Dear students. In this class we will be studying about a binary system with an eutectic. During this lecture we are going to talk about the binary eutectic system Diopside Anorthite.

At the end of this lecture you will be able to understand the Diopside-Anorthite system.

The crystallization trend of a diopside anorthite rich melt and also apply this knowledge to understand the melting trend of the same composition of the system.

The diopside and Anorthite system. Now this system represents the most simplest binary system. It contains simple eutectic and no solid solution. This system is applicable to the Gabbroic rocks, which are primarily composed of. Clinopyroxene and plagioclase.

Now let us see what the diopside anorthite system and its phase diagram looks like. The diopside anorthite binary system is illustrated in an isobaric Temperature versus composition phase diagram. Now you see the phase diagram here on the horizontal axis we have the bulk composition of the two components that is Diopside on one end and anorthite on the other end, whereas on the vertical axis we have a range of temperature. This entire system

is studied at one atmospheric pressure. Now in this phase

diagram we also see some.

Codes which are known asLiquidus now what is a liquidus?

A liquidus is a curve thatspecifies the composition of any

liquid that coexists with asolid at a particular

temperature. For example, youhave at this curve you have the

liquid and along with it thereare dioxide crystals. Here

crystals DIY stands for dioxidewhich are also forming, so these

tabs side crystals arecoexisting with the liquid.

Along this phase boundary thatis the liquidus curve. Now if I

want to know the composition ofthe a point of the liquid at

this point on the liquidus, Iwill just have two.

Drag a streetlight down to thehorizontal axis and the

composition will be known. Inthis case, the composition is.

In this case, thecomposition is about 15% an

artit. Since Anorthitestarts from zero, 215%

anorthite, and about 85% ofside.

Next we look at something calledas the eutectic point. Now

eutectic point is that point,which is the lowest on the

liquid's surface. Now you seethe Liquidus line here and the

Liquidus line here. This pointis the lowest point on the

liquidus, and it represents apoint where all the phases

coexist. Now here you have threephases coexisting, you have the

liquid you have the.

Dev said Crystal then you havethis solid crystals annotate

crystals that are coexisting at

this point. So that is aboutliquidus and eutectic point. Now

let us see how a melt that iscomposed of diopside anano tight

crystallizes in this oneatmospheric pressure condition

in bearing temperatures. Let usconsider or melt of bulk

composition X. So the bulkcomposition X melt is marked

here. Its composition is givenstraight down here, which is 75%

anorthite and 25% outside. Sincethis point represents 100%

anorthite. Now, for equilibriumcrystallization, the final solid

will also have the samecomposition as the starting

composition of the melt. We willsee this a little later.

Let's start crystalizing thismyth. So as the temperature

drops from about.

1500 degrees Celsius, 2X2,where the temperature now is

about 1455 degrees Celsius.We see the first crystal of

Anorthite forming.

So we enter this field. At thispoint an you have the yeah

Northside crystal coexistingwith the liquid. Now the first

10 Northside Crystal that formswill have a composition of pure

an orthotic that is. It will be100% an or tight so the

composition of the crystal thatforms is read across this field

onto the vertical axis. So thisvertical axis indicates that it

is 100% anorthite.

So as we cool from X1 to X2,you have the first annotate

crystal forming. Itscomposition is pure annarth

act as the temperature of theliquid's. For this

composition, the systemconsists of 1% NR tytan, 99%

liquid.

Now you see, the first crystalhas formed. It is just

consisting of 1% NR tight, 99%of it is liquid here. Now let us

drop the temperature from X2 toX3. The temperature here is

about 1400 degrees Celsius.

At this temperature we have moreand more energetic crystals that

are forming right. From here wehave annotated crystals that are

forming all of these anorthitecrystals are 100% anorthite.

Now X3 lies in the filled liquidplus crystals in this field.

As more and more pure andNorthside crystals form the composition of the liquidbecomes richer and outside now

from X2 we have reached X3 thecomposition of the solid is

given straight across and it is100% anorthite, whereas the

composition of the liquid atthis temperature is given state

across onto the liquid'ssurface. Now here the point.

