Basic concepts of geomorphology

Introduction

- Fundamental concepts are used in the interpretation of landscapes.
- Worcester (1939) defined geomorphology ,It is a description and interpretation of the earth relief features.
- Geomorphology come about as a result of dissatisfaction with the term physiography.
- It discuss upon the man adjustments to and uses of landforms.

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MOUNT EVEREST, THE SUPREME CHALLENGE

A Textbook of

Geomorphology

By

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Concept 1

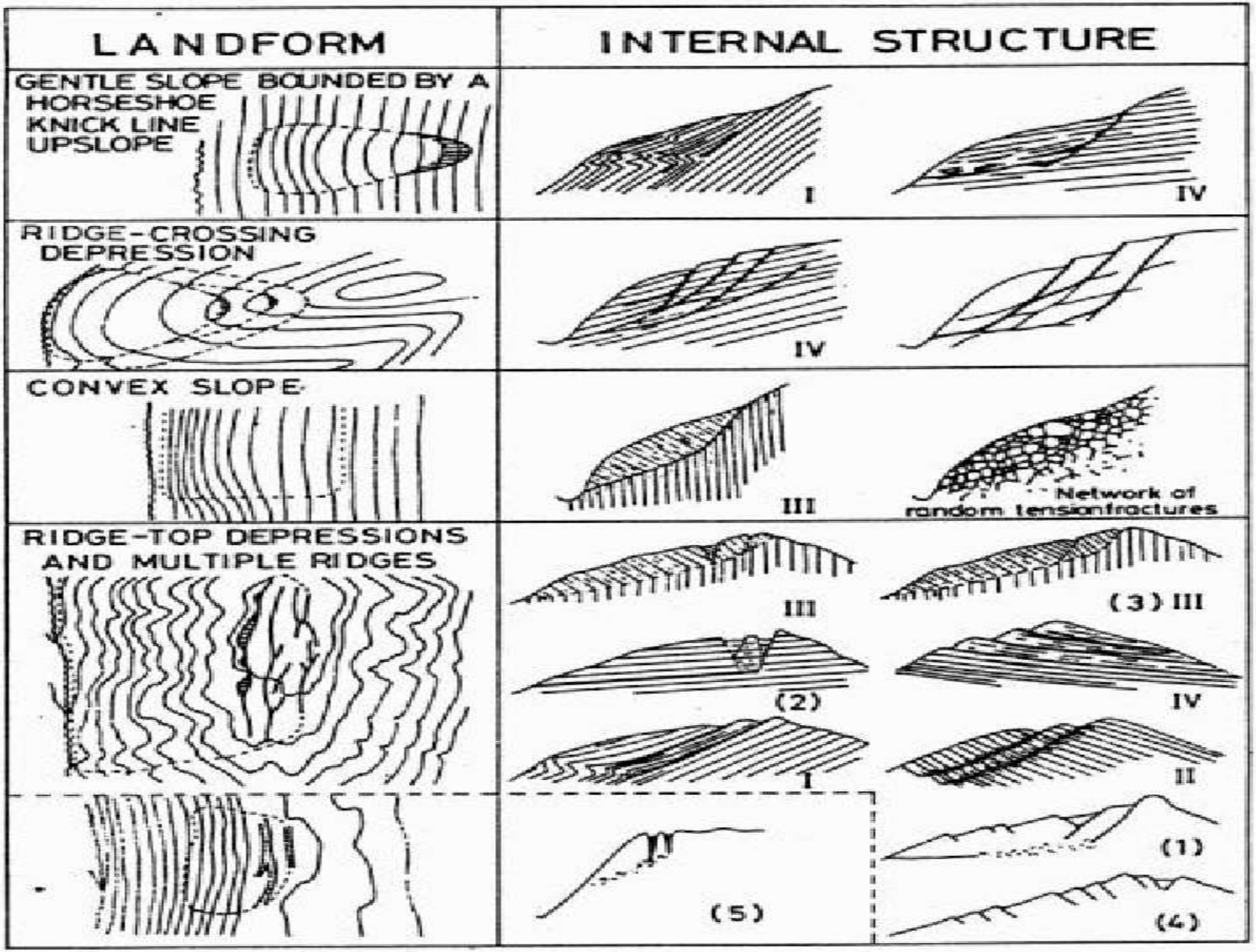
- “The same physical processes and laws that operate today operated throughout geological time , although not necessarily always with the same intensity as now”.
- Underlying principle is known as Principle of uniformitarianism .Proposed by Hutton & popularized by Lyell .
- Intensity of various geological processes has varied through geological time .”Present is the key to past”.

