

LECTURE IN SOIL SCIENCE

“SOIL FORMING FACTORS”

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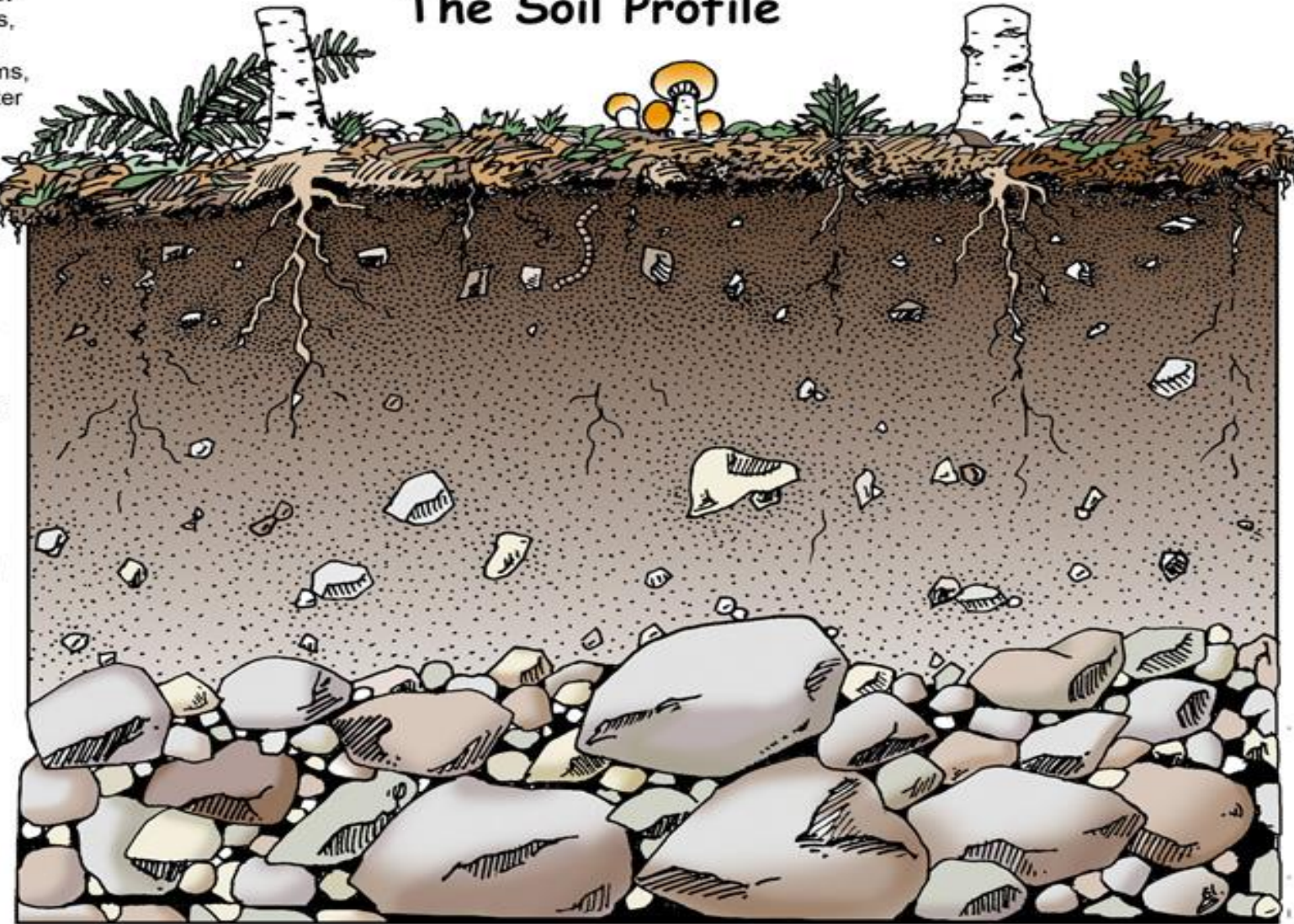
The Soil Profile

Surface Litter
leaves, branches,
animal scats &
bodies, mushrooms,
other rotting matter

**Topsoil Layer
(or humus)**
rotting organic
matter from litter
layer and
minerals from
weathering rocks

Subsoil
crumbling rock,
sand, clay, gravel
and silt

**Parent
Material**
actual bedrock
underlying the
soil layers



WHAT ARE SOIL FORMING FACTORS ?



PARENT MATERIAL



CLIMATE



TIME

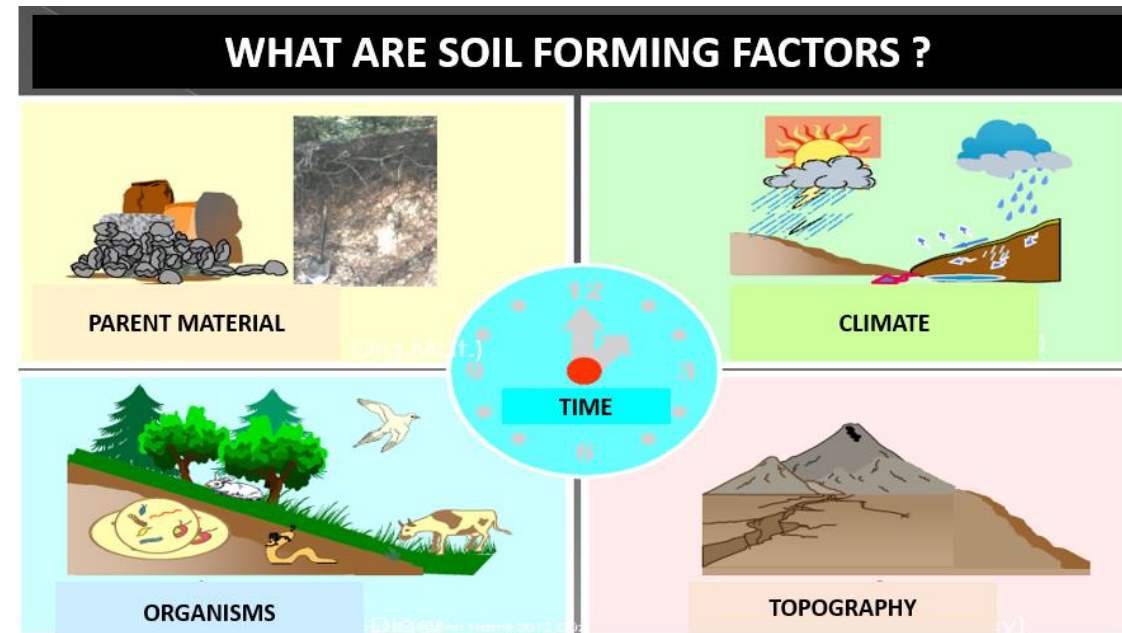


ORGANISMS



TOPOGRAPHY

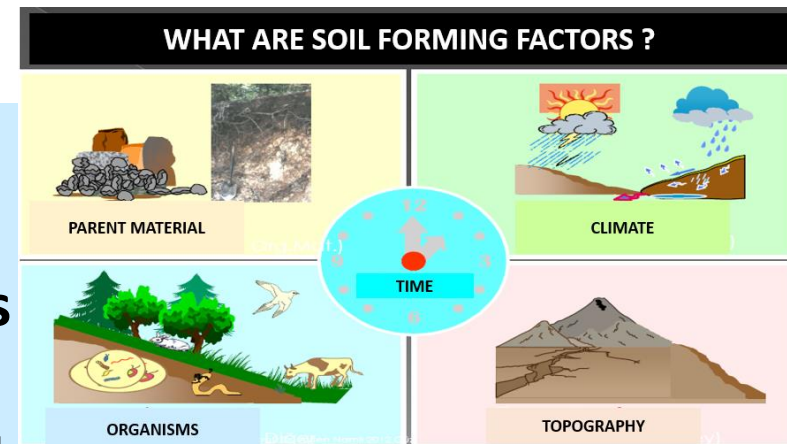
- Climate and Organisms (**active factors**)
- Parent material, time and topography (**passive factors**)



- Parent material is affected by active factors
- Time shows the degree of the effects of other factors
- Topography is a modifying factor leading the effects of active factors

Climate as an active soil forming factor...

