Soil Science and Technology
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Lecture – 05
Weathering and Soil Formation (Contd.)

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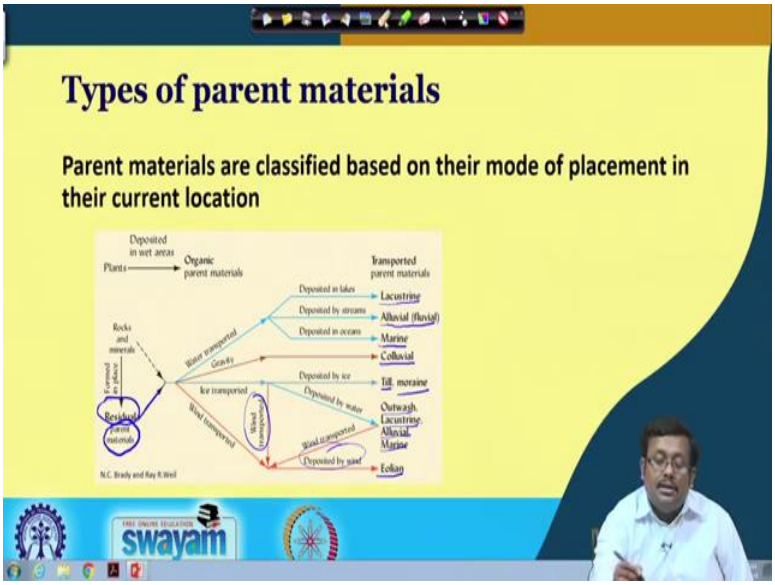

Hi, friends. Welcome to this lecture of Soil Science and Technology. Today, we will be discussing about different types of parent materials and also we will be discussing about what is soil profile and what are the important soil master horizons.

So, in the last class we stopped here while discussing the influence of parent material for soil formation. And I told you that the parent material is very important for determining the soil physical and chemical characteristics, not only that but also the nature of parent materials shows; nature of parent material governs the rate of soil formation.

Now, types of parent materials while we are talking about the types of parent materials remember that parent materials are classified based on their mode of placement in their current location. So, as you know that all soil forms from rocks and rocks breaks down into the parent materials. So, sometime parent materials develop into the soil at the place of their origin and sometimes these parent materials translocate from one area to another

area with the help of different types of forces physical forces and transporting agents and deposit in other places and therefore form soil in those places.

So, parent material can develop soil either at the place of origin or in some new places. So, depending on their location of origin or placement in their current location they are named in different ways. For example, in this slide you can see that when the rocks and minerals undergo weathering. So, they first forms parent materials and when these parent materials develops soil at the place of origin they are called residual.

Now, when this parent materials transported through different transporting agents to other places depending on the transporting agents we name them differently. For example, when the parent materials are transported through water and deposits in the lake we call it lacustrine. When the transporting agent is streams or river, we call it alluvial or fluvial. When the transporting agent is ocean, we call it marine and when the transportation occurs due to the gravitational action, we call it colluvial parent material. And when the transportation occurs due to the ice or glacier we call it, till or moraine and when this ice melts and further this parent materials deposited by water they will call outwash, lacustrine, alluvial and marine depending on various transporting agents, and when that parent material is transported through air or wind and or deposited by wind we call it either eolian .

So, as you can see based on different types of transporting agents we are naming the parent materials differently. And they are basically named based on the dominant transporting agent.

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So, as you can see here three important examples of parent materials. First of all you are seeing colluvial parent material which occurs. Now here the parent materials are transported due to the action of gravity. Second is flood plains and third one is alluvial plain both of them are formed due to the transporting action of rivers or streams. So, based on the transporting agents as you can see the soil characteristics or parent material also differs from one soil to another soil.

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Here, some example of glacial till and glacial till occur due to the due to the action of glacier and this loess which formed due to the wind action. So, based on the transporting agents as you can see we are naming them differently.

