Soil Science and Technology
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Lecture – 07
Soil Taxonomy and Classification (Contd.)

Welcome friends to this new session of a Soil Science and Technology. And in this session we will continue the Soil Taxonomy and Classification. And I will you know we will discuss different aspects of soil taxonomy what are the important factors it considers for classifying the soils. And then we will be discussing what are the important surface soil features, sub surface soil features and then what is soil moisture regime and what is soil temperature regime and so on so forth. So, let us start from where we left in the last lecture.

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So, in the last lecture, we discuss about different you know hierarchy of the soil you know taxonomy. So, as I have told you that soil taxonomy is basically combination of six different levels starting from series family, subgroup, great group, suborder and order. And we can classify any soil using this hierarchical system.

So, this you know this is the major or stark difference from other or previously described genetic and morphogenetic system that you can describe or you can classify any soil based on measurable soil properties. Just like you can classify some people a group of

people into several classes based on their hair colour based on their height. So, these are measurable soil properties. Similarly, soil taxonomy uses some measurable soil properties to classify soils.

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So, what are the major features of soil taxonomy? Well, soil classes were defined in terms of present soil you know present soil properties. And all such properties was considered were considered which affect soil genesis or the outcome soil genesis. So, in this system it is not neglecting soil genesis, it is also considering soil genesis, but in terms of some measurable soil properties. And the nomenclature were made using Greek and Latin words. And a new category called subgroup was then added to define the central concept of the great groups. And remember that this system is much easier to remember than other than earlier genetic and morphogenetic systems.

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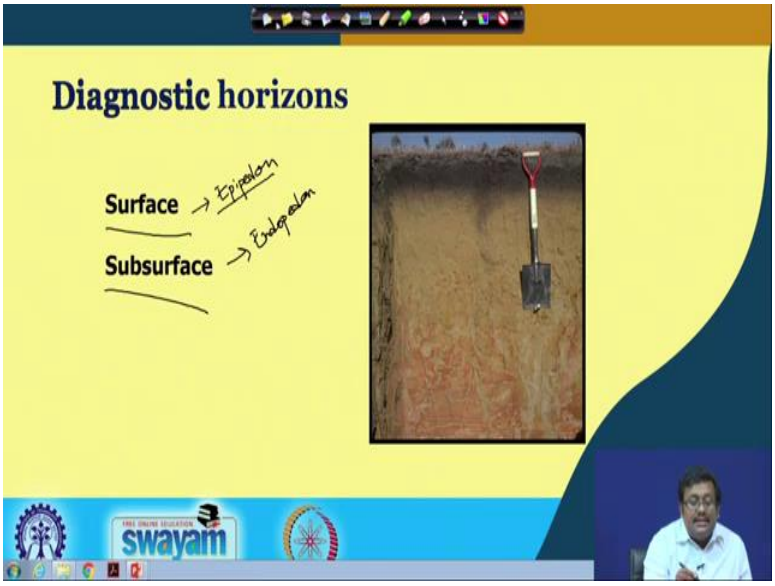

So, before discussing the orders let us first discuss the important diagnostic horizons. Remember that soils are described in terms of some visible and measurable properties, and also based on the presence or absence of certain features in their profile. So, based on certain characteristics their sub their surface horizons or subsurface horizons are differentiated. And we will discuss them one by one.

So, diagnostic horizons are basically of two types; one is called surface horizon, another is sub surface horizon. Another name of surface horizon is called epipedon; and the other name of subsurface horizon is endopedon. So, there are 8 epipedons, and 20 endopedons, each of them differing in their own characteristics. And based on whether those epipedons or endopedons are present in a particular type of soil, we classify them using the soil taxonomy, so that is the use of these diagnostic horizons. So, let us see them one by one.

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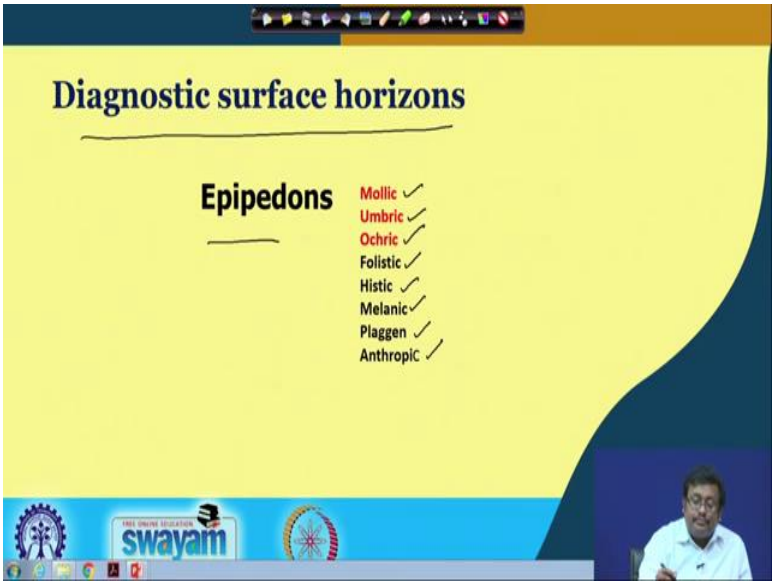

So, as you can see here I have listed here diagnostics surface horizons or epipedons. You can see there are 8 different diagnostic surface horizons mollic, umbric, ochric, folistic, histic, melanic, plaggen, and anthropic, among these, these mollic umbric and ochric are highlight at them in red because they are found in more frequency than others. So, let us discuss them one by one to know their individual properties.

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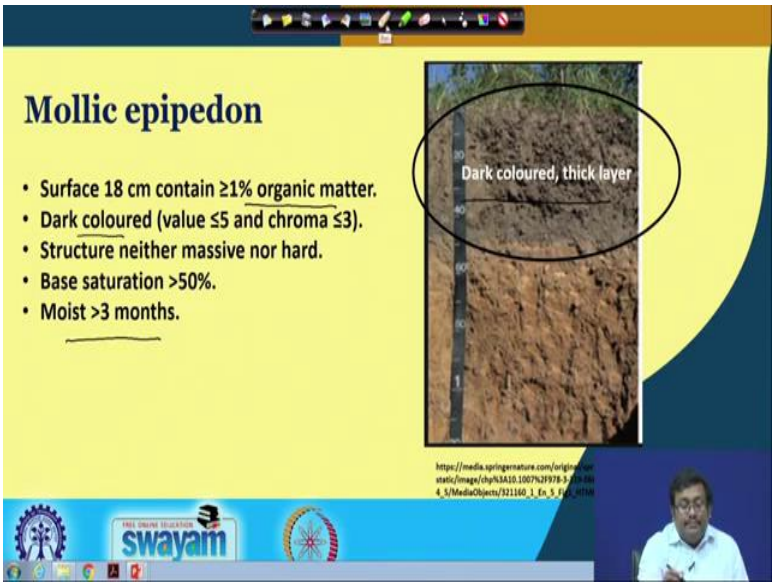

So, let us start with the mollic epipedon. So, this is the picture of a mollic epipedon the most diagnostic feature of this mollic epipedon is dark coloured and is a thick layer. So,

you will see that there is a dark coloured thick surface layer; obviously, that is a mollic epipedon. So, it must contains more than 1 percent of organic matter. And it should be dark in colour. And its structure will discuss structure in the next classes structure should be neither massive nor hard.

And it should have a base saturation greater than 50 percent that means base saturation means it should have the dominance of basic cations like sodium, potassium, calcium and magnesium should be more than 50 percent or percent, base saturation should be more than 50 percent. The other way to represent percent base saturation is the it is the percentage of basic cations among all the cations which are present in the soil. So, when the percent of base saturation goes beyond 50 that is an important feature of mollic epipedon. And this mollic epipedon remains moist for more than 3 months of a year. So, this is an example of a mollic epipedon.