Example

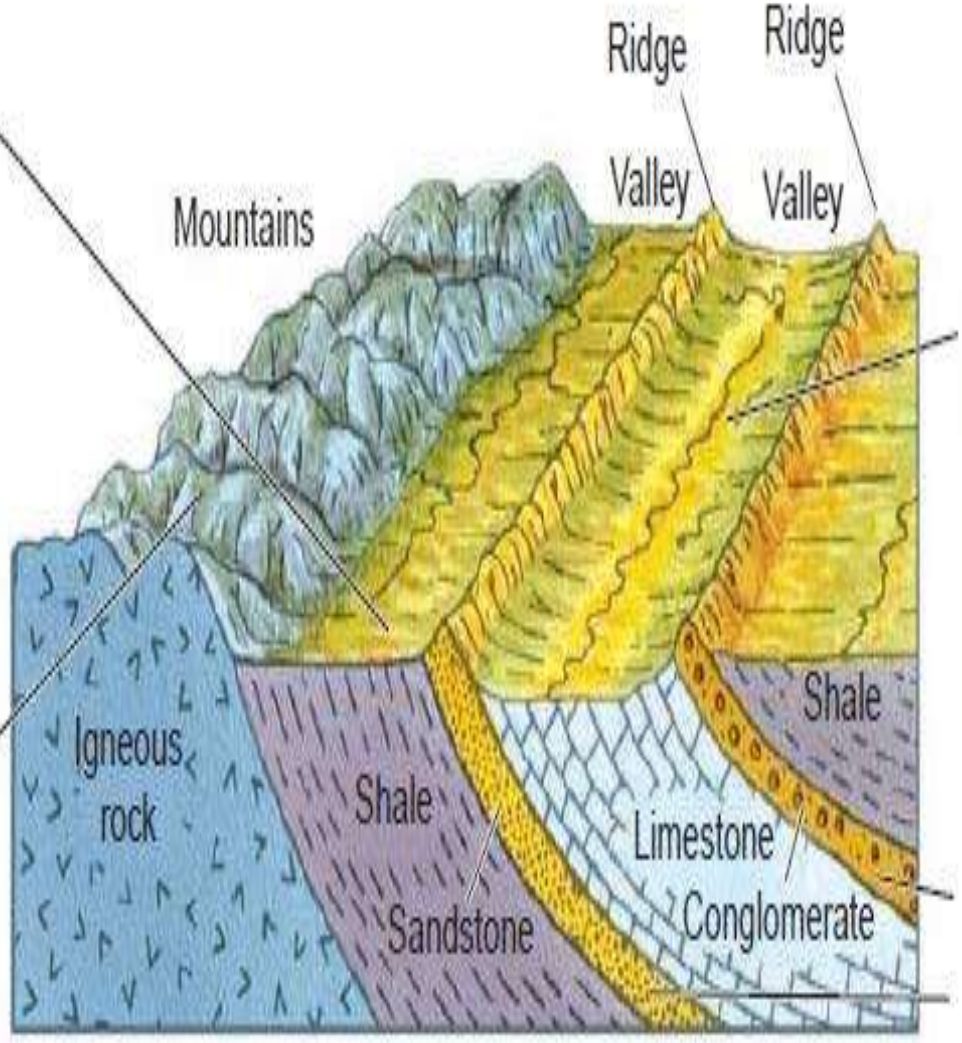
- The wind deposits deposited the Navajo sandstone during Jurassic times obeyed different laws in wind flow.
- Karsts topography of Permian period is same as occur today.
- Volcanism is predicted mostly by this principle.

Concept 2

- “Geological structure is a dominant control factor in the evolution of land forms and is reflected in them”.
- The term structure include phenomena as roc attributes; the absence or presence of structures ;rock massiveness; permeability of rocks; and various other ways.
- Structural features of rock Features are much older than the geomorphic forms developed upon them .


LANDFORM
INTERNAL STRUCTURE
GENTLE SLOPE BOUNDED BY A HORSESHOE KNICK LINE UPSLOPE
I
IV
RIDGE-CROSSING DEPRESSION
IV
CONVEX SLOPE
III
Network of random tensionfractures
RIDGE-TOP DEPRESSIONS AND MULTIPLE RIDGES
III
(3) III
(2)
IV
I
II
(5)
(1)
(4)

Shale is weak rock that is easily eroded and forms the low valley floors of the region.



Limestone is dissolved by carbonic acid in rain and surface water, forming valleys in humid climates. In arid climates, limestone is a resistant rock and usually forms ridges and cliffs.

The igneous rocks are resistant to erosion—typically forming uplands or mountains rising above adjacent areas of shale and limestone. Metamorphic rocks vary in resistance.

Sandstone and conglomerate are typically resistant and form ridges or uplands.

12.33 Landforms and rock resistance

Landforms evolve as weaker rock is eroded, leaving the more resistant rock standing as ridges or mountains.

