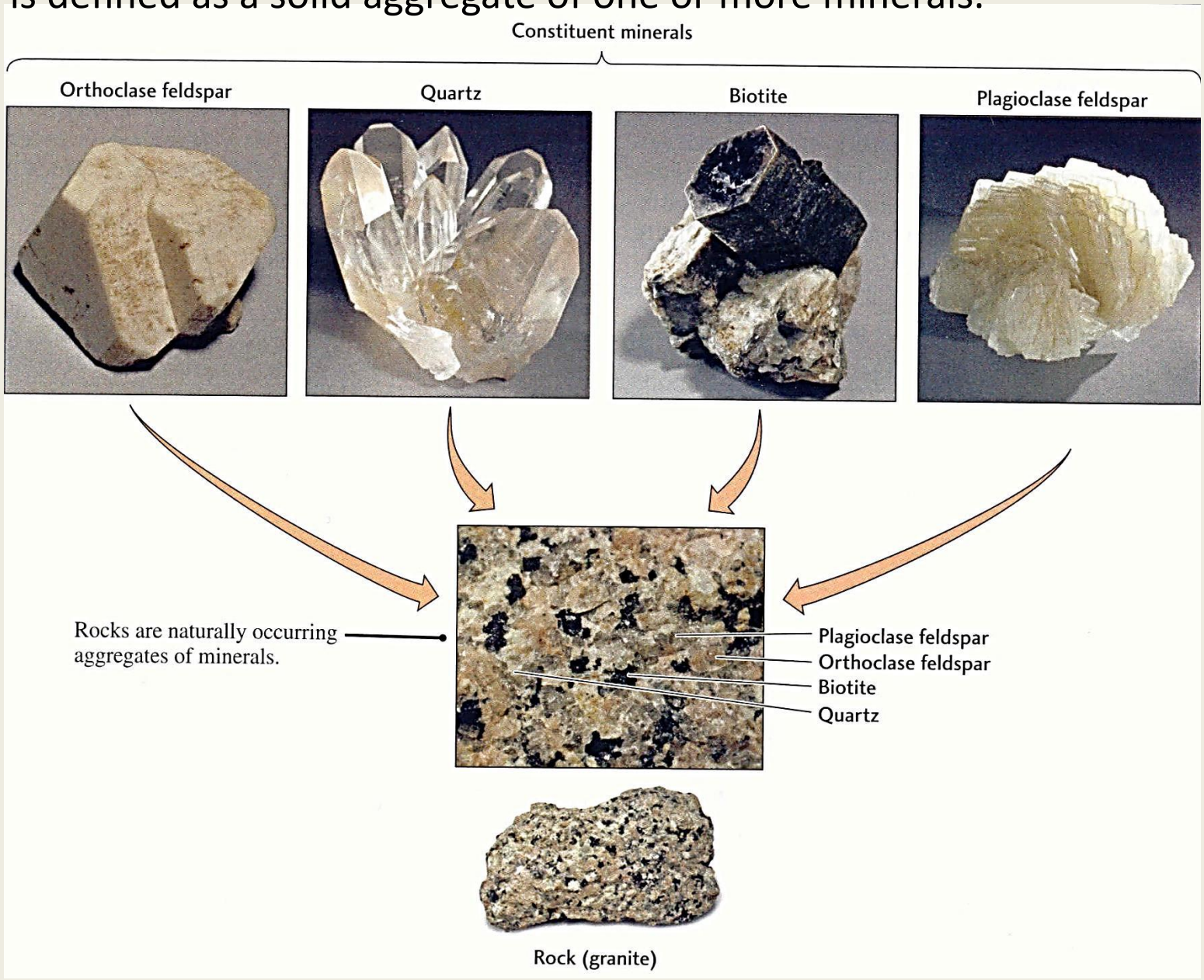
Minerals are the building blocks of rocks

