TOPIC 11: Slope Development

Duration: 42 Periods

Competency: The learner analyses spatial and temporal variations of slope development processes by examining their nature, factors influencing their occurrence and impact to devise strategies for managing slope-related hazards.

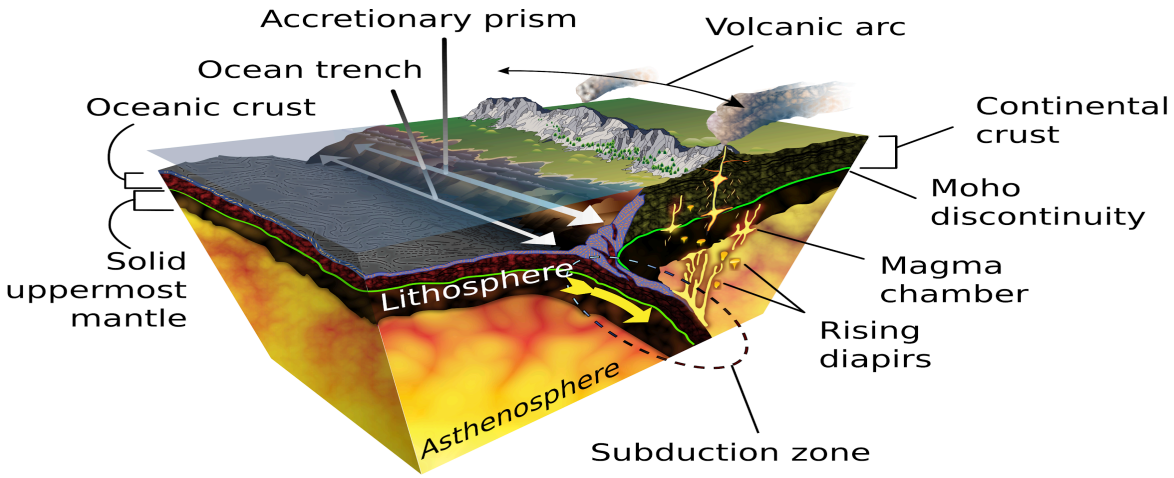
Introduction

Slope development refers to the process by which slopes are formed, evolve, and change their shape over time under the influence of geomorphic processes such as weathering, erosion, mass movement, and deposition.