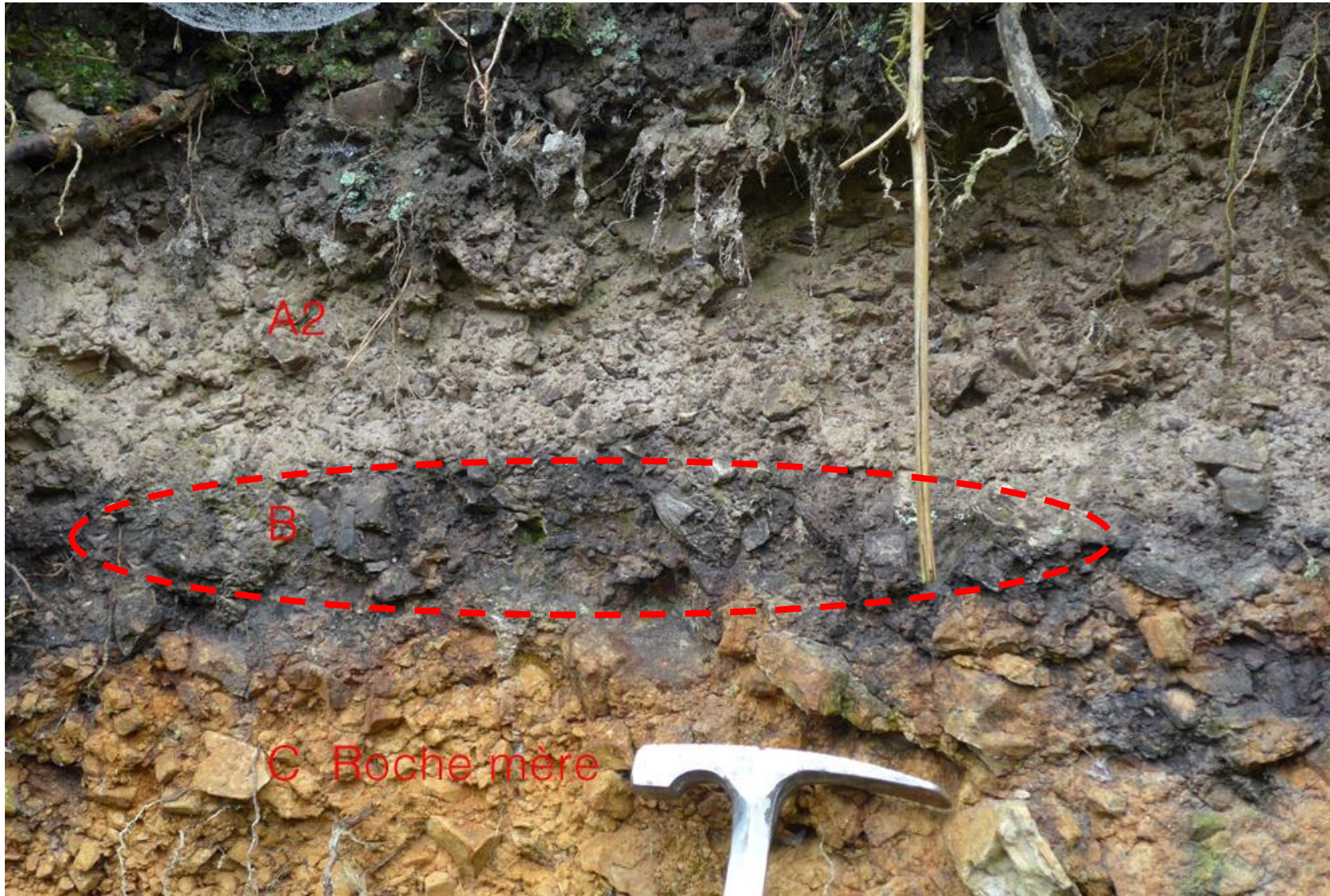
- ❑ **Heat** causes to physical and chemical disintegration of rocks
- ❑ **Rainfall** (water) causes to physical weathering of bedrock and leaching dissoluble material from upper to lower soil layers



- ❑ **Hotter (temperal)** = rapid soil formation
- ❑ **Colder** = slow soil formation
- ❑ **More precipitation (rainfall)** = more leaching



LEACHING, (a common soil formation process)
Movement of soil organic matter (humus) existed on topsoil
into deep soil layers by rain water



