Laboratory Practices in Earth Sciences: Landscape Mapping

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Lecture- 39

Hello everyone. So, today we will explore the Optically Stimulated Luminescence Laboratory. So, here in this lab, this is the OSL lab. So, step by step I will explain each section of this lab. So, in our last lecture we discussed the basic principles of the optical instrumental luminescence dating technique. So, today here we will see the laboratory procedure for the optical instrumental luminescence dating.

So, first of all we have for the dating purpose we have to collect the sample. So, we collect the sample in aluminum pipes. So, I will show you the pipe. So, here you can see this is the aluminum pipe and we collect the sample in such a type of aluminum pipe.

This pipe is sealed from one side and another side. There is this open side and we insert this open side into the ball from where we want to collect the samples. And then when we collected the sample we had to close this side with this cello tap and using the foil and cotton. So, the basic purpose of doing this exercise is to avoid the sunlight exposure for the sample. Because as we discussed in the last lecture that OSL technique is totally dependent on the light. So, as soon as your sample is exposed to the light.

So, all the stored luminescence or all the stored electrons will be gone and your luminescence will be escaped. So, you have to avoid that sunlight exposure. So, for that we have to close this sample from both sides. So, when we are in the lab. So, the first thing we have to do is open the sample in the dark lab.

So, here you can see this lab is a dark lab and it is here we are using the red light in the lab. So, that is why you can see the reddish tone on your screen. So, the basic purpose to using the red light is that the wavelength of the red light is large compared to the other visible spectrum. So, due to the high wavelength the energy of this red light is low and this low energy helps to keep your sample protected from the light source. Because this energy is the energy of red light is not sufficient to stimulate the luminescence from your sample.

That is why we are using red lights in the OSL lab. So, first coming to the lab you have to open your sample. So, to open your sample you have a few things you have to keep in

mind, the first thing is that maybe there is a certain light exposure while collecting the sample. So, that sample you have to discard from your sample which you are going to take for the laboratory procedure. So, first thing you have to discard the sample by 3 centimeters from both sides.

Why are we discarding the 3 centimeters? Because it is expected that maybe there is some portion of the sample in your pipe that has some sunlight exposure. So, the 3 up to sunlight can penetrate up to 3 centimeters. That is why we are discarding this 3-centimeter sample from both sides and you have to take the sample from the middle section of your pipe. So, that sample we will use for our laboratory processors. So, that discarded sample you can use in the dose rate estimation and moisture calculation. So, as we have discussed in our last lecture, your age calculation of the sediment is basically your dose accumulation, accumulated dose and divided by dose rate.

So, the accumulated dose is the amount of radiation which a sediment acquires due to natural radiation and the dose rate is the rate at which the sediment is getting radiation from the uranium, thorium and potassium or the natural radioactive sources. So, that is the basic idea behind the age calculation of the OSL sample. So, first when you open your sample you have to keep the central portion of your pipe and that sample you will use. So, there are a few steps after opening your sample. So, the first step is chemical processing.

So, you have to treat your sample with certain chemicals. So, that you can remove some of the carbonates and the organic content from the sample because your sample is associated with some carbonic content and the organic. So, that carbonic content to dissolve the carbonate content first you have to pour your sample with the HCl that is hydrochloric acid and then the second step is the is the hydrogen peroxide that hydrogen peroxide is basically removing the organic part from your sample. So, this if you are not removing the organic part. So, what will happen? So, when you are measuring the luminescence from the sample.

So, sometimes if there is any kind of organic content present in your sample. So, when because I will explain that in when we will discuss the reader part. So, when in the reader part you have to give a certain amount of temperature to discard some unstable traps. So, that temperature when you apply the temperature if there is at all an organic content is present in your sample. So, that is organic because the burning temperature of organic materials is very low.

So, when your temperature is there. So, it will burn your organic content and it will also give the luminescence. So, that will ultimately associate some kind of error in your H calculation. So, that is why we have to dissolve the organic part from the sample. So, we

will see that first we will use the hydrochloric acid and then organic to remove the organic part we will use the hydrogen peroxide.