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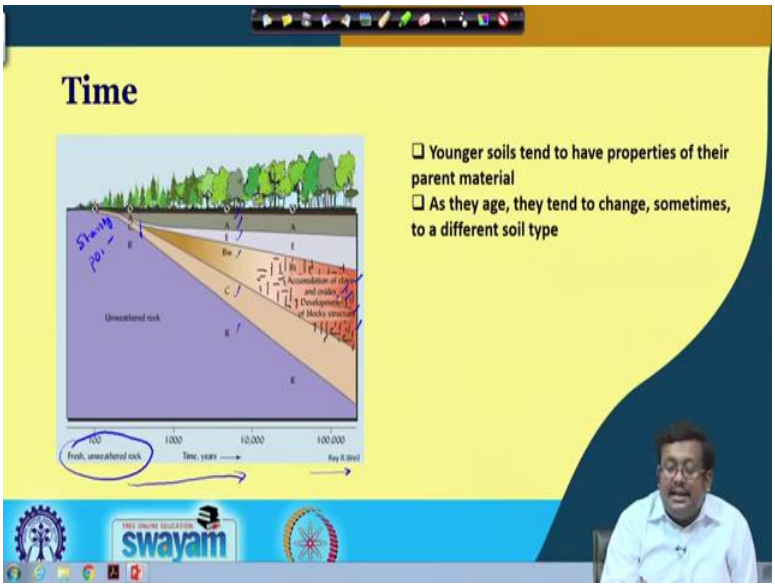

Final important aspect of factor for soil formation is time. So, you know that younger soils tend to have properties of their parent material and as they age they tend to change sometime to a different soil type. This diagram shows this in a very nice manner. Now, as you can see this is this is a starting point of soil formation. So, obviously, there will be fresh unweathered rock and as the time goes on to 100 to 1000 to 10000 to I mean 100000 and so on so forth. You can see the development of different horizons or layers within the soil like O horizon or the organic horizon, A horizon or mineral horizon, C horizon or unconsolidated horizon and R which is basically the unweathered rock.

And, as the soil formation process further as you can see the development of more horizons in the soil, and further as the soil develops you will see accumulation of clays and oxides development of different types of soil structure and so on so forth. So, these justifies that the younger soils tend to have properties which are which resemble to their parent material and as they age they tend to change and sometime to a different soil type.

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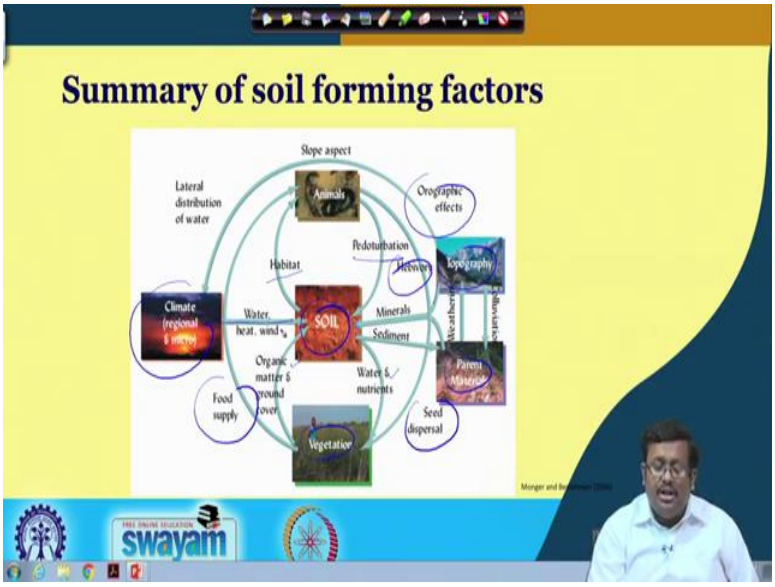

So, let us see the summary of soil forming factors. As you can see this slide shows how this five soil forming factors are intimately interconnected to each other for the formation of soil. For example: here you are seeing that the vegetation is intimately related to the soil because they supply organic matter and ground cover for the soil formation. In turn soil gives them water and nutrients. So, vegetation is an important factor as you know and these parent material gives minerals to the soil as the result of different types of physical chemical weathering and soil also deposited into sediments to form further parent materials.

Topography governs different types of soil formation, animal also effects soil formation due to the pedoturbation process. We have discussed the pedoturbation process in the last lecture and in turn soil gives the animals habitats. Climate that is regional both regional micro climate provides the water heat and wind required for soil formation or soil chemical weathering. Vegetation is also linked with the animals because vegetation supply food for the animals and animals also help in seed dispersal or herbivore. So, this is another interconnection.

So you can see the all the factors the topography and parent materials are also intimately you know related to each other because of weathering and colluviation. And you can see also the topographic factors or the mountain effects or slope effects we call them orographic effects are responsible for different types of climates which are also you

know which also influences the soil formation. So, you can see there is an intimate relations or inter connections of this five soil formation factors for soil formation.