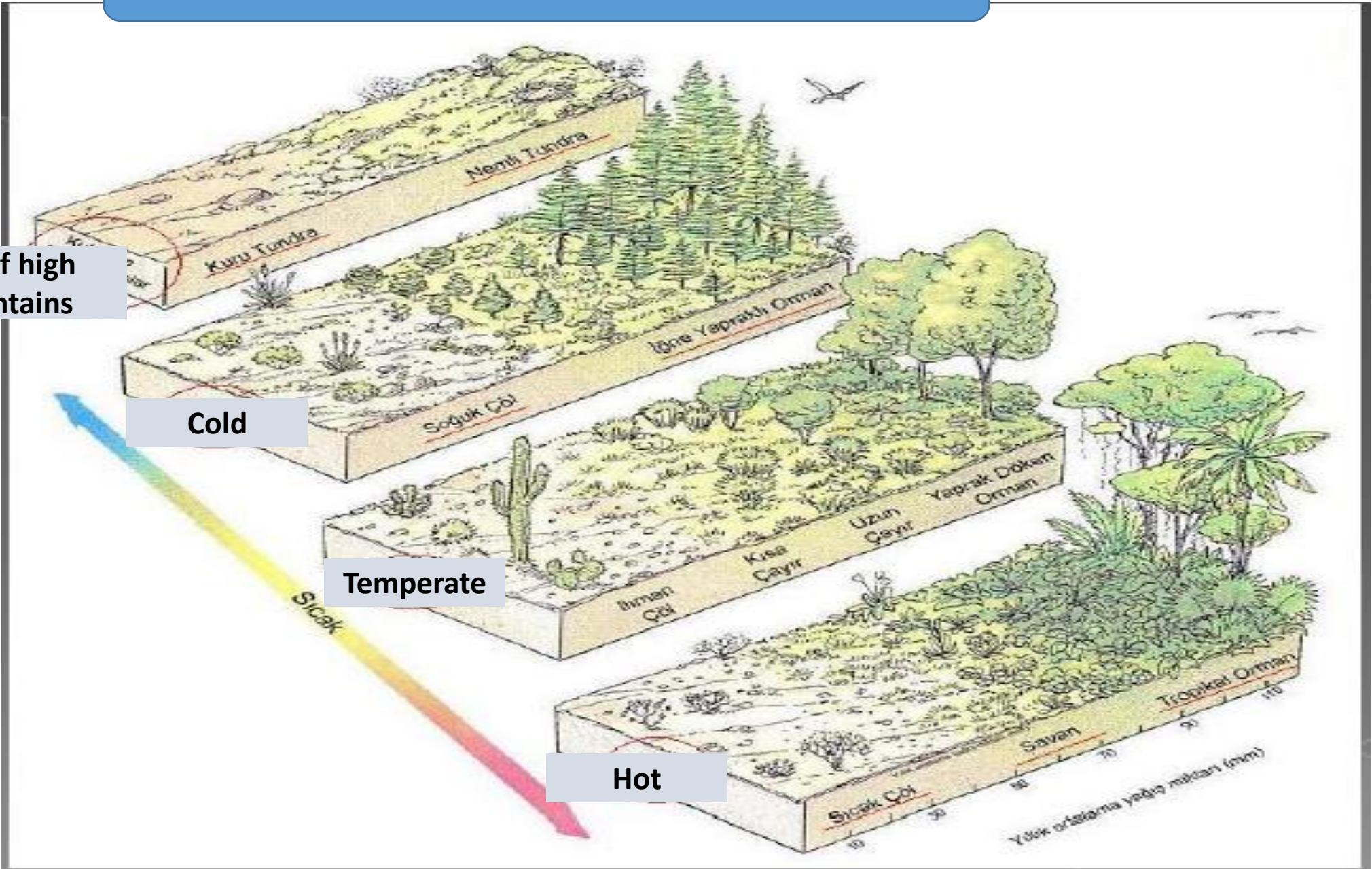
How does heat effect soil formation

Top of high mountains

Cold

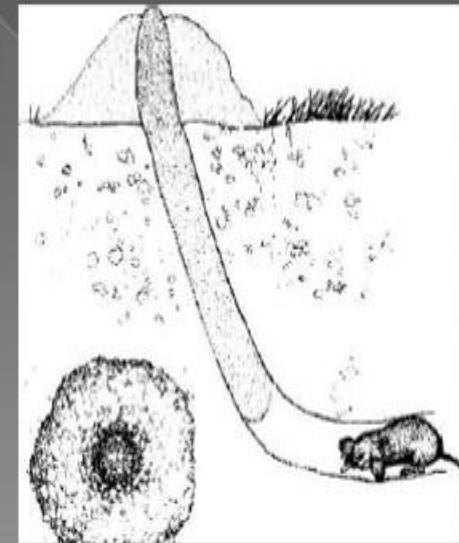
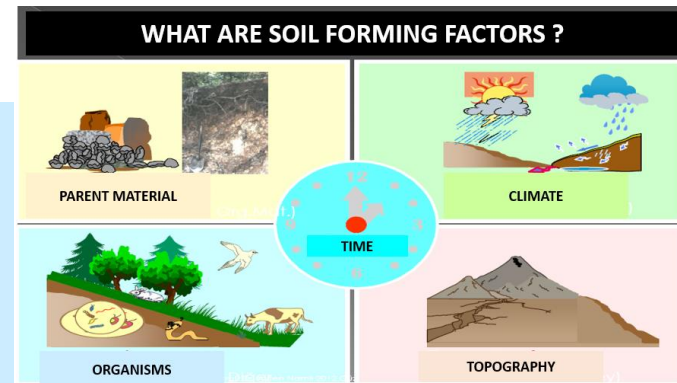
Temperate

Hot



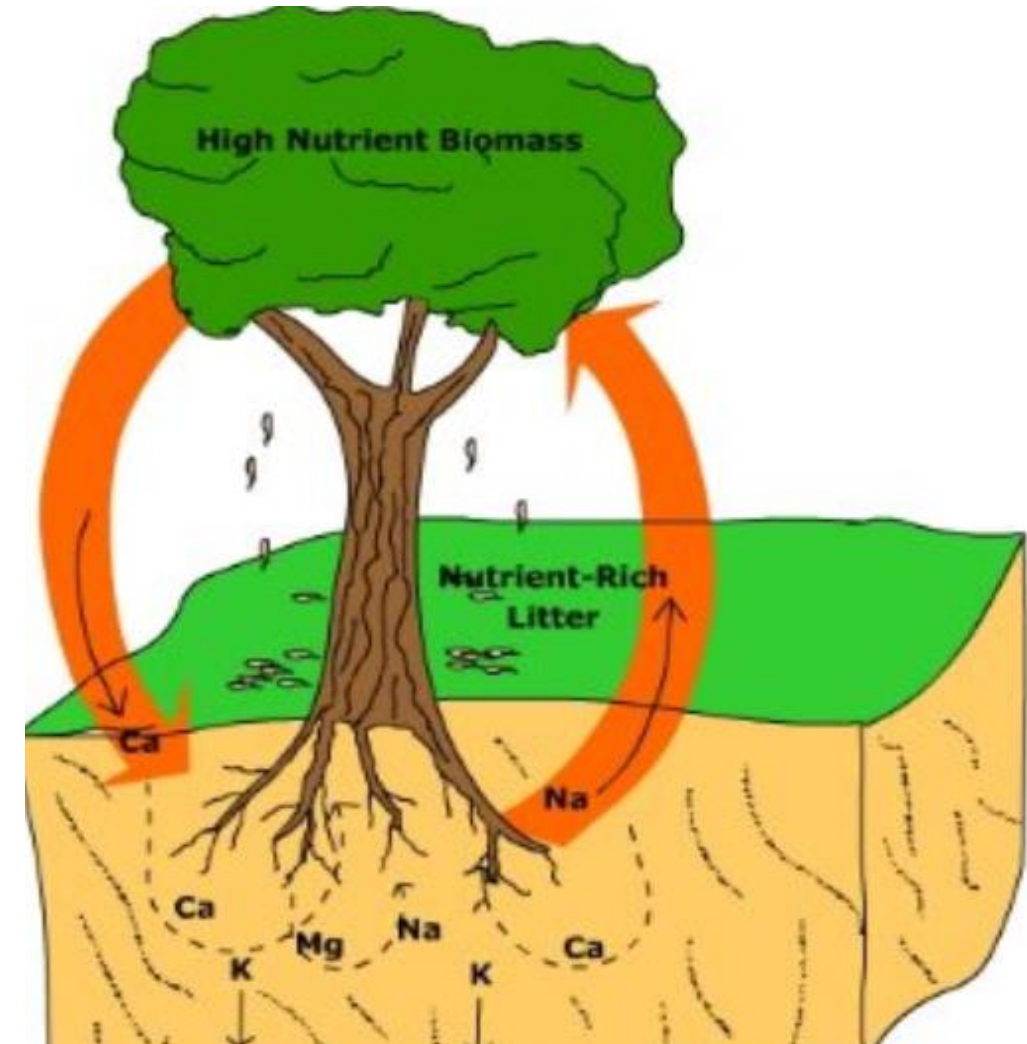
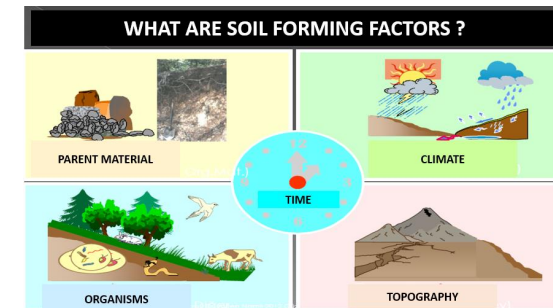
Biosphere (plants and animals) as an active soil forming factor...