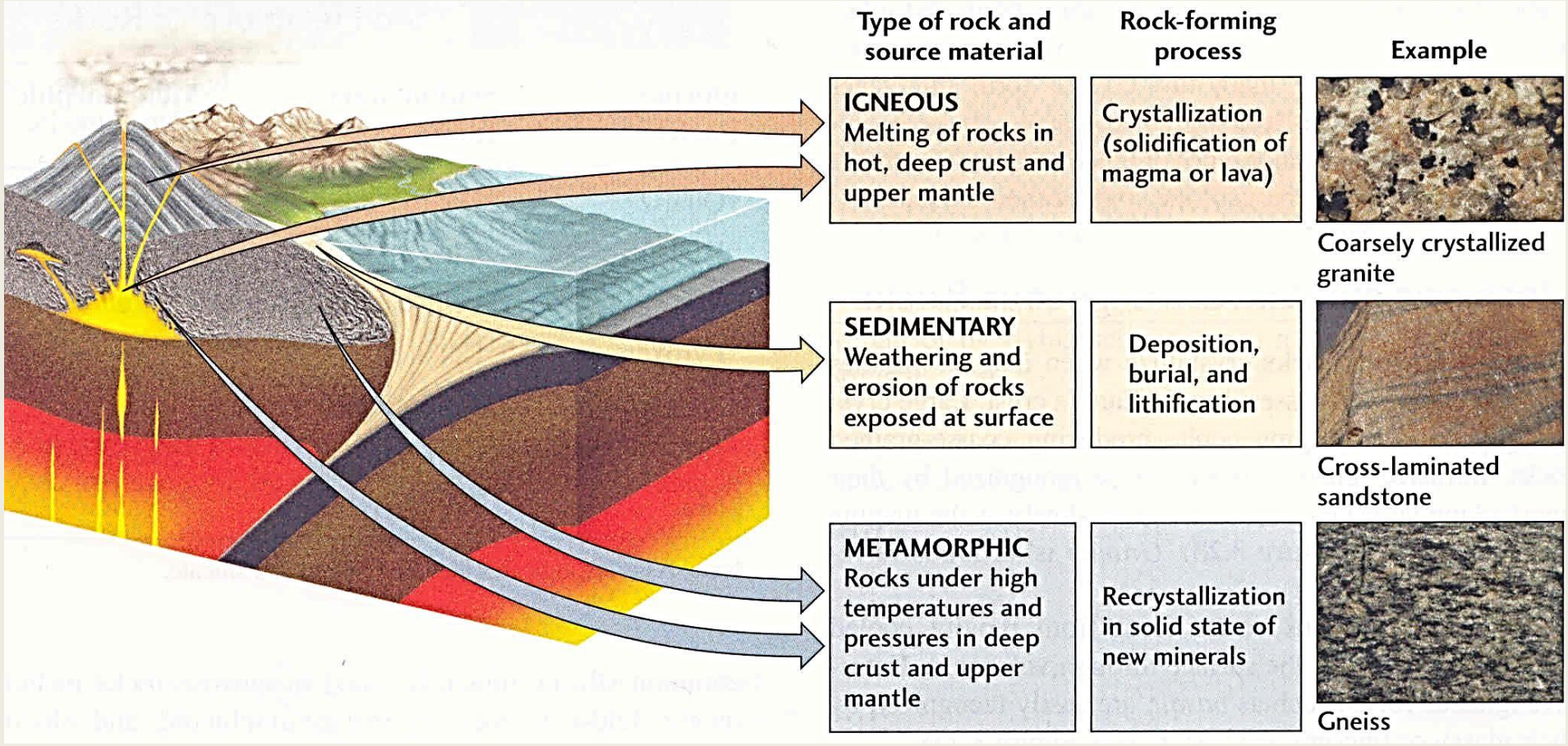
Rock is defined as a solid aggregate of one or more minerals.



There are three major groups of rocks namely, **igneous**, **sedimentary** and **metamorphic**.