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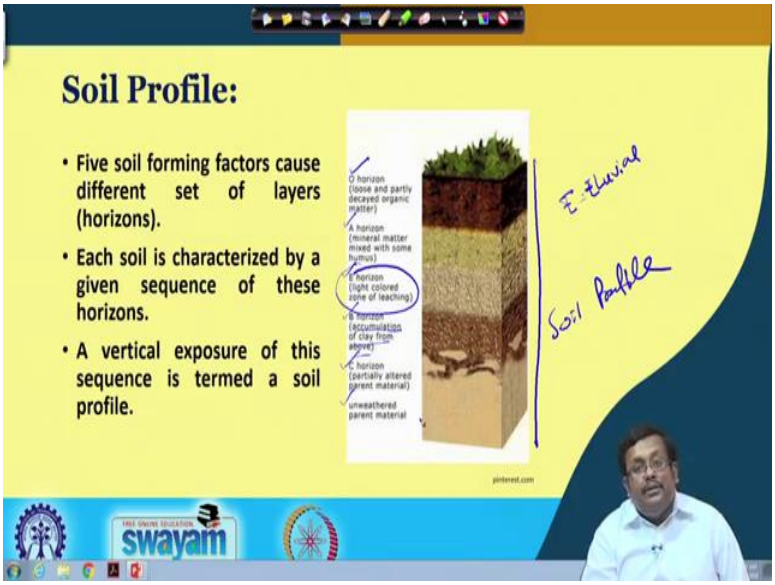

So let us see what is soil profile? Now, soil is a 3-dimensional body. So, five soil forming factors cause different state of layers if you go and cut down a soil vertically you will see different soil layers you can visually differentiate them. So, the how they occur basically? They occur because of actions from different five soil forming factors. So, each soil is characterized by a given sequence of this horizon and obviously, vertical section of this sequence is termed as soil profile. So, as you can see here the total as you can see here this total vertical section of a soil is called soil profile. An in a particular soil profile you will see some specific soil horizons or layers.

For examples; O horizons, A horizon, E horizon, B horizon, C horizon and at the bottom unweathered parent material. So, O horizons basically shows loose and partly decayed organic matters. So, remember that O horizon always occur at the top and it is dark in color and it basically composed of decaying organic matter fresh and decaying organic matter. Just beneath the O horizon you will see A horizon which is basically a mineral matter mixed with some humus or in other words mineral matters mixed with some organic matter. So, it is darker in nature.

See in some soil just below the A horizon you will see a light color horizon; we call it E horizon or eluvial horizon. So, E stands for eluvial. Eluvial horizon occurs due to the process of eluviations. Eluviation is basically movement of clay minerals or other compounds from upper layers to the bottom layers of the soil. So, this is the process of eluviation and as a result of movement of clay from upper layers to the deeper layers these resulting horizon is called light colored zone of leaching and we call it E horizon.

Just below the E horizon you will see a relatively darker horizon we call it B horizon which basically shows accumulation of clay from above. So, the all the eluviated clay from the above horizon they will deposit in the low horizon they will form B horizon. Just below the B horizon you will see C horizon which is basically composed or partially altered parent materials or small parent materials small fractions of parent materials and finally, at the bottom you will see unweathered parent material.

So, these basically shows the different soil horizons which are present within a soil profile.

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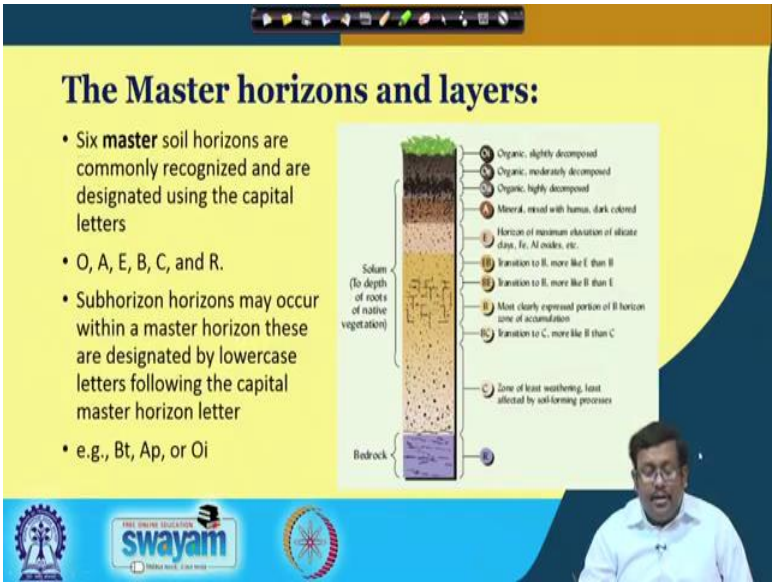

