Gr 11 Geography

GEOMORPHOLOGY

TERM 2 – WEEK 1

TOPOGRAPHY ASSOCIATED WITH HORIZONTALLY LAYERED ROCKS:

- Characteristics and processes associated with the development of:
  - ✓ Hilly landscapes
  - ✓ Basaltic plateaus and
  - ✓ Canyon landscapes
- Karoo landscapes
- Concept of scarp retreat or back wasting and
- Utilization of these landscapes by people

IMPORTANT TERMS AND DEFINITIONS (Concepts)

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1. **Weathering:** the breakdown of rocks into smaller pieces, mechanical, due to temperature differences, chemical, due to chemical reaction with minerals in the rock and water, or biological, where plants or animals break the rocks down.
2. **Erosion:** the removal of broken rock material by an agent such as wind, water or ice.
3. **Horizontally:** parallel to the horizon
4. **Strata:** layers of rocks
5. **Bedding plane**: a plane separating layers of rocks

IMPORTANT TERMS AND DEFINITIONS (Concepts)

6. **Sedimentary rocks:** rocks form from layers of sediment (deposited material) such as mud, sand or larger particles of rock, e.g sandstone, shale and dolomite.
7. **Igneous rocks:** forms from molten magma or lava, e.g granite (intrusive) and basalt and dolomite (extrusive)
8. **Intrusive** – below the surface of the Earth
9. **Extrusive –** above the surface of the Earth (you can see it)
10. **Elevated –** situated or placed higher than the surrounding area

IMPORTANT TERMS AND DEFINITIONS (Concepts)

11. **Fissures** – cracks in the surface of the Earth where lava can flow out from.
12. **Canyon** – deep valleys with steep, stepped sides.
13. **Scarp** – very steep bank or slope
14. **Pediment** – broad, gently sloping expanse of rock debris extending outward from the foot of a mountain slope.
15. **Back wasting** – slopes eroding back parallel to their original position, common in dry climates where there is very little surface water runoff, also known as scarp retreat
16. **Mesa** – flat-topped hill with the distance across its top being greater than its height

IMPORTANT TERMS AND DEFINITIONS (Concepts)

17. **Butte –** smaller than a mesa; flat topped hill with the distance across its top being less than its height
18. **Conical hill** – rounded hill that forms after the resistant cap rock of a mesa or butte has been removed by weathering and erosion.
19. **Scarp retreat** – see back wasting definition

TOPOGRAPHY ASSOCIATED WITH HORIZONTALLY LAYERED ROCKS

Horizontally layered rocks refer to **sedimentary rocks** as they are layered.

Sedimentary rocks form from deposits of sediment that are built up in a series of layers on the sea floor.

Parallel layers of sedimentary rocks are called **beds or strata**.

The junction (where layers join) between sedimentary layers are called **bedding planes.**