So, this is the part of chemical processing in chemical processing to prepare the sample. So, as in our last lecture we also discussed that there are different kinds of dating materials we are using for the OSL. So, first is your quartz and feldspar. So, in quartz or feldspar there are fine grain dating techniques and the coarse grain dating technique and also there is poly mineralic dating technique. So, here today we will mainly focus on the coarse grain dating technique.

So, in the coarse grain dating technique we are basically using the coarse grain dating technique we are basically using the coarse grain quartz samples minerals. So, in coarse grain so basically 63 microns to 250 micron we are using and these 63 to 250 microns we are using the centralite central part of this size range of quartz mineral. So, basically, we are your readers so we are using 90 to 125 micrometers here in this lab because our instrument is calibrated with this grain size only. So, here we will today we will basically focus on the coarse grain coarse dating technique part. So, the chemical processing for all the minerals, the removal of carbonate organic parts, is the same for all fine grain coarse grain or poly mineral dating techniques.

Obviously, there are certain more steps we have to take into consideration for the poly mineralic and the fine grain dating part. So, that is the different chemical processes are there if time permits. We will also explain the fine grain and the poly mineralic part, but today we will only focus on the coarse grain quartz part. So, as I was discussing the chemical processing part. So, here you can see this is the fume wood. So, all the chemical parts we have to do the fume wood because we are using concentrated chemicals and all the chemical chemicals are dangerous.

So, we have to use these chemicals carefully. So, first you have to put on the exhaust fan and then here you can see I have prepared one dummy sample. So, after opening or taking the center part of your pipe you have to pour your sample in a beaker and here you can see this is the sample and this sample we will treat first with the HCL. So, the HCL we will use the diluted HCL with one normal because if we are using the concentrated HCL. So, because as soon as you pour the concentrated HCL with your sample it will react with the carbonate.

So, an exothermic reaction will occur and that exothermic reaction the energy is very high. So, sometimes there can be some accidents in your lab. So, to avoid the accident part you have to use the one normal HCL to dissolve the carbonate. So, here in this flask you can see this is the normalized HCL with one normal. So, this HCL we will pour the sample

with this HCL.

Here I have poured the sample with the HCL. So, here you can see because your sample is having the carbonate. So, as soon as the sample interacts with the HCL. So, you can see the effervation this effervation is suggesting basically the CO2 emission. So, your HCL is reacting with the carbonate calcium carbonate.

So, as soon as the HCL reacts with the carbonate. So, it is getting CO2. So, that CO2 is coming out from the sample in the form of effervation. So, for the normal samples you have to at least keep your sample for 6 to 7 hours. It depends on the carbonate concentration in your sample if your carbonate concentration is less. So, you you have to see the the the effervation part from the sample you have to stir your sample after pouring the HCL as soon as your sample is giving the effervations you have to keep it this sample for for the for the longer time.

And when the effervation is, you cannot see the effervation is coming out from the sample , that means that all the carbonate has been dissolved and then once your carbonate has been dissolved you have to wash out the sample with distal water. We will use the distal water because we do not want any kind of reaction because HCL is already there. So, we will wash out the sample with the distal water. So, that processor you have to apply for 3, 3 or 4 times you have to be sure that all your HCL has been gone from the sample then you will again apply another chemical processing part that would be your hydrogen peroxide. The hydrogen peroxide will dissolve the organic part from the sample.

So, here you can see that because the sample is having very low carbonate that is why you are not seeing the many effervations from the sample, but if your sample is having a huge amount of carbonate then you will see the very huge effervation will come out from the sample. So, once the HCL part is done. So, we will wash out the sample with the distal water. So, you pour the distal water here. I have washed the sample 2-3 times. So, once you have washed the sample with distal water.