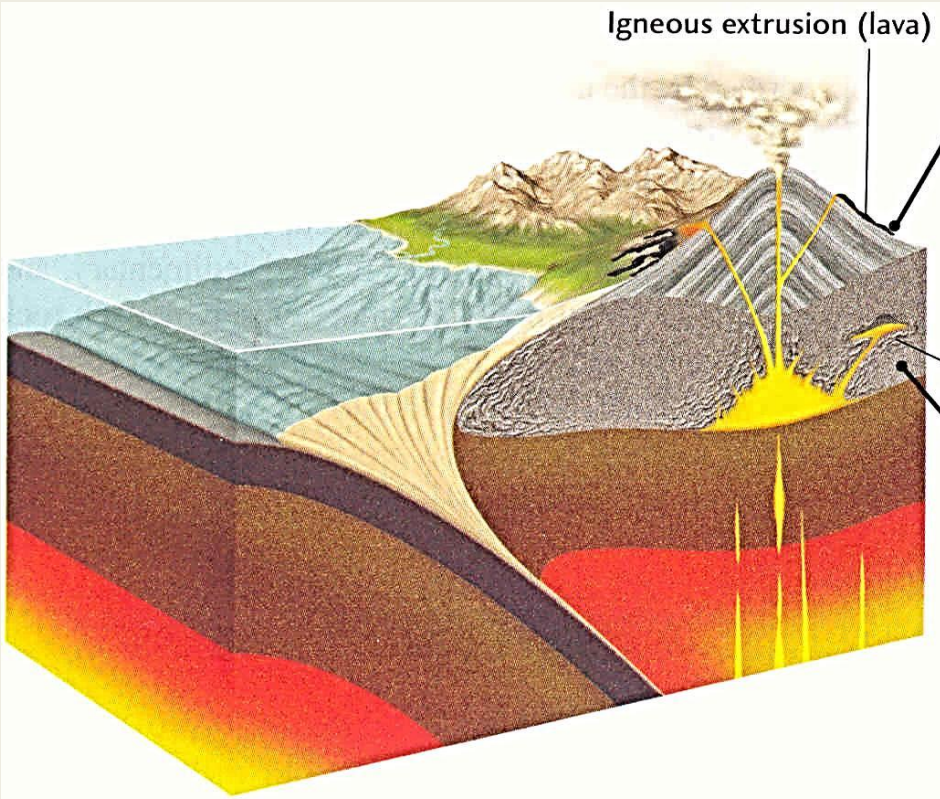
Igneous Rocks	Sedimentary Rocks	Metamorphic Rocks
*Quartz	*Quartz	*Quartz
*Feldspar	*Clay minerals	*Feldspar
*Mica	*Feldspar	*Mica
*Pyroxene	Calcite	*Garnet
*Amphibole	Dolomite	*Pyroxene
*Olivine	Gypsum	*Staurolite
	Halite	*Kyanite

Note: Asterisk indicates that the mineral is a silicate.



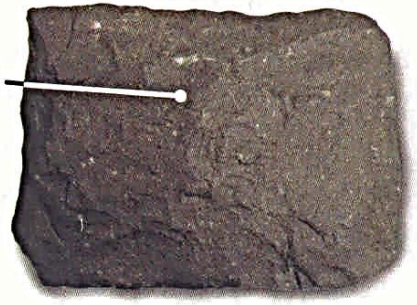
The three rock groups are formed in **different** environments by **different geologic processes**.

Igneous rocks



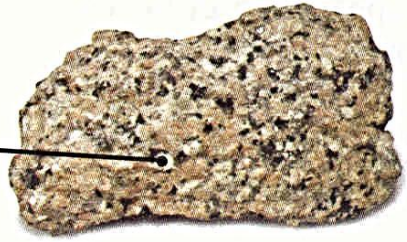
Extrusive igneous rocks form when magma erupts at the surface, rapidly cooling to fine ash or lava and developing tiny crystals.

The resulting rock, such as the basalt sample here, is fine-grained or has a glassy texture.

