OPSC STUDY: Geography Optional (UPSC & OPSC)

Optional Test Series: Test 1 (Geomorphology)

Syllabus: *Origin of the earth, Physical conditions of the earth's interior; continental drift; isostasy; plate tectonics; mountain building; volcanism and earthquakes; weathering and erosion, Concepts of geomorphic cycles (Davis and Penck), Landforms associated with fluvial, arid, glacial, coastal and karst region, Polycyclic landforms.*

: Maintain INTRO-BODY-CONCLUSION format when possible

: Use Heading and Subheading for answer clarity (better presentation and understanding)

: Stick to the Keywords (what the question demands?)

: Use Maps / diagrams/ flowcharts to enhance the quality of content.

: You must practice writing in timely and economical manner (60 MARKS: APPROX. 6 PAGES OR 1000 WORDS)

: Use paragraph style of writing instead of bullet form

Note: The model answers may exceed the word limit sometime. Thus, whenever you are writing you can shorten the answers through writing crisp answers (eliminating detailed explanation). Otherwise, you can use map, diagram or chart to explain the same answers in short.

1. **Write an essay on geomorphic cycles with reference to the theories explained by Davis and Penck. (60 marks)**

Format:

Intro

Davisian Cycle of Erosion

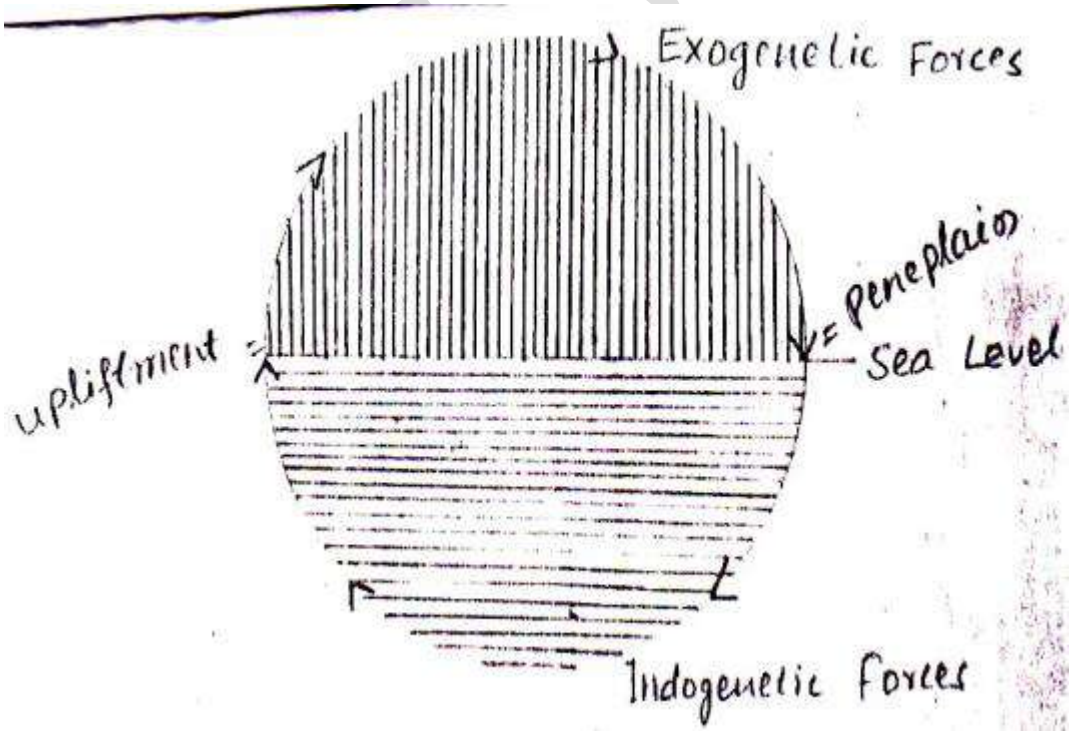
- ✓ Theory
- ✓ Stages and features

- ✓ Interruptions to the cycle of Erosion
- ✓ Positive Aspects
- ✓ Drawbacks

Penck's Cycle of Erosion:

- ✓ Theory
- ✓ Stages and features
- ✓ Positive Aspects
- ✓ Drawbacks

Broadly speaking Geomorphology is the study of land forms which is a composite result of different exogenetic activities operated on that land or on that region. But exogenetic activities try their best to make a balance with that of endogenetic and their ultimate level of balance is the sea level below which that cannot perform their respective work. so, the balance between these two activities in a cyclic process is known as the cycle of erosion.