So, then you will pour the sample with the hydrogen peroxide to remove the organic content. Here you can see the difference . Here you can see this is the hydrogen peroxide with 30 percent. So, this hydrogen peroxide you will pour your sample with hydrogen peroxide. So, this hydrogen peroxide will remove the organic part if there is any organic content available in your sample. So, that organic content will dissolve by this organic hydrogen peroxide.

So, I have poured the sample with the hydrogen peroxide and once you pour the sample with hydrogen peroxide you keep the sample for at least 12 hours. So, and then after this

hydrogen peroxide if there are any organic contents available in your sample that organic content will dissolve. So, this procedure you have to do for at least 12 hours. So, after you are done with this hydrogen peroxide part again you have to wash your sample. And, then when you wash your sample 2 or 3 times you will then dry your sample.

So, to dry you will use the oven with a constant temperature. So, here in our lab we have an oven with a constant temperature of around 45 degrees. So, at this temperature you have to dry your sample. So, it will take around 1 week to dry your sample. So, when your sample is dry then you will go for the further processor for the sample preparation.

Here this is the oven and this oven is set with 45-degree Celsius temperature. So, all your samples have to be dry at this temperature. So, here the sample which we have after the chemical treatment you have to put the sample in the oven. So, in this oven you have to dry your sample.

So, it will take around 1 week. So, after 1 week your sample will be prepared for further analysis. So, after when your sample is dry. So, we will go for the sieving part as I was discussing that for the coarse grain coarse dating part you are basically using the 63 to 250 microns. So, here in this lab we will use the 90 to 212 micron and for the dating part because our reader is calibrated with the 90 to 125 microns. So, we will use the 90 to 125-micron sand size for the dating part.

So, to get the 90 to 125 micron we will do the sieving. So, here we have a sieve. So, each sieve has a different sieve size. So, as you can see, this one is 90 micrometers. So, first we will use the 90 microns then this one is 125 microns, this one is 150 micron and this one is 180 micron and this is the last one that is the 212 microns.

So, this sieve size is basically 212 micrometers. So, similarly all sieve sizes have different sizes. So, we are using the 92 to 212-micron sieve size and at the last we are using this container. So, less than 90 micrometers will be collected here. So, we will pour the sample from here.

So, we will put our sample when our sample is dry. So, we will put our sample from the 212-micron sieve and we will assemble this sieve on the sieve shaker. So, here we have the sieve shaker. So, on the sieve shaker you have to fix this sieve and you have to do at least 15 to 20 minutes of running this sample on the sieve shaker. So, after this sieve shaker part you will get the different sand sizes according to your sieve size. So, we will choose the 92 to 125 sieve size that is this one this this one.

So, the sample which is collected on this sieve. So, that sample we will collect and that

we will do the density separation part. So, this was the part of sieving. So, after sieving , the ultimate aim is to collect the quartz from the sample. So, to collect the quartz because quartz is a kind of die magnetic mineral. So, here in our lab we are using the magnetic separator.

So, that magnetic separator is applying a kind of magnetic field after applying the voltage and current and that magnetic field is basically separating the magnetic and non-magnetic minerals. So, you can also use the heavy liquid separation part. So, that setup is not available in our lab. So, in heavy liquid separation we are basically using a poly tungsten liquid and that poly tungsten liquid is basically having a certain density. So, the mineral which is having the density more than the liquid. So, that will settle down at the bottom and the lighter mineral will float on the top.

So, because quartz is having a density of 2.6 gram per cc so quartz will settle at the bottom. So, you can get a better density to collect the pure quartz. You can first do the heavy liquid separation part and then you can go for the magnetic separator part. But in our lab, we have the magnetic separator part so we will directly go to the magnetic separator and we will see how we are separating the magnetic and non-magnetic minerals with the help of a magnetic separator. So, here you can see this is the magnetic separator and this is the main unit of magnetic separator. So, this magnetic separator is having the feed feeder and the shoot.

