Plate Tectonics
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Week - 11
Lecture – 51
Volcano and its Products- II

Okay friends, welcome to this class of plate tectonics. And, we are talking about these volcano and products. So, if you remember our earlier classes, we were talking about this volcanic system, the volcanoes at different plate boundaries and the magma supply, the lava flows. And we found that this lava composition that depends upon the depth of eruption or this magma chamber from which magma is being supplied to this volcano as well as its contamination and its volatile content. And mostly the volatile in the magma is water followed by carbon dioxide, sulphur dioxide like this. So, if the combination of all those things, the type of volcano they are defined.

And today we are going to discuss about different volcano types based on their eruptions and their products. And at the end of this class, we will talk about the Indian volcanoes. So, we have different volcanoes in Indian subcontinent and some are active and some are extinct. However, they are preserved nowadays also from this Precambrian to recent and we will talk about them.

So, type of volcanic eruption, it is divided into six types. So, the six type division is based on this depth or you can say the height of this eruption as well as the magma flow or this lava flow types. So, this six type if you can say it is Hawaiian type first one. So, the name itself says it is from the Hawaii island, then Strombolian, Vulcanian or Vulcan type, then Vesuvian like Vesuvius, then Plinian, then Ultra-plinian. And if you see this figure here, this is the Plinian type, you see the height of eruption is very high and it is forming an ash cloud.

And here this Hawaiian type if you correlate it, here you see there is no volcanic cone or very low relief volcanic cone having a caldera or a crater here. However, the Plinian type you see the slope, it is forming a pile of material. However, there is no pile of material or this pile material are low slope. So, that means most of this volcanic product that is the lava which is flowing as water. So, that this low slope is there and it is mostly the mafic lava which is flowing and once you are reaching at the end product, so that is

the Plinian type or the Ultra-plinian type, you see the height of eruption is very high.

However, here there is no height of eruption, it is on this ground level this lava is coming out and is pouring as water pores from an artesian well. So, here these volcanoes are classified and based on this explosiveness and based on the height of erupting column. So, now you see the Hawaiian type the eruption is less than 2 kilometer or 6500 feet and gradually if you see the explosiveness it is increasing and this height of this ash or volcanic product gradually it is increasing and increasing. So, based on that these volcanoes are classified into 6 categories. First we will talk about this Hawaiian type of eruptions.

So, here you see the Hawaiian type of eruption the lava it is forming an artesian type of eruption and this lava is pouring down like the water force from the hill like streams so, these are characterized by quite erupting of lava or quite eruption of lava that means no explosion, no sound. So, just it is lava is flowing and without strong shocks or explosion no shocking, no blasting or so. Lava coming out of Hawaiian eruption is very fluid and could travel for kilometers. So, it can be seen here from this animated figure and gases trapped in the lava are released smoothly therefore, this lava forms a smooth surface. Now if you remember our earlier classes when we were talking about this gaseous system or the mixture of magma it is a mixture of gaseous that means volatiles as well as the lava.

So, at depth this gaseous material they are in the saturated form with this lava. So, once they are coming close to the surface due to release of pressure this gaseous material they are released and this volatiles they released and remaining lava it is flowing down or pouring down you can say in terms of how the water flows from the streams. So, as this magma or the lava is very smooth and it is low viscosity it can easily allows this volatiles to escape that is why volatiles are escaping in a separate phase and this lava is flowing as a separate phase. Next one is the Strombolian eruption. So, Strombolian eruption that means are characterized by effusive eruptions forming lava fountains.

Now you see here this is the animated video that is how this lava fountain is there that means it is a fountain type lava is just going like artesian-type of eruption. So, here also it is effusive type that means lava pours down. So, that is effusive type and the Strombolian type eruptions are regularly and moderately explosive that means you see starting from the Hawaiian once we are reaching from the Strombolian the degree of explosiveness is increasing. So, that is why it is moderately or regularly explosive and lava effusions form layers of solidified material and give rise to stratovolcanoes. For example, here if you see this figure we have stratovolcanoes that means we have one

layer of lava flow another layer of this ejecta or this material which are erupted or which are falling down from the eruptions.

So, we have different layers one layer is purely lava flow another layer is this material which is falling down like volcanic ash, lapillae like that. So, these are stratified one layer after another that is why it is called the stratovolcanoes. The third one that is called Vulcanian eruptions or this Vulcun type eruption. So, this Vulcun type eruptions are marked by violent explosions. Now here the violence is introduced here starting from the Vulcanians.

So, this earlier one this Hawaiian type and the Strombolian type they are less eruptive or that can less explosive rather, but violent type of explosion that started from the Vulcanian type and often destroying the cone they came from. So, we know that the volcano they form this cone type and depending upon the magma composition. So, when there is explosion see part of this volcano part of this cone it is destroyed and due to destruction this magma which is or the lava which is ejected from this volcano is spreads that means it is going to into the atmosphere. Now if you see here how high this ejection is, this lava which is ejected up to this different height. So, depending upon the strength of this volcano and depth of volatile content.

