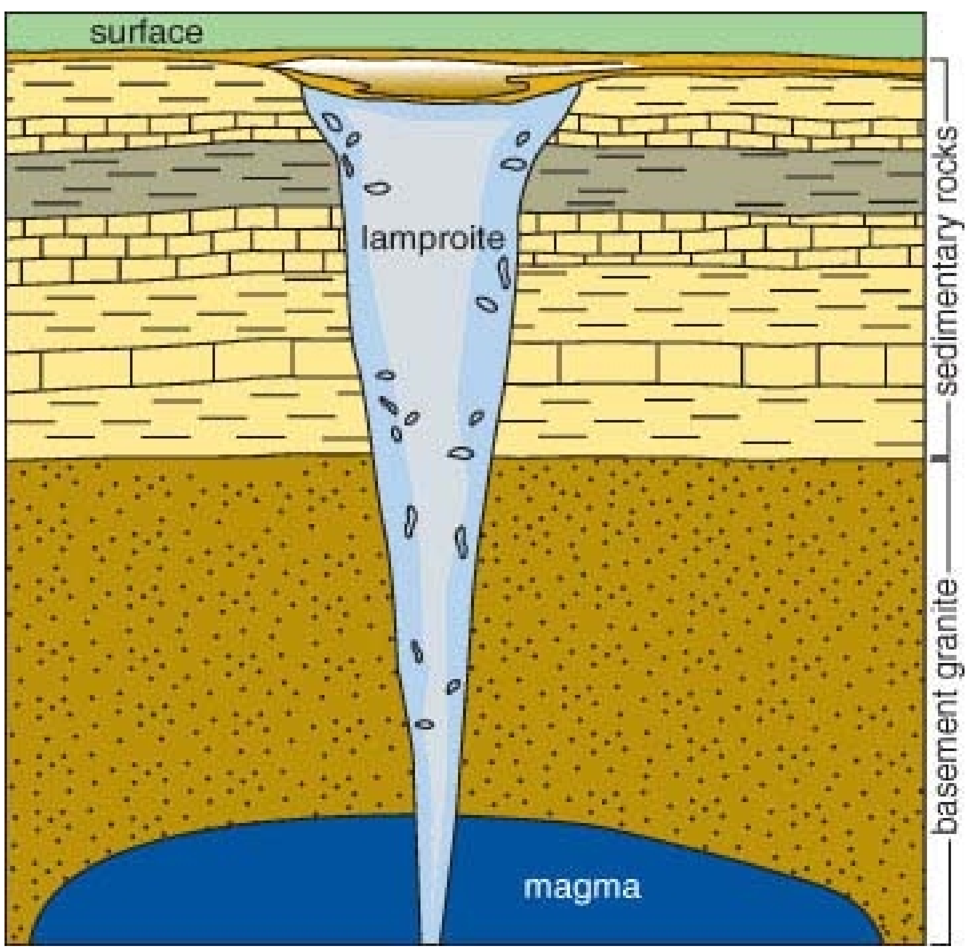
it is a accessory in some lamproitic rocks(in Walgidee Hills and west Kimberly district in western Australia , ,in south eastern of Pero,Prairie Creek in Arkansas(*2).

what is lamproites:

are ultrapotassic mantle-derived volcanic and subvolcanic rocks. They have low CaO, Al_2O_3, Na_2O, high K_2O/Al_2O_3, a relatively high MgO content

Lamproites form from partially melted mantle at depths exceeding 150 km. The molten material is forced to the surface in volcanic pipes, bringing with it xenoliths and diamonds from the harzburgitic peridotite or eclogite mantle regions where diamond formation is stabilized.