So, in this feeder you are pouring your sample and from the shoot the sample is separating after applying the magnetic field. So, here this is the magnet and a magnetic field has been applied by applying the current and voltage. So, the current and voltage is applied with the help of the controller. So, this is the controller and this is two knobs are given over here this is the current and this is the voltage part. So, you have to first set a set of current and voltage to apply the magnetic field because each mineral is behaving differently in the magnetic field.

So, to extract the quartz from your sample so we are basically keeping this voltage at 1.5 volt. So, at the 1.5 volt so this is the controller and with this controller you have to apply a certain amount of voltage and current to the instrument and that voltage and current will apply to the magnetic field. So, because different minerals are behaving differently in the magnetic field.

So, because our purpose is to extract the quartz from the sample. So, to extract the quartz we are basically applying a current of 1.5 ampere and the voltage would be 102 volts. So, at this voltage and current a set of magnetic fields will generate to the instrument and that magnetic field will be able to separate the quartz from your sample. So, here you can see

this is the controller to control the feed and shoot.

So, you have to be first on the feed and shoot. So, I have poured some samples here and with this knob you can increase or decrease the intensity of the feeder and shoot part. So, here you can see at this 1.5 ampere voltage a set of because this is the magnetic part of the instrument and this magnetic part will ultimately apply a magnetic field and as soon as your sample is coming out from this area and as soon as it reaches over there. So, here the sample will interact with the magnetic field and with this magnetic field the sample will the magnetic part will come out from this container and the non-magnetic part because at this 1.5 ampere the we can see the we can say that the quartz will come out from this come out on this container.

So, when your sample is getting alpha beta and gamma from the natural radiation. So, there is a certain depth penetration limit for each alpha beta and gamma. So, alpha can penetrate your sample up to 20 micrometers and beta can penetrate a few millimeters and gamma . The penetration depth is very high. So, it can penetrate up to 30 centimeters. So, here our lab is having the beta radiation source because we are using the grain size of 190 to 125 micron.

So, your gamma will be your gamma will enter into your sample and it will be gone. So, because we will measure the beta. So, we have to remove the alpha because alpha is already out of your sample and we have to remove the alpha from the sample. So, alpha is present in the outer 20-micron diameter in your sample.

So, that 20 micron we have to remove from the sample. So, that is because the quartz is a silica. So, we will do the HF treatment. So, HF will remove the outer skin of the sample. So, we will pour the sample with 40 percent concentration of HF hydrofluoric acid for 60 to 70 minutes. So, with this 60 to 70 minutes it will etch the outer part of your sample.

So, there are two purposes for doing the HF treatment; first is to remove the feldspar if there is any feldspar and the second is to alpha etching. So, after doing the HF because there would be some fluorescence present in your sample to remove the fluorescence you have to treat your sample with the HCl for 15 to 20 minutes to remove the fluorescence which will present after the HF treatment. So, once you have done the HF treatment.

So, you will get your quartz. So, after drying the quartz. So, after doing the HF treatment and HF and HCl treatment you will get the quartz. So, this is the quartz here you can see this is the pure quartz and this quartz for the purity you can keep this quartz on the microscope and you can see the grain of the quartz. So, the grain size of this quartz is 90 to 125 micrometers.

So, after when you are doing the HF treatment. So, in HF. So, because its outer skin will remove from the grains. So, the size will also decrease. So, you have to again do the sieving part. So, for this sieving part you have to use only the 90-micron sieve and the container.

So, with this 90-micron sieve. So, you will get the 90 to 125-micron quartz grain. So, this quartz grain we will run on the reader. So, once you get your desired grain size.

So, you will run that sample on the reader. So, in this is the reader room. So, here you can see this is the main unit of the OSL. So, this unit has been provided by the RISO and that the RISO is the providing company and that company is situated in Denmark. So, the model number is the DA 20. So, this is the main unit, this is the controller part and obviously, this is the PC for the output of the data.

