**Soil Science and Technology**
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**Lecture - 08**
**Soil Taxonomy and Classification (Contd.)**

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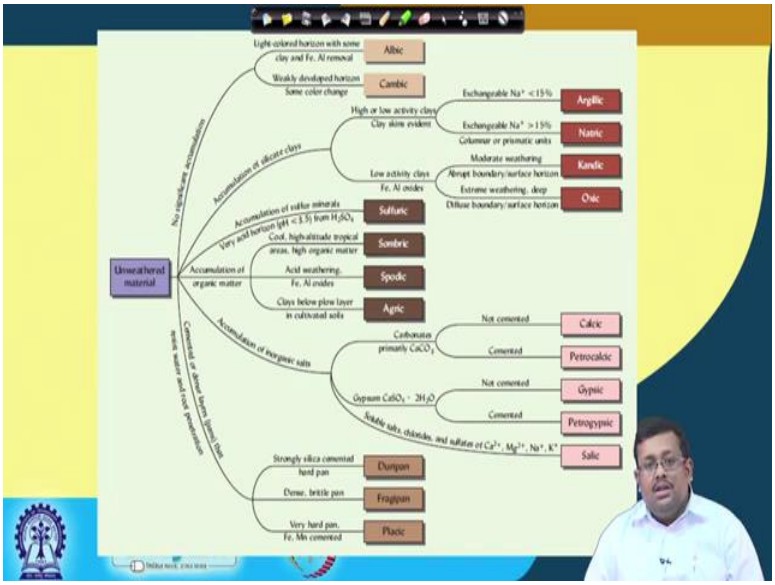


Hello friends, welcome to this lecture of Soil Science and Technology and in this lecture will be continuing the soil classification and we will continue from where we left in last class or last lecture. So, let us continue from that. So, in the last lecture we have covered what is soil taxonomy and what is soil classification, what are the different aspects of soil classification.

And then you know what you know, what are the different types of diagnostic horizons and we divided the diagnostic horizons in to major you know two broad categories. One is surface diagnostic horizon or epipedons and we then discuss 8 different epipedons and then we talked about the subsurface diagnostic horizons, we call them endopendons and there are 20 endopendons we have discussed one by one. And then you know from today onwards will be having from this lecture onwards will be discussing about different soil orders.

So, before going to the soil orders, let us check a good slide which can show you which can give you basic overview of different conditions which are required for forming

different sub horizon or different subsurface diagnostic horizons or endopendons. Now, in this screen you can see that you know if this is the starting point is unweathered parent material and you know different conditions are given here to which are required for formation of specific endopendon. For example, if there is no significant accumulation and if this is light coloured horizon with some clay and iron remove iron you know clay iron and aluminium remove, then we call it Albic horizon and if it is weakly develop horizons and showing some colour changes, we call is we call it Cambic horizon.

And; obviously, if there is an accumulation of silicate clays, then it goes to a new path and you can see there is you know due to the presence of high and low activity clays and clay skin evident we can divide them into either argillic with high you know clay content and also natric. The difference between argillic and natric is argillic contains less than 15 percent of exchangeable sodium where as natric contains by definition more than 15 percent of exchangeable sodium.

So, you can see that all these subsurface horizons or endopedons are given here and their specific pathway I mean the specific pathway which is responsible for they which is responsible for the formation is also given. So, this slide will give you an overview of different weather conditions and difference other condition which are required for formation of those diagnostic subsurface endopedons.

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So, one of the important points of this soil taxonomy is that, the soil classification is also you know based on different types of soil moisture regimes and soil temperature regimes. So, let us first discuss what is soil moisture regime. Now soil moisture regime basically shows the wetness condition of the soil horizons and their respective duration. So, the soil moisture regime or you know the acronym SMR can be divided into 5 different categories; the first one is aquic which is basically when the soil is saturated with water for sufficient period of time for and evidence of poor aeration is there.

So, in that case we call it aquic soil moisture regime. So, this aquic soil moisture regime basically you can find you know in case of water logged soils. And, second most important soil moisture regime is udic soil moisture regime which is basically you know, which basically characterise when the soil moisture is sufficiently high for year round in most years to meet the plant needs and it is an extremely wet moisture regime with excess moisture for leaching throughout the year. And we know when there is an excess moisture for leaching throughout the year, then it is termed as perudic.

The third one is call ustic which is soil moisture which is intermediate between udic and aridic. Now what is the aridic? Aridic is basically the soil moisture regime which you can see in the arid region. So, when the soil is dry for at least half of the growing season and moist for less than 90 consecutive days, then we call this soil moisture regime as aridic soil moisture regime. And finally, xeric which is found in typical Mediterranean type climates with cool and moist winters and warm and dry summers. So, basically this 5 in a nutshell shows, what are the important soil moisture regimes and based on these soil moisture regimes soil taxonomy divide or develop different classification criterias.