Examples

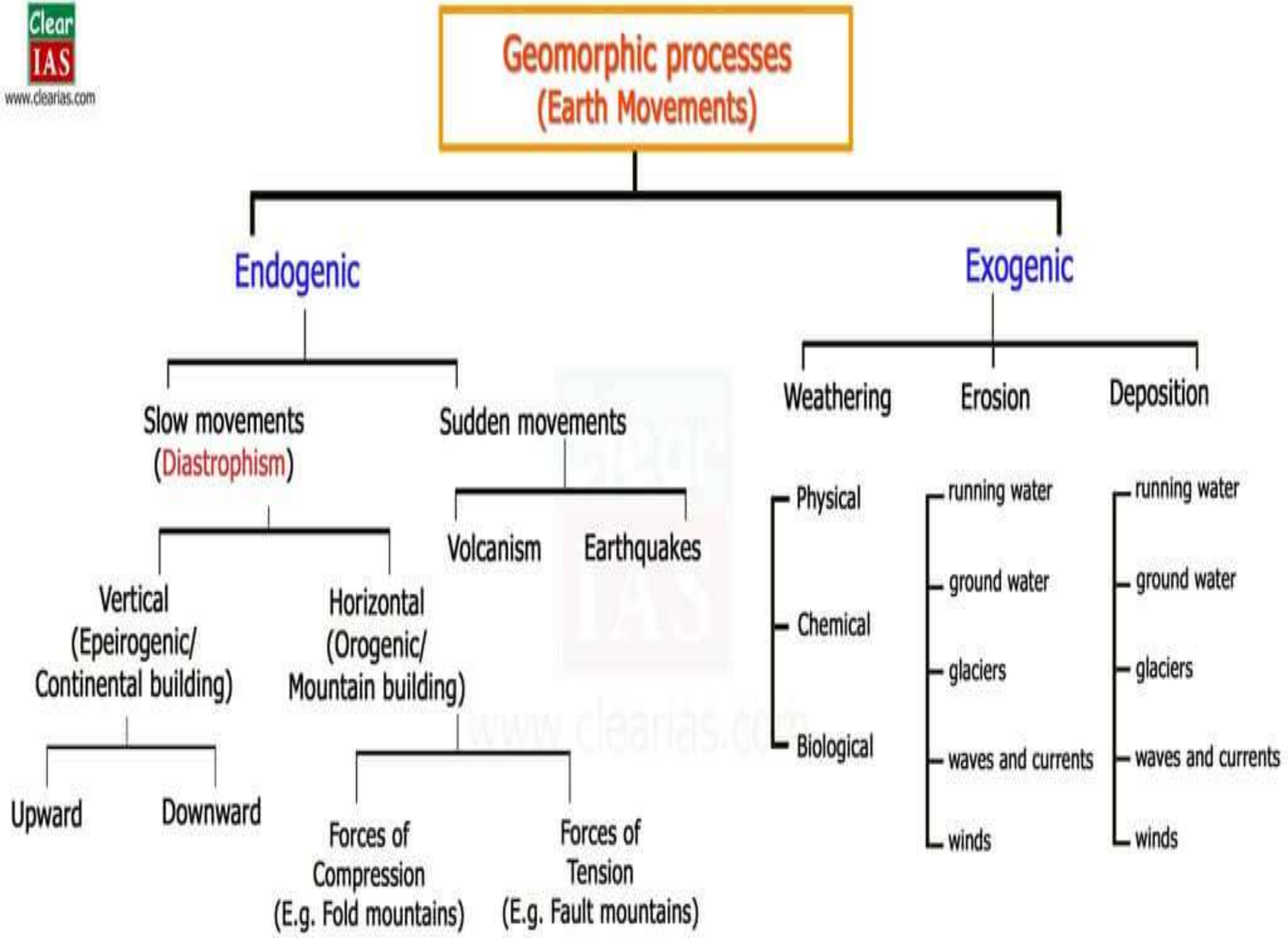
- The effect of structures are there but we may lack of ability to see them.
- The increasing application of geomorphic interpretation of aerial photographs are done by the help of this principle.

Concept 3

- “Geomorphic processes leave their distinctive imprint upon landforms and each geomorphic process develops its own characteristic assemblage of landforms”.
- It is applied to both

  Endogen -Volcanism & earthquake

  Exogenic -Weathering ,mass wasting & erosion. (designated by pencks).