- ❑ Soil animals mix soil and stimulate soil physical conditions (porosity) for soil air and water cycles



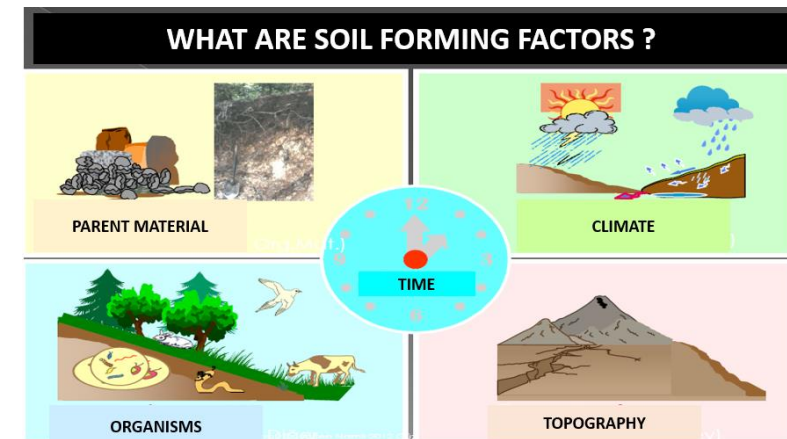
Biosphere (plants and animals) as an active soil forming factor...

- ❑ Plants are the sources of soil organic matter in soil
- ❑ Plant roots facilitate water penetration into below soil layers
- ❑ Plants protect soil surface against to erosion (by cutting wind and surface runoff) and help to rapid soil formation
- ❑ Plant communities (forest) can change climate
- ❑ Soil animals mix soil and stimulate soil physical conditions (porosity) for soil air and water cycles



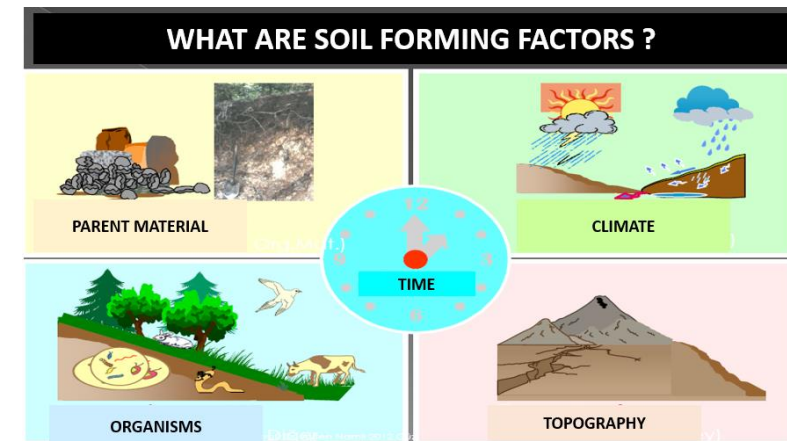
Soil parent material

- ❑ It is the material existed on the bedrock.
- ❑ Parent material can be hard (i.e. Granite, basalt) or soft (volcanic sand or sand)
- ❑ Effective in early stages of soil formation but always driven by climate
- ❑ Minerals released from parent material determine color, permeability and nutrition content of soil.
 - ❑ parent material of sedimentary rocks = light colored soil with neutral/alkaline pH and high carbonate content
 - ❑ parent material of sandstone = light soil with high sand content, high permeability and low organic matter

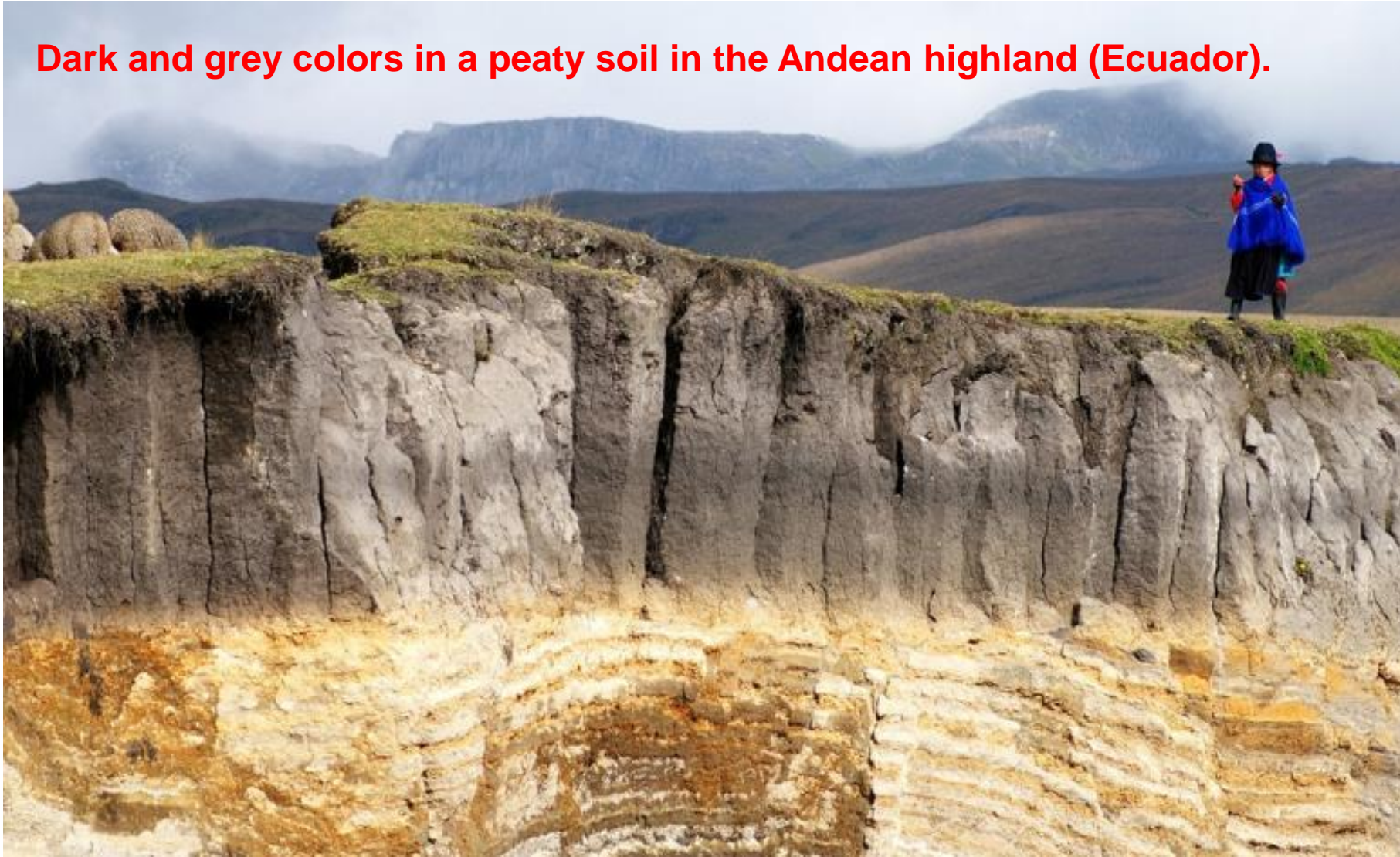


Soil parent material

☐ **Attention!** Soils formed on the same parent material can be different and similar type of soils can be formed by different parent materials (especially in the regions where climate effect is dominant)



Dark and grey colors in a peaty soil in the Andean highland (Ecuador).