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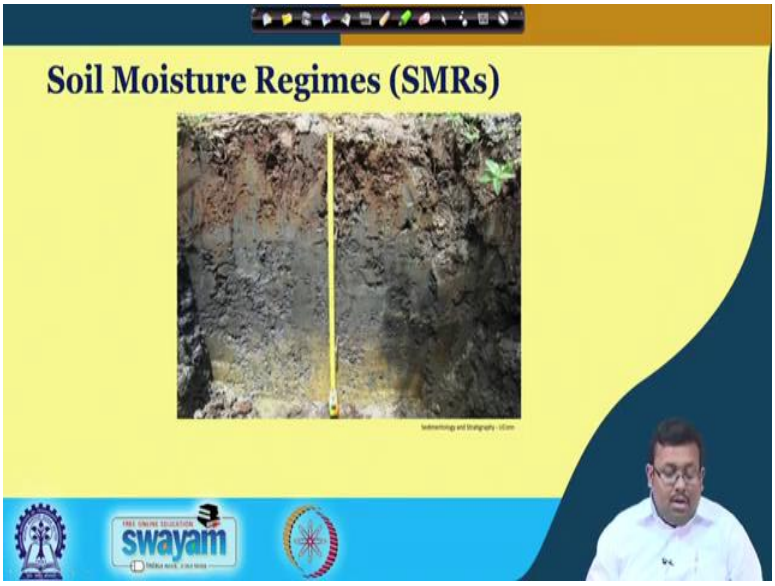


So, you can see this is you know soil moisture, this is some picture showing soil moisture regimes and; obviously, you can see gleying is evident in the soil moisture regime and which occurs due to the prolong water logged condition. And this basically shows the aquic soil moisture regime.

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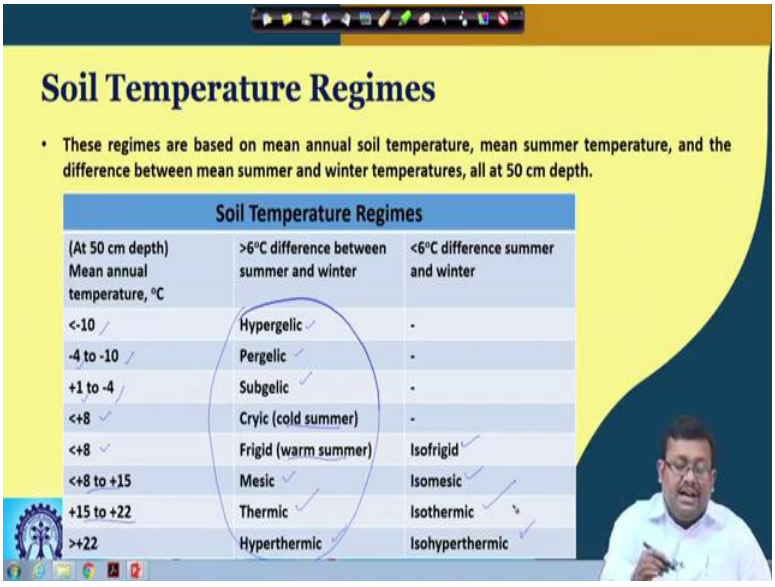


Now, let us see what is soil temperature regime. The soil temperature regimes are based on mean annual soil temperature, and mean summer temperature and the difference

between mean summer and winter temperature all at 50 centimetre depth. So, remember that all the soil temperature regimes are defined at 50 centimetre depth from the surface.

So, what are the important soil moisture regime, soil temperature regime? As we can see that at 50 centimetre depth based on mean annual temperature in degree centigrade, we have classified the soil temperature in 6 to 7 different types of classes. So, as you can see from this screen when the soil moisture regime is hypergolic; that means, the mean annual temperature should be less than 10 less than minus 10 degree centigrade so, or minus degree Celsius.

When it is in between minus 4 to minus 10 degree Celsius then we call it pergelic and when it is within minus 4 to plus 1 degree Celsius, then we call it subgelic temperature. And cryic is basically a temperature regime when the mean annual temperature is less than 8 degree Celsius. And, frigid is also a temperature regime where the mean annual soil temperature is less than 8 degree centigrade, the difference between cryic and frigid is the cryic is characterized by cold summer whereas, frigid is characterized by warm summer.

Now, another temperature regime is called mesic temperature regime where the temperature lies between plus 8 to plus 15 degree Celsius and thermic regime basically characterized by plus 15 to plus 22. And finally, hyperthermic which is characterized by plus 22; that means, more than 22 degree Celsius. Now, remember that all these temperature regimes are basically characterizing when there is a more than 6 degree centigrade, sometimes you will find it is more than 5 degree. So, some you know all these temperature regimes are named when the difference between summer and winter temperature is greater than 6 degree centigrade. And, when the difference between the summer and winter temperature is less than 6 degree centigrade, then this frigid is also named as isofrigid.

Then mesic will be termed as isomesic, the thermic will be termed as isothermic and finally, hyperthermic will be termed as iso hyperthermic. So, this slide basically shows concisely what are the different types of soil moisture regimes and how we name them and what are their different criterias.