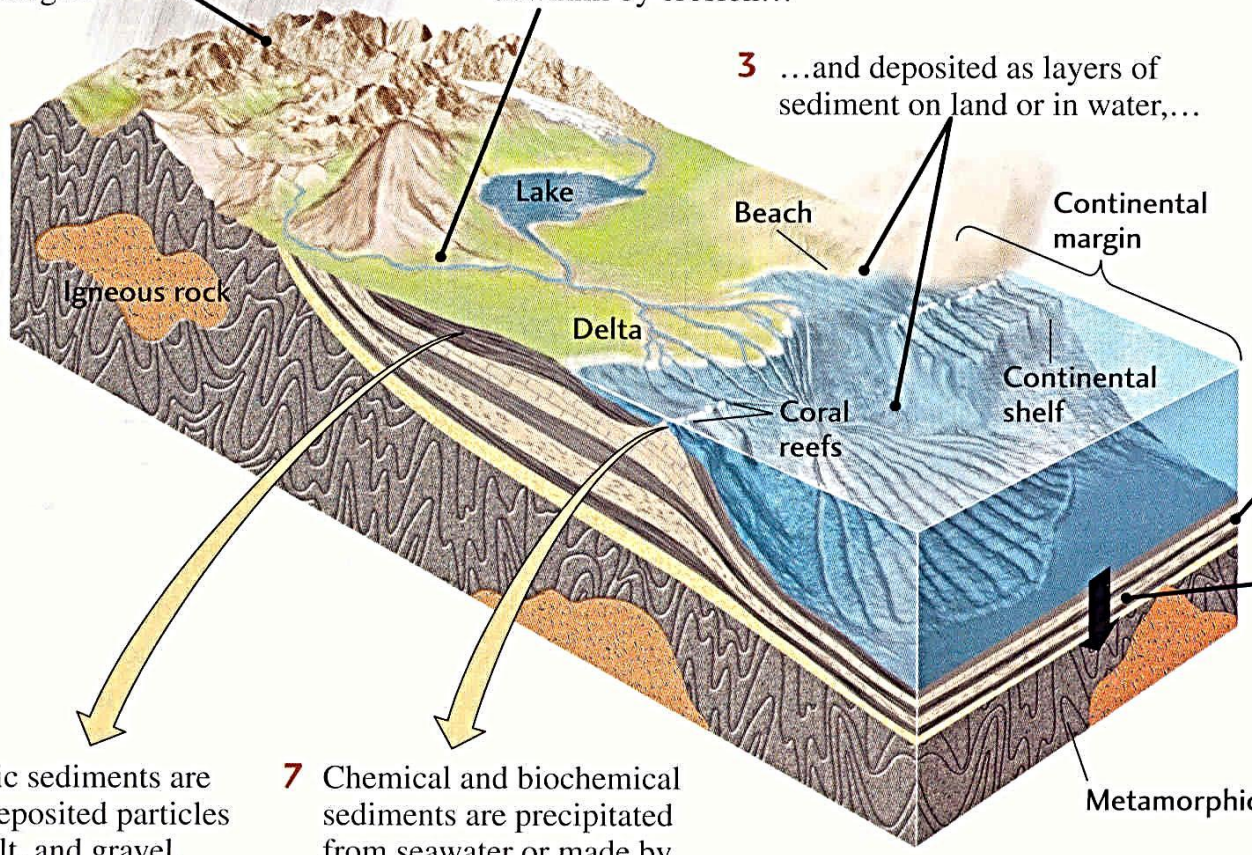


Intrusive igneous rocks crystallize when molten rock intrudes into unmelted rock masses in Earth's crust.

Large crystals grow during the slow cooling process, producing coarsely grained rocks such as the granite sample shown here.