So, here so in this reader part. So, this reader part is basically divided into 3-unit 3 segments. So, first is the radiation irradiation part, this is the for the irradiation. So, here because the OSL is a regenerative method. So, whatever radiation is accumulating in nature.

So, that radiation we are regenerating in the lab. So, for the regenerating of the radiation. So, we would need a radiation source. So, here you can see this is the pure beta source and this the beta source is the strontium 90. So, the daughter product is atrium 90 and this one is the luminescence stimulation part. So, this is basically associated with the LEDs and the filter which are basically used for the stimulation of the quartz sample quartz and phosphor sample.

So, I will come on this part and the third one is the you're this is your PMT that is the photomultiplier tube it is this one is the detector. So, ultimately all your photons or electrons have been detected by the PMT and you can see this data as a photon count on your screen and the heating plate. One heating plate has been given over here to give the temperature to your sample. So, this one is the controller. So, all the processors which have been assigned to the reader.

So, that has been controlled by this controller. So, this controller is basically responsible for the running or the management of the heating plate and the status of the sample. So, all the information you can see over this controller and this one is that this one is the main output system. This is your PC for the data interpretation and assigning the task to the system. So, here you can see this is the reader and this is one casserole has been given and this casserole there in some places has been given. So, in the OSL. So, today in the OSL technique there are basically two two methods. One is your single aliquot method and

another is the single grain method.

So, in this lab we are basically using the single aliquot method. So, what is aliquot? Aliquot is basically a sub portion of the sample. So, that sample we are placing on the stainless-steel disk.

So, the size of the disk is 9.7 mm. So, here you can see. So, these are all places where you can put your aliquot. So, we can prepare for the single aliquot part. So, we can prepare minimum 10 to maximum 100 aliquots. So, that aliquot is basically representing your sample.

So, we are measuring the equivalent dose for each and every individual aliquot. So, the sample which we have prepared, that sample we will put on the aliquot with the help of some adhesive and that aliquot we will put over here is called the casserole and that casserole has been put over here. So, on this reader and here here you can see this is one segment has been given and here one plate has been one unit has been provided over here and this plate or this unit is afflicting your aliquot or disk and each and every disk has been treated based on your protocol. I will come on the protocol part. So, whatever the protocol has been is for the measurement of the OSL for the medium size sand or quartz grain.

So, that protocol you will assign through your sequence editor. So, that is the software part. So, you one once you prepare your aliquot you put over the aliquot over here and you put your casserole on the on the reader part and you close your reader and then each and every aliquot will be treated according to the protocol which you will you has been assigned to the system. So, we will show you how we can prepare the aliquot. So, you have to first keep out the casserole. So, this is the setup for the aliquot preparation. Here you can see this is the stainless-steel disk and the diameter of this disk is 9.

7 mm. So, we will pour our sample and put our sample on this disk. So, to stick the sample on the disk we will use some adhesive. So, here we have the silica gel. So, we will put some silica gel on the disk. So, here you can see we have put the silica gel on the disk. This silica gel is basically what we are using as a kind of adhesive to stick the sample on the disk.

So, we have the sample. So, this is the sample greater than 90 micrometers and less than 125 micrometers. So, we will put our sample on the disk. So, first you have to use this spacer and with the help of this spacer is basically useful to prepare the medium size quartz aliquot. So, we will put this aliquot on the disk on the pacer and here you can see this is one space that has been given. So, this space is basically variable.

So, based on the disk size if you want to do the course coarse grain coarse grating technique. So, the space size would be quite large and this is the size for the medium quartz size. So, with the help of this you have to put your sample on the pacer. So, here you pour your sample from this hole and here you will see. So, here you can see this is where we have mounted the sample on the disk.

So, combinedly this is called the aliquot. So, a portion of the sample we have mounted on the stainless-steel disk. So, this disk we will put on the casserole. So, here in the casserole you can see some numbers are given. So, at a time you can put 1 to 1 to 48 48 aliquots.