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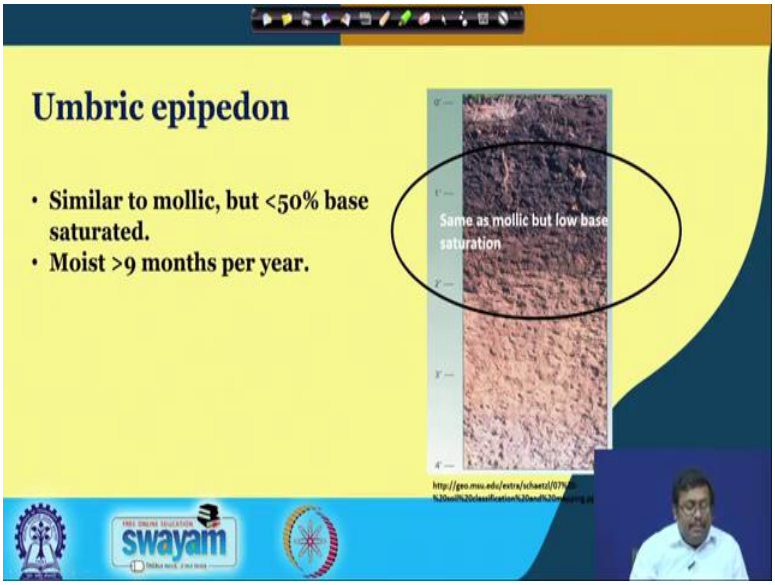

Let us see what is the next. The next one is called umbric epipedon. Now, umbric epipedon is also similar to mollic but with less than 50 percent of base situation. It is also looks like mollic, it is a dark colour thick. And it is being moist for more than 9 months per year, so that is the difference between mollic and umbric.

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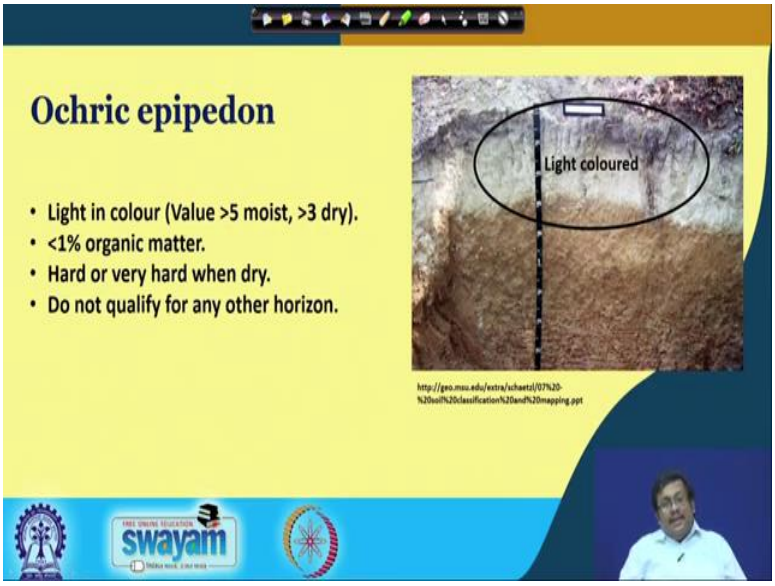

Third one is ochric; now, remember that this ochric epipedon is light in colour as you can see it is you know light in colour. And it contains less than 1 percent of organic matter; obviously, when there is in high organic matter there will be dark in color. So, it contains less than 1 percent of organic matter it is hard or very hard when dry and it do not qualify for any other horizon. So, this is why it is called ochric epipedon.

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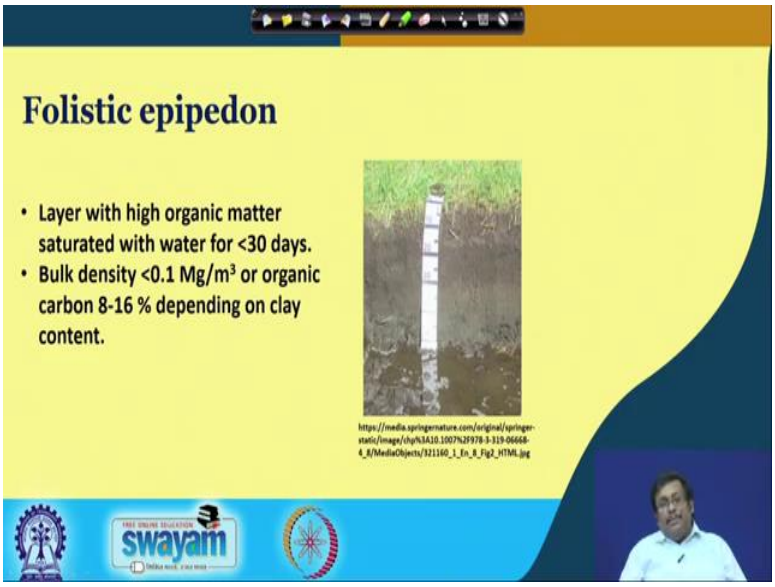

Folistic epipedon, now folistic epipedon is basically layer with high organic matter as saturated with water for less than 30 days as you can see. So, it contains high amount of

organic matter. And it has low bulk density of less than 0.1 gram per cc or mega gram per meter cube or organic carbon of 8 to 16 percent depending on the clay content. So, this is folistic epipedon.

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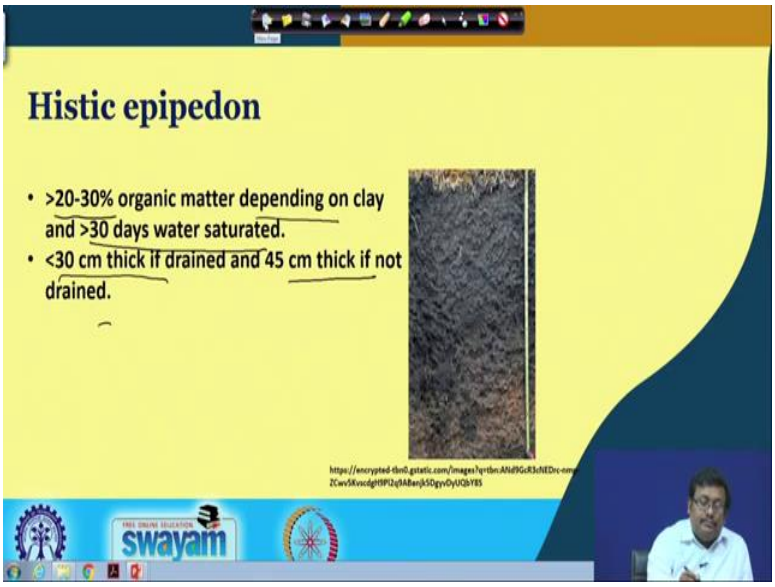

Another is histic epipedon. As the name suggest histic comes from tissue so, it is organic in nature. So, it contains more than 20 to 30 percent. Remember that it has a high content of organic matter. So, it contains 20 to 30 percent greater than 20 to 30 percent of organic matter depending on the clay and greater than 30 days water saturated. So, it remains saturated for more than 30 days period. And it is less than 30 centimeter thick if drained and 45 centimeter thick if not drained. So, these are the characteristics of historic epipedon again it is dark in colour it contains huge amount of organic matter.