An image of sedimentary rocks

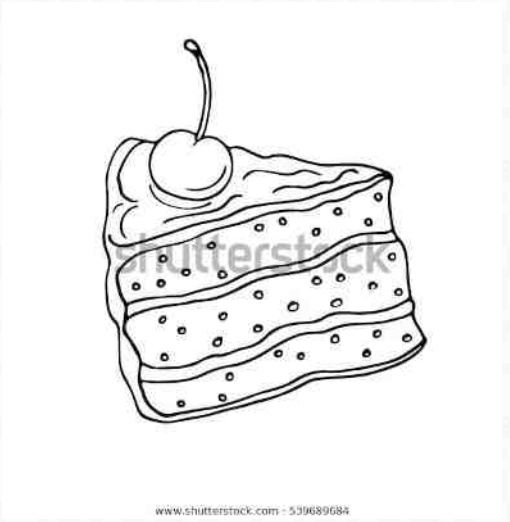
TOPOGRAPHY ASSOCIATED WITH HORIZONTALLY LAYERED ROCKS

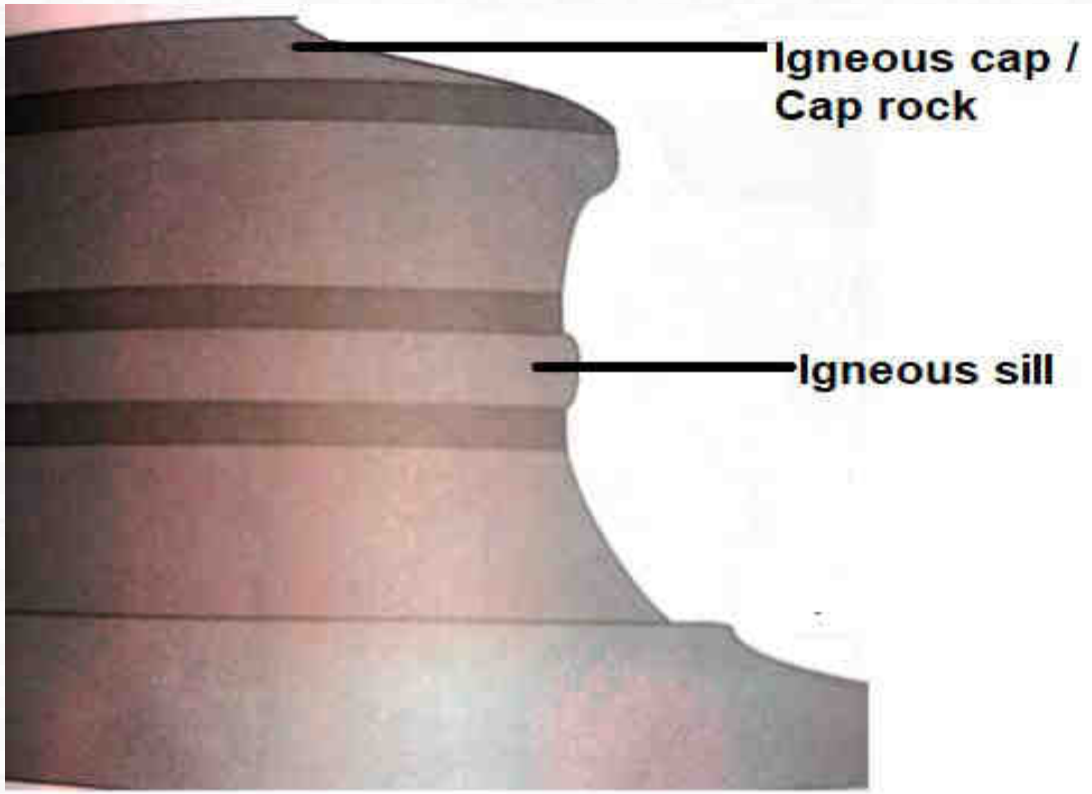
The following link can be followed if you want to revise the formation of sedimentary rocks as was explained in Gr 10.

https://www.rocksforkids.com/sedimentary-rock/

TOPOGRAPHY ASSOCIATED WITH HORIZONTALLY LAYERED ROCKS

- As is shown in the following diagram, sedimentary rocks are sometimes covered by a layer of igneous rock called cap rock or intruded by a layer of igneous rock called cap rock or intruded by a layer of igneous rock called a sill.
- Cap rock is like the icing on top of a layered cake and sills are like the icing in between.




Igneous cap /
Cap rock
Igneous sill

Characteristics and processes associated with the development of …. Hilly landscapes

WET AND HUMID AREAS CHARACTERISTICS:

- ✓ slopes are rounded
- ✓ Undulating landscapes (moving in waves)
- ✓ Deep soils on slopes
- ✓ Rocks are horizontally and sedimentary and uniformly resistant to erosion
- ✓ Steep hilly landscapes develop.

Characteristics and processes associated with the development of …. Hilly landscapes

WET AND HUMID AREAS PROCESSES:

- ✓ Chemical weathering is most active
- ✓ Therefore decomposition of rocks by chemically changing weathering
- ✓ Chemical weathering includes:
  - **Hydrolosis** – carbon dioxide mixes with rainwater to form a carbonic acid.
  - **Dissolution** – rock material becomes a solution like salt in water. Calcium carbonate in water forms a carbonic acid in solution
  - **Oxidation** – oxygen combines with iron in a rock and rust occurs
  - **Plants and bacteria** – roots can force rocks apart and allow water into the rock. Roots also release chemicals that weakens the rock. Burrowing and digging by animals allow the rock to be exposed to the elements.

Valley of a Thousand Hills - KZN

Valley of a Thousand Hills - KZN

CLASS WORK:

Study the photo on the previous slide and list some characteristics you can identify

Rounded slopes

Steep slopes

Undulating landscape

Horizontally sedimentary rocks – uniformly resistant to erosion

Characteristics and processes associated with the development of …. Hilly landscapes

ARID AREAS CHARACTERISTICS:

- ✓ Landscapes are more rugged and angular
- ✓ Weathering and erosion of horizontal layers of rock leads to steep and uneven slopes
- ✓ Soils are coarse and thin

Characteristics and processes associated with the development of …. Hilly landscapes

ARID AREAS PROCESSES:

- ✓ Mechanical weathering is active due to lack of water
- ✓ No chemical change in the rocks
- ✓ Rock is physically broken down into smaller fragments
- ✓ Mechanical weathering includes:
  - **Ice wedging** – water seeping into cracks in rocks freezes and expands – expansion causes the rock to break apart
  - **Exfoliation** – during the day – hot temperatures cause the rock to expand and at night cooler temperatures cause the rock to contract – expansion and contraction weaken the rock and layers peels off.
  - **Sandblasting** – wind carrying grains of sand wear away the weaker layers of rock
  - **Lightning strikes** – rocks split when hit by lightning

Badlands – hilly landscapes in arid areas

Badlands – hilly landscapes in arid areas

CLASS WORK:

Study the photo on the previous slide and list some characteristics you can identify

More rugged and angular

Thin soils

Steep and uneven slopes

CLASS WORK ACTIVITY

Compare a hilly humid landscape with a hilly arid landscape. Complete the following **table** to show differences.