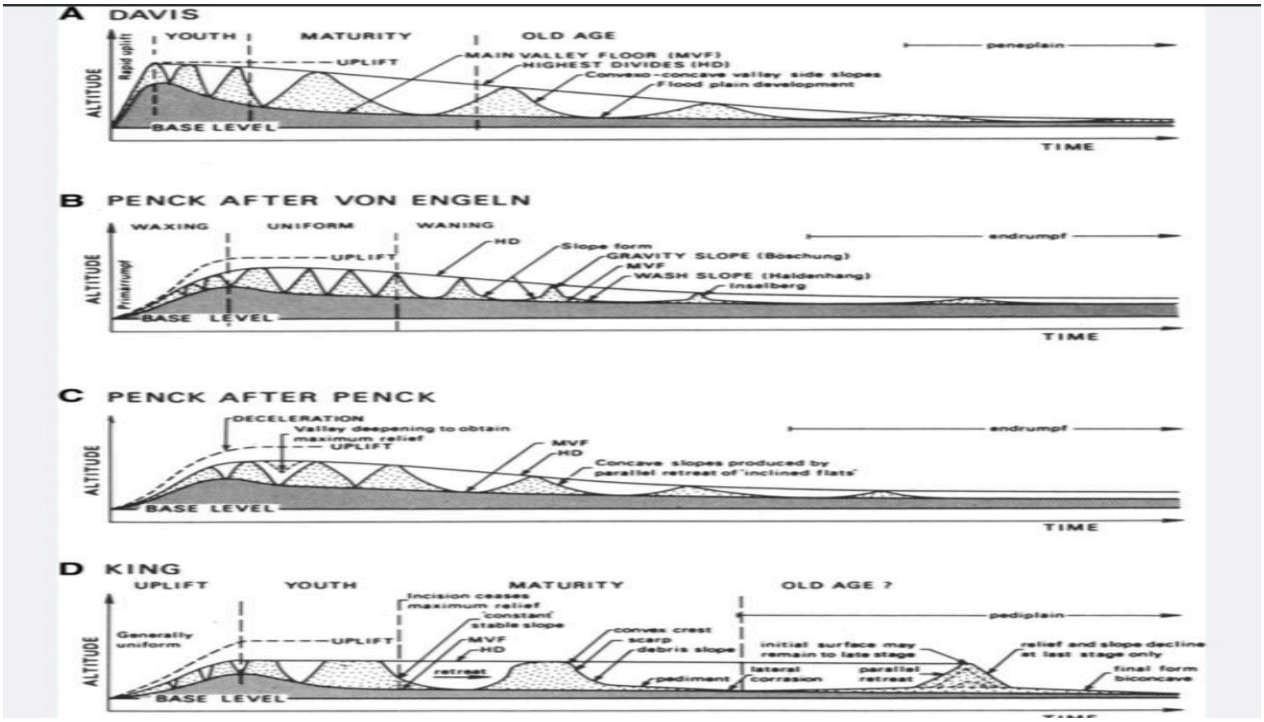
Slope

A slope is any inclined surface of the land, ranging from gentle to steep gradients, connecting highlands to lowlands.
Slope development is not static; it reflects the interaction between structure (rock type and arrangement), process (weathering and erosion), and time.
Over geological time, slopes may steepen, retreat, flatten, or change form depending on climatic conditions, tectonic activity, and the dominant geomorphic processes.

Theories of Slope Development

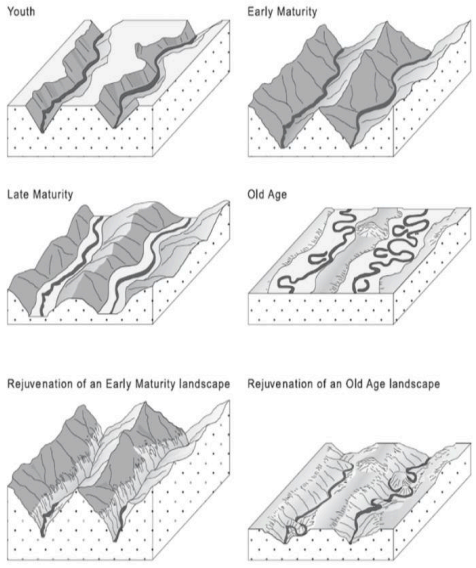


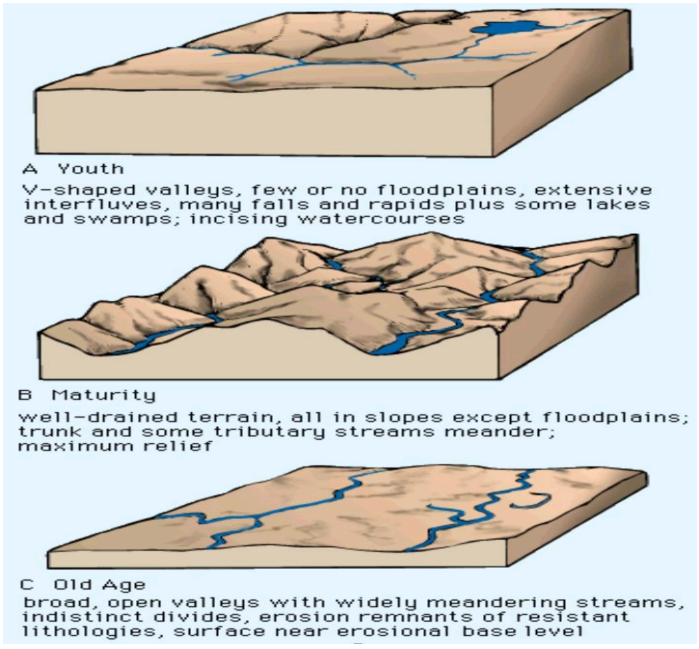
Geographers and geomorphologists have proposed different theories to explain how slopes evolve.
The most influential theories at A'Level include Davis's Cycle of Erosion, Penk's Theory of Slope Development, and King's Slope Replacement Model.



Davis's Cycle of Erosion (Slope Decline Theory)