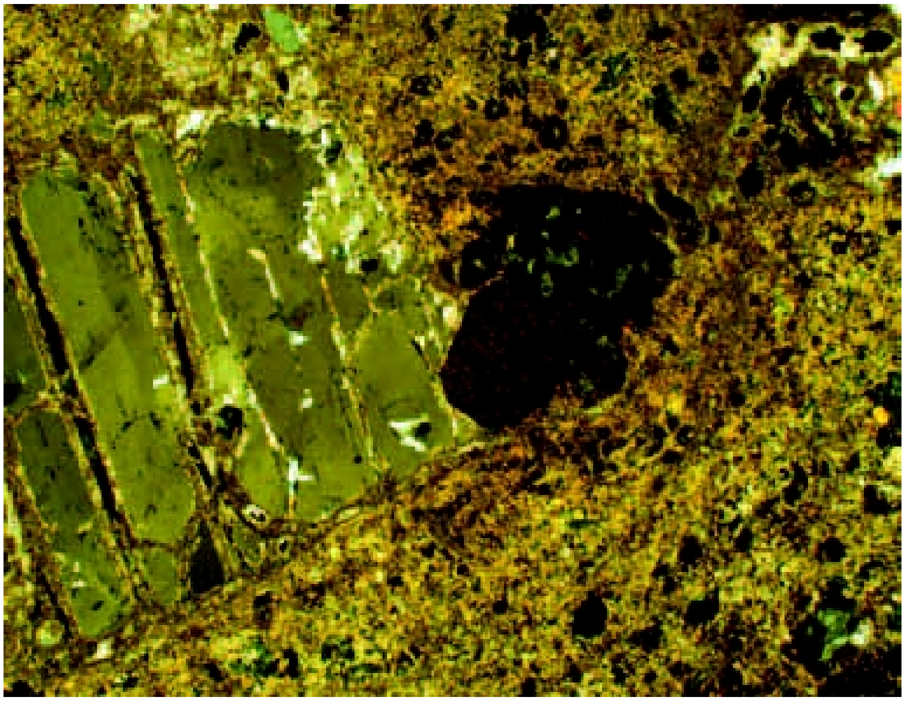
Lamproite picture (*5)

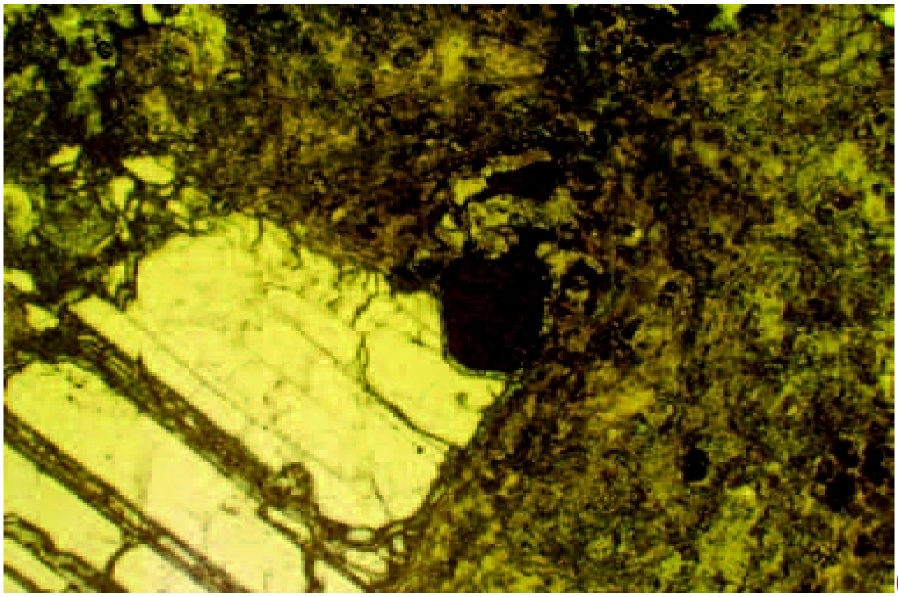


Colors:

Deep redish brown to black with adamantin luster, grey streak,and in thin section almost opaque phenocryst .(*1)

In this thin section which is lamproite you see rounded and opaque phenocrysts of priderite attached to wadeite(colorless),note the strong absorption of priderite

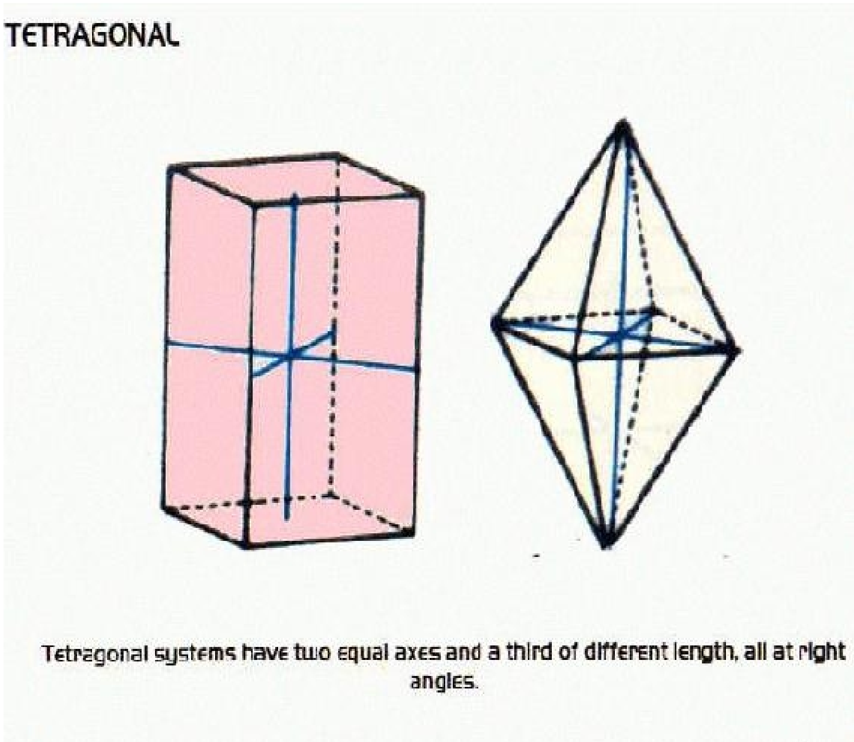


(1*)