Davisian Cycle of Erosion:

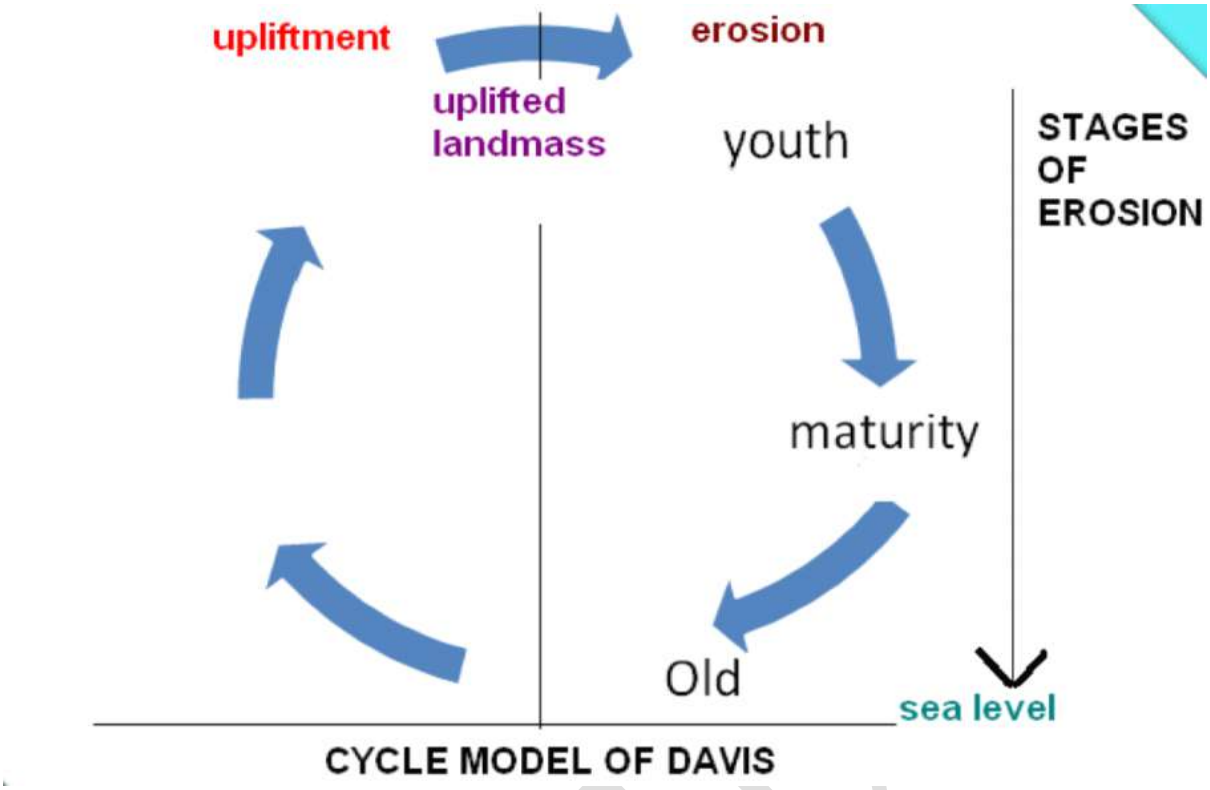
William Morris Davis advanced the idea of " geomorphic cycle of erosion " in 1899. His major objective was to describe and explain the distinctive characteristics possessed by landforms. He described that all landscapes have definite life history after its emergence. In this way through different stages and after a long time the elevated land mass becomes featureless and flat plain known as peneplain is called geographic cycle according to W. M. Davis.

Accordingly, Davis has described the landscape as the function of structure, process and stage. This means that in a landscape all these three-play dominant role. By structure meant that the nature of the rocks whether it is hard, soft, pervious, In the soft and pervious rocks cycle is completed in very short period than that no the hard rocks. Process determines that type of erosion would come on the surface and what type of landform would be under in an initial surface. Stage denotes that whether the land mass undergoing its transformation is in the young stage or in the old stage. Landscapes very in the different stages, thus the landscape is called the cumulative result of structure process and stage.

I. Structure: Which includes 'nature' (hardness, permeability) and 'attitude' (folds, faults, joints, slopes) of rocks?
II. Process: Implies the factors or agents responsible for weathering and erosion.
III. Time: Implies the stage at which the cycle is—youth, maturity or old age.