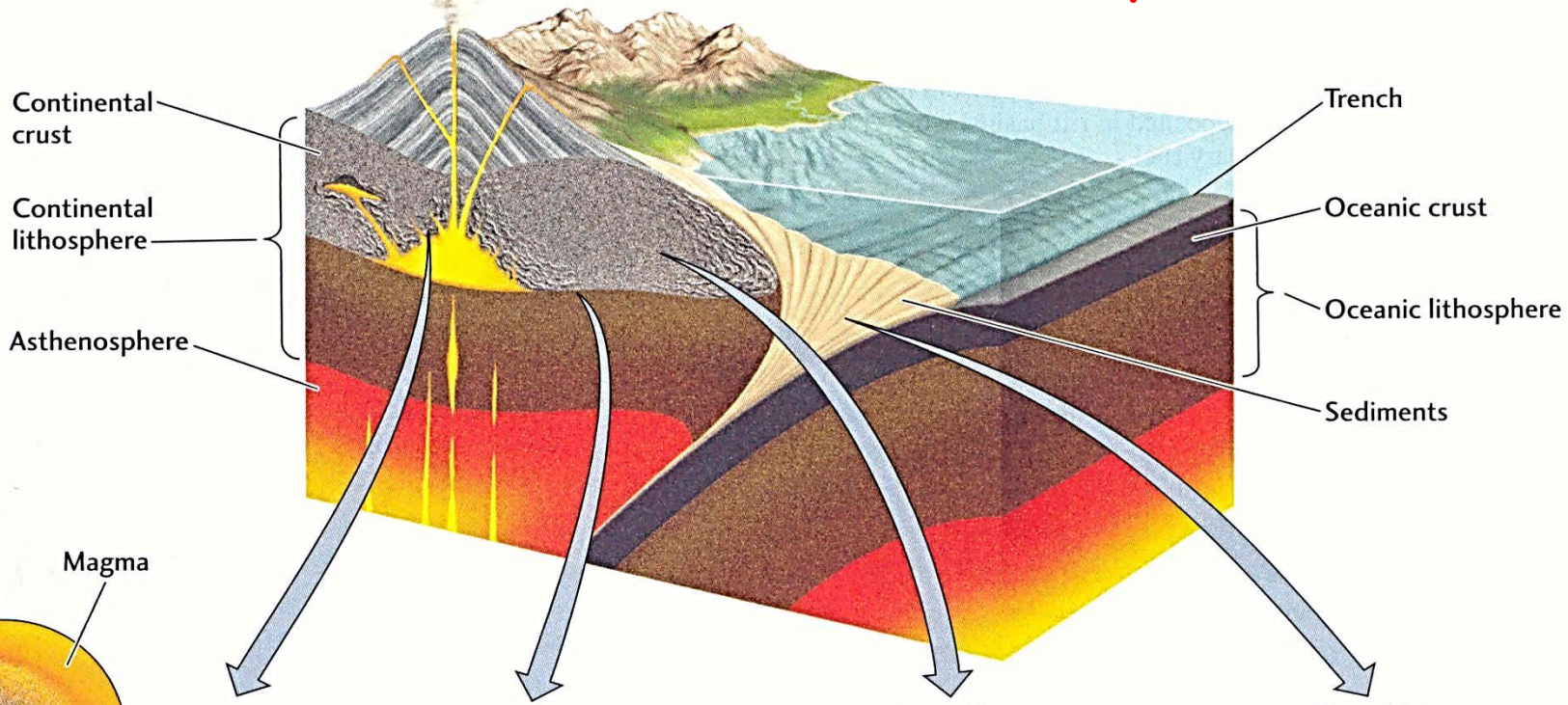
Sedimentary rocks

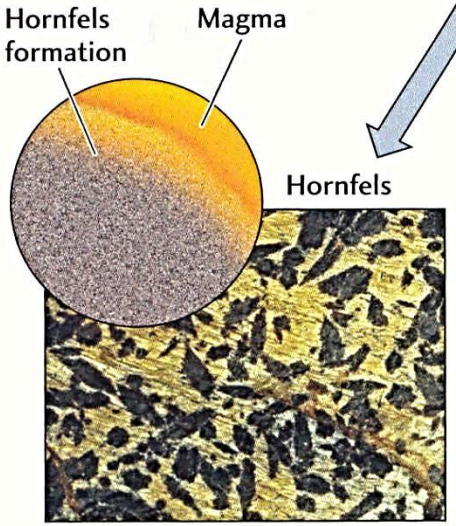


6 Siliciclastic sediments are made of deposited particles of sand, silt, and gravel.

7 Chemical and biochemical sediments are precipitated from seawater or made by coral reefs and shells.

Metamorphic rocks





Hornfels

Contact metamorphism occurs in limited areas where magma intrusion metamorphoses neighboring rock by its heat, forming hornfels.

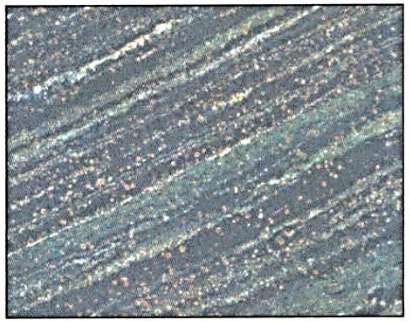
Eclogite

Ultra-high-pressure metamorphism occurs deep in the continental lithosphere and oceanic crust.