Red to greysh green colors in a soil profile as a consequence of redox processes.



Light color in a calcium carbonate-rich soil (southeastern Spain).



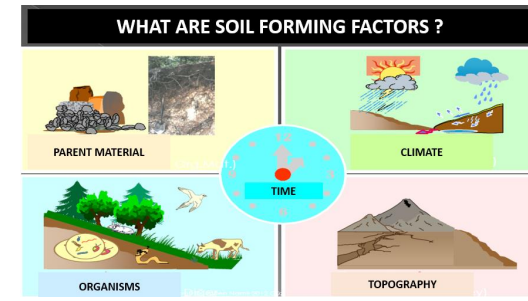
Olive-cropped red soil (Andalusia, Spain)



- Red colour (due to the massive release of dehydrated iron oxides, hematite),
- dark spots (manganese oxides)
- a yellowish colour surrounding cracks and macropores were water flows (hydration and reduction of iron minerals).

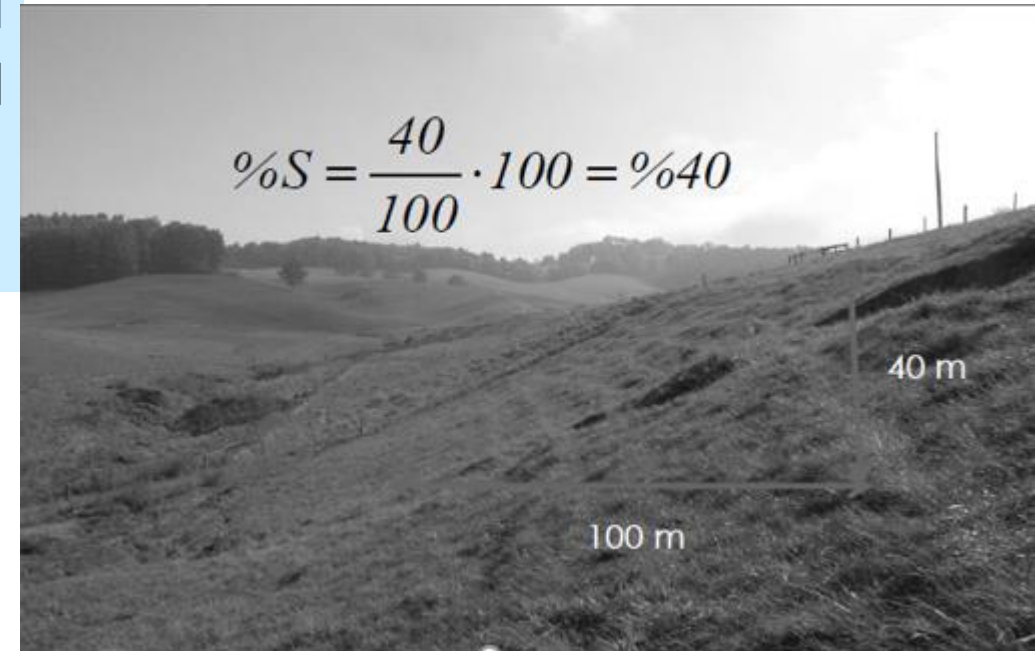
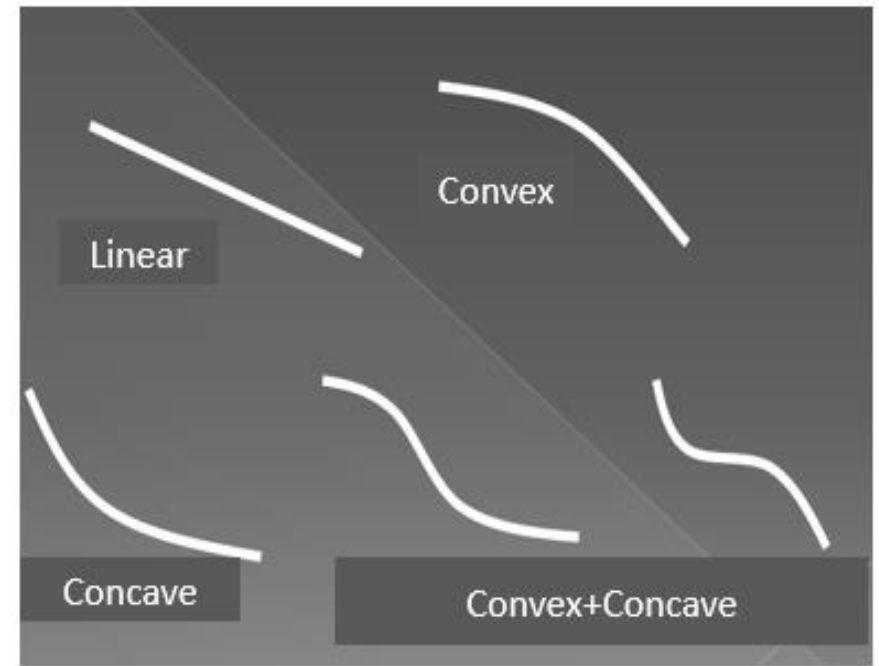
Topography (land shape and exposure)

- Land forms accelerating or decelerating the impacts of water force on soil formation



Topography (land shape and exposure)

- ❑ Slope gradient is the angle of inclination of the soil surface from the horizontal. It is expressed in percent, which is the number of feet rise or fall in 100 ft. of horizontal distance.
- ❑ Slope is important because it affects the rate at which runoff flows on the topsoil surface and erodes soil.
- ❑ Slope shapes (straight, concave or convex) and length are all important in terms of surface soil properties



Eğimli yüzeyin yüksekliğinin yüzeyin izdüşümünün uzunluğuna oranı (yatay ve eğimli yüzey arasındaki açının tanjantı)