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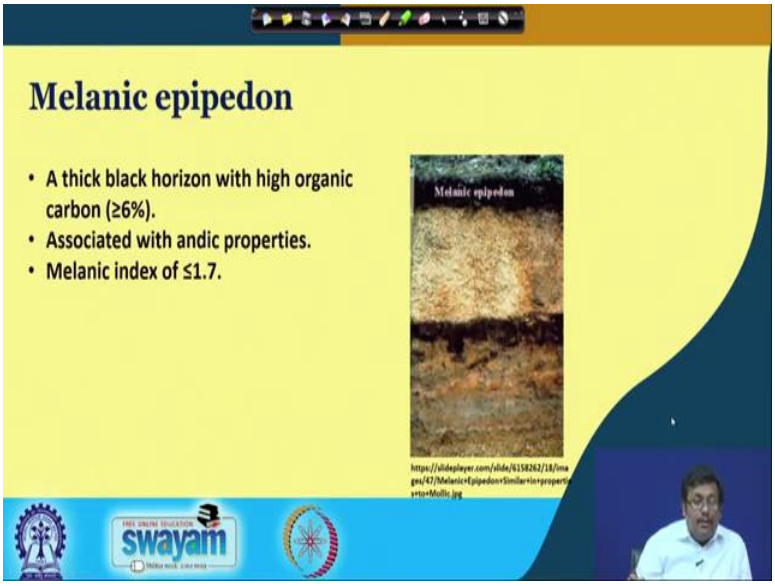

The next one is called melanic epipedon. And melanic epipedon is again a thick black horizon with high organic carbon which is greater than 6 percent. And it is generally found in andic soil originally associated with andic properties that means, in volcanic region or volcanic soil so, we will see that. So, this is called melanic epipedon.

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The next one is called plaggen epipedon. The plaggen epipedon is a man made horizon which is more than 50 centimeter thick and it contains greater than 0.6 percent of organic

matter. And it remains moist for 3 months. As you can see here it is a plaggen epipedon, and obviously, this plaggen epipedon is you know it is made due to human interventions.

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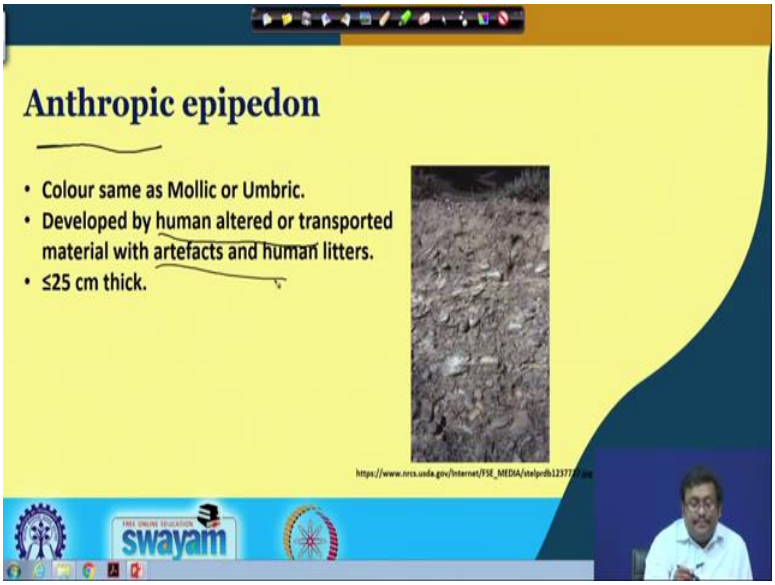

Now, the next one is called anthropic epipedon. Now, anthropic epipedon is also similar in colour of that mollic or umbric so, it is dark in colour. And remember that this anthropic epipedon is developed by human or altered or transported materials with artefacts and human litters. So, again it is kind of anthropogenic in nature and that is why it is called anthropic, the name itself suggests due to the human interventions. So, this surface horizon basically froms due to human alteration or transportation of materials with artefacts and human litters. So, this is called anthropic epipedon. And remember that this anthropic epipedon is less than 25 centimeter in thickness. So, we have covered the anthropic epipedon.

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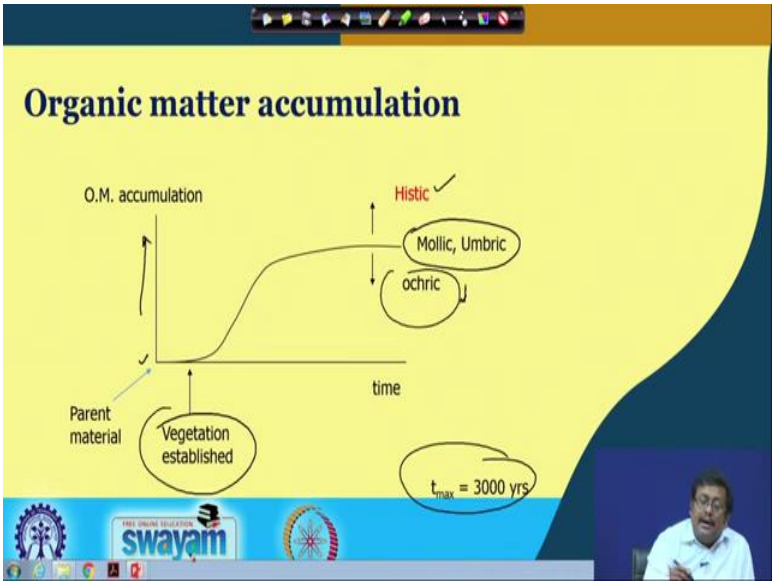

Let us see what how we can segregate this histic mollic and umbric and ochric. So, as you see here in this graph, let us see the parent material is the starting point of soil formation we already know that. And in the y-axis, we are putting the organic matter accumulation. So, as the soil will develop from the parent material, after certain period of time when the vegetation is established and after a certain period of time you can see here t max is given 3000 years.

So, you will see the organic matter accumulation will continuously increase and it will reach a plateau. And at this time we will be calling this is a mollic or umbric as you know both of them are fine organic matter. However, histic epipedon which contains more than 20 to 30 percent of organic matter will be showing more organic matter accumulation. And ochric which is basically we know light colour epipedon, will show less amount of organic matter, so that is how I mean this mollic and umbric stand in between histic and ochric epipedon. So, these graphs give you in basic idea about how we can segregate this ochric when histic from mollic and umbric. And all of these are considered as important surface soil horizons based on which soil taxonomy differentiate or classify different soils.

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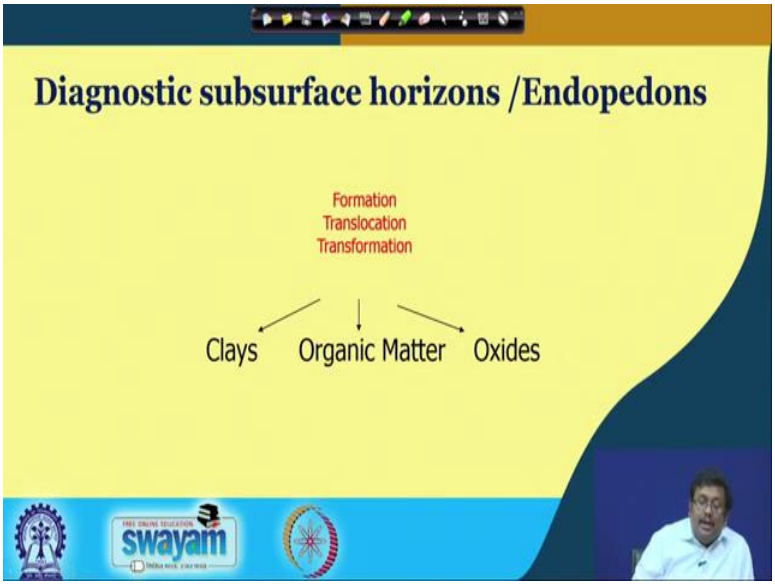

Now, let us see what the diagnostic subsurface horizons are. We have covered surface horizons or epipedons. Now, let us see the subsurface horizons. These subsurface horizons the other name of the subsurface horizon is endopedons. And remember that these endopedons are developed based on the formation, translocation and transformation of clays, organic matter and oxides. So, when clay, organic matter and oxide, translocate from one part of the soil to another part and when it transform from one you know one form to other form, then they create this diagnostic subsurface horizon or endopedons.