LANDSCAPE	HILLY HUMID	HILLY ARID
SLOPES		
DOMINANT TYPE OF WEATHERING		
SOILS		
VEGETATION COVER		
PROCESS OF FORMATION		

Characteristics and processes associated with the development of …. Basaltic plateaus

CHARACTERISTICS:

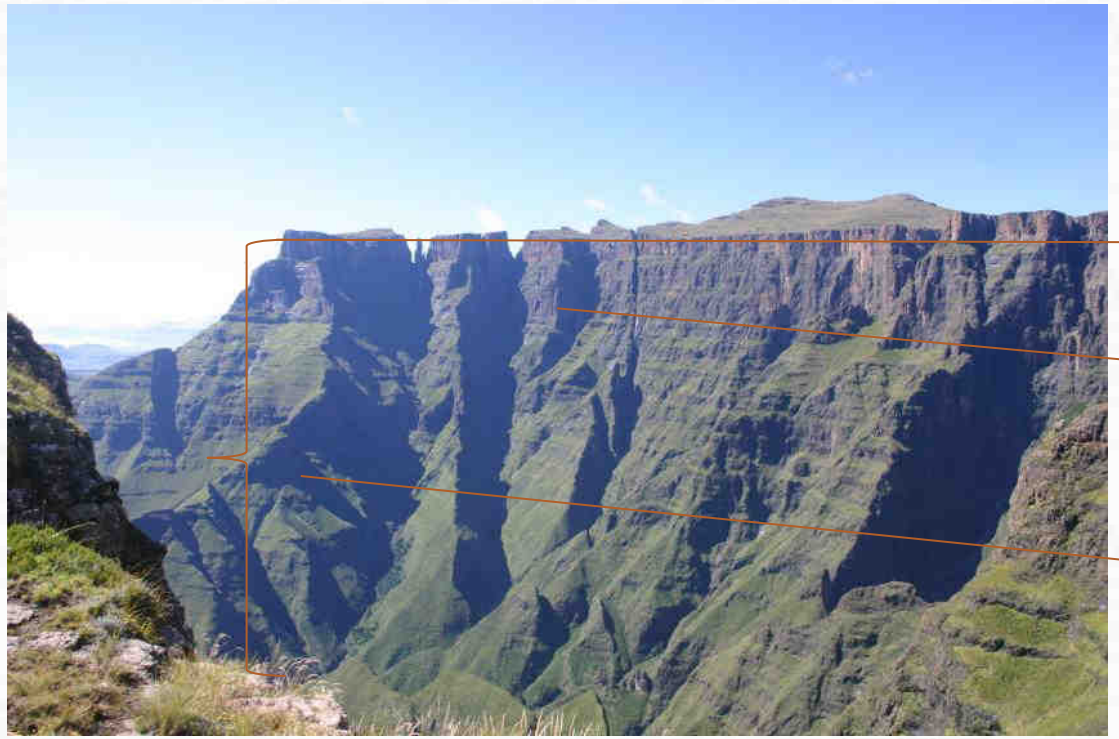
- ✓ Flat top landforms and elevated thousands of metres above sea level
- ✓ Found on every continent
- ✓ Landform must have at least one steep side
- ✓ Vertical joints on basalt layers due to shrinkage when cooling
- ✓ Basalt is uniform in resistance to weathering and erosion and results in flat plateaus with steep cliffs
- ✓ Deep clefts form owing to weathering along vertical joints.

Characteristics and processes associated with the development of …. Basaltic plateaus

PROCESSES:

- ✓ Some plateaus formed as result of upward movement of the Earth's crust.
- ✓ When Gondwanaland broke up million years ago, large fissures formed on the Earth's crust and magma welled up from deep below the surface.
- ✓ Lava flowed from these fissures over the surface as huge horizontal sheets of molten rock and built up a high flat landscape.
- ✓ Outpour lasted very long and covered about the whole of SA – lava built up to a layer of 1,5 km in the area of Drakensberg and up to 5km in other areas.
- ✓ Lava flowed as far as Zimbabwe.

Characteristics and processes associated with the development of …. Basaltic plateaus



Steep cliffs

Deep clefts owing to weathering along vertical joints

Depth of the basaltic layer

Characteristics and processes associated with the development of …. Canyon landscapes

CHARACTERISTICS:

- ✓ Also known as a gorge
- ✓ Form deep, steep-sided valleys with narrow valley floors.
- ✓ More common in arid areas due to more active mechanical weathering
- ✓ Most famous in the world – Grand Canyon – formed by the Colorado river.
- ✓ Second largest canyon is the Fish River Canyon in Namibia.