Topografya ve Eğimin Yönü Bakı

- Eğimin yönü, eğim derecesi $>$ % 10 olduğunda önemli olmaktadır



A

E

Bt

C

A

Bw

C

Exposure and soil erosion



Northern side is well covered resulting a better soil formation

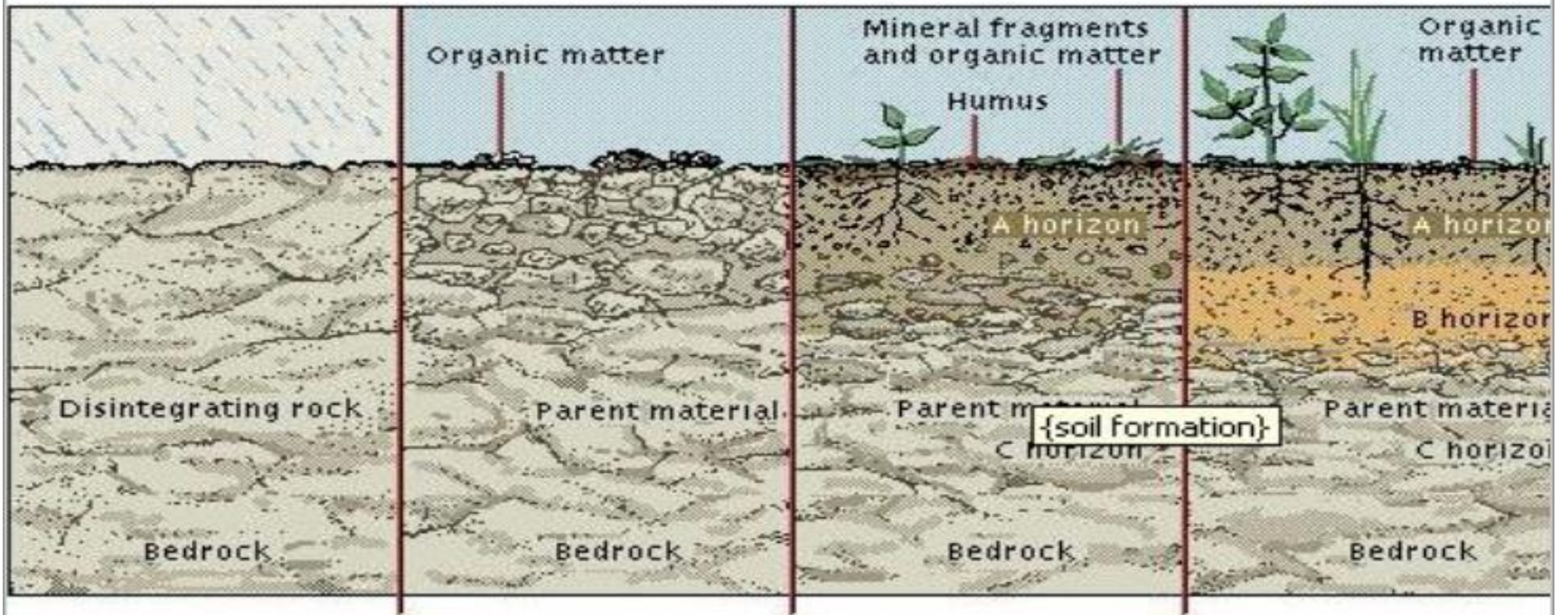
Southern side is naked giving a weaker soil formation

Time (as a passive factor)

- Young mature and old soils
- Affected by climate
- Temperate region soils are more mature than those of dry reigons



BASIC STEPS IN SOIL FORMATION



Bedrock begins to disintegrate

I

Organic materials facilitate disintegration

II

Horizons form

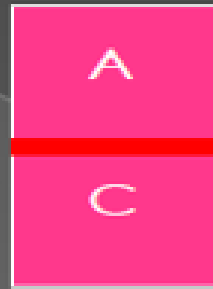
III

Developed soil supports thick vegetation

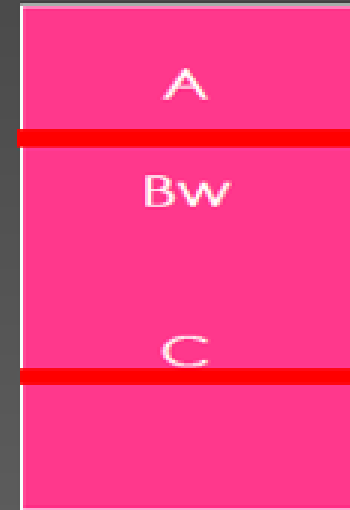
IV

Time Factor (Sequence)