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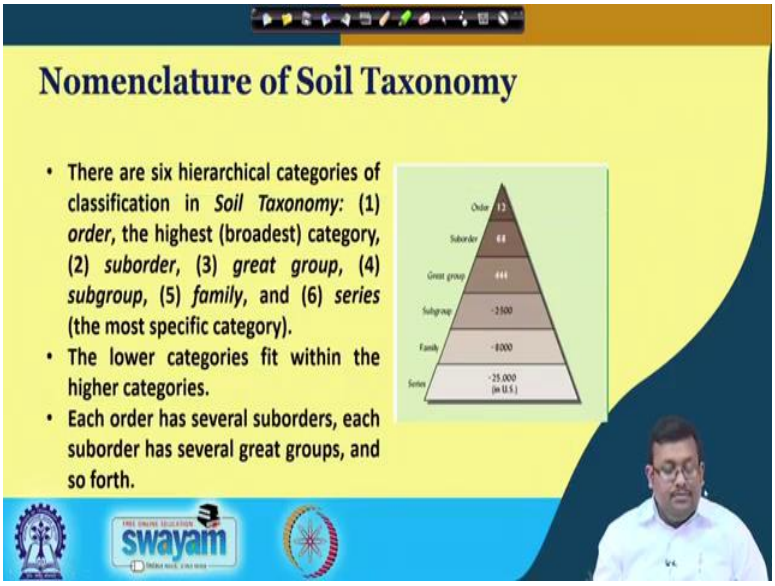


So, let us see what are the different types of nomenclatures which in used for soil taxonomy. Now there are 6 hierarchical categories of the soil taxonomy as we have discuss already in the last lecture. So, the lowermost group is called soil series which is most specific. So, above the soil series there are soil family and above the soil family, we call it soil subgroup. There are 25,000 soil series which is identified in United States and there are more or less 8,000 families of soil which have identified so far.

There are 2500 subgroups above the subgroup there is great group around 444 and then suborders 68 suborders. And finally, there are 12 orders. So, order is the highest category in the soil taxonomy. So, the lower categories fit within the higher categories and; obviously, each order has several suborders in each suborder has several great groups and so on so forth.

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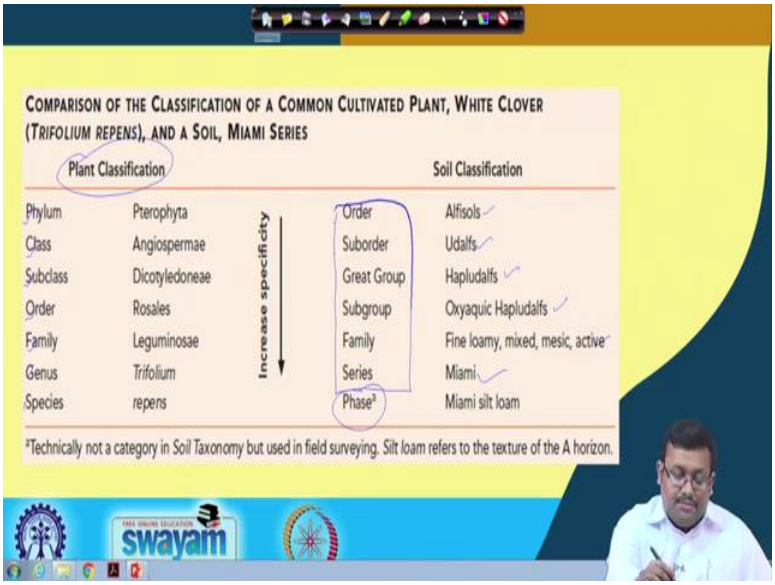


So, if you compare the nomenclature or classification of a common cultivated plant with a soil series called Miami series, then it is quite clear how we have given how we can we know name different soils. For example, you can see the plant can be classified into different a phylum class and sub class order family genus and species. Up to species level which is the most specific you know level you can classify that particular plant.

Similarly, a soil can be classify into order, suborder, great group subgroup family series. Now up to series these 6 levels are included in the soil taxonomy. The last one is not generally included in the soil taxonomy, but generally we used when you are go for soil survey in the field. So, will be only concentrating on these 6 soil classification levels. We can say it levels are hierarchical levels.

So, we can see order which is alfisols and then suborder udalfs great group is hapludalfs, subgroup oxyaquic hapludalfs, then family fine, loamy, mixed, mesic, active and finally, series Miami. So, each soil can be described on the basis of these nomenclatures in the soil taxonomy and that is why soil taxonomy is always better than earlier morphogenetic systems of soil classification.