Characteristics and processes associated with the development of …. Canyon landscapes

PROCESSES:

Follow the following links to visualise this process

https://www.nationalgeographic.org/encyclopedia/canyon/

https://www.youtube.com/watch?v=t6IBg4Srb6E

https://www.youtube.com/watch?v=-v_RLRT9930

Characteristics and processes associated with the development of …. Canyon landscapes

PROCESSES: (In a paragraph of not more than eight lines, describe how Canyon landscapes form)

- ✓ Develops over long period of time
- ✓ Vertical erosion is dominant
- ✓ Upliftment takes place and river cuts down into the horizontal layers forming steep-sided valleys
- ✓ Over time valley becomes deeper
- ✓ the deeper the valley – the faster the erosion becomes: canyon well channels water in the river into a smaller area.
- ✓ This is the reason for the side top and narrow valley floor

Characteristics and processes associated with the development of …. Canyon landscapes

PROCESSES: (In a paragraph of not more than eight lines, describe how Canyon landscapes form)

- ✓ Develop in areas of alternating horizontal layers of resistant and less resistant rocks such as sandstone and shale
- ✓ More resistant layers form vertical cliffs; less resistant layers form gentle slopes
- ✓ Overall effect is step-like valley with a river on the canyon floor.

FISH RIVER CANYON IN NAMIBIA

Resistant layer – vertical cliffs

Vertical erosion or down ward erosion

Less resistant layer – gentler slopes

CLASS WORK ACTIVITY - CANYONS

Study the following FIGURE showing a Canyon landscape and answer the questions that follow:

CLASS WORK ACTIVITY - CANYONS

1. Define a *canyon*.
2. Make use of the photo and list some characteristics of a canyon.
3. In a paragraph of not more than EIGHT lines, describe the formation of canyons.

KAROO LANDSCAPES

CHARACTERISTICS:

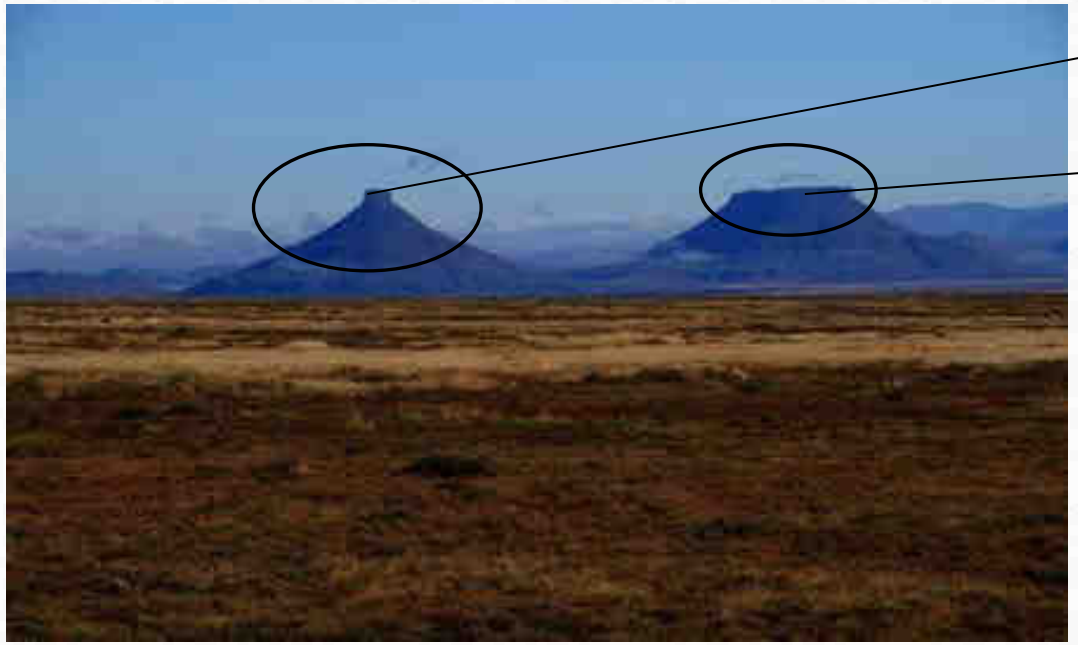
- ✓ Forms due to erosion over millions of years
- ✓ Characterised by flat-topped hills separated by wide flat plains
- ✓ Dolerite sills form the flat tops of the hill – more resistant to erosion.