So, let us see what are the master horizon. Obviously, there are six master horizons and this six master horizons are commonly recognized and designated using the capital letters like O horizon, A horizon, E, B, C and R, R is basically the parent bedrock. So, this six are the basically the master horizon. Subhorizons may occur within a master

horizon and these are designated by lower letters following the capital master horizon letter; for example, Bt, Ap or Oi we will discuss them later on. As you can see in the picture also if you know all this sub horizons are given for example, Oi which basically stands for slightly decomposed organic horizon, Oe stands for moderately decomposed organic horizon and Oa stands for highly decomposed organic horizon.

So, like that all the master horizon can be sub divided into sub horizons. And this sub horizons are basically indicated by lower case letters following the capital master horizon letter.

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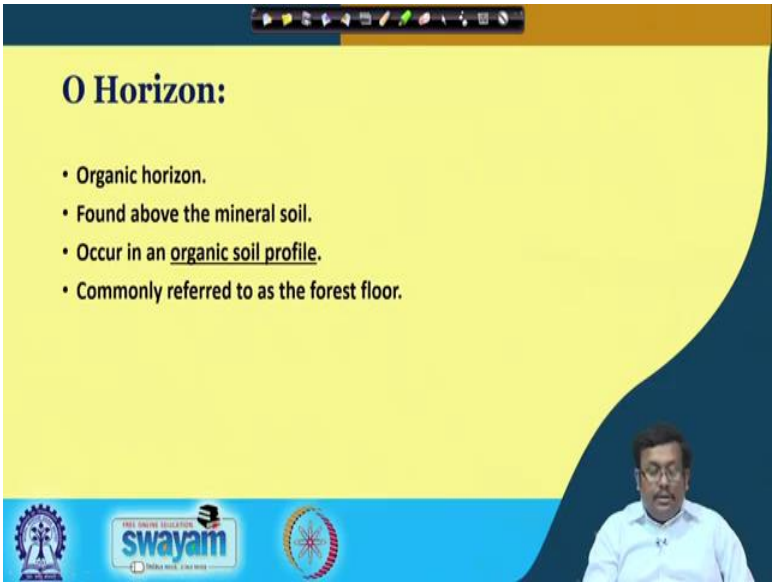

So, let us discuss them one by one. So, O horizon is basically the organic horizon which is found above the mineral soil and it basically occurs in organic soil profile and commonly referred as the forest floor. So, the thickness of the O horizon basically differs from one soil to another soil. Obviously, in case of forest soil the thickness of the O horizon will be more as compared to the soil which develops in the desert region and this O horizon is darker in color and it occurs just above the A horizon.

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So, often this O horizon has three subdivisions Oi is fibric. So, it basically in the fibric horizon or fibric material means you can see recognizable plant and animal parts. The second important is Oe horizon we call it hemic materials which is basically composed of finely fragmented residues intermediately decomposed and finally, Oa horizon or sapric materials which consists of highly decomposed smooth amorphous residues.

So, based on the phase of decomposition or I would say the stages of decomposition we can differentiate o master horizon into three sub horizons that is fibric, hemic and sapric.

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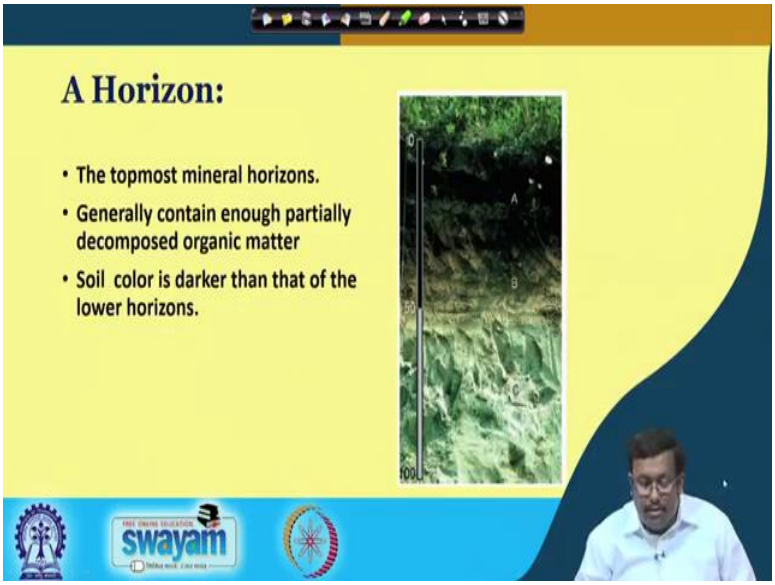

Now, let us see what is A horizon? A horizon is basically the top most mineral horizon. In a horizon you will see there it generally contains enough partially decomposed organic material. So, it is darker in color and soil color I mean it is darker in color then the lower horizons and it is one of the most important master horizon.