Then the explosion involves emission of volcanic bombs, gas cloud and large quantity of ash. So, volcanic bomb what is volcanic bomb, what is gas cloud and what is other things we will talk in next few minutes. So, at this time just you say it is one of this eject product. So, that one of the volcanic product it is bomb that means it is shape it is near about rounded shape that is why it is called bomb. Then gas cloud you can see a cloud of huge amount of gas is released from here and large quantity of ash.

So, gradually the explosiveness as increases the amount of material also increasing particularly those materials which are ejecting to the atmosphere from this volcano their percentage is also increasing. And the emission consists of very viscous lava rich in silica and large quantities of gas. Here comes this chemistry. So, once this silica content increases that means it long-chain silicate structures are able to develop. So, that means the stiffness of this lava increases.

At the stiffness of this lava increases so that means magma becomes very viscous. So, for erupting a viscous magma it needs tremendous force. That is why this trace is released with violent explosion so that this explosion can takes place in this siliceous magma. So, whenever there is siliceous lava is associated there is violent explosion is

also associated with that. Then another type it is called Vesuvius type of eruption it is coming from the Vesuvius.

So, here the eruptions are similar to this Vulcan type eruption. However they can be characterized or distinguished that very heavy initial explosion that emits this magma chamber completely. So now you see whenever this magma is stored in this magma chamber this eruption is so high that this total magma chamber become empty. So now you see if you remember our earlier classes when we were talking about the presence of magma at this magma chamber it is providing support to the overlying or this overburden. So now it becomes empty so that means a void space is created and to compensate that void space this volcanic part of this volcano it is subsiding down.

So this caldera subsidence it is one of this primitive region for this type of empty of this magma chamber and this Vesuvian type of eruption it is distinguished from this previous one that is the Vulcanian type of eruption this is the empty of this magma chamber. So that means the total magma chamber becomes empty so that is why there will be caldera collapse and the eruptive material can reach up to 20 to 25 kilometer height. Now you can imagine 20 to 25 kilometer height material so much stress was stored in that system and particularly it is the reason for this felsic nature of this magma. Then Plinian type of eruption the name Plinian eruption is derived from this Pelee volcano and which erupted very violently in 1902. So you can see this eruption is there and a huge cloud of volcanic ash it is forming in the sky and eruptions occurs as a plug formed by solidification of volcanic ducts and this magma is very acidic and therefore extremely viscous and the eruption is quite explosive forming a river of expelled materials.

So now this is the Plinian type of eruption and the volcano is there and this is the volcano and which is characterized by this Plinian type eruption that means due to 20 to 25 kilometer it can send its ash up to depth height. Then another type is called ultraplinian that means again it is more explosive to that. So Plinian in the last classification we had up to Plinian type of so this is another explosion that means we are adding some explosion more so that we are putting it in the ultraplinian type and the explosion of ultraplinian is exceeding the Plinian eruptions. So it is very violent and the eruption is so explosive it disintegrates the entire volcanic structure that means whatever the volcanic cone it was formed earlier and this explosion can totally destroy the volcanic cone. So the volume of expelled material is staggering and it is escaping gas could even impact the global climate.

So if you remember when we are talking about this climate change by the tectonics

process, so you had discussed there that in different geological time the plate motion and subduction there are many times volcanoes are erupted and due to this volcanic action that means huge amount of gas huge amount of dangerous gas it is the atmosphere and is responsible for the climatic change. So the ultraplinian eruptions are the largest of all volcanic eruptions and are so voluminous that large calderas form above the vacated magma chamber. These eruptions are more intense and by higher eruption rate than Plinian one and form higher eruption column. So that means starting from the Plinian, so this ultraplinian it is taking to more volcanic column, so the earlier it was 20 to 25 kilometer so this one is more than that. So that means violent wise it is more and this height wise it is also more and it can totally destroy the volcano structure.

So now after eruption what is the product? This is called pyroclastic material, pyro means fire, so it is coming from fire, so that is called pyroclastic material. And the pyroclastic material if you see this figure it was starting from the dust particle like the ash volcanic ash if you remember when we were talking about the eruption of the Toba volcanic and this ash nowadays we can find in the Narmada valley and other part of the Indian subcontinent. So that means you have tiny particles very tiny particles that can travel about thousands of kilometer through air. So this volcanic product it may be very fine grain particle like ash that is clay size or less than clay size particle and it may be boulder of that means huge size. So here the materials of various size that released from volcano creating an explosive eruption.