KAROO LANDSCAPES

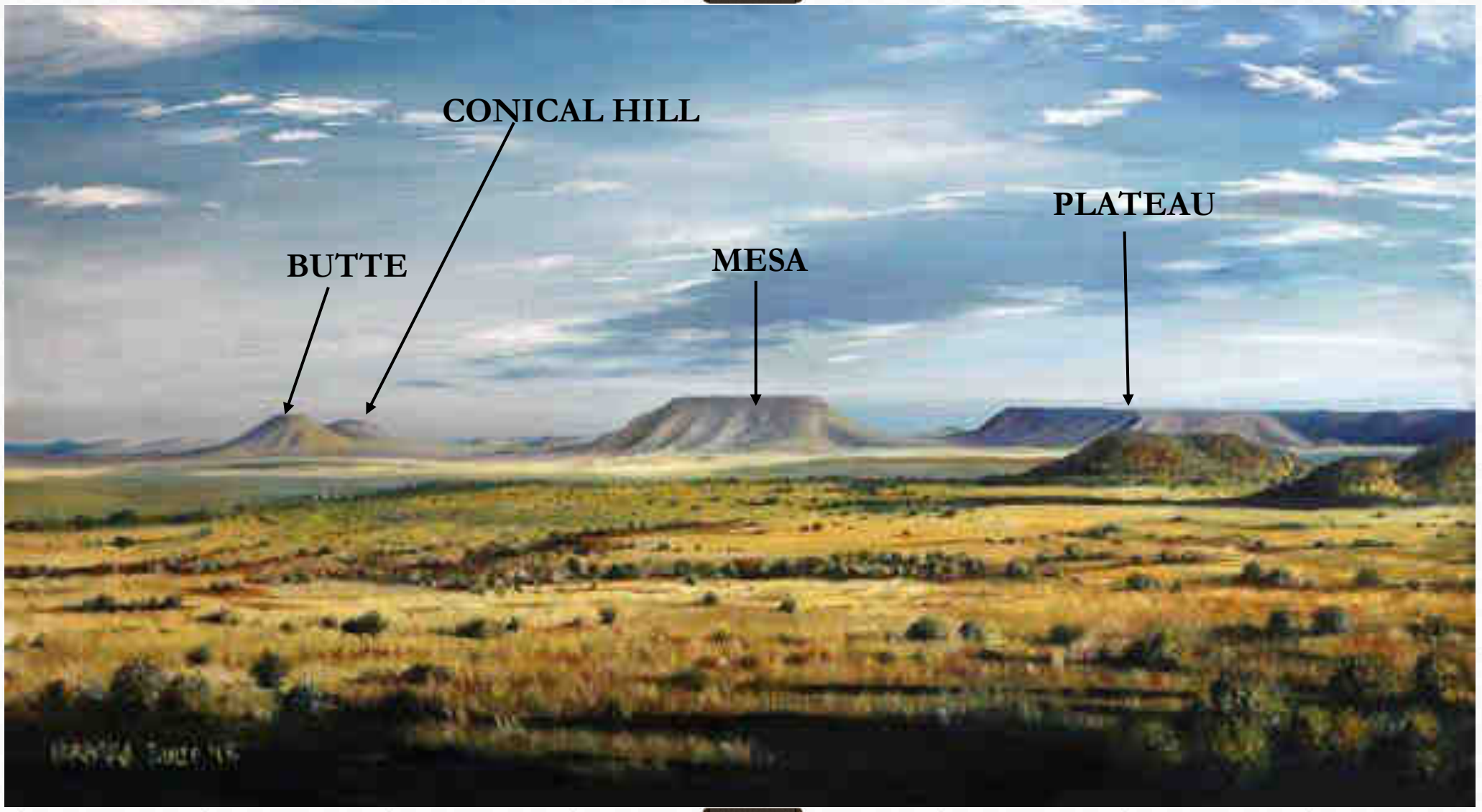
PROCESSES:

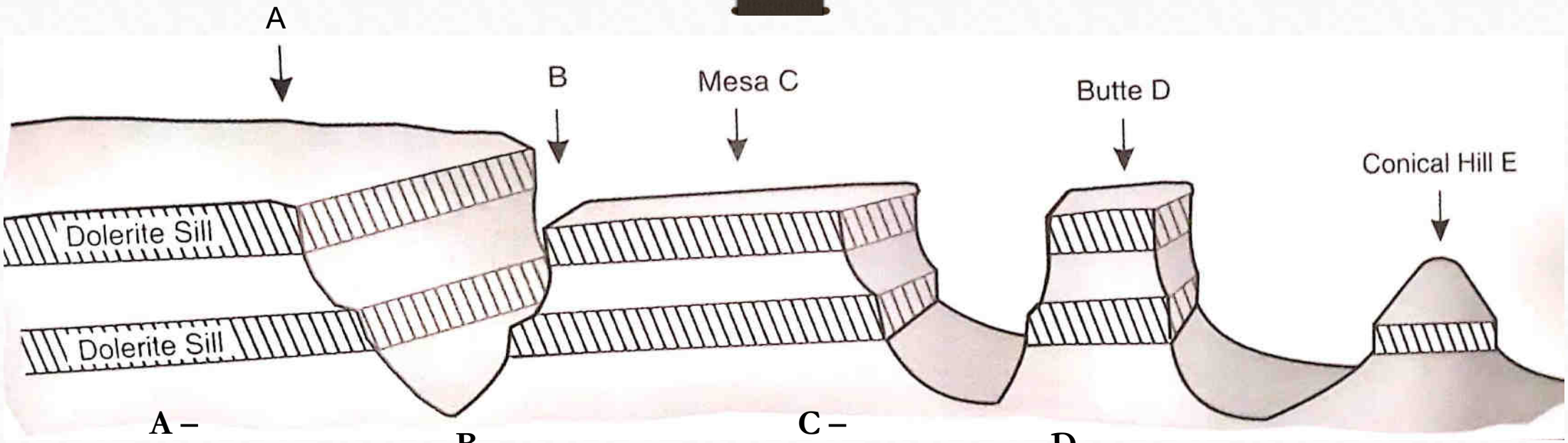
- ✓ Magma intruded between horizontal layers of sandstone and shale that had formed over most of SA.
- ✓ Magma cooled and formed horizontal sills
- ✓ Layers of sedimentary rocks were removed by weathering and erosion – sills of dolerite were exposed.
- ✓ Typical in Karoo with flat-topped hills.
- ✓ Dolerite is more resistant to erosion than the sandstone and shale.

KAROO LANDSCAPES



https://www.123rf.com/photo_56715952_karoo-landscape-in-south-africa.html


CONICAL HILL
BUTTE
MESA
PLATEAU



A –

River carve its course across a plateau

B-

Rejuvenation /uplift cause river to erode downwards into layers of rock – canyon may form

C –

Further erosion of slopes of plateau will result in development of a mesa

D –

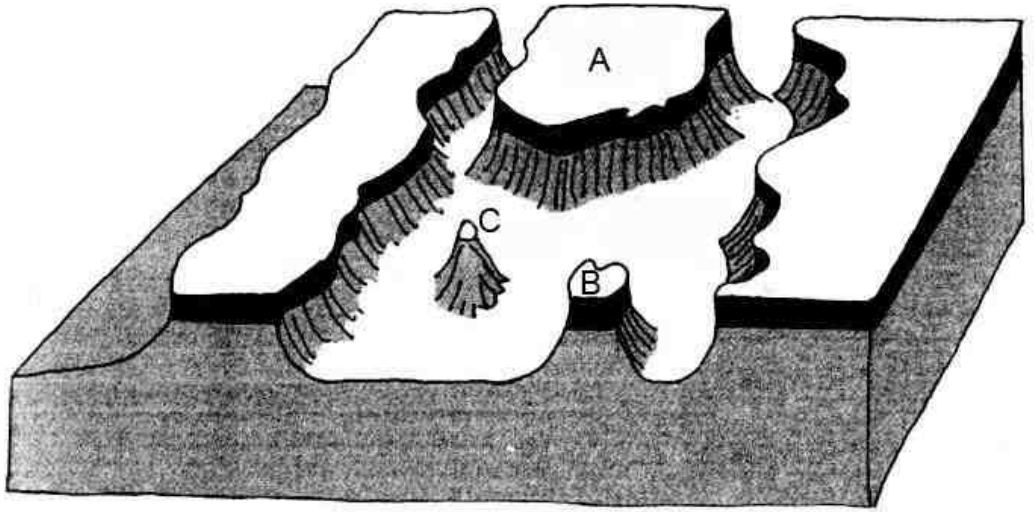
Erosion of slopes of the mesa will result in formation of butte

E –

When harder dolerite sill has been eroded (removed) a conical hill remains

CLASS WORK ACTIVITY

The following FIGURE illustrates a characteristic Karoo landscape found in areas with horizontal strata:



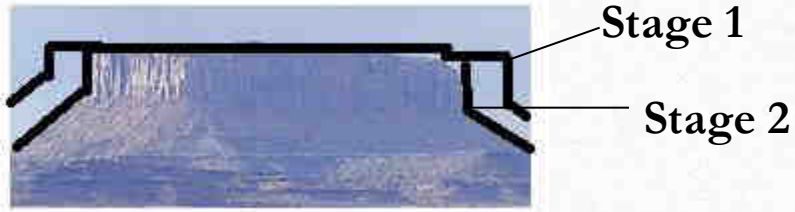
CLASS WORK ACTIVITY

1. Identify the flat-topped hill at A. (1 x 1) (1)
2. Describe the cap rock on top of this flat-topped hill mentioned in QUESTION 1. (1 x 2) (2)
3. State how C can be differentiated from A and B. (1 x 2) (2)

SCARP RETREAT OR BACK WASTING

Over time, through scarp retreat and back wasting plateaus are reduced to mesas and mesas are reduced to buttes.