Davis assumes that each landscape has definite life history. As soon as a landmass emerged, erosional agents start their works on it and finally take it to ultimate featureless surface. Newly uplifted landmass has been called initial surface upon which erosion starts.

For the purposes of demonstrating his cycle concept in the simplest and persuasive way, Davis imagined as an initial form a mass of land up lifted from beneath the sea by earth movements.



CYCLE MODEL OF DAVIS

The Stage of Youth:

Davis assumed that the uplift of the land took place very rapidly, so that the processes of denudation were able to act almost from the start on what was in effect, a stable mass.

The uplift is complete and has stopped. Immediately erosion of the uplifted block sets in. The streams follow initial irregularities available without adjusting to the structure. These are consequent streams. The floors of the valley suffer down cutting while the summits remain almost unaffected. Increased relief heralds the beginning of mature age, indicated by widening of the gap between lines 'A' and 'B' (Fig. 1.44).

Characteristics of young landscape:

- Few Consequent Streams with few Large Tributaries
- Headward Erosion by Small Tributaries and Gullies
- Development of V-shaped Valleys
- Lack of Floodplain Development
- Interstream Tracts — wide and poorly drained; development of Lakes and Swamps
- Waterfalls and Rapids exist where stream crosses resistant rock beds

- Stream Meandering may exist on flat, undissected initial surface but are closely confined
- Maximum Altitude → Maximum Potential Energy

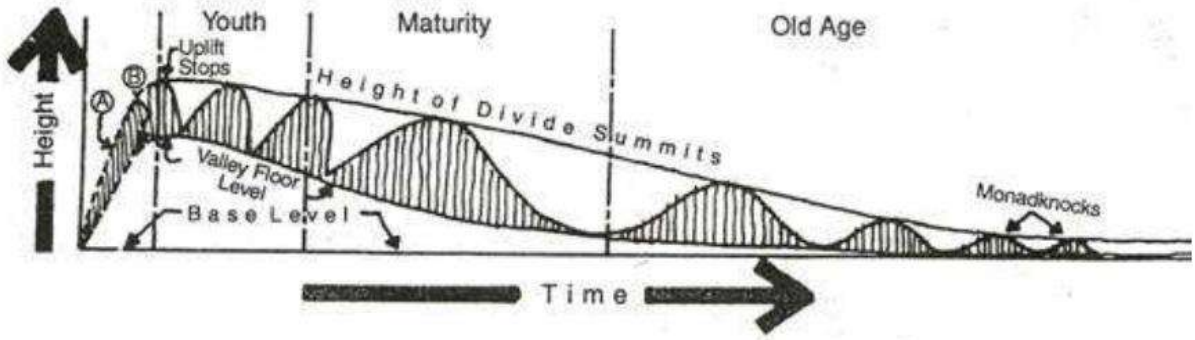


Fig. 1.44 A graphical presentation of geographical cycle proposed by W.M. Davis.

The Stage of Maturity:

At this stage, the vertical erosion slows down and the horizontal action increases. A characteristic feature is the erosion of mountain tops at a faster rate than lowering of the valley floor. The coming closer of lines 'A' and 'B' indicates emergence of a gentle slope. The subsequent streams gain importance now.

Characteristics of mature landscape:

- Valleys extend → well-integrated Drainage system
- Adjustment of streams with lithology and structure →Existence of Longitudinal Tributaries along belts of weak rock
- Stream divides sharp and ridge-like →minimum interstream uplands → Maximum Relief at early Maturity
- Attainment of Profile of Equilibrium by master Streams
- Elimination of lakes and waterfalls
- Wide Floodplains at Valley floors
- Conspicuous Meanders – free to shift positions over floodplains
- Width of the Valley floors do not exceed the width of the Meander belts
- Maximum possible Relief
- Topography consists much of Slopes of Hillsides and Valley sides

The Stage of Old Age:

A gentle gradient, accentuated by horizontal action and deposition, reduces the erosion intensity. A thick layer of sediment represents the earlier erosion activity. The landforms get mellowed lines 'A' and 'B' run parallel to each other. Relicts of mountains or monad knocks are dotting the water divides and a featureless plain—peneplane is produced.

