Welcome students, this is

physical properties of minerals,

hardness and crystal form.

Outline

the hardness of minerals

determination of hardness.

Mohs scale of hardness

crystal,

form of minerals,

and types of crystal form.

Learning outcomes students will be able to

understand what is hardness and crystal form.

Understand the procedure to find

out hardness of unknown minerals,

distinguish between various crystal forms.

Hardness.

Hardness is minerals,

resistance to abrasion or scratching.

Relative hardness is determined by

Scratching

trying to scratch a surface of 1 mineral

with an edge or corner of 2nd mineral.

If the scratch or abrasion results

the first mineral is softer.

So in 1872 a German mineralogist

Frederick Mohs devised the simple way to determine the hardness

of an unknown mineral by arranging

10 minerals in series according to

their increasing hardness values,

giving Mohs scale of hardness.

So when we try to determine

the hardness of this mineral,

we have to we can we can determine

the relative hardness of this

mineral with respect to this mineral

so we can scratch this mineral

with this or this mineral.

With this anything is possible

but we have to check which

mineral scratches which mineral,

who scratches whom.

So if this mineral scratches this

mineral that means this mineral is hard.

If this mineral scratches this mineral

that means this mineral is hard.

What we need to check is.

The powder of any of the

mineral on any of the minerals,

so whoever is powder lies on the surface.

That mineral is soft.

Absolute hardness is a measure of materials,

ability to resist permanent deformation,

that is, a measurable hardness.

The scale of Mohs scale of hardness this

standard minerals do not advance in any

definite or regular ratio of hardnesses.

So there are those,

so these are most common minerals

appearing in rocks starting from talc,

which is the hardness of 1 followed

by gypsum hardness of two calcite,

hardness of three,

flourite hardness of four,

apatite hardness of five, feldspar

hardness of 6, quartz hardness of seven,

Topaz hardness of eight, corundum hardness of nine, diamond hardness of 10.

Now these minerals are given

numbers from one to 10.

The meaning of this statement is talc and gypsum if we compare gypsum

is not twice hardest.

Talc or apatite is not five times hardest than talc

Diamond is not 10 times harder than talc.

The absolute hardness

of each mineral is different than these.

Then the then the hardness shown

in the most scale of hardness.

Now another value is shown there or in the

table about non mineral substances which

are known substances with hardnesses.

Now the hardness of 2.5 is

human fingernail hardness.

Also aluminium hardness. 5.5 is the

hardness of pocket knife blade also glass.

6.5 is the hardness of metal

file all or streakplate

So these are the known hardness

is which we can use to check

relative hardness of minerals.

Determination of hardness.

So in actual practice,

the hardness of an unknown mineral

can be determined observing the ease

or difficulty with which mineral

can be scratched by the other.

We have hardness box which has all these

mohs scale of hardness minerals in this box,

right from talc to corundum

since diamond is non economical

to keep in the hardness box.

Usually most of the rock forming minerals

have hardnesses that are less than seven,

hence this hardness box takes care

of almost all possible minerals

that are available for us to study.

To check their hardness is so mineral

under study should be scratched

by the standard minerals from the

Mohs scale of hardness.

Take for example this mineral.

Now this mineral.

If it scratches orthoclase from the

Mohs scale of hardness that is.

This mineral scratches orthoclase

from the Mohs scale of hardness

and quads scratches this mineral

from the Mohs scale of hardness

Then the hardness of this mineral

is between orthoclase and quartz

Now going through the Mohs scale of

hardness orthoclase hardness of six. Quartz

Hardness of seven.

Hence this mineral has hardness

between 6 to 7.

Hence any unknown mineral.

If its hardness is to be determined,

this Mohs scale of hardness box

minerals need to be used and every

mineral from the hardness box needs

to be scratched on the unknown

mineral to check it's for hardness.

Precautions while determining hardness.

Now sometimes when one mineral

is softer than the other,

portions of the first mineral will

leave mark on the second mineral.