CRYSTAL SYSTEM: Tetragonal

Three axes, two are equal in length, one is unequal. All three axes are at 90° to each other.

Characterized by a single 4-fold or 4-fold rotoinversion axis.



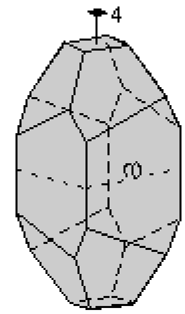
Crystal class:4/m **Space group**: I4/m

Tetragonal System

In this system there are 7 crystal class ,i will explain only crystal class belong to priderite.

- **Tetragonal-dipyramidal Class, 4/m,**
- **Symmetry content - 1A$_4$, 1m, i**

  This class has a single 4-fold axis perpendicular to a mirror plane. This results in 4 pyramid faces on top that are reflected across the mirror plane to form 4 identical faces on the bottom of the crystal.



CRYSTAL HABITE:

General shape of crystals is crystal habit,it controlled by the environment in which crystal grow in case of crystals with varieties habits and in my case, priderite, the habit is controlled by structure.

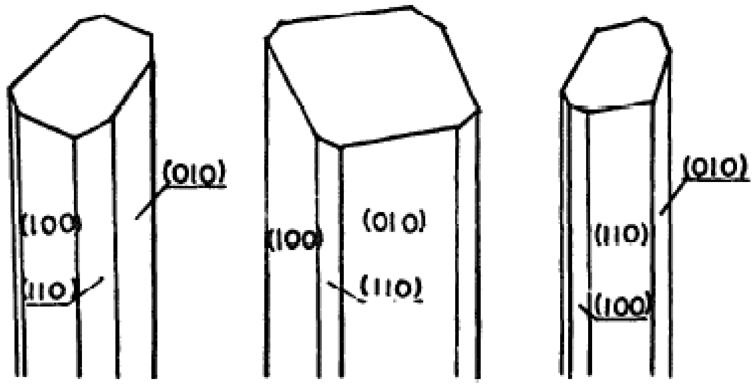
Various kinds of Priderite were synthesized by solid state reaction by different scientists ,in 1996 Hitoshi ohsato,shoji okuda and Yoshihito Moriyama synthesized 3 kind of priderite with different composition ,in 1600 degree centigrade and priderite grown in crucible were acicular or prismatic and alongate C axies,exactly similar to what we can find in nature

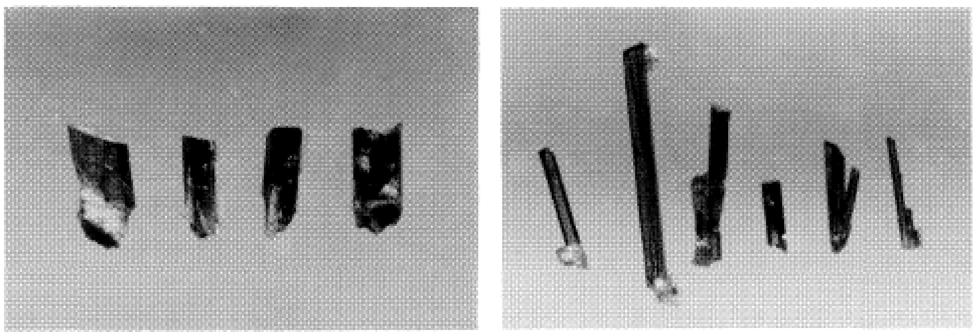
Priderite habit:

in finer grained lamproites it occurs as minute rods of the order0.05mm long but in coarser it occurs as prisms measuring up to 1×0.5mm(*1)K.Norrish