STAGES OF SCARP RETREAT OR BACK WASTING



STAGES OF SCARP RETREAT OR BACK WASTING

STAGE 1: (original position)

Pieces of rock fall from the cliff face, cliff wears back parallel to the original position. Broken pieces collect on the talus slope below. Angle of the talus slope remains parallel to its original position.

STAGE 2: (later position)

Where scarp retreat and parallel back wasting take place, plateau area decreases but cliff (scarp) and talus keep the same angle.

ACTIVITY – SCARP RETREAT IN THE DRAKENSBERG

Study the photo showing a part of the Drakensberg near the Golden Gate and answer the questions that follow.

ACTIVITY – SCARP RETREAT IN THE DRAKENSBERG

1. Name the two main types of rocks that make up the Drakensberg.
2. Explain the meaning of *caprock*.
3. Give evidence from the photo to proof that the top layer of rock is more resistant to erosion than the rock layer below.
4. Explain the process of scarp retreat
5. Draw a diagram to show how this landform will change due to scarp retreat or backwasting.

UTILISATION OF LANDSCAPES BY PEOPLE

HILLY LANDSCAPES: HUMID

- Soils are more developed – agricultural activities
- Slopes are better drained due to vegetation cover and contour ploughing – therefore limit soil erosion
- Heavy farming machinery will be limited on steep slopes

UTILISATION OF LANDSCAPES BY PEOPLE

HILLY LANDSCAPES: ARID

- Slopes are more rugged.
- Limited use of land due to less water and soils are thinner
- Limited cultivation of slopes
- Large scale erosion due to lack of vegetation
- Grazing is more suitable

UTILISATION OF LANDSCAPES BY PEOPLE

BASALTIC PLATEAUS

- Weathered basaltic rocks produces fertile soil rich in iron
- Fertile soil and high rainfall – produce good agricultural land
- High altitude plateaus can experience low temperatures in winter – not suitable for agricultural activities
- Access to high plateaus will be limited and requiring building of mountain passes which are expensive

UTILISATION OF LANDSCAPES BY PEOPLE

CANYONS:

- Steep sides and limited valley floor space – difficult to farm
- Water on valley bottom not always accessible
- Form physical barriers as they are too wide to build bridges across
- Tourist value due to beauty

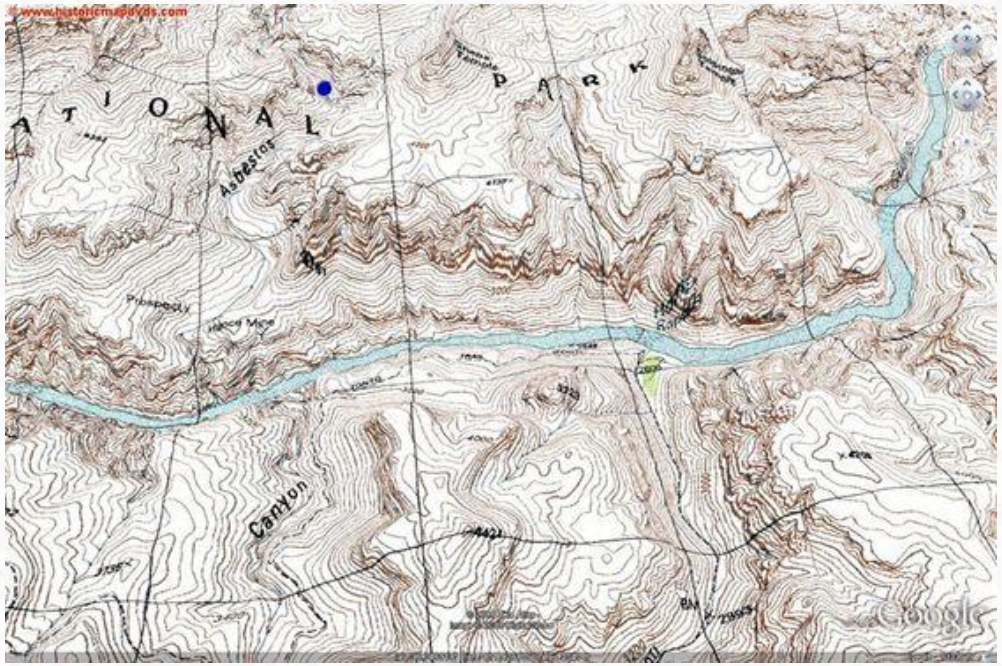
UTILISATION OF LANDSCAPES BY PEOPLE

KAROO LANDSCAPES:

- Flat and easy for farming
- Flat and easy for building urban areas and transport routes
- Mostly in dry areas – limit agricultural activities
- Soil is thin and rainfall is limited
- Rainfall in form of thunderstorms – sheetwash will increase run-off – no infiltration
- Large-scale sheep farming takes place
- Tourist destination