That may be mistaken for a scratch.

Such mark can be rubbed off,

whereas the true scratch will be permanent,

like when calcite is scratched by quartz or

calcite is scratched by any other mineral.

This calcite will leave white

powder on the Quartz itself.

That does not mean

calcite is scratched quartz.

We we need to check the scratch,

so we need to remove the powder.

And check the scratch where it is present,

whether it is on quartz or calcite.

The surface is of some minerals are

frequently altered to material that is

much softer than the original mineral.

Hence of fresh surface of the specimen needs

to be tested and must therefore be used.

So hardness needs to be checked

only on the fresh surface and not

on the soft altered surface.

The physical nature of a mineral may

prevent a correct determination of hardness.

For instance, if a mineral is pulverulent

Or granular It may,

it may be broken down and

apparently scratched by the mineral

much softer than itself.

It is always advisable when making

the hardness test to confirm it by

reversing the Order of Procedure.

That is,

do not only try to scratch mineral A

mineral B,

but also try to scratch mineral B by

mineral A and check where the scratch

remains and where the powder remains.

This Mohs scale of hardness is not

linear and close to being exponential.

The hardnesses of the softest

minerals are more similar than the

hardnesses of the four hardest ones.

Quartz, Topaz, corundum and diamond.

Gypsum is only slightly harder than talc,

but Diamond is a hardness five

times greater than corundum.

Hence we can see from this graph

that the minerals till quartz have

absolute hardness is very close

to each other but from Topaz

corundum and diamond they have absolute

hardnesses which are very different

and diamond is 5 times harder than.

Corundum

the hardnesses of the mineral

relates to its weakest bond strength.

Graphite is a bond strength.

Graphite has a hardness of 1.5,

where is Diamond's hardness of 10

Both are made up of carbon,

but in diamond the carbon atoms are

arranged in cubic system and

tightly bonded whereas in graphite.

The bonding is weak in One Direction.

If we ignore these values,

the type of bonding that takes place in

diamond is a 3 dimensional structure,

whereas in graphite is a 2 dimensional

structure and the above and this above

plane is having a weakness plane

that gives rise to its low hardness.

Now, the scratch hardness may vary

substantially with the direction and

crystallographic plane in minerals.

This is kyanite

So Kyanite typically when scratched

parallel to its length,

that is along this length,

the hardness is 5,

but at right angles to each,

the hardnesses 7.

So in this direction the hardness is 5

whereas in this direction the hardness is 7.

Now we'll see crystal form,

so under favorable conditions the

minerals attain certain definite

geometrical forms by virtue of which

they are bounded by flat surface

is and is referred to as crystal.

The general descriptive terms associated

are crystallized, so this image is

Show you crystallized parts of a crystal.

This crystallized part means it

has developed all possible faces.

This is this is quartz and these are garnets

which have developed all possible faces.

These are again crystallized forms

of quartz which are which have

developed all possible faces.

The other types is crystalline.

Crystalline is a term used to

denote that no definite flat

surface or the faces are developed,

but a confused aggregate of imperfectly

formed crystal grains that have interfered

with one another during their growth is seen.

For example, this this is pink quartz.

This is pink quartz

This is crystalline,

whereas this is transparent quartz.

This is crystallized.

This is this is developed all the faces

whereas this mineral has not developed faces,

but internally it is a confused aggregate

And it has structurel intact.

Crypto crystalline are varieties

where it refers to microscopic

examination of mineral specimen. cryptoCrystalline minerals do not have

good form megascopically that

is in hand specimen but however,

under the microscope their partial

crystallization and formation of

mere traces of crystal structure

is clearly revealed.

Example some varieties of quartz

like Bloodstone, Chalcedony,

Jasper, agate,

etc are all crypto crystalline.

Last property is amorphous
means this minerals with total

absence of any crystal structure

all possible and they are referred

to as amorphous minerals.

Another variety zeolite variety

is called as Opal.

This is bibliography. Thank you.