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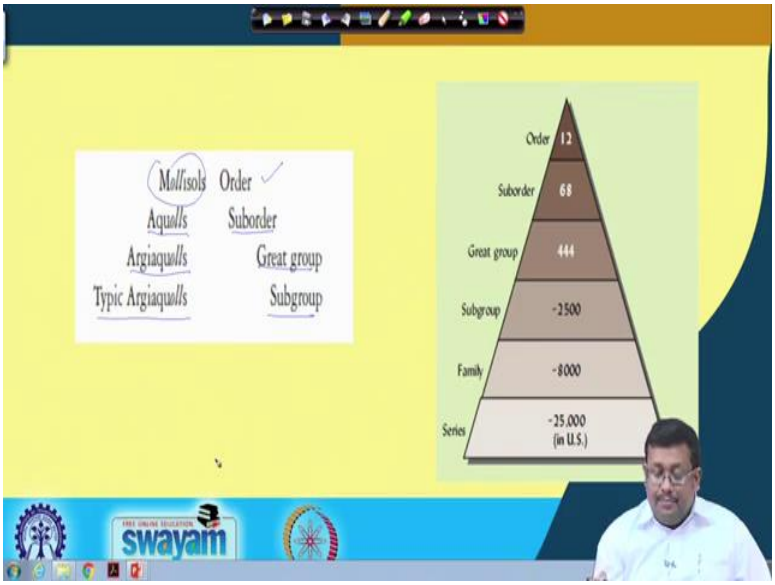


So, for example, let us see if there is a mollisol we will discuss what is mollisol you know in a few minutes. Then let us start with the order which is mollisol and you can see suborder which is aquolls and great group which is argiaquolls and subgroup that is typic argiaquolls why, what are the you know the indicates will discuss in a minute.

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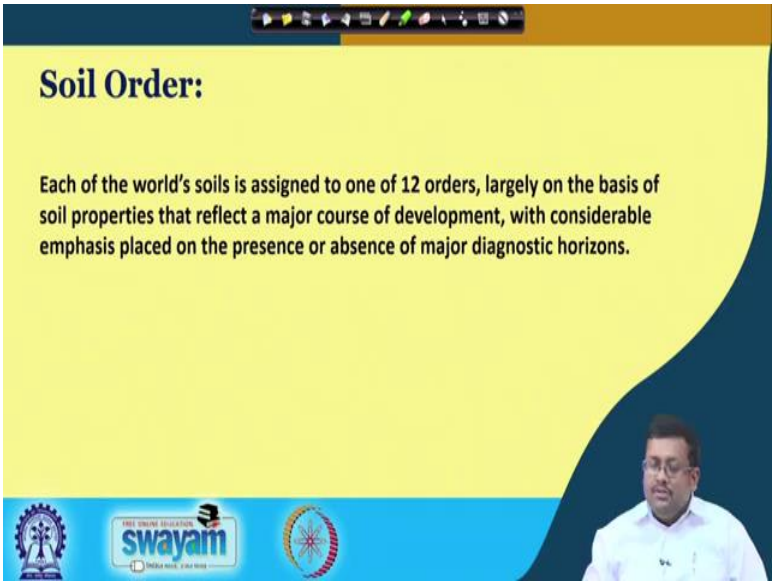


So, let us starts with the soil order first. So, each of the world soil is assigned to one of the 12 soil orders. Remember that there are a total of 12 soil orders; largely on the basis of soil properties that reflects a major course of development with considerable emphasis

placed on the presence or absence of major diagnostic horizons. So, each order is characterise by the presence or absence of a specific diagnostic horizons and we will see that from the next slide onwards.

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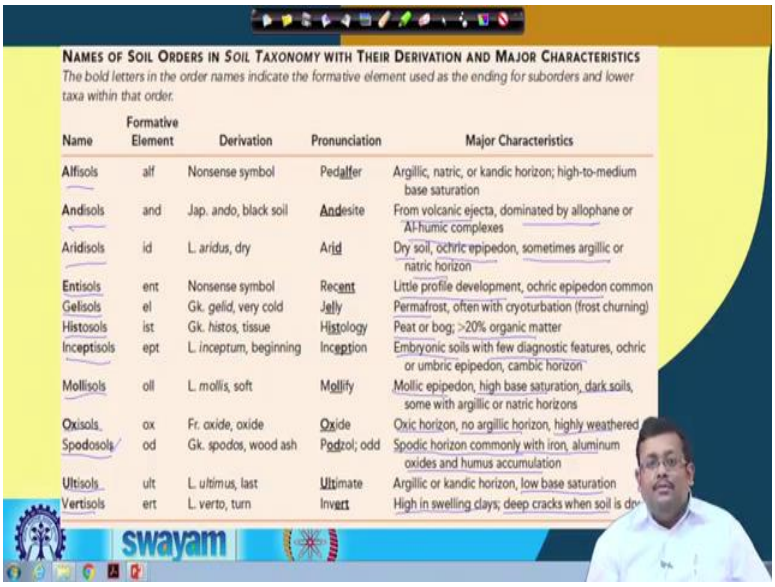


So, let us see this is a compiled list and you can see that we have listed here twelve different soil orders. For example, alfisols then andisols, then aridisols, entisols, gelisols, histosols, inceptisols, mollisols, oxisols, spodosols, ultisols and vertisols and each of them are characterized by a specific you know surface or subsurface horizon. For example, in case of alfisols, you will see that argillic, natric or kanic horizon is present where as high to medium base saturation you will find.