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So, there are 20 endopedons; I have given here names. So, starting from agric, then albic, then anhydritic, then argillic, calcic, cambic, duripan, fragipan, glossic, gypsic, kandic, nitric, oxic, petrocalcic, petrogypsic, placic, salic, sombric, spodic, sulfuric, all these are important subsurface horizons or endopedons. Now, remember that a considerable amount of subsurface horizon occurs due to illuviation or deposit of eluviated materials from upper horizon to lower horizons which I have already covered in our soil formation lecture. So, I have highlighted and red texted these albic, argillic, kandic, oxic and spodic, because they occur in the nature in higher frequency.

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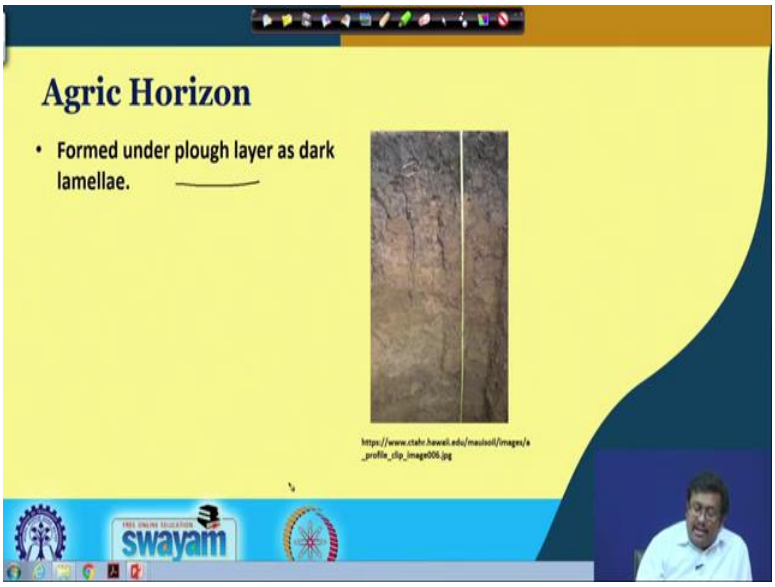

So, let us discuss them one by one. So, let us first see what is agric horizon? Now, agric horizon is basically the horizon which forms due to you know which forms under the plough layer as dark lamellae. So, obviously, this agric horizon occurs due to the plough action and it occurs below the plough layer as you can see. So, it is an important subsurface horizon or edopedon which occurs due to human action.

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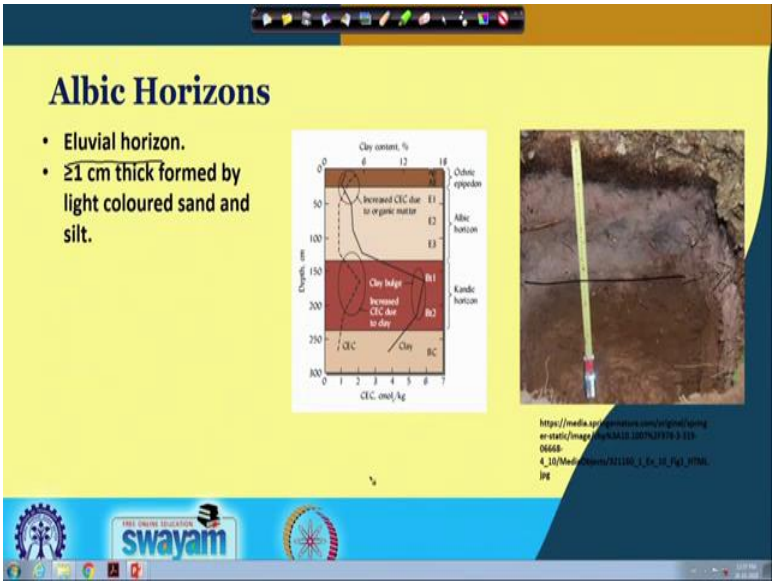

Second is albic horizon; now, the albic horizon is basically an eluvial horizon. Now, I have already told you what is eluviations? Eluviation is movement of clay and other materials from upper part of the soil profile to relatively lower part of the soil profile. So, this is called eluviations and this eluviation this albic horizon should eluvial horizon and it is greater than 1 centimeter theme thickness and formed by light colour sand and silt.

So, as we can see this is an example of this subsurface albic horizon and here we are putting in the x axis C E C and in the y axis we are putting the depth of centimeter. So, obviously, at the top there will be ochric epipedon followed by albic horizon, so obviously, below the ochric horizon there is an albic horizon followed by kandic horizons. So, again all we know albic horizon is an important eluvial horizon or subsurface horizon.

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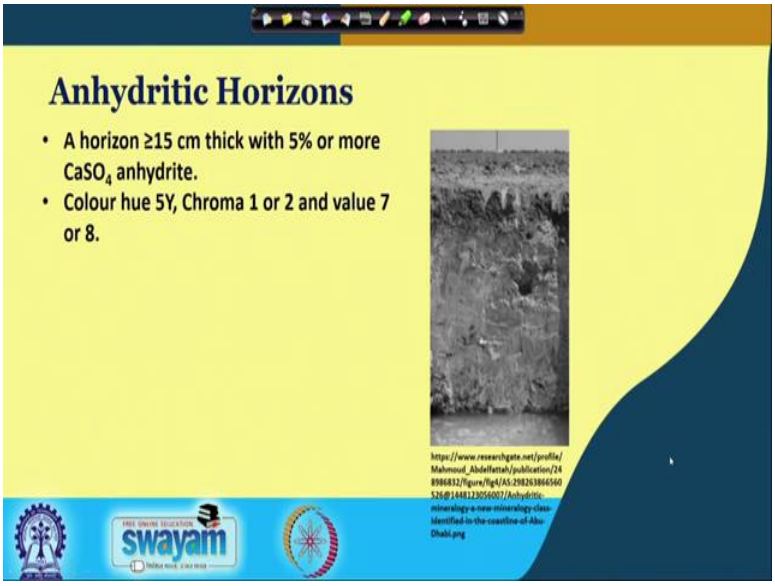

Now, next one is called anhydratic horizon. This horizon basically is greater than 15 centimeter in thickness and with 5 percent or more calcium sulphate anhydrite. The other name of calcium sulphate, it is anhydrite. So, this horizon basically contains more than 5 percent of calcium sulphate. And it shows different colour hue, chroma and values. Its hue is 5 y which is a domical spectral colour. Chroma is 1 or 2 which is purity of the colour, and value is 7 or 8 which is the degree of darkness or lightness. So, this is an example of anhydritic horizons.

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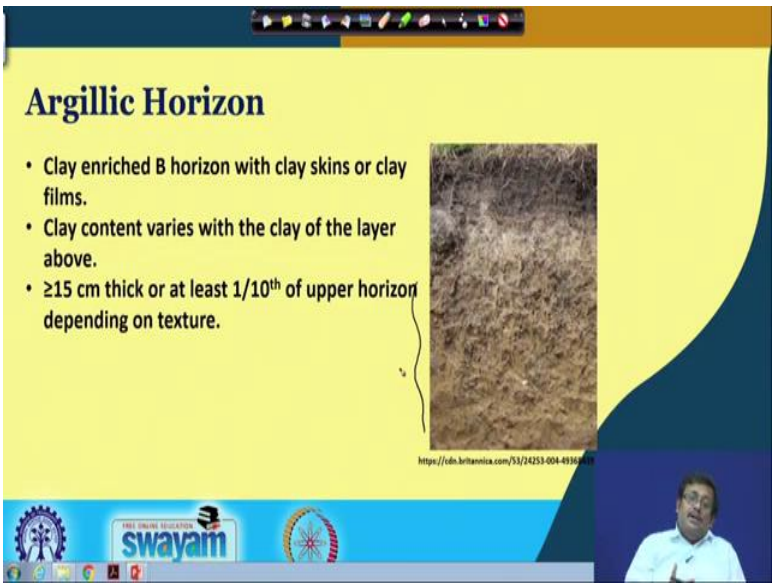

The next one is call argillic horizon, and this is very important one. Argillic horizon is basically you can see in B horizon. Now, it is clay enriched remember that it is enriched in clay. So, clay enriched B horizon with clay skins or clay films. And clay content varies with the clay of the layer above. And obviously, it is greater than 15 centimeter thick and at least 1 by 10th of upper horizon depending on the texture. So, in this picture, obviously, the lowermost part is argillic horizon which shows higher accumulation of clay which has been eluviated from upper horizons.