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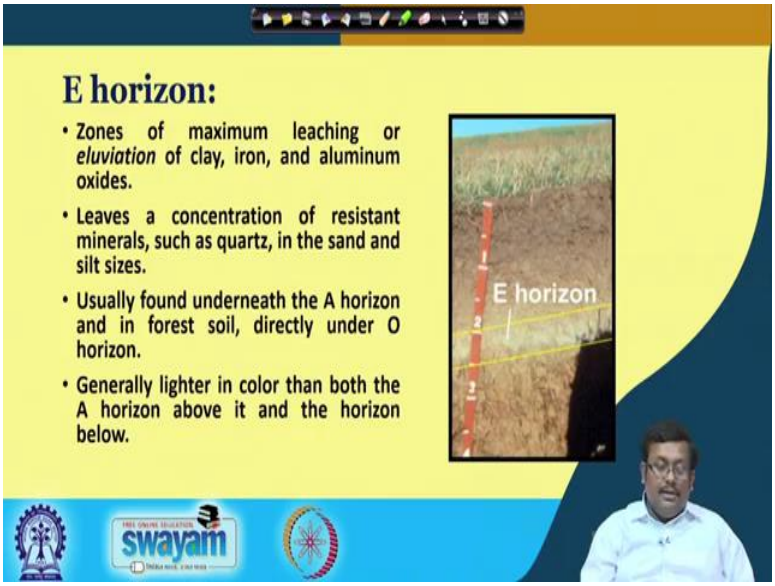

E horizon: so zones of maximum leaching or eluviation of clay iron aluminum oxides. Remember that, again this E horizon occurs due to the process of eluviation of clay iron aluminum and it leaves as a result of a this eluviation of clay iron aluminum it leaves a concentration of resistance minerals such as quartz and sands and silt. And, it usually found underneath the A horizon and is the forest soil directly under the O horizon.

And, it is generally lighter in color than both the A horizon above it and the horizon below because all the clay which are darker in color have been already moved downwards. So, that is why it is also called bleach horizon. So, as you can see in this soil there is a clear bleached E horizon which is lighter in color and this is called E horizon or eluvial horizon.

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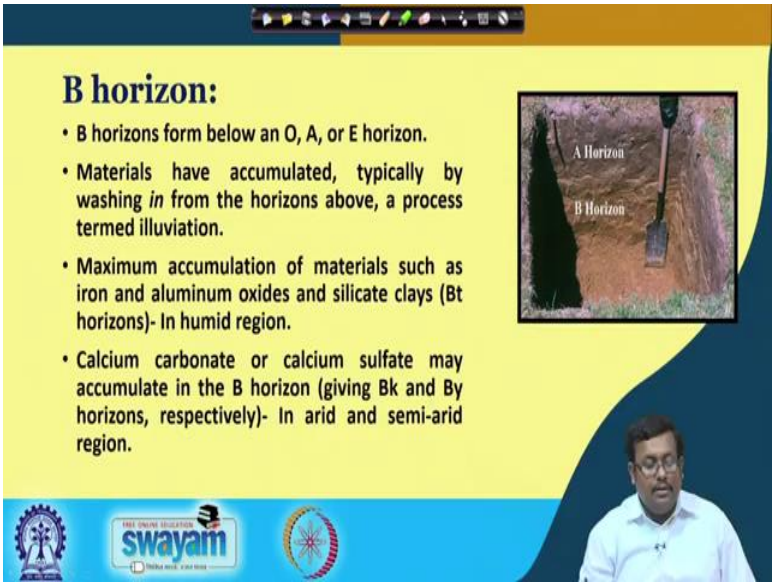

So, the next important master horizon is B horizon and B horizon form below an O, A or E horizons. So, materials have been accumulated in the B horizons materials have been accumulated typically by washing in the form of horizons above a process termed as a illuviation.