In case of andisols you will these are mainly present in volcanic areas and it is basically dominated by allophane which is a kind of clay mineral we will discuss them in details later on an aluminium and humic complexes. In case of aridisols which is mostly found in case of arid region, you can see the major characteristic are dry soil; obviously, because there found in aridic region and it is characterise ochric, epipedon. If you remember the ochric epipedon, it is a light colour epipedon which is devoid of organic matter

So obviously, in the arid soil when there is a high amount of temperature most of the organic matter will be oxidize. So, that will be there will be formation of ochric, epipedon an of sometime there will be argillic or natric horizon entisols entisols are the

you know young most young soils and they have little or profile development and only ochric epipedon is common. And; obviously, gelisols gelisols are basically found in in you know very cold climatic or cold regions and; obviously, they are you know they are characterized by permafrost when there is you know permafrost condition. And permafrost means when the soil is frozen for most part of the year then it is called a permafrost condition and histosols as the name suggest means it is showing the fibrous characteristics. So, as the name suggest it is composed of peat or basically peat type of soil peat or bog which contains greater than 20 percent of organic matter. Inceptisols: inceptisols are embryonic soils with few diagnostic horizon it is little bit developed than that of entisol.

Mollisols which contain mollic epipedon with a high base saturation which you know this is the basic characteristics of mollic epipedon and in they are basically dark in colour. Oxisols: they are present their characterise by the presence of oxic horizon and they do not have any argillic horizon and there highly weathered and because they developed in warm and humid climate as the result of intense weathering. Ultisols ultisols are you know ok. Spodosols: spodosols are spodic horizon which commonly you know spodic horizon commonly with iron aluminium oxides and humus accumulation in the spodic. In the spodic horizon as you remember there will be eluviation of iron and aluminium as well as some iron aluminium oxides and humic matter from top of the profile to the bottom of the profile.

So, this spodic horizon is present basically in spodosol. Ultisol you know they have low base saturation; these are also highly weathered soils. And finally, vertisols which has very you know this soils are having high swelling type of clays and they produce deep cracks when soil is dry and we will discuss I am just giving a basic overview and then we will discuss all of them one by one. So, this slide gives you an idea that how soil taxonomy is based on measurable soil properties and we know each category either it is broad category or specific category is based on some measurable soil property.

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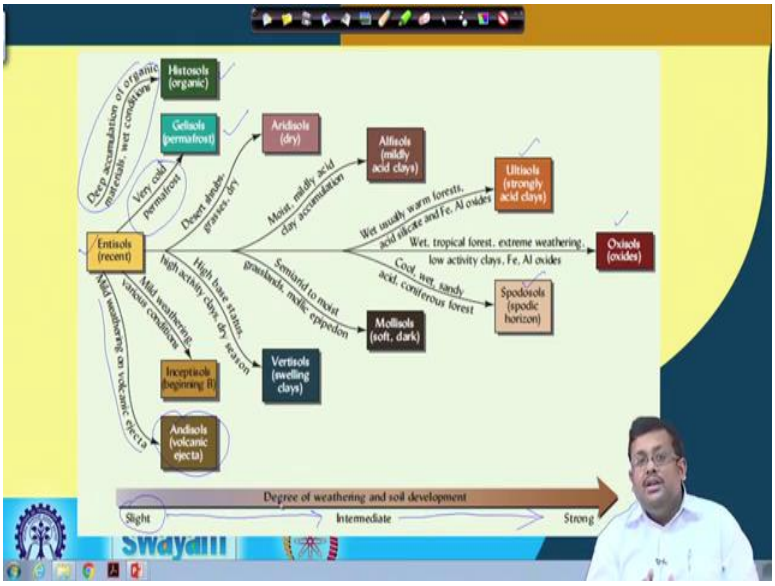


So, these slide shows how you know different soil difference soil order forms depending upon degree of weathering and soil development. So, as you can see when there is in entisol is the starting point because it is recent recently developed with poor horizon development and degree of weathering is very slight and as we go from slight to intermediate degree of weathering and from intermediate to strong degree of weathering is ultimately oxisoil is forming. And; obviously, ultisol, spodosol these are also highly you know these are also highly weathered soils and; obviously, what are the different conditions which are needed for development of these individual order you can see.

For example, when there is a starting point entisoil and very very cold and permafrost condition; obviously, there will be formation of gelisols as I have already told you in the last slide. When there is a deep accumulation of organic materials wet conditions; obviously, in peat you know peat type of parent material, then we call it histosols. And when there will be you know volcanic you know mild weathering and volcanic eject is there, then we call we will calling it andisols because they are forming in you know in volcanic area. So, on so for they you can see in this slide it is showing that how depending upon the weathering intensity one soil order changes from you know from relatively less mature to relatively highly weathered soil orders.