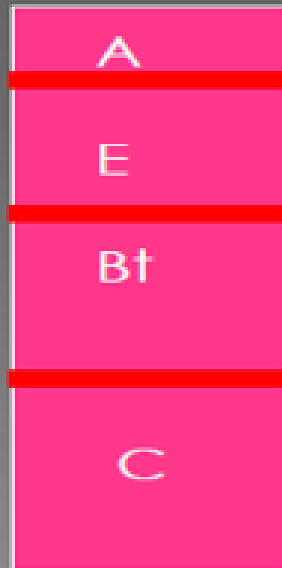
Young =



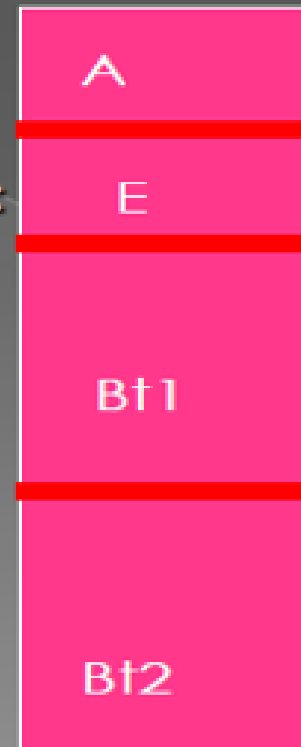
Grown up =



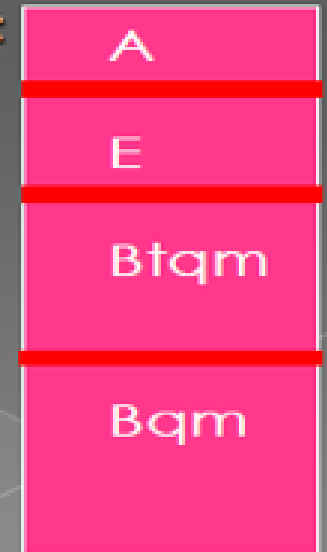
Mature =

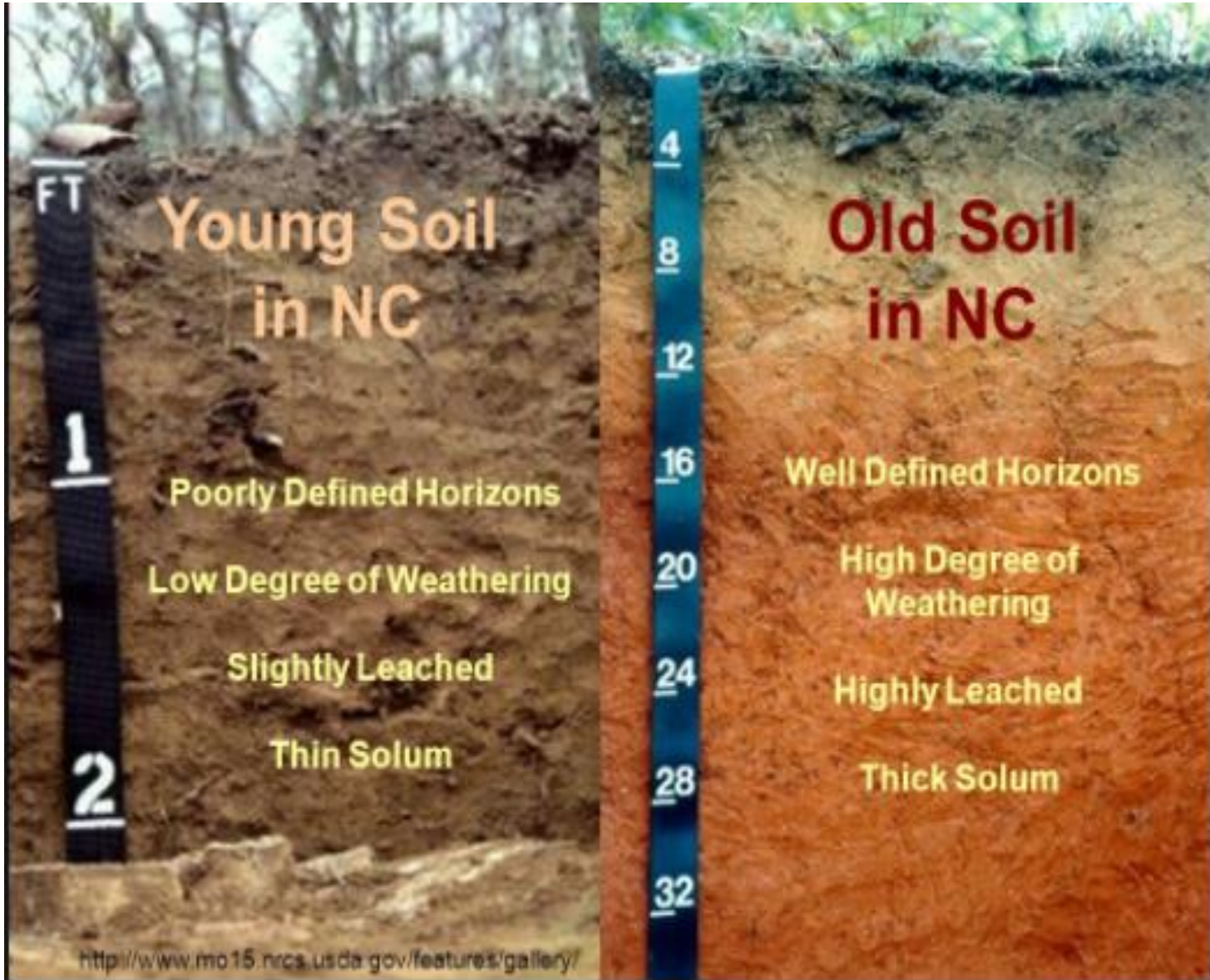


Mature-II =



Old =







Young Ca rich soil in IL

Most young soils
contain large
amounts of
calcium.

Old Ca deficient soil in NC

Old, highly
weathered soils
contain much less
calcium.

**Soils formed from parent materials low in Ca
(e.g., quartz sand) contain low levels of Ca**

Physical chemical and biological facts in soil formation

- Erosion (aşınma)**
- Disintegration (ayrışma)**
- Aggregation (birleşme-kümelenme)**

Physical chemical and biological facts in soil formation

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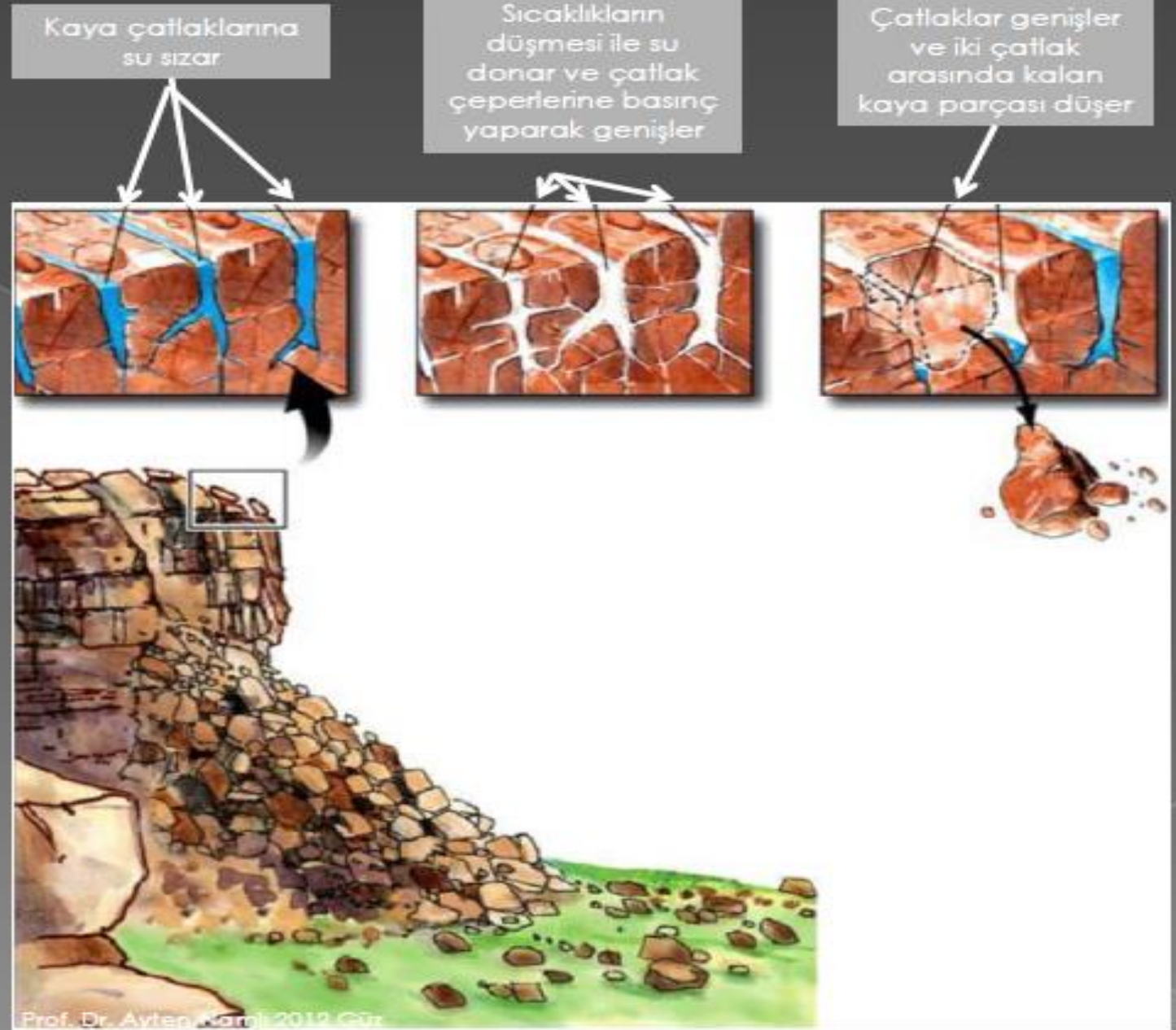
Fiziksel Parçalanma