Characteristics of old landscape:

- Tributaries – less numerous than in Maturity but more than in Youth
- Valleys – extremely broad & gently sloping laterally and longitudinally
- Extensive Floodplains with broadly Meandering Streams
- Valley widths – greater than those of the Meander belts
- Stream divides reduce in heights, gently sloping→ Residual hills (MONADNOCKS)
- Lakes, Swamps, Marshes on floodplains, not on interstream areas
- Mass Wasting – dominant over fluvial processes
- Extensive areas are or at near BASE LEVEL OF EROSION

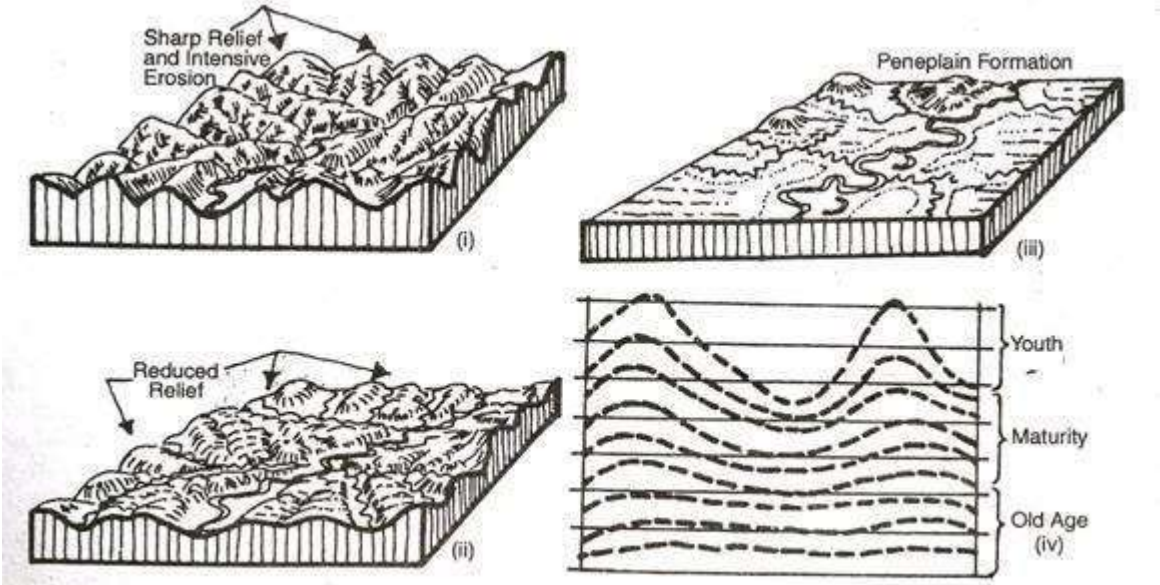


Fig. 1.45 Three stages in Davisian cycle of erosion—(i) youth (ii) maturity (iii) old age. (iv) Gradual obliteration of relief plotted on a graph.

Interruptions to the cycle of Erosion:

- Some change causes stream to speed up and cut deeper.
  1. Uplift of Land
  2. Lowering of Sea Level
  3. Greater stream flow

- Stream valley takes on youthful characteristics but retains features of older stages as well.
- Can happen at any point in the cycle
- Leads to development of Polycyclic or Multicyclic Landscapes.

Positive Aspects:

1. The Davisian cycle affords a genetic classification and nomenclature of landscape, as compared to a morphological one and provides the means of expressing texture and the build of a landscape.
2. The consideration by Davis of change in base level as indication of the initiation of a new cycle has certain advantages. One, the base level change can be considered a unit of time compared to the geologists' stratigraphical time unit. Two, the base level changes during glaciations are accommodated.

Drawbacks:

1. In a way, the geographical cycle proposed by Davis is backward looking as it considers complete suspension of uplift after the erosion has set in.
2. There are no logical grounds for the assumption that flat slopes are old and steep slopes are young. Other variables controlling the slope are nature of soil material and the bedrock, climate, vegetation and the downslope factors acting at the slope foot.
3. An ideal Davisian cycle would take millions of years to complete. What about the earth movements during the cycle?
4. Too much of generalisation in the Davisian cycle presents an inadequate framework for landform interpretation.
5. There is little evidence to prove that landforms actually evolve to an end product or peneplane.

Penck's Cycle of Erosion:

Penck propounded the theory of erosion in 1953. Though Penck has accepted the concept of the cycle of erosion but not like the concept given by Davis. Penck was the main critic of the Davisian cycle. Penck has also told wrong the concept of structure, process and stage in the penenplaination of any landmass and he said that **landforms are the result of phase, rate of uplift and degradation.** That means "*how much upliftment as taken place, how much the rate of erosion is". Penck has given*

some different terminology at the place of Davis different stages. He has also accepted three but that are not showing the time factor but the rate of upliftment.