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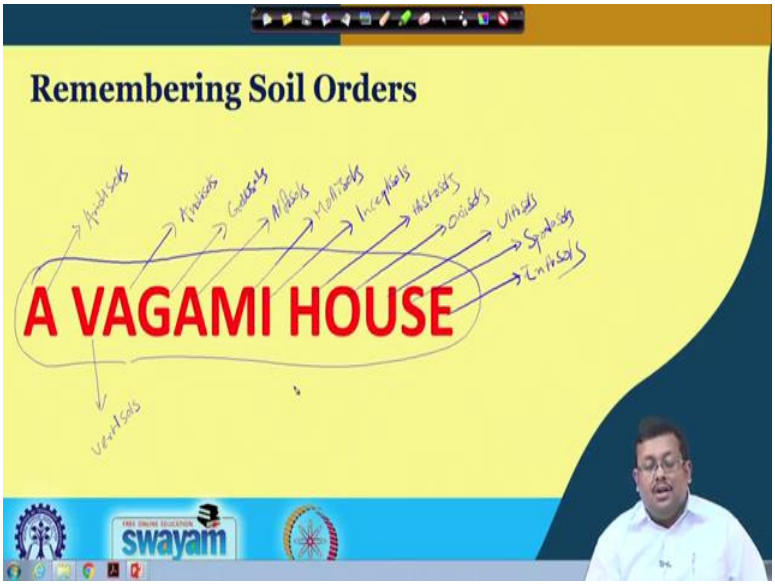


So, now one questions we always have the in our mind that how to remember this 12 soli orders. It is always not easy task to remember all the soil 12 soil orders. So, there is a simple way to remember this 12 soil orders and you can remember this name of all the 12 soil orders with a by remembering this thing that is called A VAGAMI HOUSE.

Now, this basically you know shows all the 12 orders the starting of all the twelve orders in a concise form, how? So, let us see. So, this A basically stands for example Aridisols, this V Vertisols, this A Andisols, G Gellisols, A Alfisols, M Mollisols, I Inceptisols, H Histosols, O Oxisols, U Ultisols, S Spodosols, E Entisols. So, if you remember this thing, it will be easier for you to remember all the soil orders.

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So, let us see more details about the individual soil order. So, let us start with the most young soil order that is entisols. Now; obviously, as you can see the pictures, there is no clear horizon development. So, it is recently developed mineral soil with no horizon, no diagnostic horizon; you cannot see any specific diagnostic horizon. And obviously, there will be low degree of soil development due to less time because they are young in nature and; obviously, they occurs in all states of India special in Indo-Gangetic region.

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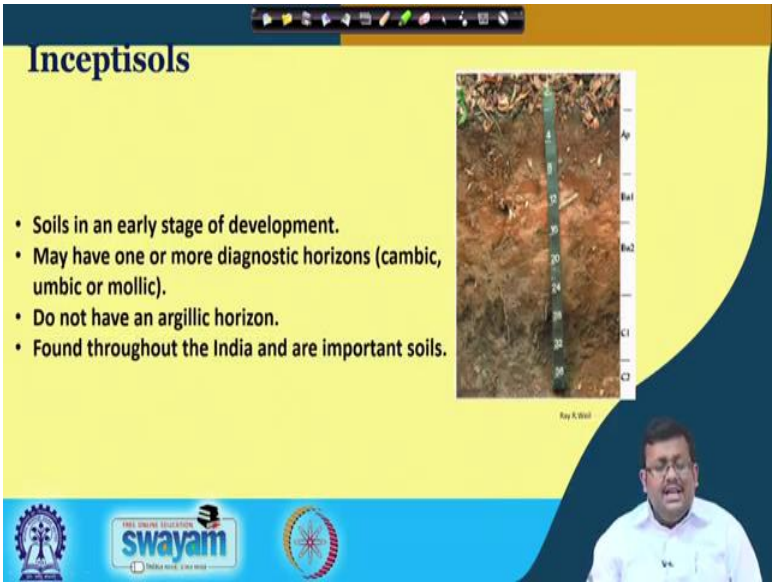

So, this is an example of entisols. The relatively more mature sols is called inceptisols because these soils are in the early stage of development and they may have or one or more diagnostic horizons like cambic you know umbic or you know mollic and then this umbric actually it u m b r i c. And then so, it should be read as umbric. So, one r is missing and mollic is there. So, these soils do not have any argillic horizons because they are relatively immature and finally, they are found throughout the India and they are very important soils. So, these are you know these are the characteristics of inceptisols.

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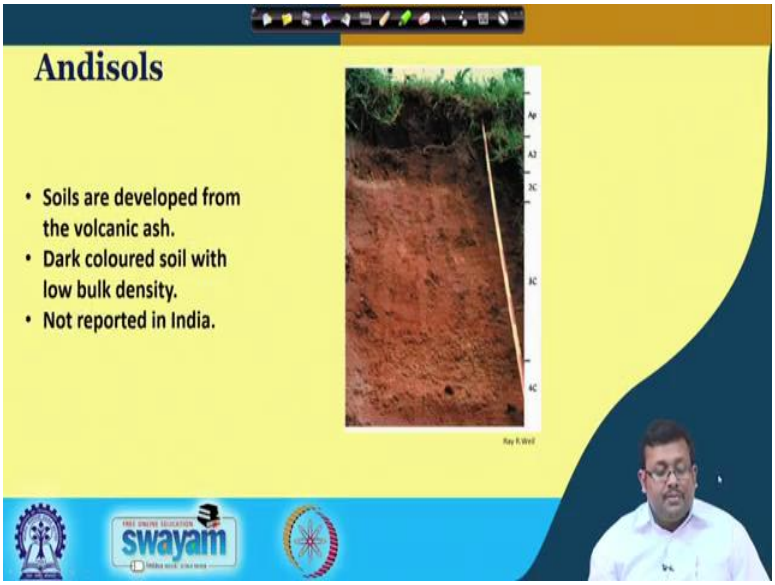