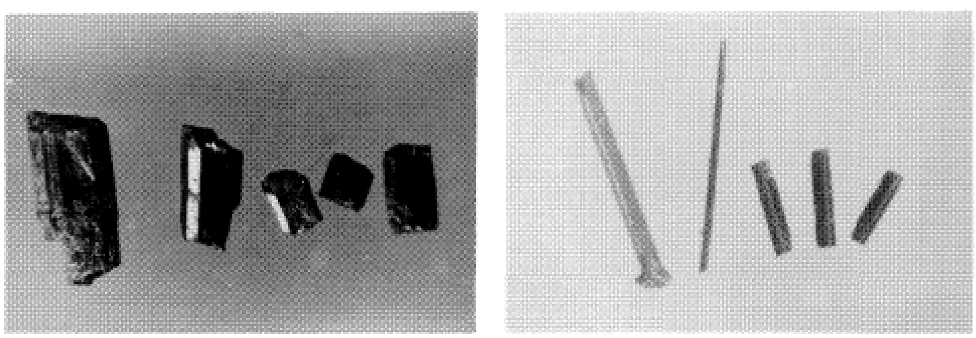
prismatic and acicular form,crystals elongated along the c-axis, (*3)Hitoshi,..which synthesize priderite in laboratory

(growth and characterization of potassium and rubidium priderite single crystals with Hollandite-type syructure by Yoshinori Fujiki,satoshi Takenouchi,Yoshito Onoda,Mamoro Watanabe(1987)

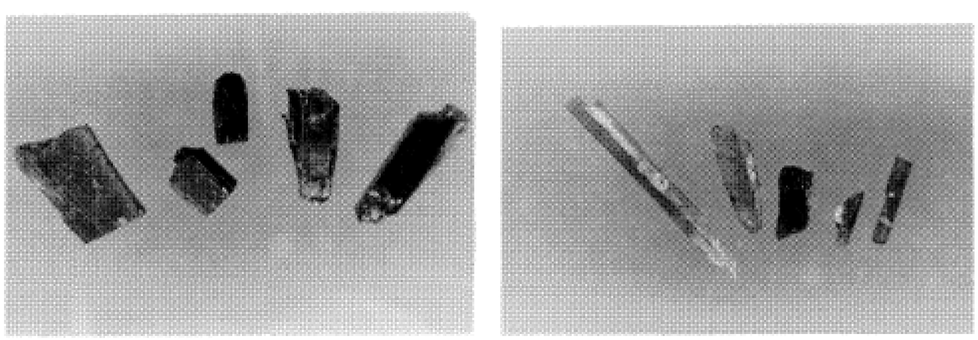




(a)



(b)



(c)

2mm

Single crystals of K-Al priderite (a),K-Fe priderite(b),K-Mg priderite(c)

Characterization of K-Al,Al-Mg prideite grown from melts by hitoshi ohsato,shoji okuda,Yoshihito moriyama and Iwao maki ,mineralogical journal,vol18,No4,pp161-168 (1996)

According to this article priderite which synthetize in lab with different composition are vary in morphology ,the (100) prismatic faces developed wider than those of (110)in K-Al (a)and K-Mg (b) priderite,and in K-Fe (c)the (110) prismatic faces developed wider than (100) .

(3*)