Now, you all know about eluviations. Eluviation is movement of clay iron and aluminum from upper horizon to the lower horizon. So, when the eluviated materials deposited at the lower horizon or in the B horizon these process is called illuviation. So, remember that the B horizon occurs mainly due to the process of illuviation. So, in the B horizon you will see maximum accumulation of materials such as iron aluminum oxides and silicate clays and as a result of illuviation of silicate clays there will be a sub horizon. Specific sub horizon we call it Bt horizon, you will find it in the humid region. And, remember that calcium carbonate or calcium sulphate may accumulate in the B horizon giving rise to Bk and By horizon respectively in arid and semi arid region these are again this Bk and By are again subhorizons.

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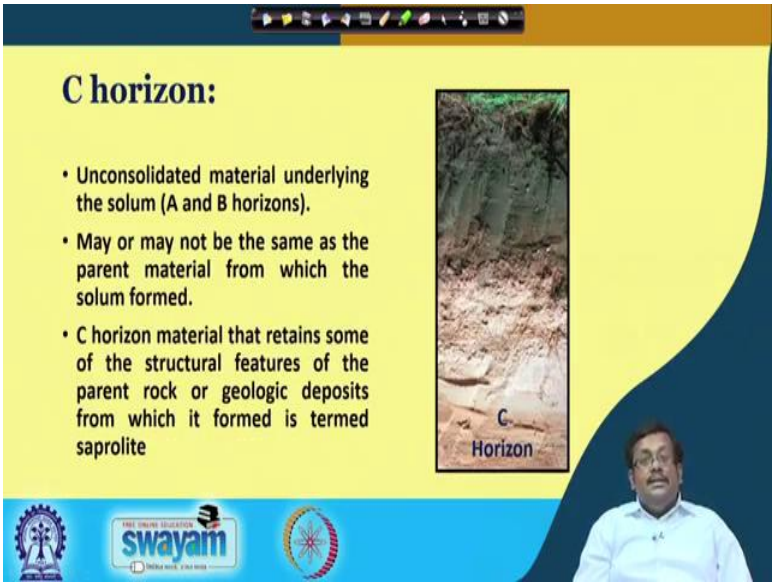

C horizon: C horizon is basically the unconsolidated material underlying the solum. Now, what is solum? We generally consider A horizon plus B horizon combinedly as solum or in other words solum is the basically combination of A horizon and B horizon. So, C horizon is unconsolidated material which generally occurs at the bottom of the solum and this C horizon may or may not be same as the parent material from which they the solum formed. And finally, C horizon material that retains some of the structural features of the parent rocks or geologic deposits from which it forms is termed as saprolite.

So, as you can see in the picture there is a clear demarcation of C horizon which is basically the unconsolidated parent materials.

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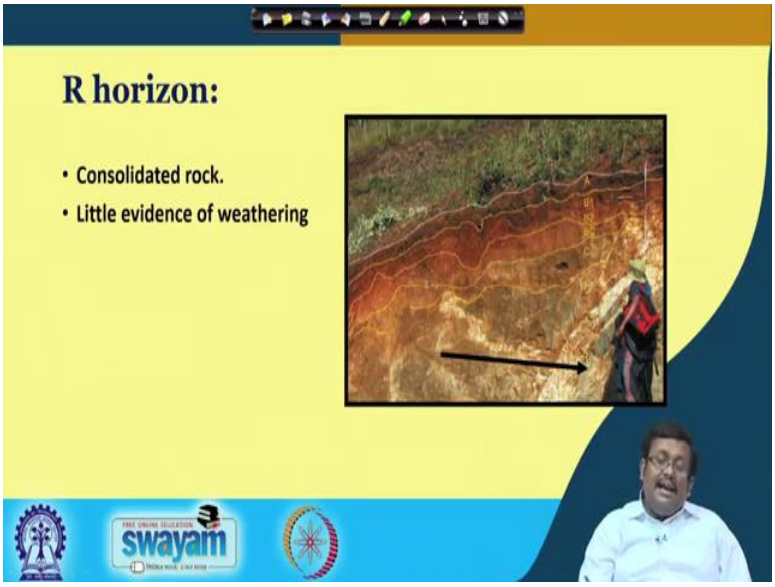

So, we have covered both O, A, E, B and C horizon. And let us see the final one that is R horizon which is basically the consolidated rock from which the soil forms. And you will see very little evidence of weathering in this unconsolidated rock and generally we termed this horizon at R horizon as you can see in this picture.