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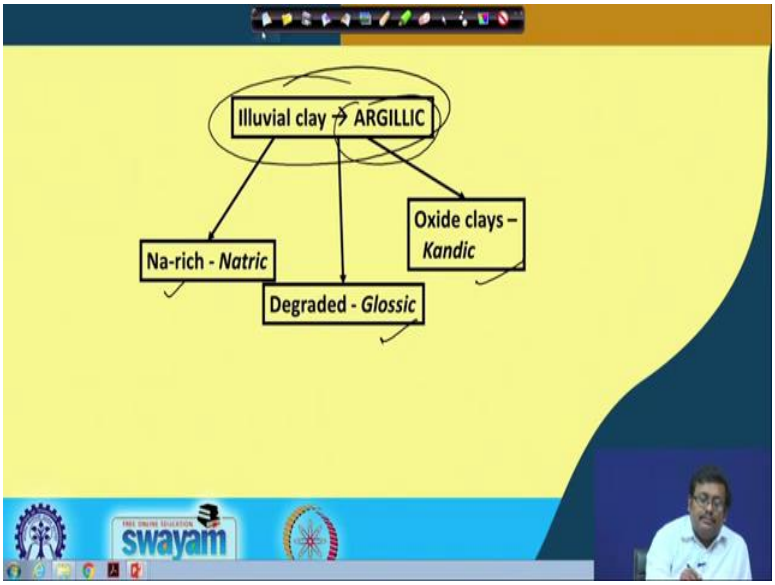

So, illuviation of clay into argillic horizon, it again can be differentiated into three sub into this argillic horizon can be further differentiated into three subsurface horizons. One is called natric horizon; another is glossic horizon; another is kandic horizon.

Now, this natric horizon is basically composed of illuvial clay, but with a sodium enrichment. When there will be illuviation of clay and simultaneously there will be degradation, we will call it glossic endopedons. And finally, when there will be argillic horizon, but with oxide clays then will term it as kandic horizon. So, these in other words, these natric horizon, glossic horizon and kandic horizon occurs from the illuviation of the clay or this is basically these three subsurface horizons or endopedons or modifications of argillic horizon.

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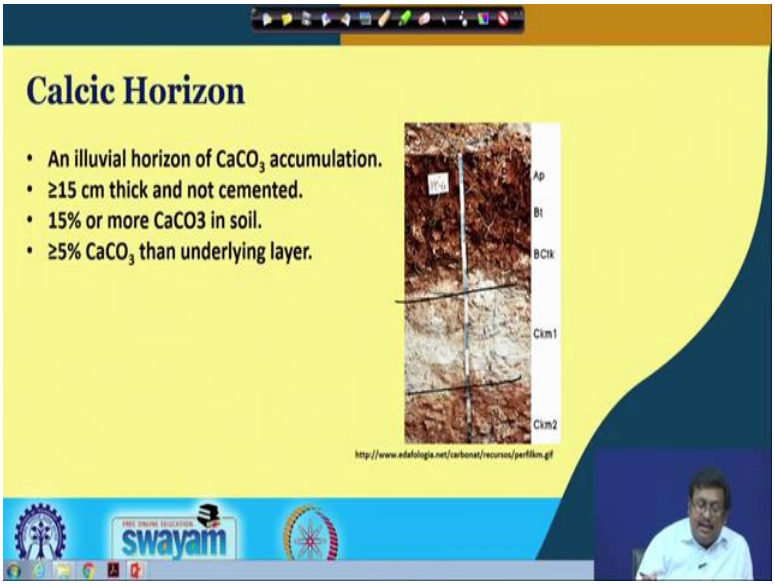

Now, next is calcic horizon; calcic horizon basically shows illuviation of calcium carbonate as the name suggest. It is more than 15 centimeter in thickness and it is basically cemented. And it contains 15 percent or more calcium carbonate. And it contains 5 percent or more calcium carbonate than that of underlying layer. As you can see the name you know of this in this soil profile, this layer is basically the calcic horizon and it is white in colour. And this is very important subsurface horizon.

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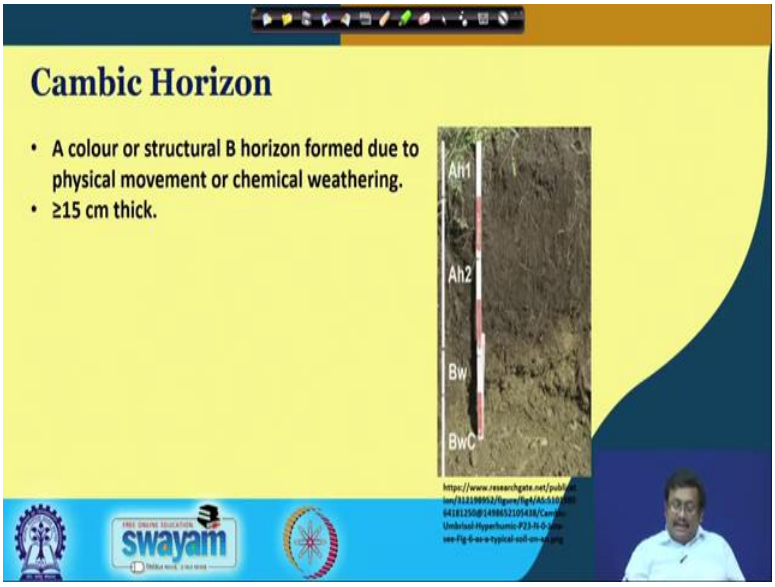

So, cambic horizon; cambic horizon is basically a colour or structural B horizon formed due to physical movement or chemical weathering. And it is generally greater than 15 centimeter in thickness.

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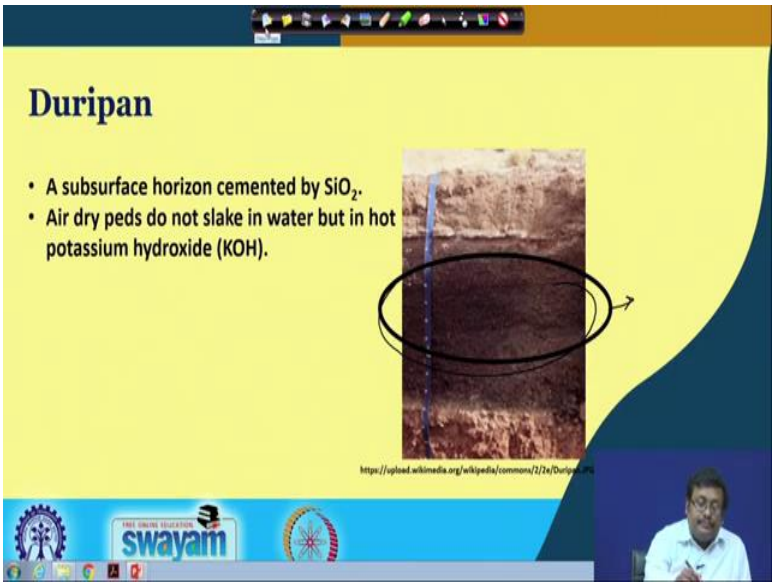

The next is called duripan; duripan is again a subsurface horizon which is cemented by silica and it is air dry peds or air dry soil which basically do not slake in water, but in hot potassium hydroxide. So, you will see that this is duripan and these are highly cemented by silica. And these are very dry and they do not slake in water, but they can be you know they can be slaked in the contact of a potassium hydroxide.