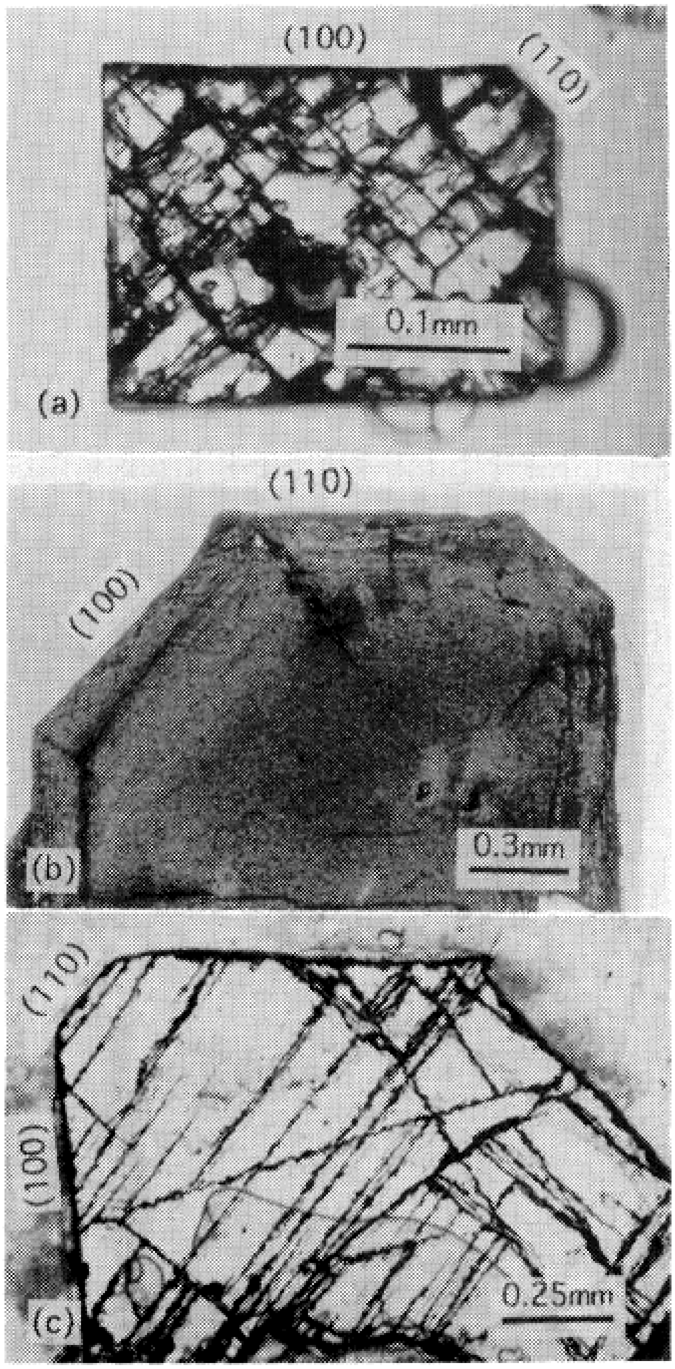


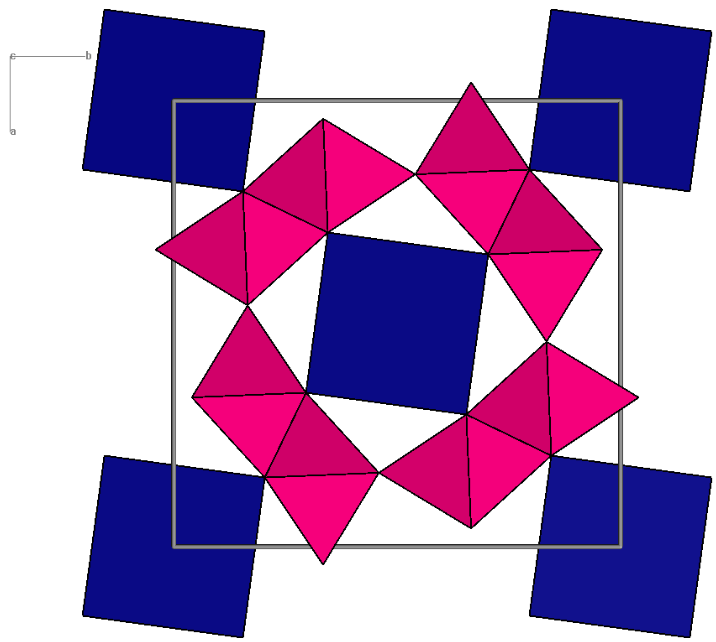
FIG. 2. Thin sections perpendicular to *c*-axis for each priderite: K-Al-priderite (a), K-Fe-priderite (b), and K-Mg-priderite (c).

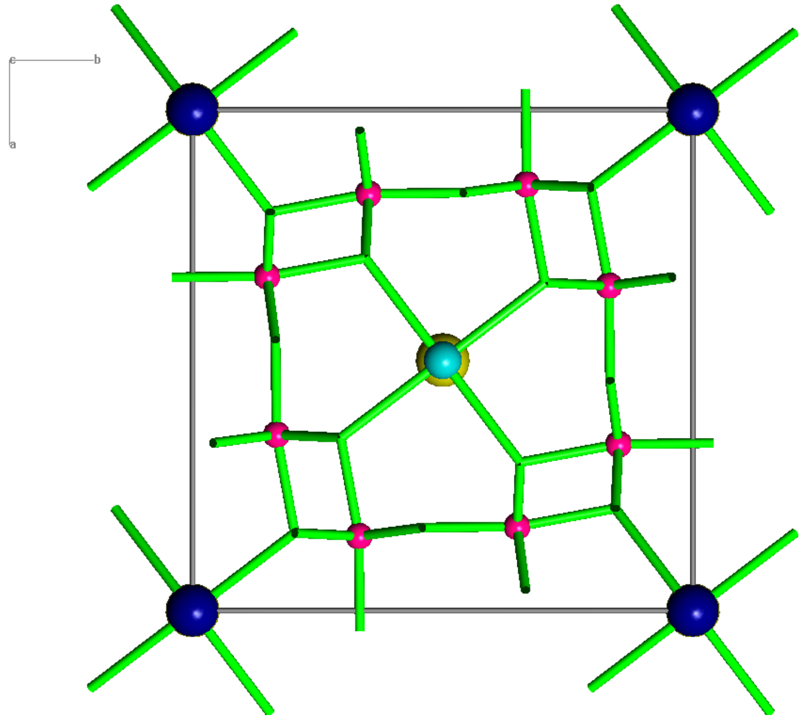
(3*)

Cleavage: Is tendency of mineral to break parallel to atomic planes ,a weak bond is usually accompanied by a large inter planer spacing because the attractive forces can not hold the plans closely.