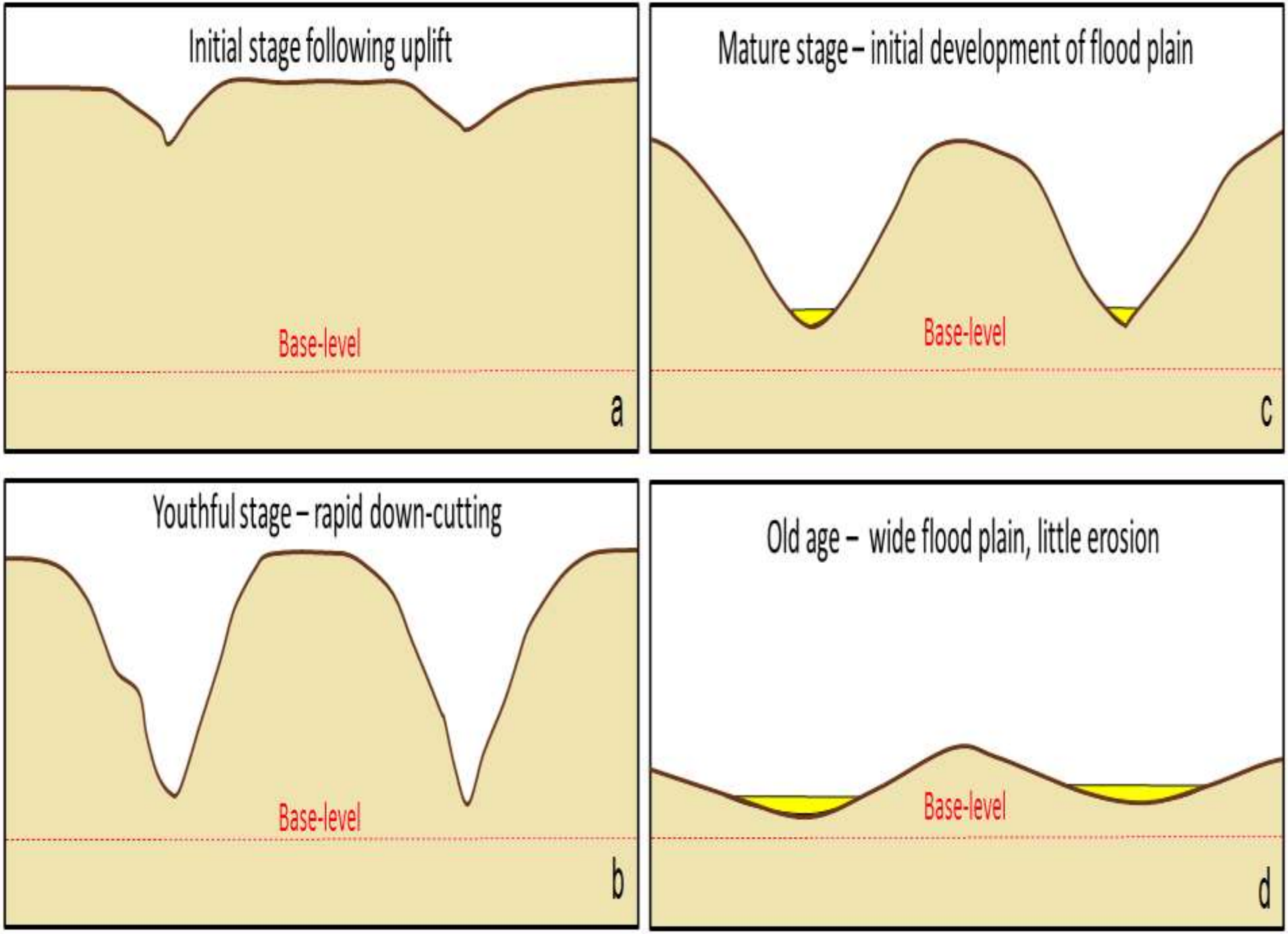


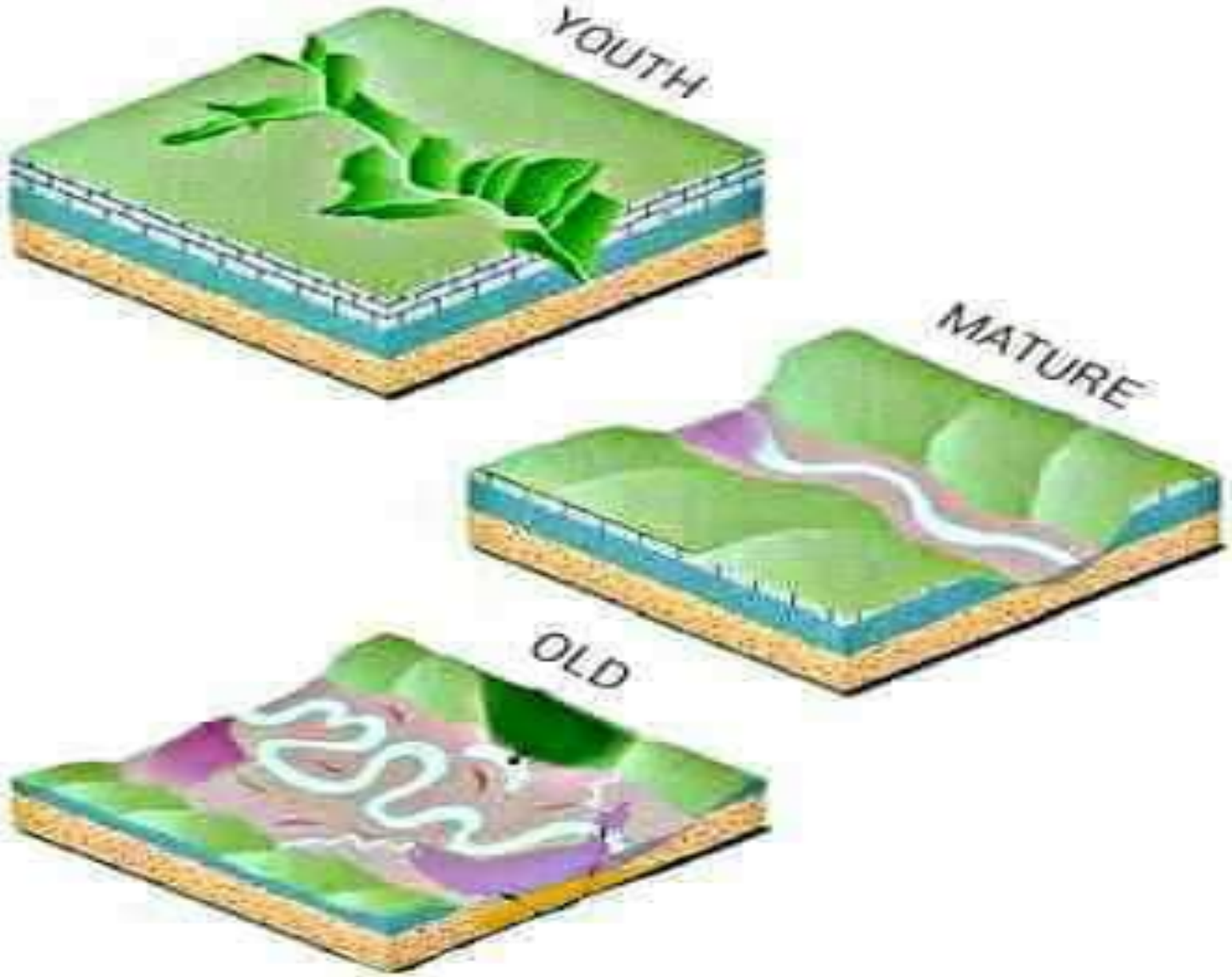
Example

- Individual process responsible leave their stamp upon the earth surfaces.
- Geomorphic processes do produce distinctive landforms mae possible for genetic classification.
- Landforms are classified based on the genetic classification. It also emphasis the genetic relationships of landform assemblages.

Concept 4

- “As the different erosional agencies act upon the earth surface there is produced a sequence of landforms having distinctive characteristics at the successive stages of their development”.
- Talks about the geomorphic cycles.
- By Davis an metaphorical terms youth, mature, old are commonly used to designate the stages of development.


Initial stage following uplift
Base-level
a
Youthful stage – rapid down-cutting
Base-level
b
Mature stage – initial development of flood plain
Base-level
c
Old age – wide flood plain, little erosion
Base-level
d



Example

- This principle is applied to every cycle of different geological processes
- Partial cycle is more than a completed cycle and they also leave the imprint on the surface.

Concept 5

- “Complexity is more than the simplicity in geomorphic evolution”.
- Rare to find an landscape that influenced b y single geomorphic process.
- More multicyclic than monocyclic landscapes.
- Older topography also seen on the new landscapes is called exhumed or resurrected landscapes also seen.