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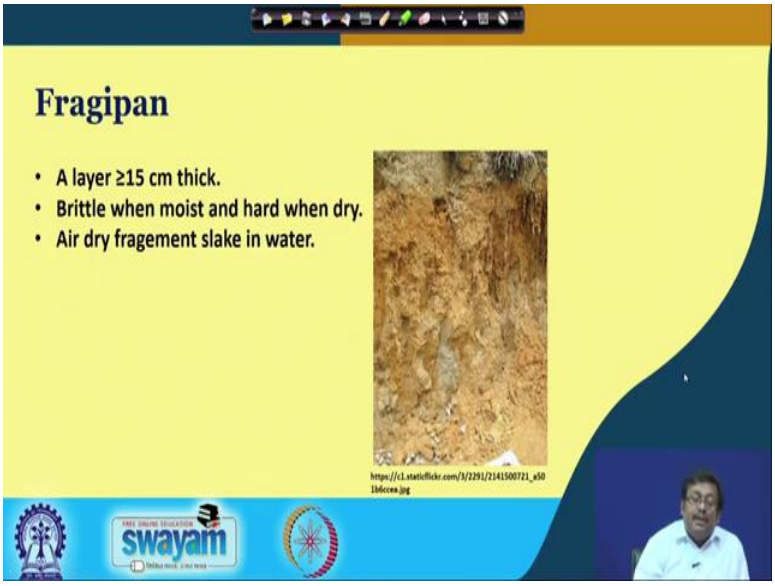

Another one is called fragipan. Now, fragipan is again greater than 15 centimeter in thickness and it is brittle when moist and hard when dry. And air dry fragment generally slake in water. So, this is an example, this is basically an example of fragipan.

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The next one is glossic horizon. As I have already told you it a modification of the glossic horizon as we have seen in the previous thing. It is a degraded argillic horizon. So, similarly this glossic horizon is a remnant of argillic or kandic horizon from which

clay and free iron oxide were removed. So, again it is a modification of argillic horizon and generally it is greater than 5 centimeter in thickness.

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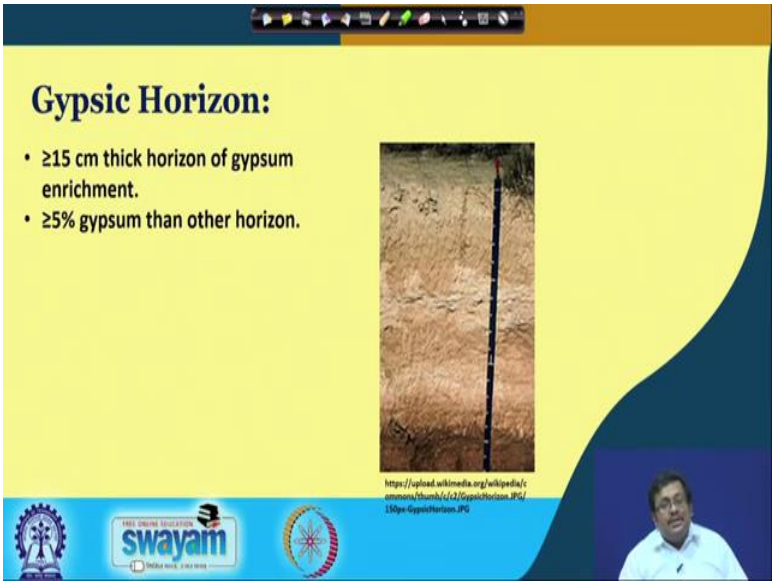

The next one is called gypsic horizon, obviously, it is greater than 15 centimeter in thickness and shows the accumulation of gypsum. And this horizon basically contains higher gypsum content, 5 percent more gypsum content than that of the under lying soil horizons.

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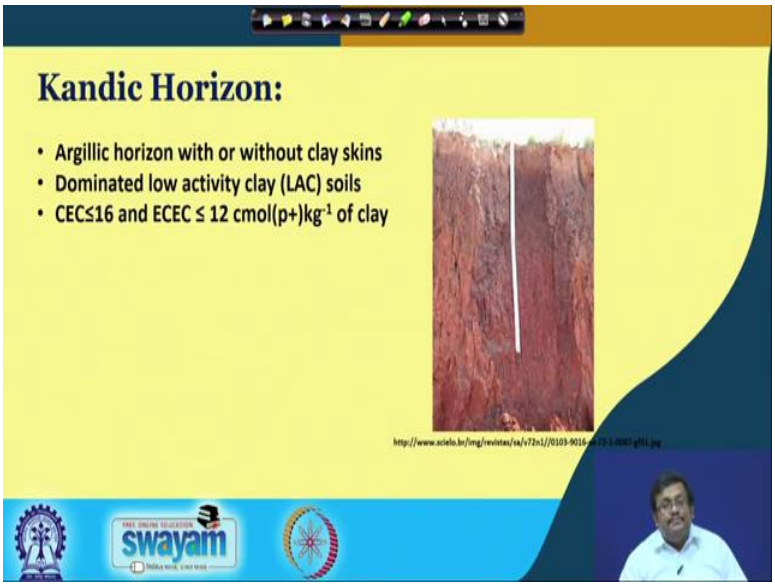

Now, kandic horizon remember that the kandic horizon is mainly composed our low activity clays or in other words this kandic horizon is a modification of argillic horizon. So, it is basically argillic horizon with or without clay skins. And it is basically dominated by low activity clays. And it has a cation exchange capacity of less than 16, and effective cation exchange capacity of less than 12 centimole proton per kg of clay.

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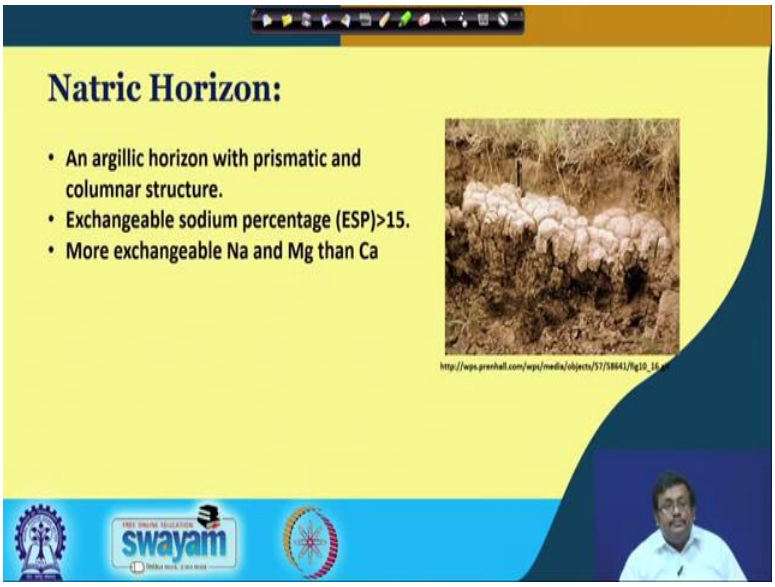

So, it can be found basically red and lateritic soil and it is dominated by low activity clays. Natric horizon; natric horizon is an argillic horizon which shows the dominance of sodium with some prismatic and columnar structures, we will discussed structure later on. And it contains exchangeable sodium percentage greater than 15. So, this is an important property. And it contains more exchangeable sodium and magnesium than that of calcium. So, as you can see this is you know this is a natric horizon which is showing accumulation of sodium and these are having columnar structure.