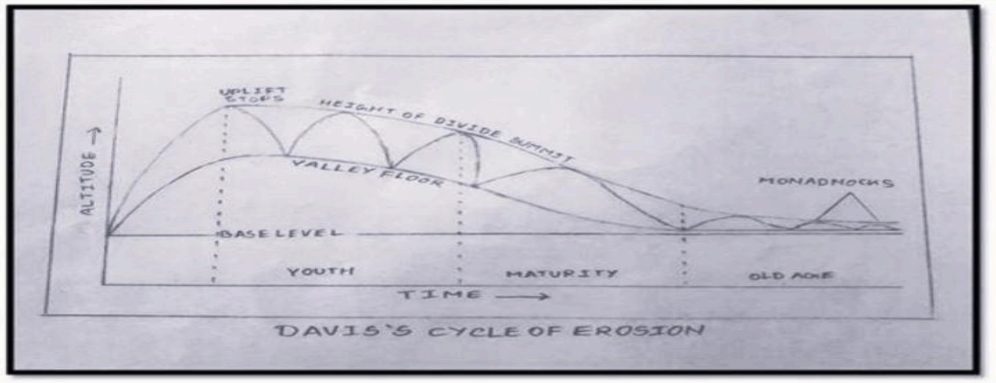
Illustrations





William Morris Davis proposed that slope development occurs as part of a cycle of erosion, which he linked to stages of landscape evolution: youth, maturity, and old age. According to Davis, slopes gradually decline in angle over time as erosion progresses.

At the youthful stage, after uplift of land, rivers actively cut downwards through vertical erosion.
Slopes are steep and rugged because erosion is concentrated in valley deepening rather than widening. Weathering produces debris, but much of it is removed quickly by running water.
During the mature stage, vertical erosion slows and lateral erosion becomes dominant.
Valleys widen, interfluves are reduced, and slopes begin to lose their steepness.
Mass wasting and weathering increasingly shape slopes, making them gentler and more rounded.
In the old age stage, relief is greatly reduced and slopes are very gentle. The landscape approaches a peneplain, where erosion has nearly leveled the land to a low, rolling surface.
According to Davis, slope evolution is therefore characterized by slope decline, where slopes become progressively gentler with time.

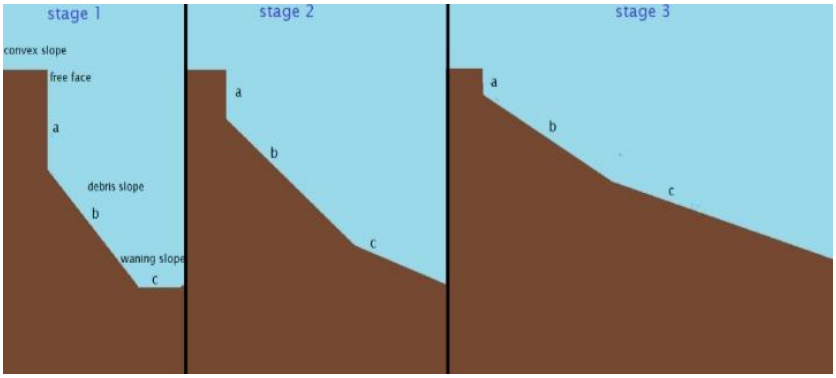


Criticism

Davis's theory assumes uniform climate and uninterrupted uplift, which rarely occurs in reality. However, it remains important for understanding long-term landscape evolution.

Penk's Theory of Slope Development (Slope Replacement and Parallel Retreat)

Illustration



Walther Penk challenged Davis's ideas by emphasizing the relationship between uplift rate and slope form.

Penk argued that slope shape depends on whether uplift is increasing, constant, or declining, rather than following a fixed cycle of youth, maturity, and old age.

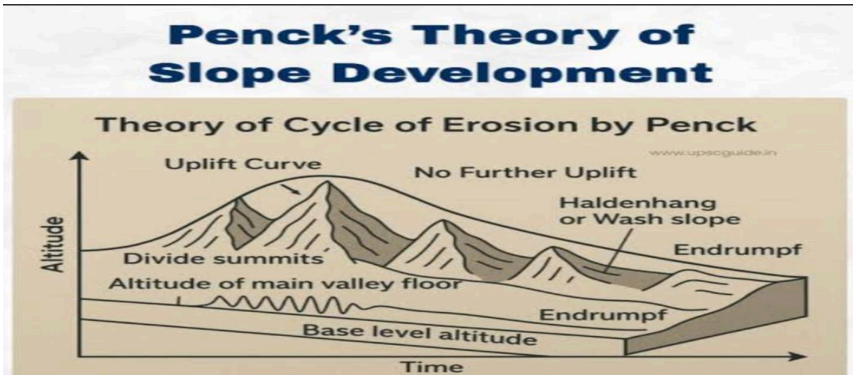
According to Penk, when uplift is rapid and continuous, slopes tend to be convex because erosion cannot keep pace with uplift.

Where uplift and erosion are balanced, slopes are straight.

When uplift slows or stops, erosion dominates, producing concave slopes.

Penk proposed that slopes evolve mainly through slope replacement, where the upper part of the slope changes form while the lower slope extends outward.

Instead of slopes simply declining in angle, Penk suggested that slopes may retreat backward while maintaining their general steepness for long periods.