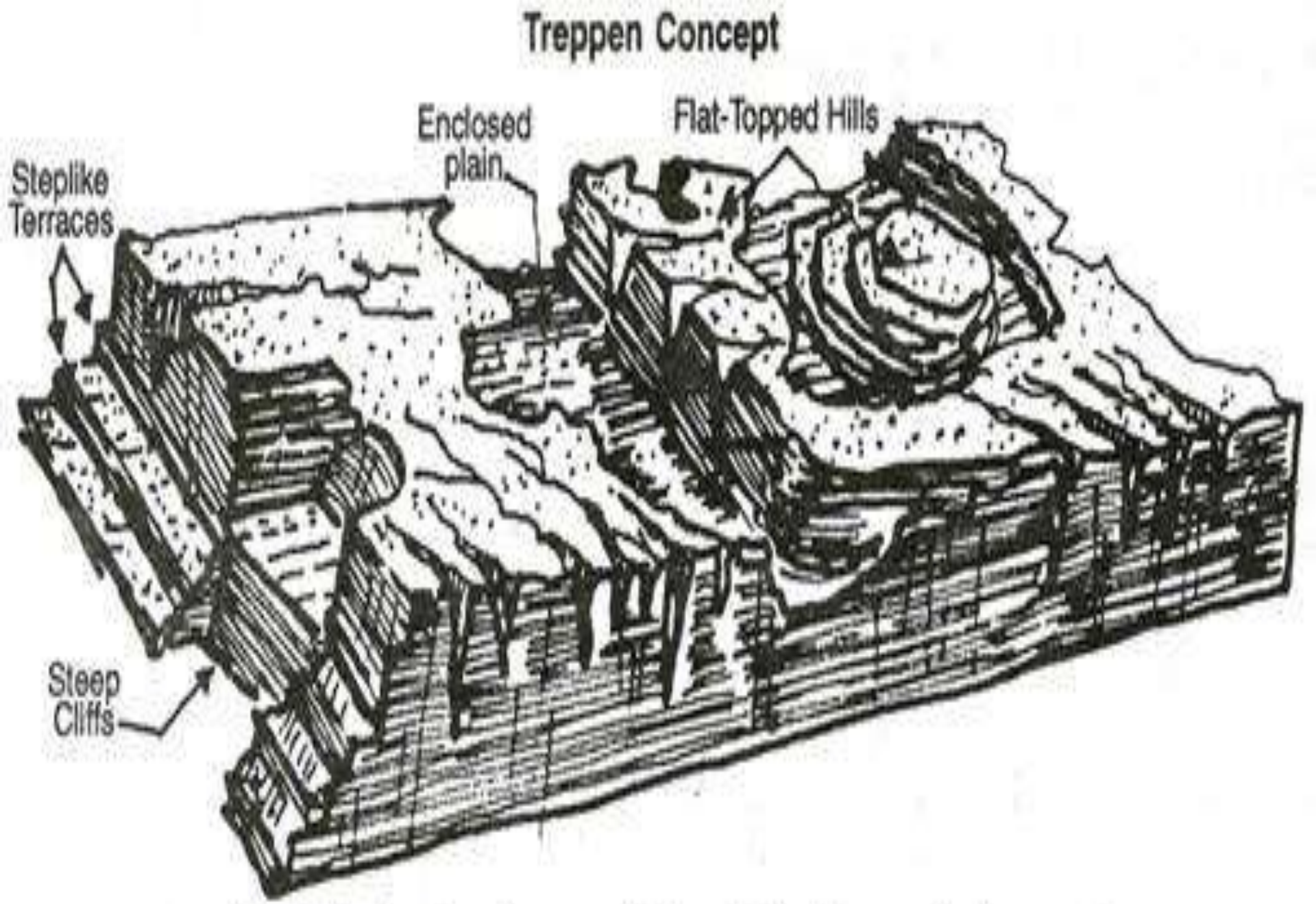
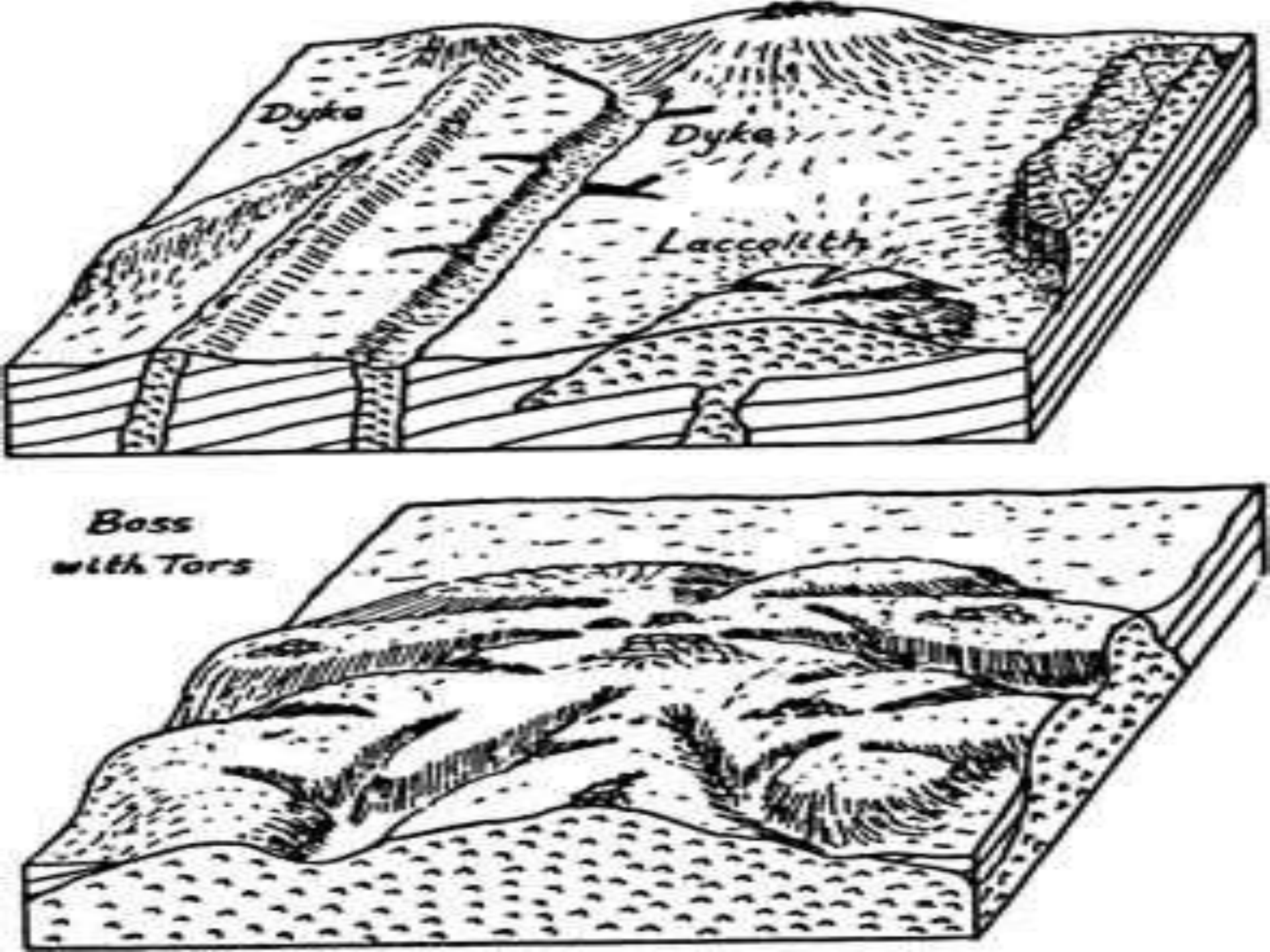


Fig. 1.87 A schematic presentation of the Treppen landscape.


Dyke
Dyke
Laccolith
Boss
with Tors

Concept 6

- “Little of the earth topography is older than tertiary and most of it no older than Pleistocene”.
- Topographic features so ancient are rare , and they do exist ,are more likely exhumed forms due to degradation through geological time.
- Ashley (1931) believed that most of the geomorphic landforms are formed in post Miocene.

Example

- Most of the topographical features on the Himalayan range is attained in Pleistocene age.
- Longwell came to conclusion that it started in early Pliocene.