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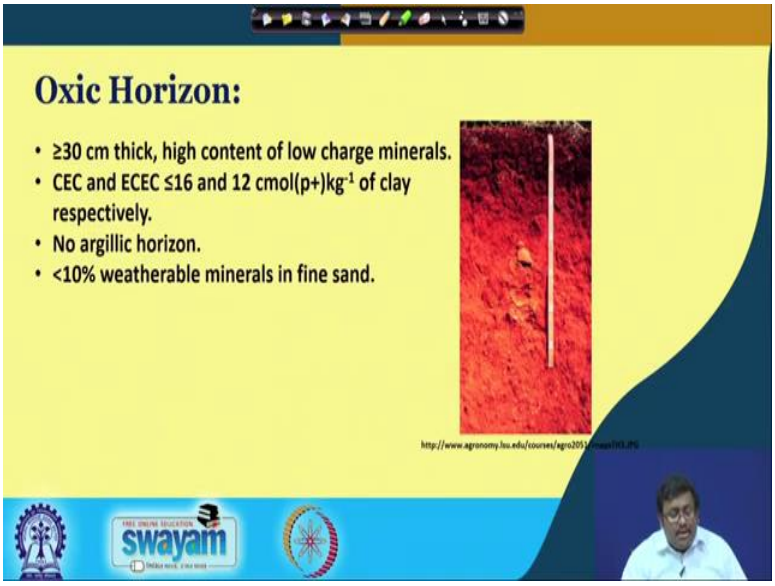

Oxic horizon; oxic horizon is basically greater than 30 centimeter in thickness, and high content of low charge minerals. And it has got CEC and ECEC less than 16 and 12 centimole proton per kg of clay, respectively. And it contains no argillic horizon. And it contains less than 10 percent weatherable mineral in fine sand.

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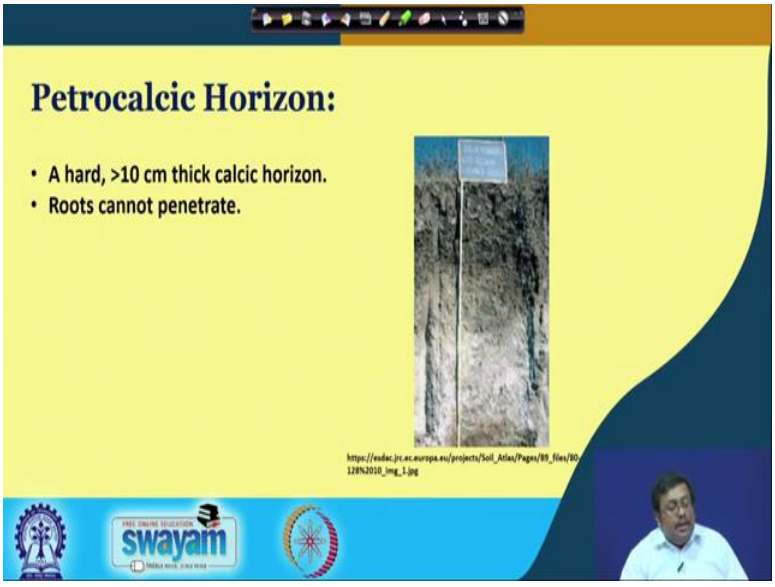

Next one is petrocalcic horizon; it is basically a hard greater than 10 centimeter thick calcic horizon. And due to the presence of this subsurface horizon root cannot root of the

plants cannot penetrate into the soil. So, this is bad or this is harmful for proper growth of the plant. So, this is called petrocalcic horizons.

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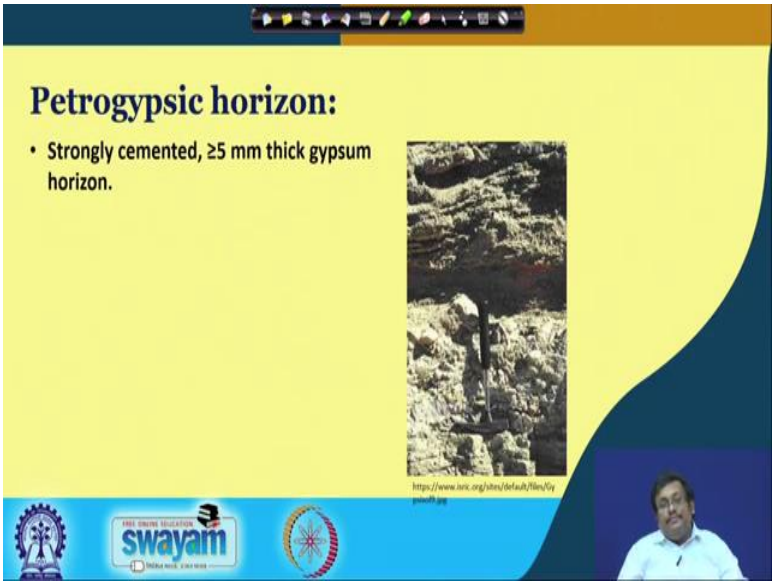

Another is petrogypsic as the name suggests again it is strongly cemented greater than 5 millimeter thick gypsum horizon. And it is similar to petrocalcic horizons instead that is it is dominated by gypsum.

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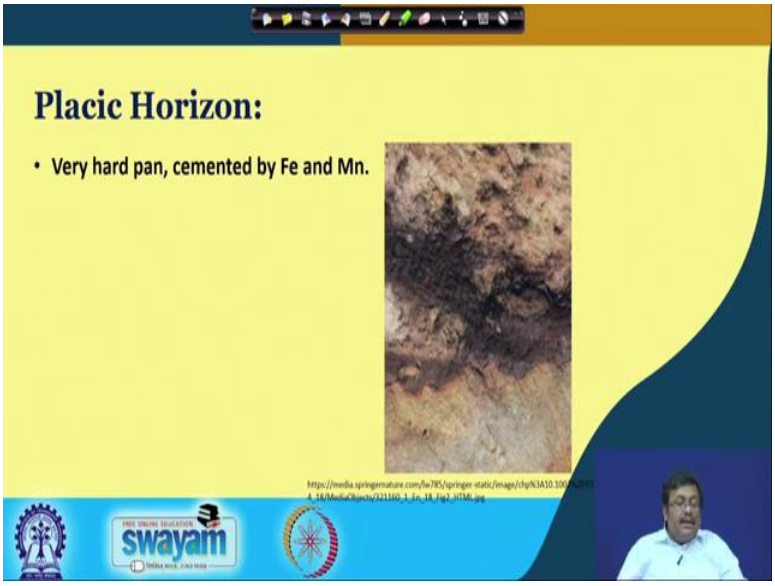

Placic horizon, it is again a very hard pan and it is very hard pan and cemented by iron and manganese. So, placic horizon is basically dominated by iron and manganese.