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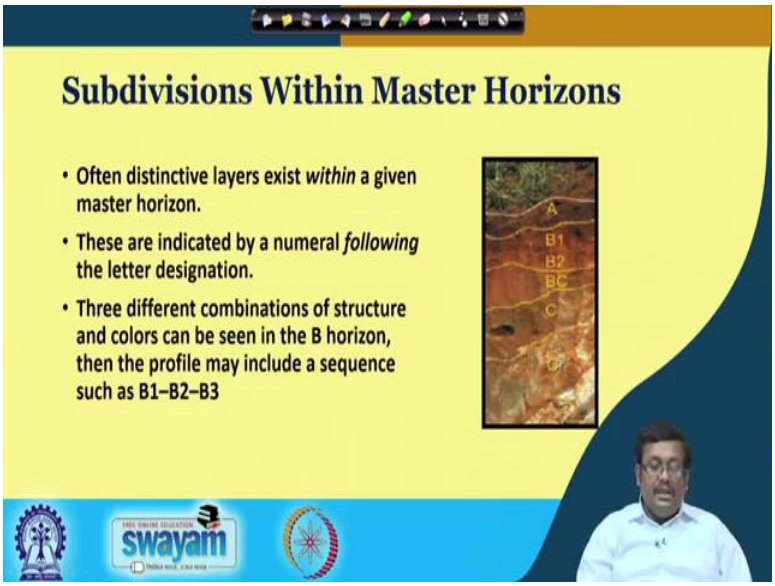

So, what is the sub division within the master horizons? Obviously, the often distinctive layers exists within a given master horizons and these are indicated by a numeric no numeral following by the letter designation. For example, we know three different

combination of structure and color can be seen in the B horizon then the profile may include a sequence of B 1, B 2 and B 3. So, you are seeing we are including numerical digits just after the letter designation of the master horizon to show this sub division or sub no or sub horizons.

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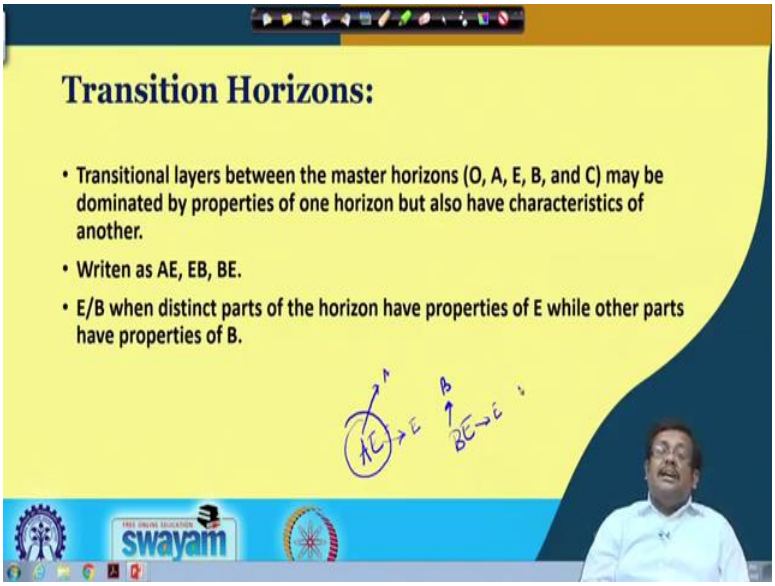

And, there is another important horizon we call transition horizons. So, transition horizons or transition layers occurs between the master horizons and may be dominated by properties of one horizon, but also have characteristics of another. As we write I mean you know we generally denote them as AE, EB and BE and so on so forth. So, E slash B when distinct parts of the horizons have properties of E while other parts have properties of B.

Now, when we call AE horizon for example, that basically denotes that this soil or these horizon has characteristics mostly similar to A horizon and some properties are similar to E horizon. Similarly, while we are talking about BE horizons; that means, this horizon are this horizon is having is showing the properties mostly of B horizon and some properties from E horizon. So, this is the physical interpretation of these transition horizons.

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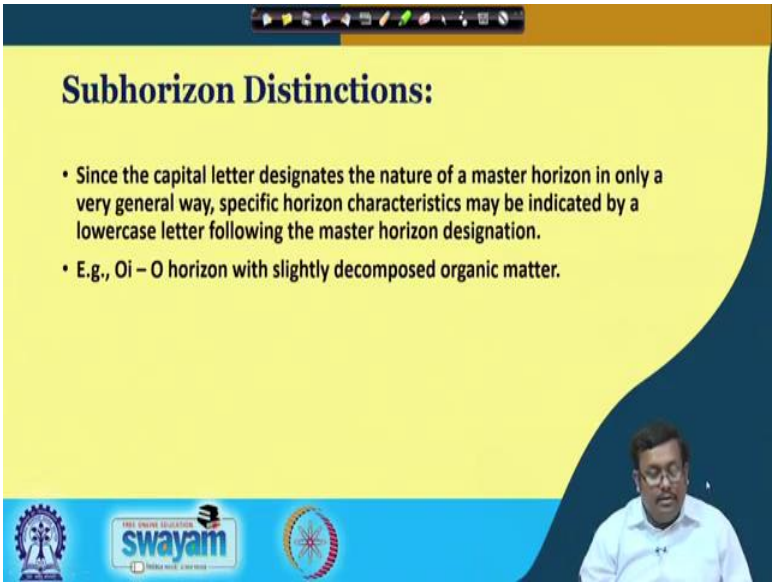