Andisols; Andisols are developed from the volcanic ash and they are dark coloured soil with low bulk density and they are not generally reported in Indian condition or India

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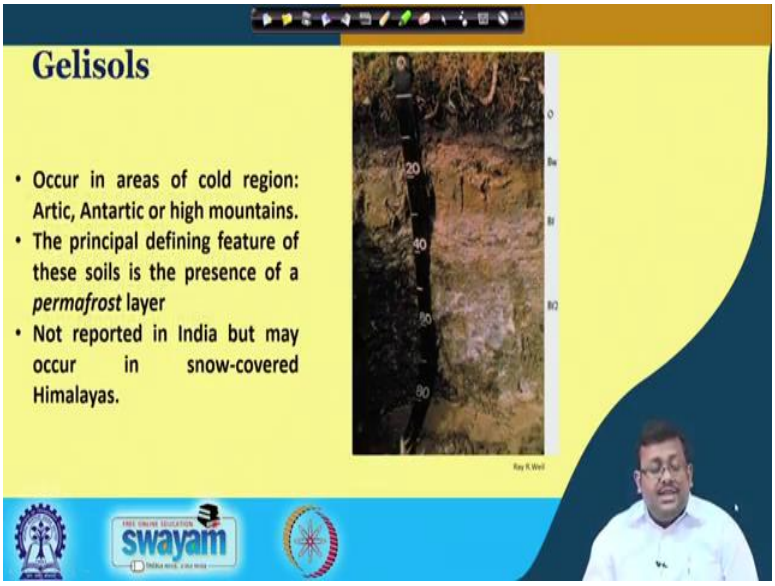


The next one is gelisols, they are occur in cold region especially in the Arctic and Antarctic regions or high mountains. And the principal defining feature of these soils is the presence of permafrost layer and permafrost layer when the soil is frozen for the most part of the year. And it is basically not reported in India, but may occur in some snow covered Himalayan regions.

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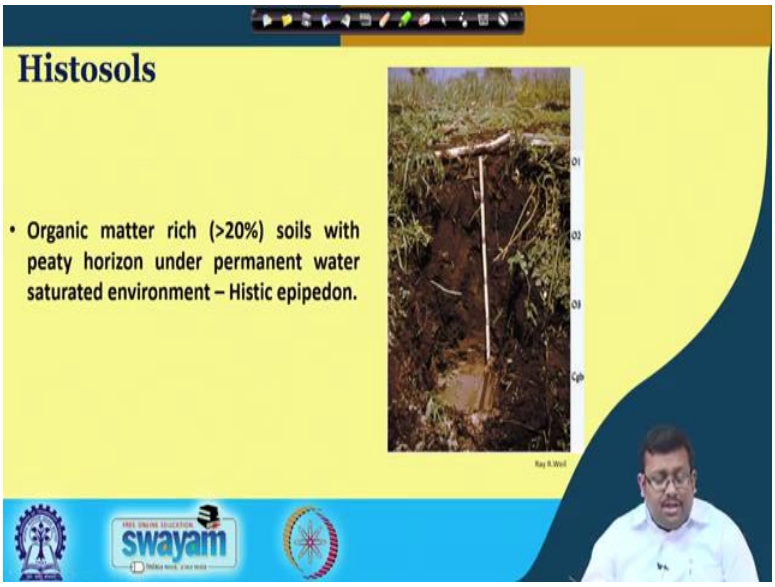


Histosol as the name suggest the organic matter rich more than 20 percent soils with peaty horizons under permafrost water saturated environment or in other words when

you see the histic epipedon. So, when the presence of histic epipedon is evident then it is; obviously, histosols.

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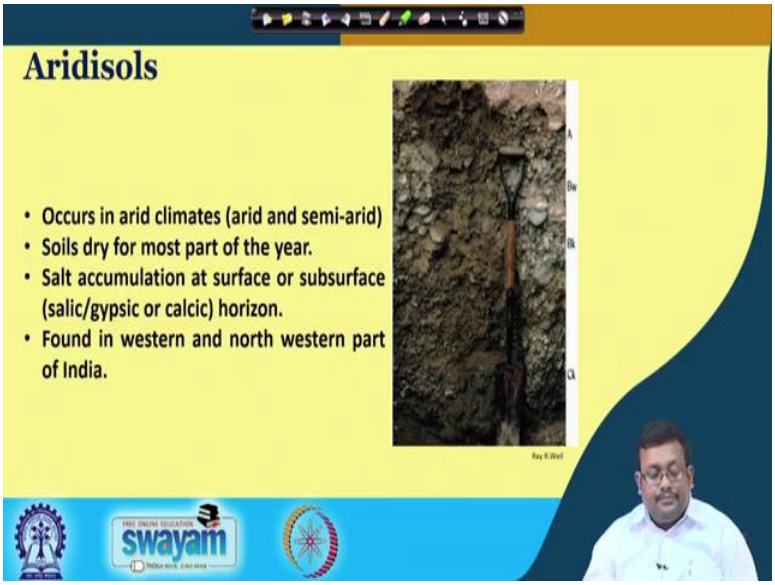