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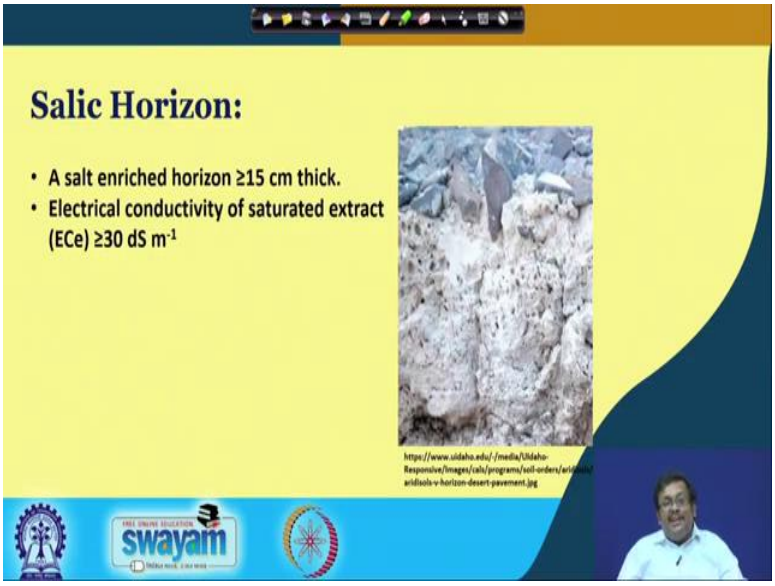

Salic horizon is the name suggested it is a salt enriched horizon which is having thickness of greater than 15 centimeter. And it has electrical conductivity of saturation extract greater than 30 dS per meter

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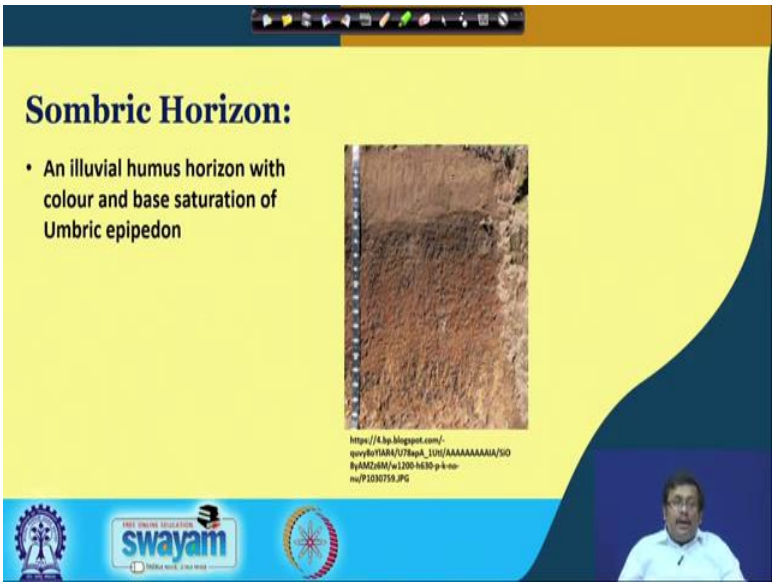

So, sombric horizon it is an illuvial humus horizon with colour and base saturation of umbric horizon. If you remember the umbric horizon it is dark in colour, but base saturation is low. So, similarly the sombric horizon is an illuvial humus horizon with colour and base saturation of umbric epipedon.

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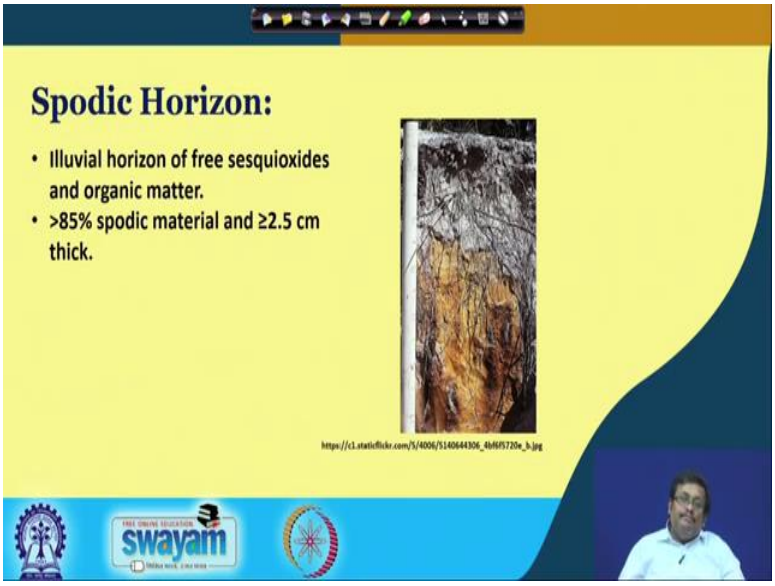

Finally, spodic horizon which is an illuvial horizon of free sesquioxide and organic matter sesquioxide and is basically combination of iron oxides and aluminium oxides. And this spodic horizon basically shows you know accumulation of iron oxides and aluminium oxides and organic matter. And it contains greater than 85 percent spodic material. And it is generally greater than 2.5 centimeter in thickness.

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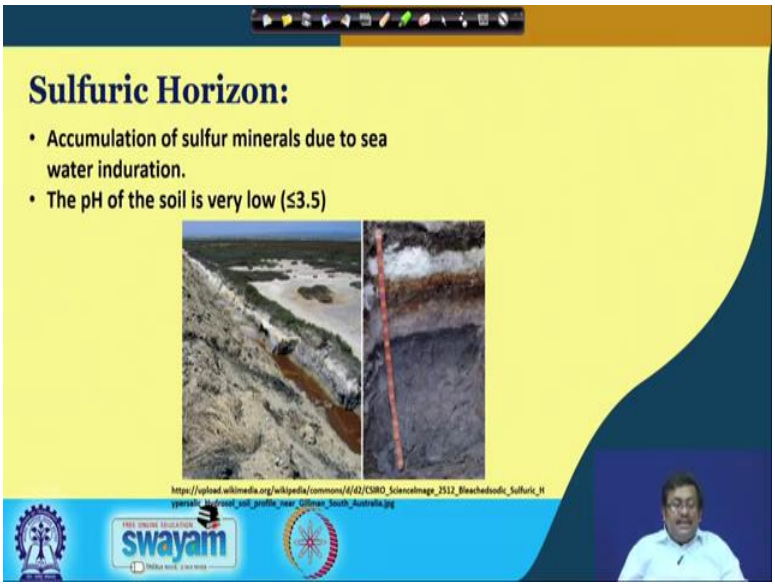

Sulfuric horizon shows accumulation of sulfur minerals due to the sea water induration. In India, in Kerala region, we will find this type of sulfuric horizon in Kari or Pokkali soils and the p H of the soils is very low which is less than 3.5.

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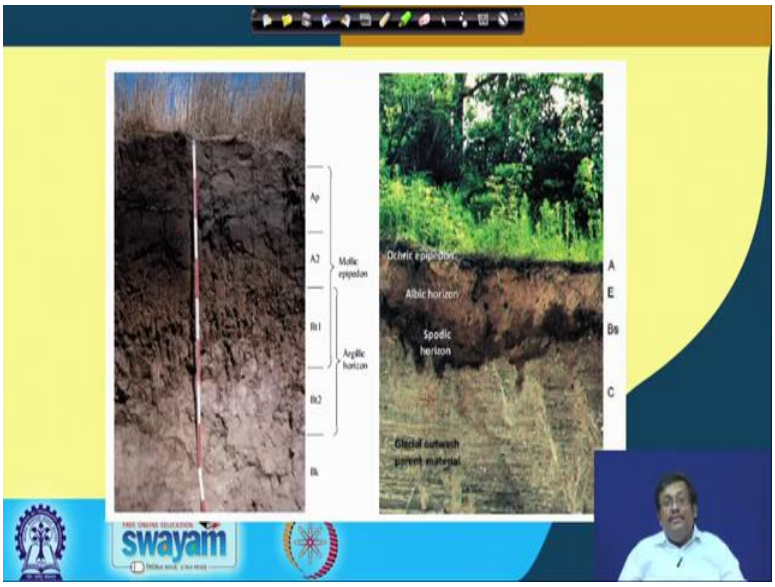

So, in a nut shell, you can see in this picture different surface and subsurface horizons. Here you can see surface ochric epipedon, and subsurface albic horizon, spodic horizon, and below that there are some you know parent material and glacial outwash. So, in this session, you got an idea about what are the important surface diagnostic horizons and subsurface diagnostic horizons. So, in the next session, we will be discussing about soil moisture regime, soil temperature regime and 12 different soil orders.

Thank you very much.