In priderite cleavage basal (001)is highly perfect and parallel to the prism(010)is fair.

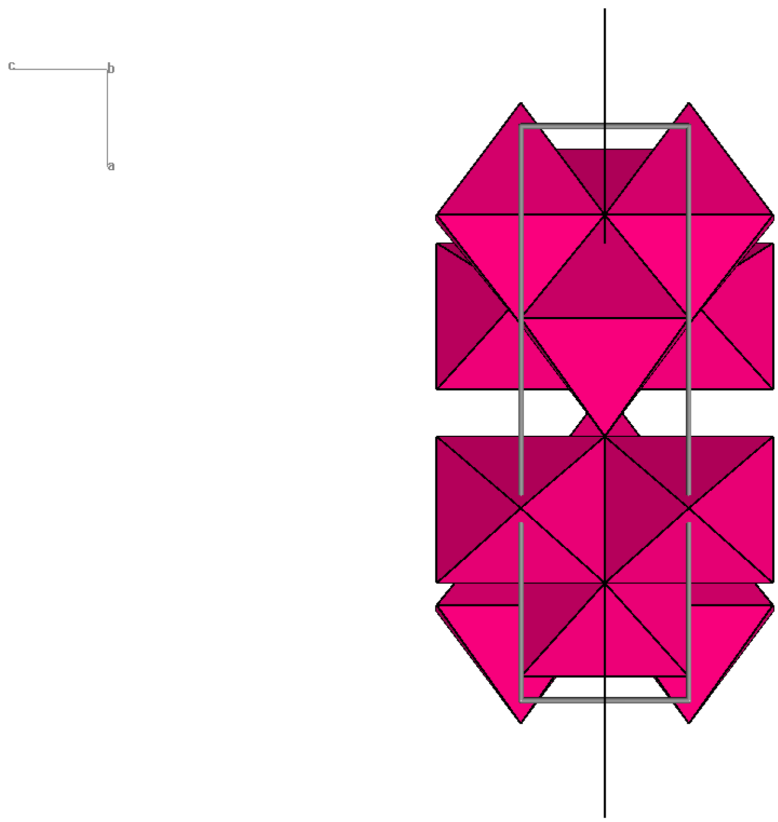
(001) section

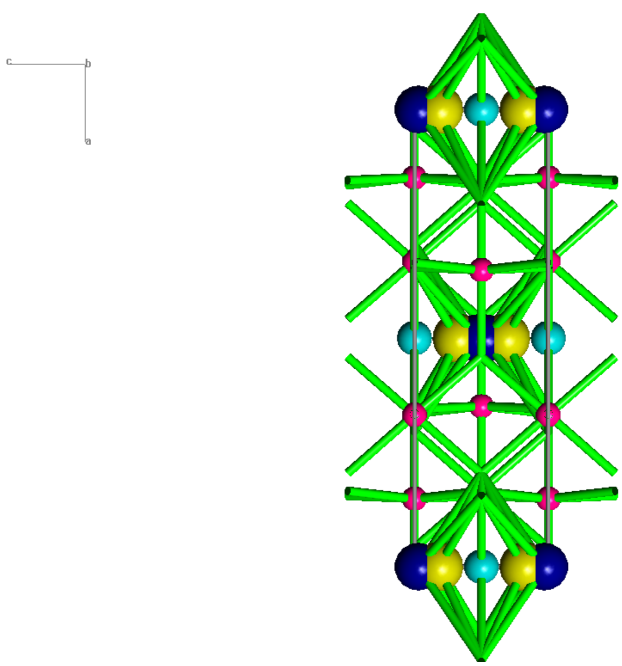




c
b
a

(010) section





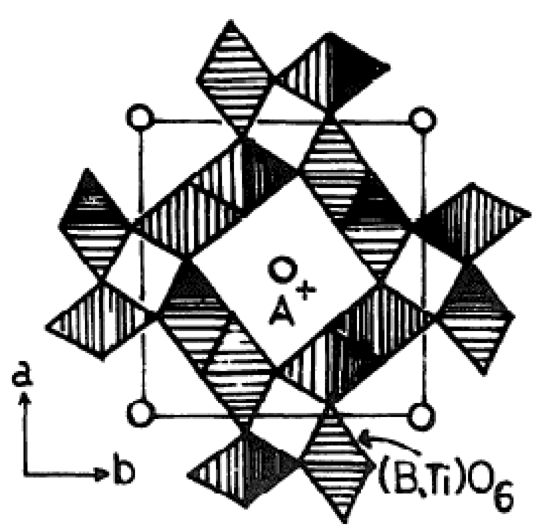
Unit cell parameter:

a: 10.139 b: 10.139 c:2.9664 90 ,90, 90

atom	x	y	z	Occupancy
K	0	0	0.03	0.33
Ba	0	0	0.18	0.05
Na	0	0	0.5	0.02
Ti4+	.85138	.33235	0	0.84
Fe3+	.85138	.33235	0	0.13
Mg	.85138	.33235	0	0.03
O1	.65498	.29604	0	0.0062
O2	.04076	.33441	0	0.0068

it is known that in this tunnel 33% of site is K and 5% is Ba and the rest is empty,

so we see that there is opportunity for some other ion to occupy into this site but there should be charge balance in crystal structure .

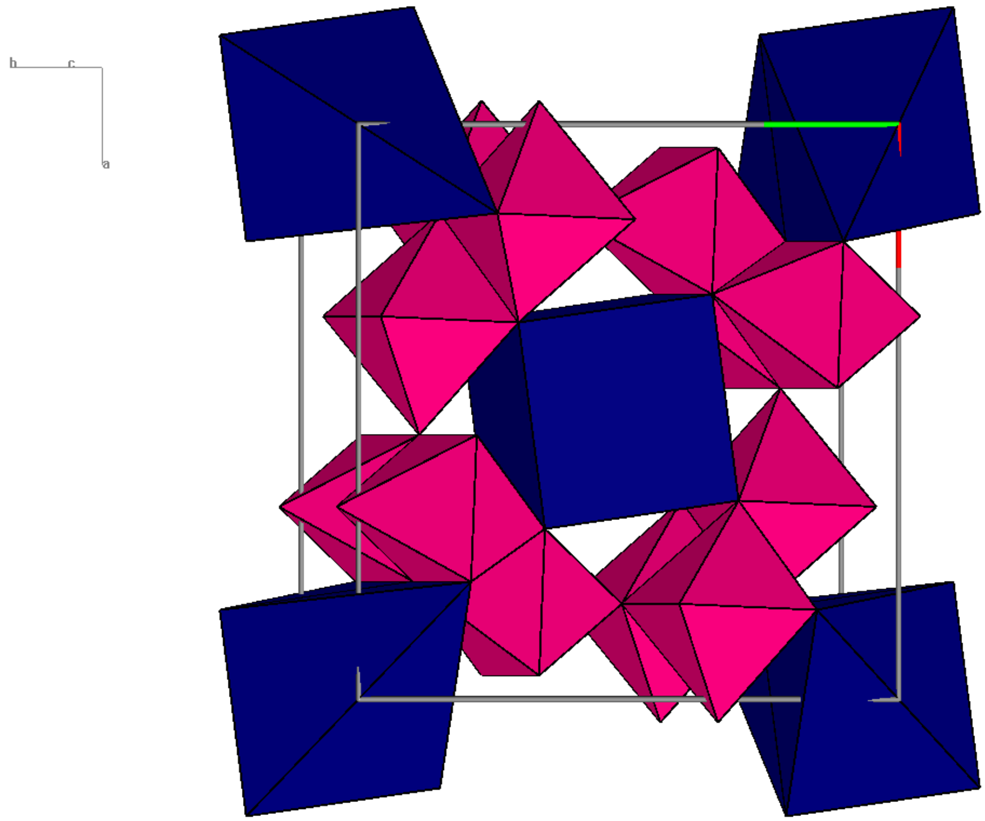


The tunnel structure of priderite,view along c axis . (4*)

as you see K and Ba are square plane and has coordination 4

K is a big cation with low charge and for fulfills its valence needs 8 oxygen ,so if we increase the bond radius of A site to 3.2 A^o we can see other neighbours of K and Ba which are 8 oxygen, and if we look at geometry file of that we see that there is two bond length K-O, 2.94 A^o and 3.03 A^o ,the shorter are closer to cation (K^+)

(geometry file of priderite in radius 3.2 A^o)


b
c
a

Type of Bonding in Priderite:

In Priderite geometry data file ,if we look at bond length of K-O ,it is 2.94 A^{o} and Ba-O is 2.76 A^{o},while for Ti-O it is 1.97 A^{o} so we see the strongest bond is in B site between Ti-O which has CN:6 ,octahedral, has shorter bond length with covalent character and is more stronger than K-O and Ba-O bonds which are more ionic bond .