So, here you can prepare 48 aliquots and at a single time you can run 48 aliquots on the system. So, we will put this sample on the position number first. So, here you can see I have put this aliquot in the first position. So, you keep remembering this first position because when we will use the sequence editor on the PC and we will assign the system that all the because we will we are going to run this sample on the reader. So, we will perform all the protocol on the position number first only because all the other parts are empty.

So, we will not use that part, but when you are doing that you are measuring the age for your sample. So, you can at least try to prepare at least more than 10 aliquots. So, that would be sufficient for the age estimation or equivalent dose estimation because the equivalent dose is basically the average of all the aliquots. So, what does your instrument do? So, it basically calculates the equivalent dose for all the individual aliquot and the the sum of this all aliquot you are using for the average of all these aliquots you are using for age estimation of your sample. So, equivalent dose is basically the laboratory dose and it is equivalent to the dose which a sample is accumulating in nature.

So, that is why I am frequently using the term the equivalent dose. So, now we will put this casserole on the reader and we will see how we can use the protocol to get the equivalent dose. So, we will put this casserole on the instrument. So, this is the sequence editor. So, you can see this sequence editor you are basically using to assign the different protocol to the system.

So, because we are using only position number 1, we will assign the position here. So, we will write 1 and you can copy this and you assign 1 to now. So, this entire sequence which you are seeing on your screen. So, this is called the SAR protocol. This SAR protocol was designed by Wintel and Muray in 2000 and was updated in 2005 and 6 again.

So, this is the SAR protocol. So, the SAR protocol is basically a processor to estimate the natural radiation and regenerate that radiation in the laboratory. So, here you can see in the run number 1 here you can see first it is the preheat then OSL 125 degree for 40 second

and then a beta dose for 50 second then TEL then OSL and then illumination blue LED. So, this is the protocol and this is the procedure which we are applying to our sample. So, first we will apply that this portion is empty because in this run number 1 we are estimating the natural radiation, the radiation which has been accumulated in the sample naturally.

So, the first step is to preheat. So, preheat is basically in the last lecture as we have discussed whatever unstable traps are available in your sample. So, that trap we have to remove. So, for that we have to assign a certain temperature. So, this temperature is only removing the unstable traps from your sample because there are two methods to stimulate the luminescence from your sample: first is your temperature and another is the light.

So, here we are stimulating the sample with the help of light. So, for the cores or dating technique part we are using the blue light. So, here you can see on the second row you can see this is the blue LED which we are using for 40 seconds. So, on the sample we will put the blue LED for 40 seconds and then as soon as your sample interacts with the blue LED it will start giving the luminescence.

So, all the traps will be empty. So, then we will apply a test dose. So, this beta is for 50 seconds. So, this is the test dose which we are going to apply in the sample. So, this test dose is basically as you can see in each run we are using a constant test dose. So, the purpose of doing this is to check the sensitivity correction because if there is a we are repeatedly applying the temperature and then beta dose to the sample.

So, sometimes the orientation of the crystal structure has been changed. So, there due to this change in orientation. So, the crystal is behaving differently. So, sometimes it is giving the luminescence it is giving, sometimes it is giving less or sometimes it is more. So, to check the sensitivity.

So, we are assigning a constant test dose for each run. So, we will calculate the L Lx by the Tx. So, that is the luminescence in the natural sample and the test dose in the sample. So, we will divide for each run and we will see what the changes are happening in the sample. So, that processor is called the sensitivity part sensitivity correction. So, thus from the run 2 this is all the laboratory processor which is assigned to resundate the dose which we are getting in the natural sample or the in in the natural.

So, here we are giving the 50 second the beta dose for 50 second beta dose for 100 then 250 and then 0. So, this 0 is basically we are giving, we are giving nothing and we are expecting nothing. So, that is basically what we are doing to check the recuperation. So, recuperation means that whether or not the preheat which we are assigning 240 degree Celsius is the preheat it also means removing any sample from the stable traps or not.