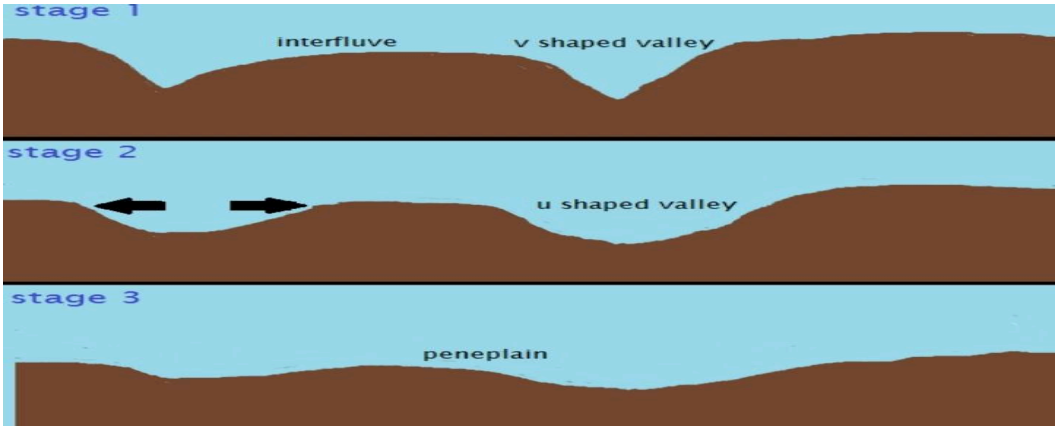


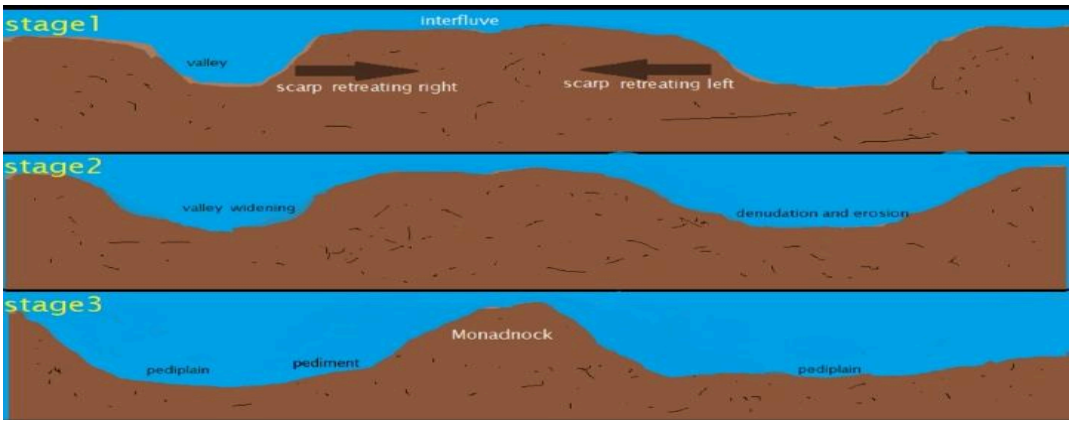
Significance:

Penk's theory recognizes the dynamic nature of crustal movements and better explains slope development in tectonically active regions.

King's Slope Replacement Model (Parallel Retreat Theory)

Illustrations





L.C. King further developed the idea of parallel slope retreat, particularly in arid and semi-arid environments. According to King, slopes do not gradually decline in angle as Davis suggested. Instead, they retreat laterally (backward) while maintaining their steepness.

King observed that in dry climates, weathering is limited and erosion occurs mainly through mechanical processes such as rock fall and sheet wash. As a result, steep slopes retreat parallel to themselves, leaving behind gently sloping rock surfaces called pediments at the base of slopes.

Over time, pediments widen as slopes continue to retreat, eventually forming extensive plains known as pediplains.

This process is known as slope replacement, where steep upper slopes are replaced by gentler lower surfaces, not by uniform slope decline.

Relevance:

King's model is particularly useful for explaining slope development in parts of East Africa and other tropical dry regions, making it relevant to Uganda's geography syllabus.

Comparative Understanding

- ➢ Davis emphasized time and erosion cycles, with slopes declining in angle.
- ➢ Penk focused on uplift rates and dynamic slope forms.
- ➢ King highlighted climate and parallel retreat, especially in dry regions.

Together, these theories show that slope development is complex and context-dependent, influenced by climate, tectonics, rock type, and geomorphic processes.

In conclusion

Slope development is a fundamental concept in geomorphology that explains how landscapes evolve over time.

The theories of Davis, Penk, and King provide different but complementary explanations of slope evolution.