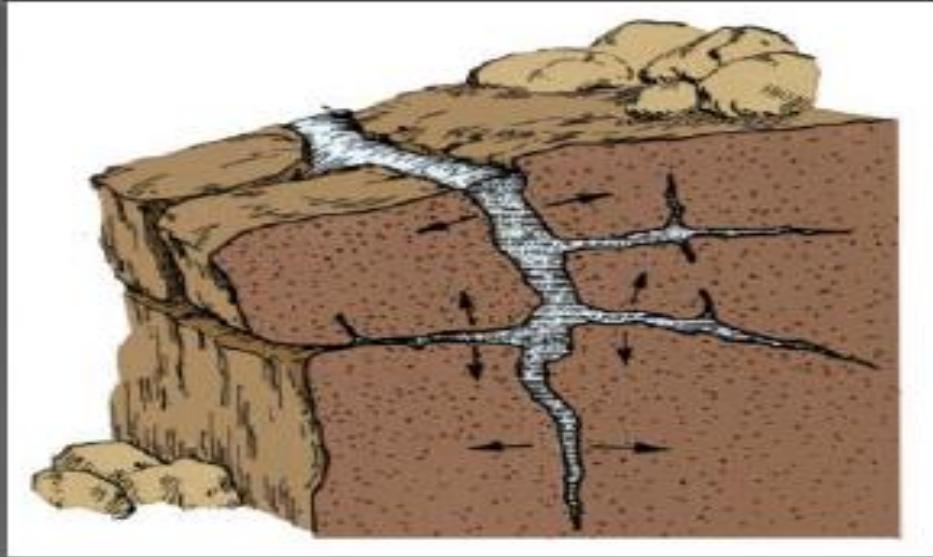
Aşınma- Ayrışma- Birleşme



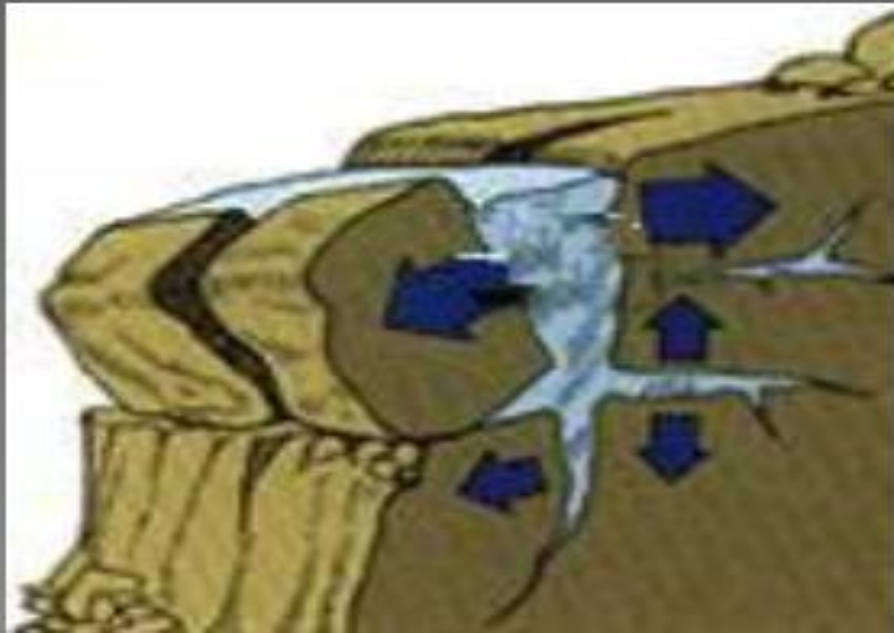
- Kayalar, yağış, sıcaklık, rüzgar gibi iklim koşullarının etkisiyle parçalanır.
- Parçalanan kayalardan taş ve çakıl meydana gelir. Bunlar ya oldukları yerde, yada taşınarak biriktikleri başka bir yerde parçalanmaya devam ederler.
- Kaya ve mineralin şekil ve büyüklüğünü değiştiren aşınma – parçalanma
- Kimyasal ve minerolojik yapı değişmez

Buz Kaynaklı Aşınma ve Parçalanmalar





- 9% genişleme
- Kuvvet = 21 kg/m²



Mekanik ayrışma (aşınma)

Kaya ve minerallerin, kimyasal yapılarında herhangi bir değişim olmaksızın, daha küçük parçacıklara aşınması



Biyolojik aşınma

Yosun ve likenler toz tanelerini yakalar yüksek Org.maddeli ince bir film oluşur, buda kayanın dayanıklılığını azaltır

Buz-kaynaklı ayrıklar
Çatlaklarda suyun donması ve çözünmesi

Kristal Gelişimi
Buharlaştan tuzlu sulardan tuz kristallerinin oluşumu

Mekaniksel Kırılmalar
Kayaların genişleme ve büzülme sonucu kırılmaları

Kök Girişimleri
Kaya çatlaklarında kök gelişimi

Termal Genişleme ve Büzülme
Isınma ve soğuma sonucu mineral kristallerinin hacimsel büyümesi ve küçülmesi

Sürtünme
Bir akışkan ile taşınan taneciklerin çarpışmaları

Toprak Oluşumunda Kimyasal Ayırıştırma Etmenleri

Ana kayanın kimyasal bileşimini değiştirmek suretiyle ana materyal ve toprağın oluşturulmasına hizmet eden etmenlere kimyasal ayırıştırma etmenleri adı verilmektedir.

- Belli mineraller kısmen veya tamamen değişerek, yeni mineraller oluşur,
- Fiziksel ayrışmalarla ufalanmış veya gözenekli hale gelmiş olan materyallere, kimyasal etmenlerin etkisi kolaylaşır,
- **Su, hava ve sıcaklık**, kimyasal ayrışmalarda büyük rol oynar,
 - Kurak bölgeler → fiziksel aşınma
 - Yağışlı ve sıcak bölgeler → kimyasal ayrışma

Kimyasal ayrışma

Kaya ve minerallerin, kimyasal yapılarında değişimler



Yükseltgenme

O₂ varlığı

Hidroliz

H⁺ veya (OH₃)⁺

Hidrasyon

H₂O

Karbonasyon

CO₂ veya H₂CO₃

Solusyon

Ca⁺², Mg⁺², K⁺, Na⁺

İndirgenme

O₂ yokluğu

Biyolojik Etmenler

- ◆ Liken, mantar, bakteri, solucan



Likenler;
(mantar-alg ortak yaşam)
mantarın ayrıştırıcı özelliğini kullanarak kayanın üzerini yavaş yavaş ayrıştırır ve kayanın rüzgar ve yağmur ile parçalara ayrılmasına neden olur.

Mantar algin fotosentez özelliği sayesinde besin elde ederken,
Algler mantarın ayrıştırıcı özelliği sayesinde mineralleri elde ederler.

SOLUCANLAR



- açmış oldukları galeriler
- dışkılarının içermiş olduğu yüksek besin maddesi nedeniyle **toprak**

verimliliği

- stabil agregatların oluşumu
- toprak strüktürünün iyileştirilmesi
- toprakların infiltrasyon ve su tutma kapasitelerinin artırılması gibi bir seri **fiziksel özellik** üzerine olumlu etkileri bulunmaktadır.

HAYVANLAR;

- ◆ Toprakta dehlizler açar
- ◆ OM'yi inorganik materyalle karıştırır
- ◆ Solucanlar, toprağı vücutlarından geçirerek fiz. ve kim. değışime yol açar.

YÜKSEK BİTKİLER

Kökleri,

Üst aksamları

Erozyon önleyici özellikleri

Bitki ve hayvanlar; ana materyalin parçalanmasından daha çok toprağın olgunlaşmasında etkilidirler