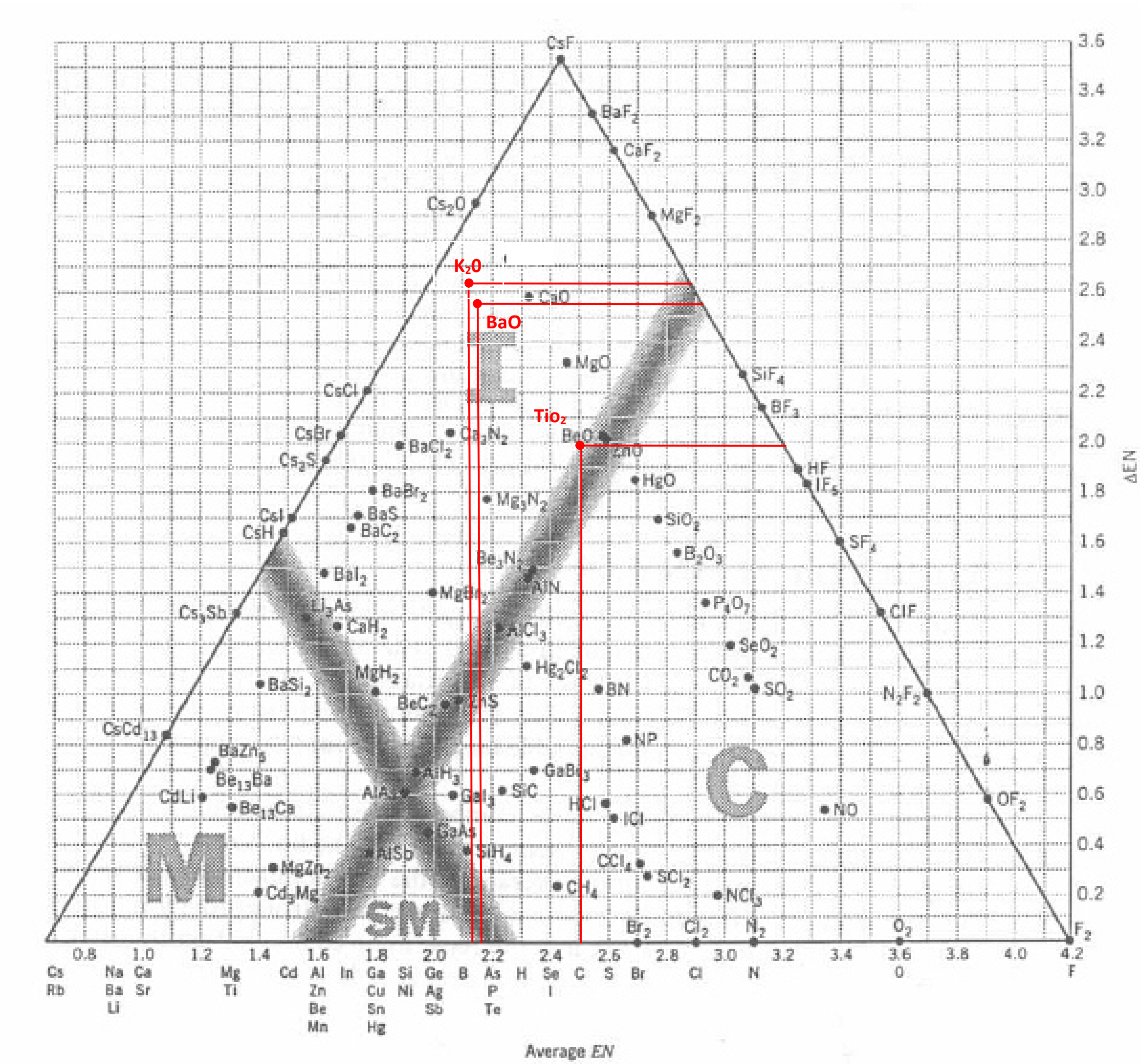


FIGURE 5.10 Bond type triangle for elements with electronegativities ranging from Cs to F. The lines separating the regions into ionic (I), metallic (M), covalent (C), and semimetallic compounds (SM) may be determined empirically and correspond approximately to lines parallel to the triangle sides drawn through Al and Te. (from Purdue University workshop by Dr. George Bodner)

K-O	3.44-0.82=2.62	3.44+0.82/2=2.13
Ba-O	3.44-0.89= 2.55	3.44+0.89/2=2.16
Ti-O	3.44-1.54=1.99	3.44+1.54/2=2.49

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1-

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Growth and characterization of potassium and rubidium priderite single crystals with hollandite type structure by yoshinory fujiki ,Satoshi Takennouchi,Youshito onoda,Mammro watanabe(1987)

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lamproite picture is from website:

http://www.kgs.ku.edu/Extension/fieldtrips/guidebooks/SCKS/SCKS3.html

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