Concept 7

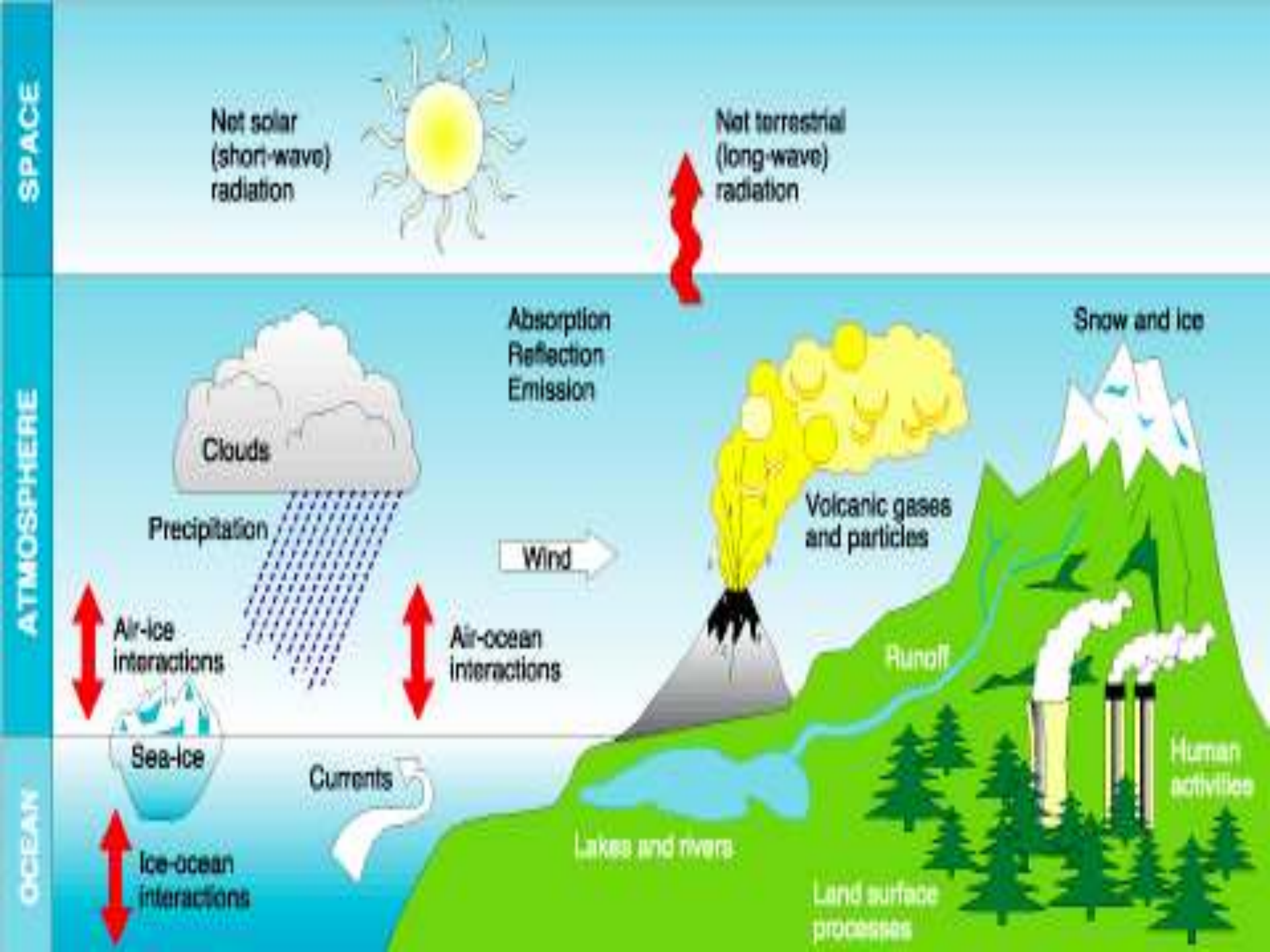
- “Proper interpretation of present day landscapes is impossible without a full appreciation of the mainfold influences of the geologic and climatic changes during the Pleistocene”.
- Most of the world topography is the recognition that the geologic and climatic changes during the Pleistocene have the far-reaching effects upon present day topography.

Example

- Glacial outwash and wind-blown materials of glacial origin extended all over the world.
- Certainly in the middle latitudes the climatic effects are profound.
- Pleistocene diastrophism played important role in Himalayan formation and grand canyon.