So, we will check by applying the 0 dose in the sample. So, if we are giving nothing. So, we are expecting nothing if at all we are getting some signal on this run. So, that means that the signals are coming out from the temperature not from the light source and then again and the last run we are giving the similar dose which we have applied in the first or second run. So, this similar dose we are using to check the recycling test. Recycling means on the two runs we are giving the same dose, that means the photon count should be the same on both runs.

So, that is basically to check the recycling means the repeatability of the sample. So, we will run this sample because we have put one sample. So, this entire processor is called the single aliquot regenerative SAR protocol and this SAR protocol is basically applying in for the quartz dating or a poly mannolic dating and the feldspar dating. So, this is the latest protocol which is available for the OSL dating technique part.

So, here we have prepared one sequence for this sample. So, as we have put one aliquot on the position number first. So, we will first preheat the sample when we will stimulate it with the blue LED and then we will give the beta dose for 30 seconds because the samples are having a dose of 4 gray. So, in the second it would be around 40 30 or 40 seconds then we will again preheat and then stimulate. So, we will run this sequence.

So, here in the preheat part because we are using the 240-degree Celsius temperature. So, for that we have to use nitrogen. So, in the instrument I discussed, we have the heating plate. So, we have to flow the nitrogen to minimize the temperature or to avoid the damage of the heating plate. So, for that we are using nitrogen.

So, the flow rate is 30. So, we will keep on this nitrogen for the temperature above 180 degree Celsius. So, as when you are applying the temperature above 180 degree Celsius. So, that time you have to use the nitrogen in your system. So, we will run this sample. So, to run you have to save the winix win 5. So, it will take 9 minutes. Here you can see all the parameters you have to see the dark count, the calibration LEDs and the beta irradiation is on.

So, it will start automatically in 6 seconds or you can start by pressing on the start. So, when your system is on so you can see this one first it will preheat the sample. So, all the information you can you can see over the controller part. So, all the information you can see over the controller part here you can see the system is down and the nitrogen flow is on and here you can see it is paused for 5 seconds and then it will lift the rising lift. So, that means your aliquot has been lifted by the knob which is provided over here and here you can see that it will heat the sample up to 240 degree Celsius the temperature is rising at a

rate of 5 degree Celsius per second. So, it will go up to 240 degree Celsius and when it will go to 240 degree Celsius it will heat the sample and then nitrogen will flow and it will minimize the temperature and then it will be shifted to the next run.

So, it will go to the OSL part then in the next step it will stimulate the sample with the blue LED. So, here you can see the first part has been completed. It preheated the sample to 240 degree Celsius. Now it will stimulate the sample with blue LED as soon as your sample is getting exposed with the blue LED. So, you will see the grab will plot over here. So, that grab you will see here you can see now your sample is stimulating with the blue LED. So, as soon as the sample is exposed for the blue light.

So, in the OSL part so it in one or two seconds it or all your stored electrons are empty. So, you would see a curve like this and in the case of the feldspar you will see a gentle decay curve. So, this is the decay curve related to all this decay curve and the growth curve we have discussed in the earth theory part. So, you can follow that lab and follow that class. So, you can see in this sample this is the count photon count and this is the time.

So, for the age estimation we are basically considering the photon count for the initial 0.8 second and this is what you can see in the background part. So, that background we have to subtract from the sample.

So, you have to take the integration of the initial 0.1 0.8 second data of the photons and you have to subtract the last 4 seconds. So, you can see this is the 40 second data which we can see on our screen. So, you have to take the 0.8 second or 1 second data for the age for the equivalent dose calculation subtracting from the 4 second data from the last of your data. So, this is the natural radiation which has been accumulated in your sample.

So, in the second run you can see that now your sample is empty. So, in the third run the regenerative part is started from the run number third. So, in the run number third. So, the beta source has provided 30 second beta radiation to the instrument at a rate of 0.105 gray per second that is the rate of the beta source for this instrument and then we will again do the preheating part and then once preheat is done.