So when this system is breaking due to volcanic eruption and this huge amount of gas and ash is going to the atmosphere it is two types of product. One is one product which is from this magma or the lava itself when the lava is erupting it is coming down to this surface when falling it will be atmospheric interaction so it will solidify. So it will create some particles and that particle size may vary. And another type of product which is the explosion or destruction of its own earlier structure earlier volcanic cone was formed and due to subsequent explosion this volcanic structure was totally collapse and it is totally destroyed so it is fragmented. So one type of fragment which is coming from the destruction of its own volcano own structure another type of fragment which is coming from this lava which is solidifying at the atmosphere and it is falling down.

And third product which is the ash very tiny particles which is coming to the atmosphere and is falling down after even if many times or many times later. So that means we have different products one is volcanic ash it is less than 2 millimeters size and the another is lapilli between 2 mm to 64 mm. Then another is volcanic bomb or volcanic block it is more than 64 mm size and this volcanic bomb and volcanic blocks you see this is bomb it is the product of lava if you see its roundness and this is the volcanic blocks you see it is

very angular because this is the fragmentation or fragmented product of this volcano and this is the product of the lava which was ejected to the atmosphere and while it was falling it has taken this rounded or sub rounded type of shape. So these are this volcanic product and this product particularly the ash which are responsible for the climate change because it remains in the atmosphere for years and it is totally caught up the sunlight to the atmosphere and it changes the ecosystem. So that is why in the geological past where there is tectonics boundary that is geological time scale boundary as there many boundaries are demarcated or the many boundaries are witnessed this volcanic eruption and it is cut off of sunlight from this atmosphere to the solar system.

So collectively either these are loose material thrown from a volcano is referred as tepra. So this whole total this material is called tepra individual fragments are referred to general terms that is called pyroclasts. So the collective material it is called tepra, but individual particle it is called pyroclasts. So now you see this pyroclast or the tepra how they are classified one is ash then pumice, scoria, bomb, then spatter, then pelee's hair structure, then reticulate, so there is accretionary lapilli. So their characteristics is written here.

So ash it is mostly fine grained less than 2 mm diameter, whole or the broken crystals. So if you remember last class when we were talking about ash it is mostly the glass particles un-crystallized the glass particles very tiny glass particles and it can go inside our body through our inhales. So that is why this inhaling this volcanic ash it is very dangerous. Then it is pumice there is highly vacculated volcanic glass, vesicles are there. So pumice it is one type of rock it forms it is so light that it can float on water so that is pumice.

Then the scoria it is poorly vaciculated volcanic glass and its density it is same and it can sink in water however it can float on water. The difference between this pumice and scoria is that both density is same however one can float on water another can sink on water that depends upon these vesicles. Then another is bomb that is fluidal clot of magma that particularly cools during flight. So this magma during this artesian activities it is going up while falling down it is forming small type small that means particulates and like water drops and this is taking near about rounded shape that is called bomb. Then spatter, spatter is irregular fluidal clots of magma that can coalescence on impact.

So one to other they can impact together. So while falling one droplet another droplet so their coalescence with each other so that is called spatter. Similarly pelee's hair structure that is hair long thin strands of glass it is while it is falling it is taking a shape of

long chain type. So it is forming this pelee's hair structure. Then reticulate it is polygonal lattice like network of very fine glass rods and very highly vesicular all these things have been discussed in further slides. So this here the eruption type or eruption style says here this ash all kind of volcanoes that can produce ash.

Pumice it is silicic explosive. Then scoria it is explosive eruption particulate strombolite and volcanians. Then similarly bomb, Hawaiian, strombolite and volcanic that means whatever we have discussed so far different types of explosion this materials which are produced that different type of explosion can produce different type of material. And some volcanic eruptions they have also common product so irrespective of their type of eruptions they can produce for example ash every type of volcanic eruption can produce ash. Then pyroclastic material that we have discussed so far these are these different pyroclastic material volcanic blocks, volcanic bomb, lapilli, volcanic ash. So depending upon the size the ash already we have discussed it is less than 2 mm then 2 to 64 that is lapilli and 64 mm above it is block or bomb.

And blocks are solid fragments of volcano that form when an explosive eruption shatters the pre-existing rock. So here this is the difference one is block and another is bomb. When this pre-existing volcanic cone it is shatters and it is destroyed by this volcanic eruption and is made into different fragments that is called volcanic block. However bombs you can see here this material which was ejected from this lava from the volcano as lava and while falling down it is taking different shapes so you can say the volcanic bombs.

So bomb and block this is the difference. Then effect of gas on a lapilli and bomb. So we have lapilli, we have volcanic bomb and now we have gas also. So some gas is also trapped within that rock types. So how it is taking the shapes? Now if you see the presence of a gas in erupting lava can cause lapilli and bomb to take on distinctive form as the lava freezes around the gas bubbles giving the rock a vesicular or you can say hole-filled texture. Here you can say here this lapilli and bomb how this vesicular structure is given.