Aridisols as the name suggest occurs in arid climates arid and semi arid region soils are dry for most part of the year. Salt accumulation at surface or subsurface occurs due to the form and forming salic, gypsic and calcic horizons found in western and north western part of India especially in Gujarat and Rajasthan area.

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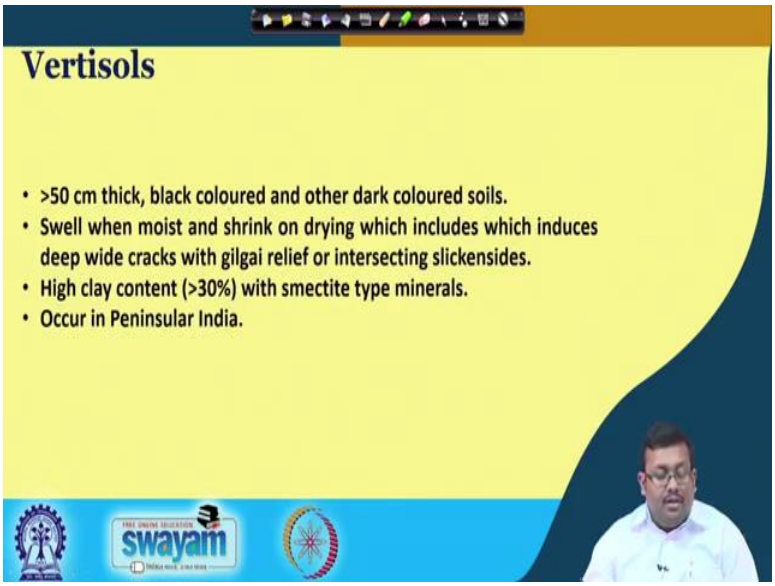

Vertisols are more than 50 centimetre thick black coloured and other black coloured soils and they have a special characteristic they can swell when moist and shrink on drying which includes deep cracks and gilgai relief or intersecting slickensides. And they have got high clay content more than 30 percent of clay content with smectite type of minerals will discuss smectite type mineral later on and basically they occur in peninsula India. And this type of soil you can find in Maharashtra region of India especially the black coloured soil are present and this soils a very good for cotton cultivation.

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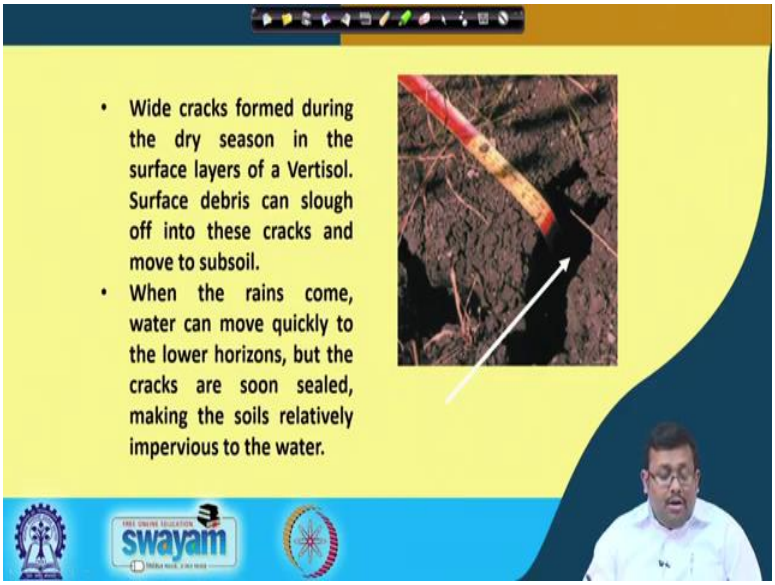


So, you will see that in this type of soil wide cracks are formed.

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So, in this soil you will see that deep cracks are basically formed wide and deep crack as you can see here due to the dry season in the surface layer and you know surface debris can slough off into these cracks and move to the sub surface soils. And when the rain comes water can move quickly into the lower horizons, but the cracks are soon sealed making the soil relatively impervious to the water.

So, these soils basically show shrink and swell property. So, in the dry season when there will be no water, they will form wide cracks and during the wet season when the water enters it will seal those cracks and ultimately the soil will swell. So, this types of characteristics is very important characteristics of vertisols. And let us stop here and from next lecture we will be continuing from here will be continuing from vertisols and will be finishing of all other soil orders.

Till then thank you.