So, then in the next step, run number five, we will measure the regenerative dose in the laboratory. So, here we are basically trying to regenerate the radiation which has been accumulated in nature. So, we are trying to regenerate that radiation in the lab. So, the basic concept of the OSL or the regenerative part is that the amount of radiation which has been accumulating in nature in kilo year time. So, that radiation we can generate in the laboratory in a few seconds because we have a strong radiation source.

So, the rate of this radiation source is kept quite high compared to natural radiation. Now, the preheat part has been done. So, you can see now that it is shifted on the run five the OSL blue light stimulation. So, you will see the curve as soon as the blue LED is exposed to expose the sample.

So, you will see another curve. So, that curve would be the regenerative curve. So, that curve we are regenerating in the lab. The first curve which you are seeing over here is the natural curve, the radiation which has been accumulated in nature and on the second curve we have provided the 30 second beta radiation that would be around 4 gray 4 to 5 gray. So, that we have assigned and then we will stimulate that radiation in the laboratory by applying the blue LED. Then we will compare whether the curve of this one is similar to this one or not.

So, here you can see this curve is what you are seeing on the screen. So, this is the regenerative curve. So, this curve has been built after you apply a 30 second beta dose to the sample and then you are exposing the sample with the blue LED. So, you are getting this curve. So, the photon is around 250 and here also you can see it is more than 150.

So, it is quite similar to what we can see over here. So, your analysis part has been done. So, that file you can see over where you have saved your file in your directory. So, this is the binax file which has been generated after you applied the sample. So, here you can see this is the curve and this curve the equivalent dose this is the photon OSL counts per 0.

16 seconds and this is the time. So, this is the graph of counts by versus time. So, this is for the natural part and on the second run second. So, this one is for the laboratory part. So, we have regenerated the radiation which has been accumulated in nature. So, this is the photon count. So, this photon counts from the photon count you can estimate the equivalent dose. So, to estimate the equivalent dose you can here you can see two sections have been given one is single aliquot regenerative and another is single grain regenerative.

So, because this one is the single grain regenerative what we are doing, single aliquot regenerative. So, you can use this option to estimate the equivalent dose from your sample. So, as I already told you that to estimate the equivalent dose you would at least require the 10 aliquots to run on the reader. So, here we have applied only one aliquot. So, from this one aliquot you can estimate the equivalent dose by comparing your natural and regenerative part.

So, in the because here on the sequence editor part you would see that we have applied 30 seconds. So, if we are applying the 30 second and we are getting 250 photon counts. So, what would be the dose for this section if we are getting 170 photon count. So, that is the

simple elementary method.

So, you can do the simple calculation and you can estimate the equivalent dose. So, the equivalent dose would be around 4 grays for this sample. So, that you can estimate from comparing the laboratory dose or laboratory photon count by natural photon count. So, here what I am trying to say is that if you are giving 30 seconds and you are getting 220 photon count. So, what would be the dose if you are getting 170 photon count for this.

So, you have to compare both this data and you would get the dose in nature. So, this was the part of estimating the equivalent dose. So, for the age calculation you have to also estimate the dose rate. So, the dose rate you can estimate from measuring the concentration of uranium, thorium and potassium in your sample. So, there are many ways to estimate the concentration of uranium, thorium, potassium in your sample. So, here in this lab we are using the gamma spectroscopy. So, that gamma spectroscopy basically gives you the concentration of the uranium, thorium and potassium. You can also go for the ICP MS and you can also use the sodium iodide detector.

So, this kind of instrument you can use to estimate the concentration of the uranium, thorium and potassium and once you are having the concentration of uranium, thorium, potassium and you are having the equivalent dose. So, you can estimate the age of the sample. So, the age of the sample would be your equivalent dose divided by dose rate.

So, by calculating the equivalent dose and dose rate you would be able to estimate the age of the sample. So, we will stop here and I hope you enjoy the course. So, this was the last lecture or last lab from our side course and thank you so much.