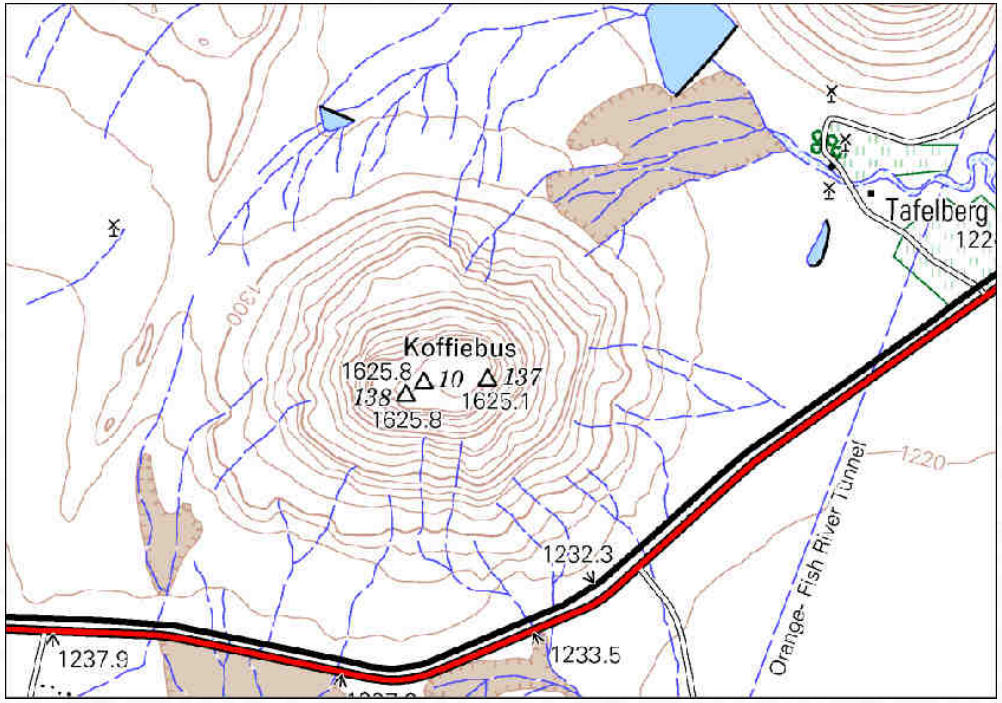
MAPWORK – CONTOURS AND LANDFORMS

CANYON



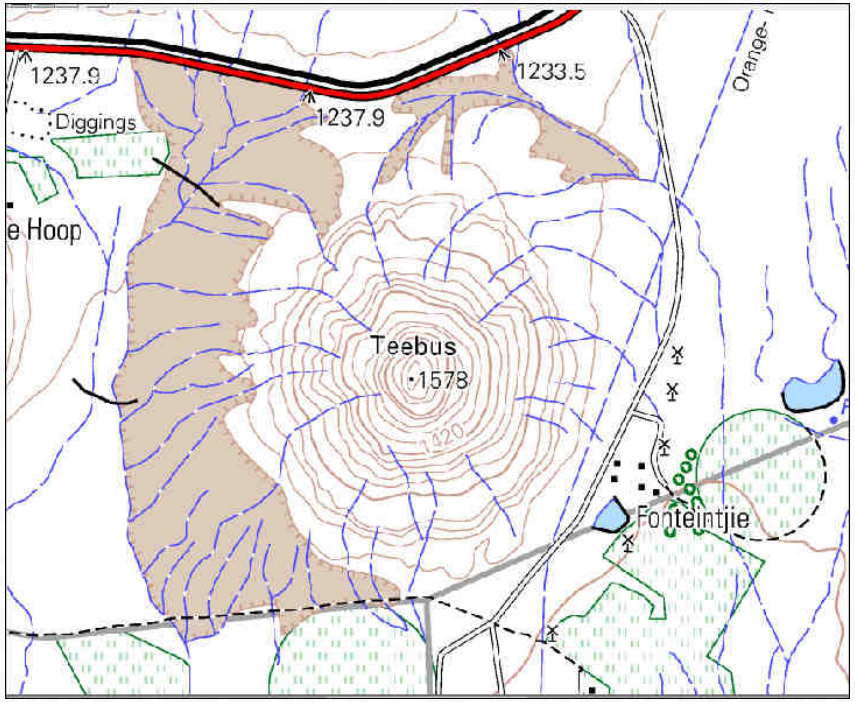
MAPWORK – CONTOURS AND LANDFORMS

MESA



MAPWORK – CONTOURS AND LANDFORMS

BUTTE



CROSS SECTIONS

The following links will explain how to draw a cross section on a map

https://www.youtube.com/watch?v=9w-KOodmiZc

https://www.youtube.com/watch?v=BH6fxgAKHCU

https://www.youtube.com/watch?v=y3hPFCW9f7M