So, since the capital letter designates the nature of master horizons in only a very general way specific horizon characteristics may be indicated by a lower case letter following the master horizon designation. For example, Oi that is O horizon with slightly decomposed organic matter, we have already seen this.

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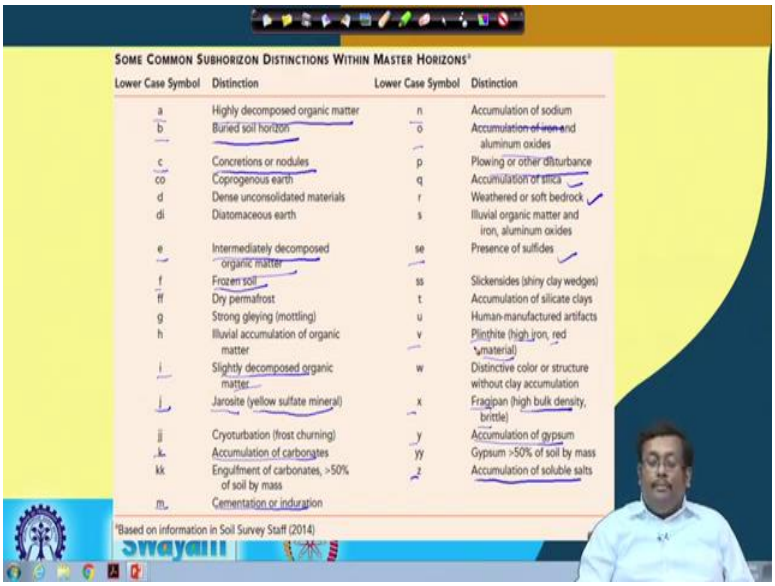

So, in this slide or in this table you will see some common sub horizon distinction within the master horizons. For example, if you use lower case symbol a sorry, if we use lower case symbol a that will you know that will denote highly decomposed organic matter. If

we use lower case symbol b that will denote buried soil horizons, if we use c that will see that will denote concretion of nodules, if you use e; that means, intermediately decomposed organic matter, if you use f that will show frozen soil, if you use i that is slightly decomposed organic matter. If you use j that is showing basically jarosite or yellow sulfate mineral present into the soil, if we use k that will see that will denote the accumulation of the carbonates. If you will use m that will indicate the cementation or induration inside the soil, z basically denotes the accumulation of soluble salts, y denotes accumulation of gypsum, x denotes fragipan which is the layer with high bulk density and brittleness, v shows plinthite which is high iron red color material.

So, as you can see also n shows accumulation of sodium, o denotes accumulation of iron aluminum oxide, p denotes plowing or other disturbances. Similarly q denotes accumulation of silica, r denotes weather weathered or soft bed rock, s shows illuvial organic matter and iron aluminum oxide and sc shows presence of sulfides.

So, as you can see all these symbols when you use along with the along with the letter symbol of master horizon they show different or I mean specific soil property. And, for describing any soil a soil scientist or a scientist has you know need to have one needs to have complete understanding of all these important process which are responsible for soil formation. And by visually seeing any soil profile you can understand; what are the important soil processes which occurred for the formation of that particular soil.

Remember one thing that all soil will not show the similar sequence of soil horizons, one soil will show some horizons and another soil will show another set of horizons, some horizons may not be present in all the soils specifically E horizon which is only present in specific soils. And, most of the time these horizons differentiation are done in the field by the experienced soil scientists by using some qualitative diagnostic features, their color, their structure, their texture as well as some small visual characteristics and in other words every soil profile gives basically the snapshot of the processes through which that particular soil forms.

By this we have concluded the soil forming factors as well as soil profile. If you have any question regarding or any if you need any clarification feel free to email, and I will be more than happy to answer your queries. And, from the next lecture will be starting a new topic. And I hope that you have learned something new in these lectures.

Thank you very much.