That corresponds to thistemperature on the liquid's

surface, gives us thecomposition of the liquid. Now

this composition of the liquidis about 63% anorthite and 37%

outside, so you see as we havemoved from X2 to X3, the

composition of the liquid keepschanging. Along this liquidus

curve. Now if we had to move alittle lower from X3 to say X4,

the composition of the liquidwould be given by a point

corresponding to the liquidus.

At that temperature, thetemperature of X4.

So as more and more pureanorthite crystals form the

composition of the liquidbecomes richer and outside.

Now to know the relative amountsof the phases at a given

temperature, we use somethingcalled as the liver principle.

How much? What is the proportionof the anorthite crystals that

have formed at this spot? Orwhat is the proportion of liquid

that is remaining after theanorthite crystals had formed?

This is understood or is deducedby the liver principle. Before we understand what a liverprinciple is, let us understand water tieline means.

Now a tie line is the line thatconnects the composition of the coexisting phases at aparticular temperature. For example, if you look at thisline now at this particular temperature at X3, thecoexisting phases are liquid and anorthite crystal. Thecomposition of liquid and crystals is given by thecomposition of the liquid is given by L3, whereas compositionof the Northside crystal is given by this point here.

Now, this line that connectsL3 to this point is known as the tie line. So the tie lineis the line which connects the composition of the twophases that are coexisting at a particular temperature,which is extreme.

Now according to the liverprinciple, the amount of a given phase is proportional to thelength of the segment of the tie line on the opposite side of thebulk composition. To understand this better, we said this is thetieline. So if I want to know how many anorthite crystals orwhat is the amount of anorthite crystals that have crystallizedas we lowered the temperature here, the amount of crystals anearth at crystals that have

crystallized is proportional.

Do that. Length of the segmentwhich is on the opposite side of

the bulk composition. Now thisline, this red line marks the

bulk composition that we startedwith. So this is 1 segment of

the tie line and this is theother segment of the tie line.

To understand the amount ofenergy that crystals that are

formed, it is proportional tothe length of this segment. The

segment on the opposite side,whereas the letter is the amount

of liquid that is present.

Is proportional to the length ofthe segment on the opposite

side, so the liquid compositionis here. It is proportional to

the length of the segment on the

opposite side. OK, so that isthe liver principle. Now let us

look at X. 4X4 has reached 1274

degrees Celsius. Now at thispoint, the liquid composition

has moved down the liquidus to asurface from L3 to the eutectic.

So at this point, what is thecomposition of the liquid of the

liquid? It is given by thiseutectic point. So from here as

we decrease the temperature, theliquid composition has moved

down along this liquid's and nowits composition is given by this eutectic point, which is 42%anorthite and 58% diopside.

Now you notice that the liquidcomposition has changed from

having 75% anorthite, 2 having

42% anorthite. And this resultsfrom the fact that as

temperatures dropped from 1:45one 1455 degrees Celsius to 1274

degrees Celsius and Northsidecontinuously starts forming and

as a result the liquid isdepricated in anorthite content.

So overall the bulk compositionhas remained the same. Only the

proportions and compositions ofthe phases involved have

changed. Now what happens atthis eutectic point, dive site

begins, Crystallising Spell SA.Northside crystals are forming,

so at this point the temperatureremains constant until the last

drop of the liquid hascrystallized and as the liquid

is crystalizing we have diopsidean annotated data simultaneously

forming. Now hear this point isan invariant point, hence the

degrees of freedom is 0.

If you slightly change thetemperature, you will move into

the oil crystals field, soeutectic point is an invariant

point where all three phasescoexist, and I've said and

anorthite simultaneouslycrystallize. Now when the

crystallization is complete, thefinal solid that is formed, the final rock that is formed, willhave the amount of anorthite and

offset crystals which are equalto the initial bulk composition.

Now, if we lower the temperaturefrom X4 to cure all of the

crystallization is complete anany lowering of temperature will

not change the phases and theproportions of minerals that are

formed will remain constant. Sofar all tomotley you have to

know that at the end ofcrystallization, the bulk

composition that we get in theend product, that is the rock is

the same as the bulk compositionthat we begin with X one.

Thank you.