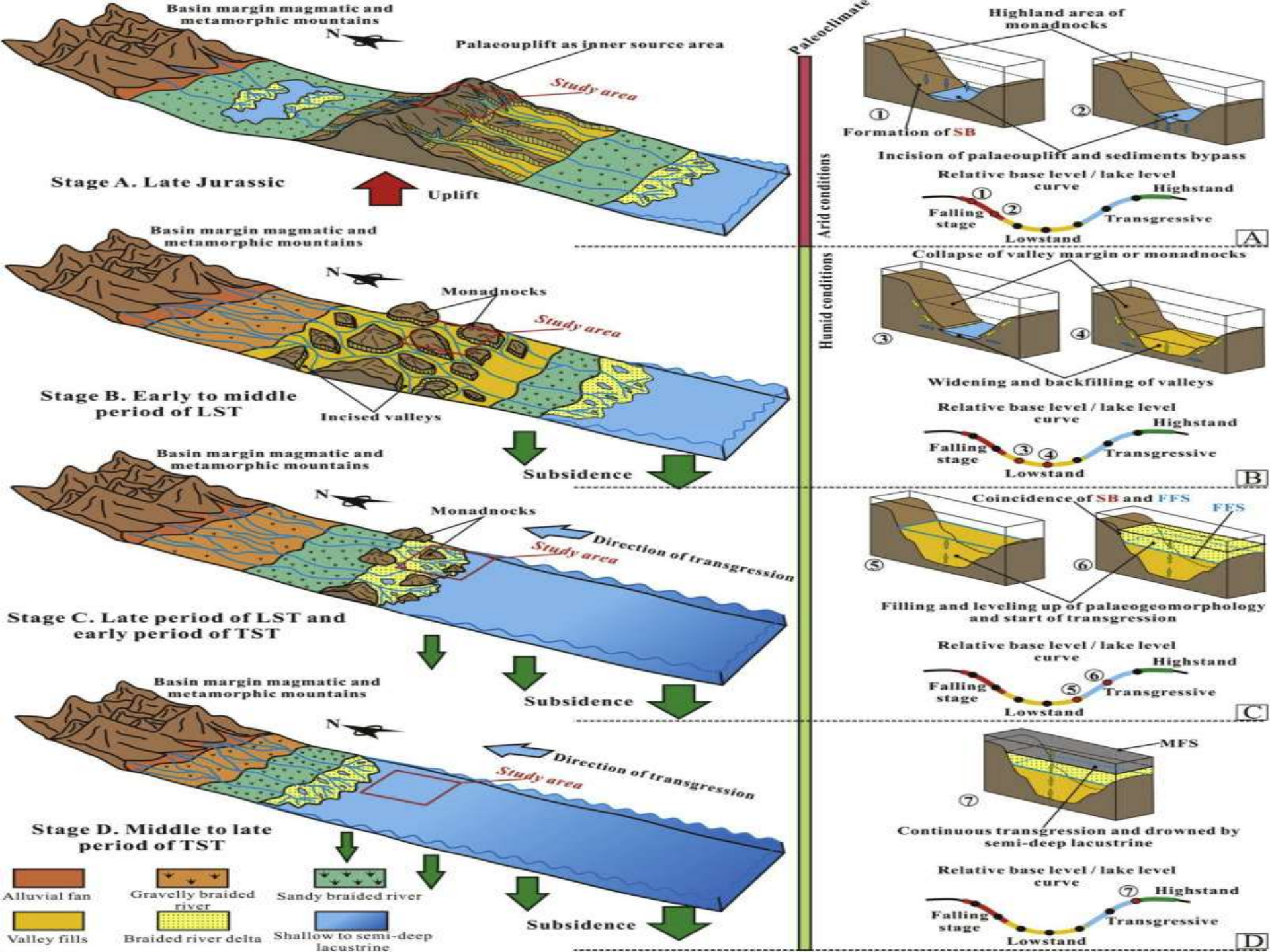
Concept 8

- “an appreciation of the world climates is necessary to a proper understanding of the varying importance of the different geomorphic processes”.
- Climatic factors such as temperature precipitation should influence the operation of the different geomorphic processes.
- High altitude within climatic condition should be concerned which impose modifications.
- Human activities influence also concerned more.


SPACE
ATMOSPHERE
OCEAN
Net solar (short-wave) radiation
Net terrestrial (long-wave) radiation
Absorption
Reflection
Emission
Snow and ice
Clouds
Precipitation
Wind
Volcanic gases and particles
Air-ice interactions
Air-ocean interactions
Runoff
Sea-ice
Currents
Human activities
Lakes and rivers
Ice-ocean interactions
Land surface processes

Concept 9

- “Geomorphology, although concerned primarily with present day landscapes , attains its maximum usefulness by historic extension”.
- Historical approach on the geomorphic landscape is needed for proper interpretation.
- Application of uniformitarian's principle is needed for this approach.
- This aspect is also called as paleo geomorphology which includes stratigraphy and sedimentology.


Basin margin magmatic and metamorphic mountains
N
Palaeouplift as inner source area
Study area
Stage A. Late Jurassic
Uplift
Basin margin magmatic and metamorphic mountains
N
Monadnocks
Study area
Stage B. Early to middle period of LST
Incised valleys
Subsidence
Basin margin magmatic and metamorphic mountains
N
Monadnocks
Direction of transgression
Study area
Stage C. Late period of LST and early period of TST
Subsidence
Basin margin magmatic and metamorphic mountains
N
Direction of transgression
Study area
Stage D. Middle to late period of TST
Subsidence
Alluvial fan
Gravelly braided river
Sandy braided river
Valley fills
Braided river delta
Shallow to semi-deep lacustrine
Paleoclimate
Arid conditions
Humid conditions
Highland area of monadnocks
① Formation of SB
② Incision of palaeouplift and sediments bypass
Relative base level / lake level curve
Falling stage
Lowstand
Transgressive
Highstand
A
Collapse of valley margin or monadnocks
③
④ Widening and backfilling of valleys
Relative base level / lake level curve
Falling stage
Lowstand
Transgressive
Highstand
B
Coincidence of SB and FFS
FFS
⑤
⑥ Filling and leveling up of palaeogeomorphology and start of transgression
Relative base level / lake level curve
Falling stage
Lowstand
Transgressive
Highstand
C
MFS
⑦ Continuous transgression and drowned by semi-deep lacustrine
Relative base level / lake level curve
Falling stage
Lowstand
Transgressive
Highstand
D

Thank you