Welcome students.

This module is physical properties

of minerals, cleavage and fracture.

Outline is
property of cleavage in minerals.

Types of cleavages,

properties of fractures in

minerals and types of fractures.

Learning outcomes

students will be able

to understand cleavage in minerals,

understand fracture in minerals and

distinguish between cleavage and fracture.

Cleavage.

Cleavage refers to the property or

tendency of the mineral to split

along certain definite planes of

weakness is called as cleavage planes.

Many minerals have certain

crystallographic planes along which

chemical bonding is weaker than others.

Because cleavages are controlled

by structure and symmetry,

they're always crystallographic planes.

There may be no cleavage where a mineral

is equally strong in all directions.

Example quartz..

So when minerals have weaknesses within them,

and since it is

crystallographically controlled,

they are usually planes of weaknesses

that are present in the minerals.

Usually when hammered,

these minerals would break

along these planes.

These planes are called as cleavage planes.

Now, if the bonding is strong in all

three directions within the mineral,

such that there are no weakness

planes present within the mineral,

the mineral will not possess any cleavage.

So there may be more than one cleavage

in any mineral and hence the minerals

cleavage is referred to as one set cleavage,

two sets cleavage, three sets,

cleavage, even up to four.

There are even six sets of

cleavage is cleavage planes.

So if the cleavage plane is very,

very clear and it is very distinctly seen.

Like for example in mica,

while if the cleavage set is

not very clear then the term

imperfect is used.

So there are a distinct cleavages

and there are indistinct

cleavages or imperfect cleavages.

In general,

weaker bonding gives rise to cleavage planes,

while if the atomic bonding is

very strong then there is an evenly

distributed such that there is no scope

for development of cleavage planes.

Then there is no cleavage.

So minerals with only One Direction of

weakness, such as gypsum and mica,

have One Direction of cleavage and usually

break to form thick slabs or sheets.

So if they have One Direction of cleavage,

usually they break into break into

slabs or sheets and you get sheets.

So we say they have basal cleavage.

Kyanite and Anthophyllite,

on the other hand,

have two good cleavage is so they

easily break into splintery shapes.

The minerals may also have three

sets of cleavage is or even

four or even six cleavages.

So we use geometric terms such as

cubic or octahedral or prismatic to

describe cleavages whenever appropriate.

Now let us see what is 1 set of cleavage.

This is Muscovite,

and this is one set cleavage

that is in this direction.

This is also set to have a basal cleavage,

so this is One Direction cleavage

and gives the rest two minerals

that are in this fashion.

Now two sets cleavages are those

cleavages which are at right angles

or they may not be at right angles.

In this particular crystal there is a

cleavage here and there is a cleavage

plane here so this cleavage plane

and this cleavage plane is the same.

This cleavage plane and this cleavage

plane is the same hence this mineral

is set to possess two sets of cleavage

is 1 here and the other one is here.

Another example is amphibole.

They also have two sets cleavages,

but they do not meet at right angles.

They meet at 60-120,

They make angle of 60 degrees 120 degrees.

There could be three sets of cleavages.

Example is halite. This is a cube.

wooden model of cube.

This is also set to have cubic cleavage.

This is three sets of cleavage.

This is one set cleavage.

This is second set of cleavage

and this is the third set along

which the mineral can break.

So this cleavage and this

cleavage is the same.

This cleavage and this cleavage the same and

this cleavage and this cleavage the same.

Hence this mineral is set to

possess three sets of cleavage.

That meet at right angles.

This mineral is calcite.

This also has three sets of cleavages

but it does not meet at right angles.

This is one set.

This is the second set and

this is the third set.

All these three cleavages do

not meet at right angles.

Four sets of cleavages

are possessed by fluorite.

It is also called as octahedral cleavage.

This wooden crystal

of octahedron depicts the cleavage,

the cleavage planes are this one.

This is one set of cleavage.

This is second set of cleavage.

This is third set of cleavage, this is

4th set of cleavage for this plane.

This is the common plane for this.

The plane is towards me for this.

The plane is here and for this the

plane is here so there are four sets

of cleavages that are possessed

by this mineral of fluorite.

And this is a wooden

crystal model of octahedra.

Then there are six sets of cleavages

that are possessed by spahelerite

This is the wooden crystal

model of sphalerite,

where in this is one set cleavage.

This is the second set.

This is third set.

This is fourth set.

This is fifth set and this is 6 set

so the complementary cleavage for

this is here for this lies here for

this is here for this plane is this

side for this plane is this side

and for this plane is this side.

So this particular crystal

processes six sets of cleavage.

The cleavage can also be called

as prismatic when there are

multiple directions of good.

Cleavage is all parallel to

One Direction in the crystal.

This this cleavage can also be

called as prismatic because there

are multiple cleavages in One

Direction so the the these are

prismatic faces of the crystal so

the cleavage is called as prismatic.

Now coming to fracture

fracture is a

general term used to describe a way

the way mineral breaks or cracks.

Now this fracture term is different

than cleavage because the fracture

planes are those planes which

are not cleavage planes.

So these characters are significant

and hence it is important to

distinguish between smooth surfaces

resulting from cleavage planes as

against the rough surface is that are

usually associated with the fracture,

since fracture is independent of cleavage.

Some crystal structures have bond

strength equal in all directions.

Hence breaking will not follow

a particular direction,

resulting into a fracture.

Taking example of this mineral,

this mineral has two sets of cleavages

and this mineral also has fracture.

So the the minerals that have

cleavages do also process fracture.

But all minerals that have

fracture do not possess cleavage.

For example,

quartz has a fracture but does

not have cleavage.

Let us see the types of fractures now.

So that atomic structure is not the

same in all directions and chemical

bonds are not the same strength.

Most crystals break along

preferred directions,

so the orientation and manner of breaking

are important clues to crystal structure.

So if the fractures are

extremely planar and smooth,

then the mineral is set to have good

cleavage and not good fracture.

So the types of fractures here

we see transparent quartz

The fractures shown are here.

These fractures are called

is conchoidal fractures.

That is when the mineral breaks

is concentric circles,

which may either be concave or convex.

So these are the concentric

circles that I'm talking about.

This is the way in which the glass breaks.

So this type of fracture is shown by quartz.

Exhibiting gradually diminishing

undulations which resemble the

lines of growth of the shell when

it is feebly displayed,

the term sub conchoidal is used.

This is beautiful example

of conchoidal fracture.

This is of Obsidian glass.

These are the lines that form

because of the fracture.

Second type of fracture is even fracture

when the mineral surface is evenly flat.

The fracture is even.

For example a feldspar.

This feldspar has this

cleavage and this cleavage.

So there are two sets of cleavages.

So when the mineral breaks in any other

direction then the cleavage is fracture.

Hence this is the fracture plane.

Now when this fracture plane has not many

undulations but has a little undulations,

And it is more even the

fracture is called is even.

There is uneven fracture.

When the fracture surface is rough due

to minor elevations and depressions,

so the term is used is uneven

example orthoclase. Now these are the

close photographs of the minerals.

These are cleavage planes

of orthoclase or feldspar,

whereas this part shows fracture.

This does not have many undulations

so this is known as even fracture.

This mineral is microcline.

This is.

A cleavage plane and this

is a cleavage plane.

Both these are types of feldspars only.

Both are K Feldspars

but the colors are different.

So this part shows even fracture.

This is bibliography.

Thank you.