Penck made certain deviations from the views of Davis. One, the erosion does not remain suspended till the uplift is complete. In fact, he said, the geomorphic forms are an expression of the phase and rate of uplift in relation to the rate of degradation, and that interaction between the two factors, uplift and degradation, is continuous. Two, the rate of uplift keeps changing. **Penck proposed three types of valley slopes** on the basis of erosional intensity acting on crustal movements.

1. **Straight slope:**

   Indicating uniform erosion intensity and a uniform development of landforms or 'Gleichformige Entwickelung' in German.

2. **Convex slope:**

   Indicating waxing erosion intensity and a waxing development of landforms or 'Aufsteigende Entwickelung.

3. **Concave slope:**

   Indicating waning erosion intensity and a waning development of landforms or 'Absteigende Entwickelung.'

Refer, to Fig. 1.46. The cycle has several stages.

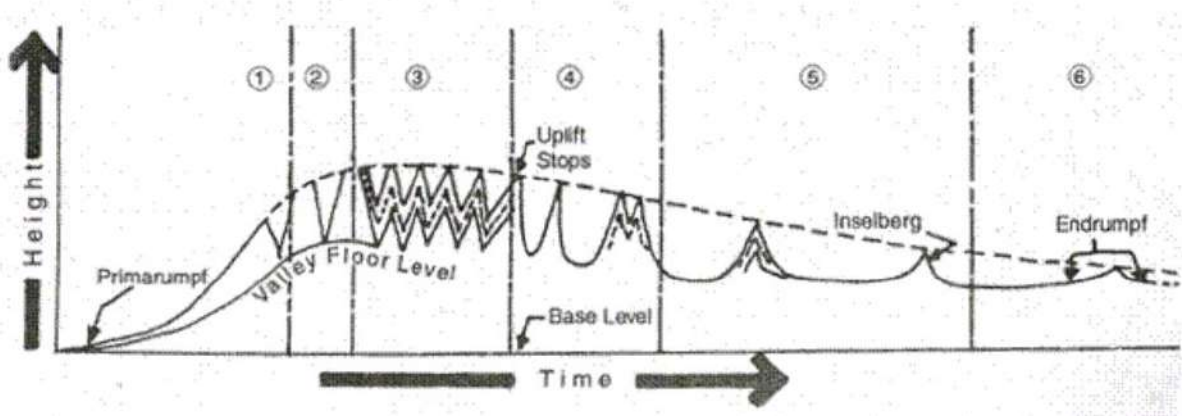


Fig. 1.46 A graphic presentation of Penck's geographical cycle.

Stage 1:

With uplift, the interfluves, as well as the lower parts, rise. There is a lack of brisk undercutting. Penck used the term 'Primarumpf' to represent the characteristic landscape before upliftment. Primarumpf is, in fact, initial surface or primary peneplane representing either newly emerged surface from below sea level or a 'fastenbene' or 'peneplane' type of land surface converted into featureless landmass by uplift.

Stage 2:

Here, the rate, of downcutting is less than the rate of uplift. There is not much change in relief.

Stage 3:

Rate of downcutting becomes equal to the rate of uplift. Again, there is not much change in relief.

Stage 4:

Uplift comes to an end and the downcutting further intensifies. The height of interfluves decreases. Deepening of valleys accelerates. A convex slope results: this is the stage of waxing erosion or Aufsteigende Entwickelung.

Stage 5:

The downcutting and the deepening of valleys slows down. The interfluves are rounded and further lowered. A concave slope results: this is the stage of waning erosion or Absteigende Entwickelung.

Stage 6:

Uniform erosion or Gleichformige Entwickelung characterises the end product— endruiripf or endplain.

Positive Points:

1. Penck followed a deductive approach and did not restrict himself to any particular condition.
2. Compared to the Davisian cycle, Penck's approach was forward looking.
3. Penck, quite appropriately, emphasised the mutual relation between uplift and the deepening of valleys. This indicates Penck's respect

for geological evidence. Penck's third stage is evident in the Middle Alps.

Drawbacks:

1. Penck gave too much importance to the role of endogenetic forces.
2. The orderliness in landform changes, as assumed by Penck, may be difficult to achieve.
3. Inadequate knowledge about the initial pristine landscape does not allow much verification.
4. The concept of geographical cycle of erosion itself has been criticised by many, since many of the cyclic generalisations are based on untested assumptions. An overemphasis on historical and evolutionary studies in landforms results in the reconstruction of stages of evolution becoming the focus of study.

::