PROSES PELAPUKAN BATUAN DAN MINERAL

1. Fisik
2. Biologi-mekanik
3. Kimia
ASAL TANAH

1. Batuan keras : beku, sedimen, metamorfosis
2. Bahan lebih lunak dan lepas (abu volkan, bahan endapan baru)
refers to numerous processes that convert bedrock exposed at earth's surface to smaller pieces that can be eroded by wind, rivers, waves or glaciers, as well as processes that chemically attack minerals in rock to produce a variety of dissolved substances.

*is that suite of processes acting at or near the Earth's surface that either reduce the particle size, alter the mineral combination, or both of rocks.*
Weathering

- The breaking down of rocks and other materials **near or on the Earth’s surface** is called weathering. A slow, continuous process, it affects all substances exposed to the atmosphere.
BATUAN KERAS

REGOLIT
Bahan-bahan lepas (termasuk tanah) yang berada di atas batuan

TANAH
PELAPUKAN FISIK

• Tahap awal proses pelapukan
• Dua tahap:
  1. Pemecahan jadi bagian dg ukuran bervariasi
  2. Pelembutan jadi bagian dg ukuran lebih kecil + agak merata
• Ciri:
  1. tdk ada perubahan susunan kimia
  2. tdk ada pembentukan mineral baru
Terjadi cepat pd daerah dg perbedaan suhu tinggi
Di sub tropis / daerah dingin → tanah tua
Tropis → tanah muda
PELAPUKAN FISIK
Mechanical weathering by exfoliation (sheeting) *(left)*
Exfoliation occurs as rocks expand when brought to the surface from deep in the crust where pressures are much higher than at the surface.
*Photo: exfoliating granite in Yosemite National Park*

**Mechanical weathering by frost action *(right)***
Freezing and thawing widens fractures over time. Pieces can then fall off the cliff and move down the slope.
Rocks can be broken apart by changes in temperature. As rocks are heat up in the sun during the day, the outside of the rock expands. The inside of the rocks remain cool and do not expand. When the air temperature drops at night, the outside of the rock cools and contracts. This continuing cycle causes particles to break off. This is called exfoliation.
Frost Action

Unlike most liquids, water expands when it freezes. The repeated freezing and melting of water, called frost action, is another cause of mechanical weathering. When water freezes in cracks in the rocks, it expands, making the crack larger. In time, this causes the rock to break into pieces.
A small crack in a rock fills with water during the daytime. As the water begins to freeze at night, it starts at the top, sealing the crack.

As the water freezes completely, its 9% growth exerts an outward force on the sides of the crack, increasing the size of the crack by a maximum of 9%.

If the ice thaws the next day the resulting water will not fill the crack, which is now both wider and deeper because of its 9% expansion. Dew or rainfall on the rock surface can refill the crack.

The process begins again, this time with a larger initial crack.

Again the crack expands by as much as 9%. Continued freezing and thawing, particularly with the daily addition of water to keep the crack full, eventually does significant fracturing of the rock.
PELAPUKAN KIMIA

• Pelunakan + penguraian pecahan batuan dan mineral ke dalam elemen penyusunnya yang sering diikuti dengan pembentukan mineral baru (mineral sekunder).
• Suhu + air berpengaruh besar →
• Tropis (t + ch besar) → pelapukan kimia cepat
• Hasil : mineral liat
How acid rain affects stonework.
The picture on the left was taken in 1908.
The picture on the right was taken in 1968.
• Hidrasi
• CaSO4 + 2H2O $\rightarrow$ CaSO4 2H2O
• Mineral lebih lunak
• Dehidrasi
• CaSO4 2H2O $\rightarrow$ CaSO4 + 2H2O
• OKSIDASI
  • Fe^{++} \rightarrow Fe^{+++} + e^{-}
  • disintegrasi
  • mineral mudah hancur

• REDUKSI
  • Fe^{+++} + e^{-} \rightarrow Fe^{++}
  • Mobil \rightarrow mudah tercuci
HIDROLISIS

K Al Si₃ O₈ + H⁺ → H Al Si₃ O₈ + K⁺

- Feldspar

- Struktur kristal rusak + mudah hancur
PELAPUKAN BIOLOGIK -MEKANIK

Pemecahan/penguraian batuan akibat kegiatan hewan atau tanaman:

- Akar pada retakan batu
- Rayap, semut, serangga merombak BO + mencampurkan dengan mineral → tanah.
- Penguraian BO → as.organik + CO2
The roots of plants sometimes loosens rock material. A plant growing in a crack can make the crack larger as the root spread out. This is known as root-pry. It is organic since this activity is caused by living things.
PROSES PELAPUKAN BATUAN

1. Disintegrasi:
   - Gejala mekanika
   - Proses pengurangan ukuran batuan dan mineral tanpa mempengaruhi komposisi mineral

2. Dekomposisi:
   - Gejalan kimia
   - Terjadi perubahan kimia
• Proses pelapukan batuan : proses geologi
• proses pembentukan tanah : proses pedologi
The rate of weathering depends on several factors, including:

1. The composition of the rock
2. The amount of time that the rock is exposed on the Earth’s surface
3. The amount of exposed surface on a rock
Two different types of rocks in the same climate can weather differently, depending on the minerals that make up each rock type. If the minerals in a rock resist chemical weathering, the rock is called a stable rock. The stability of a rock can vary depending on the climate in which the rock is found. Limestone is stable in a dry climate but not in a wet climate.
Mineral Stability in Weathering Zone

Olivine
Pyroxene
Amphibole
Biotite
Muscovite
Clay
Quartz
Al Oxides
Fe Oxides
Ca Plagioclase
Na Plagioclase
K Feldspar

Least Stable
Most Stable
The amount of time that rock is exposed on the Earth’s surface also affects its rate of weathering. A very old rock that has not been exposed to the forces of weathering can remain almost unchanged. If a newly formed rock is deposited on the Earth’s surface it will begin to weather right away.
The amount of exposed surface area on a rock also affects its rate of weathering. As rocks are broken down into many small pieces, more rock surfaces are exposed and more weathering takes place. In rocks that contain many joints or cracks, various chemicals easily come into contact with the rock surfaces and break them down.
TANAH SEBAGAI SISTEM TERBUKA

INPUT :
• Pelapukan batuan
• Pelapukan BO
• presipitasi

OUT PUT :
• Serapan hara oleh akar
• evapotranspirasi
• pencucian
SUSUNAN KIMIA DAN MINERALOGI
BAHAN INDUK

MINERAL

1. SILIKAT

2. BUKAN SILIKAT
SILIKAT

- Struktur sangat kompleks
- Satuan utama Silika-oksigintetrahedron :
- Ion silika sebagai pusat dikelilingi 4 ion-ion oksigen yang berdekatan dengan jarak sama
- Pembagian :
  - Rangka silikat : pyroksin, amphibil
  - Rantai silikat : olivin, zirkon
  - Orto dan lingkaran silikat :
  - Lempeng silikat : mika
BUKAN SILIKAT

- Struktur sederhana
- Variasi dalam kelarutan + ketahanan terhadap penguraian
- Oksida-oksida, hidroksida-hidroksida, sulfat-sulfat, klorida-klorida, karbonat-karbonat, fosfat-fosfat
• Keberadaan mineral kuarsa yang tinggi dalam tanah dapat mengindikasikan tiga hal:
(1) tanah sudah mengalami tingkat perkembangan lanjut;
(2) cadangan sumber hara tanah yang rendah;
(3) bahan induk tanah tersebut bersifat masam.