So one difference is there between this scoria and this pumice is that the pumice forms in the gas-filled felsic lava. However scoria it is the mafic counterpart of this pumice. So both have the same density one is felsic that we say it is the pumice another is the mafic we say it is the scoria and it floats on water it sinks on water because it is mafic that is why it sinks on water. So mafic lava can also form reticulate. Reticulate it is a very rare and fragile rock in which the wall surrounding the bubbles all burst leaving behind a delicate network of glass you can say here.

This wall which is surrounding this structure which is collapsing and it is the glass which are very well connected delicate network of glass it is there and that is called the reticulate type. So this is all about this product of volcanoes and this are volcanic types. Now we will talk about the Indian context. We have number of volcanoes in India and some of them are extinct and some of them are active. And the volcanoes when we say we always it comes in our mind that it should lava erupt should there.

So, it may possible that some of these volcano particularly if you remember when we were talking about this convergent plate margins. So, what is this composition of the plate which is going down it was determined by this mud volcanoes. So, this mud volcano they are coming at this subduction zone and they say about this composition because they consist of clasts which are coming from this higher depth. So, mud volcanoes are there some of the volcanoes they are erupting mud rather lava. So, including this mud volcano we have 7 volcanoes in India and we can say this is extinct, extinct extinct and we have stratovolcano, stratovolcano this is mud volcano.

So, this one is active now this barren island which is in Andaman Nicobar island this is active at present and otherwise you can say most of them are extinct and this is you can say dormant type and this is mud volcano. So, let us talk about individually first is the barren island. So, you can say how this lava is coming out and this gas is coming out. Barren island it is active volcano in the South Asia it is located in Andaman Sea around 138 kilometer away from this Port Blair and this first and the last eruption occurred in the year 1787 to 2017 respectively. So, here as it is active now, so we can visit there to see this lava and something else.

Then another volcano that is you can say it is dormant now it is this Narcondam island. So, it is a small volcanic island around 6.8 square kilometer area it is situated in the Andaman Sea. So, this is active and this is dormant. Then another is this is the Baratang island this is the mud volcano you can see here this is the field photograph is the mud volcano it is Ranchiwalas island it is the Andaman island again.

So, it is an area of 242.6 square kilometer. So, this mud volcano if you remember when we were talking about this convergent plate system they are very peculiar at the convergent margin and at the Andaman where the Indian plate is subducted under the Indo-Burmish arc. So, that is why this presence of mud volcano is there. So another is the Deccan trap very familiar this is the Deccan plateau basalt, basaltic flow it is flow is around 500 kilometers or so. You see Mumbai and Jabalpur distance so much, but still we have this extension of the Deccan trap and at present this whatever the exposure is

there much part of this exposure it is to the peripheral side it has been eroded, but this basaltic lava flow it is forming a prominent geological domain in the Indian geology. So, Deccan plateau it is located in Maharashtra and the adjacent states and covers an area around 5 lakh square kilometer and visible step or stairs and it solidified flood basalt.

So, this steps and stairs like appearance that is why it is called traps. So, that is trap that is we say Deccan trap, Rajmahal trap. So, this is different trap we used. This trap is not an English term it is from Greek term it coming from Trappa.

So, Trappa means steps. So, here we can say the different steps, step like appearance. So, this is one flow this you can say the youngest flow then this another flow third flow fourth flow like that. So different flows of different generations they are stacked one after another and giving a step like appearance that is why it is called trap. So, within that we have also intertrappians which are the sedimentary layers. Then in the geological map if you see this extension of this Deccan trap it is huge and these are the field photographs different layers of the basaltic lava flows they are here and many mineral deposits like this chromite deposit and aluminum that is bauxite deposit are also found in the Deccan trap.

So, this one another one this is Dhinodhar hills it is in Gujarat it is an inactive volcano or it is an extinct volcano. Its elevation is around 386 meter and is extinct volcano located around 75 kilometer from Bhuj. So, these are the field photographs. So, as their extinct volcano no more description is required. And Dhosi hill it is Aravalli hill range it is in Haryana you can see these are the field photographs and this is the Google Earth image how this is the crater and this is the product of volcanoes.

So, in Haryana we have Dhosi hill volcanoes and another is the Tosham hill it is also in Haryana in Aravalli range this is the extinct volcano which in average elevation of 207 meter it is part of this Aravalli mountain range in Haryana. So that means Indian context we have both Dormant volcano, we have active volcano, we have extinct volcano as well as we have a mud volcanoes and the product we have already discussed. So, this is all about your volcanic product. So thank you very much we will meet in the next class.