Micaschist

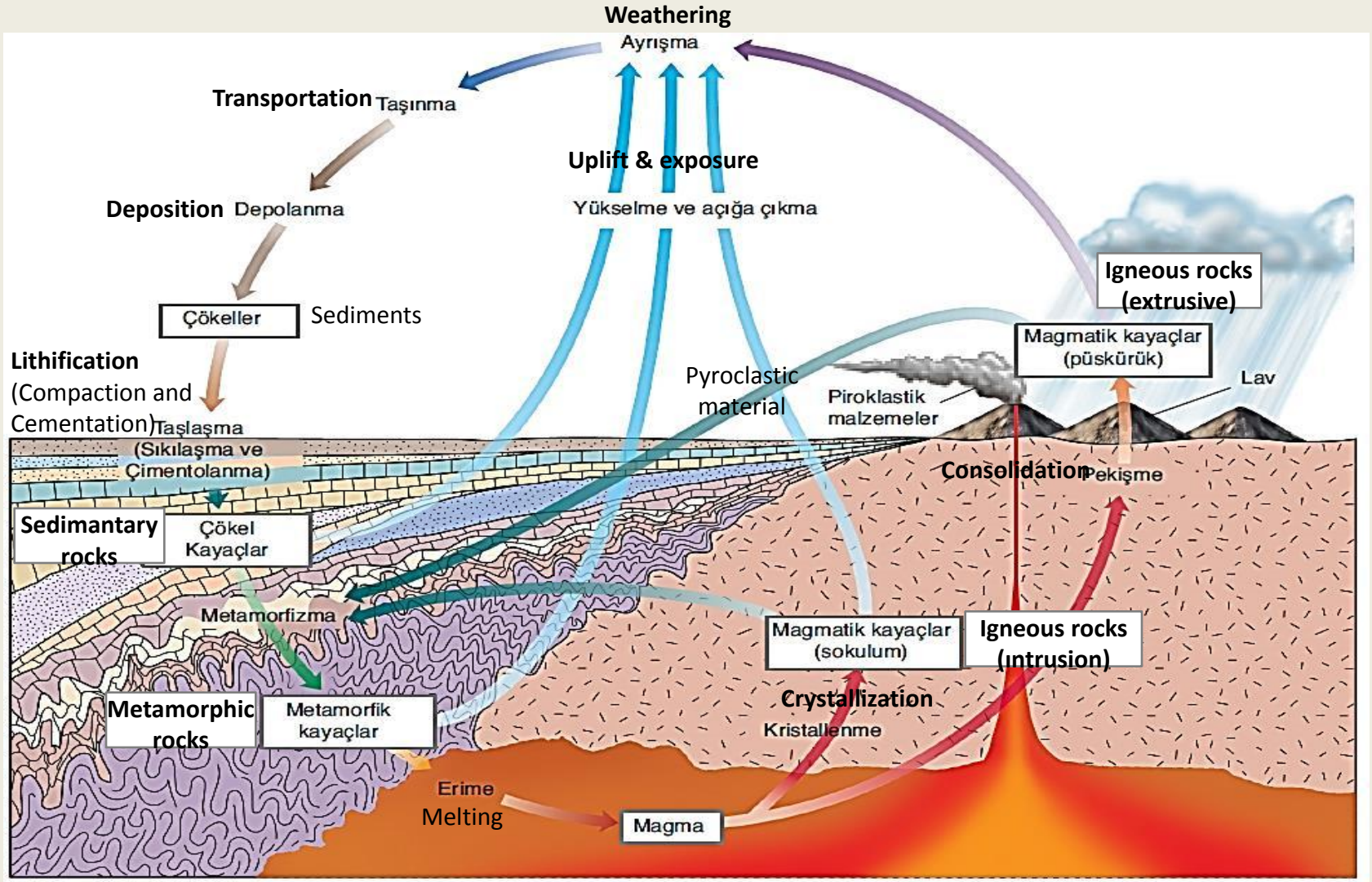
Regional metamorphism occurs where high pressures and temperatures extend over large regions.

Blueschist



High-pressure, low-temperature metamorphism occurs where oceanic crust subducts beneath the leading edge of a continental plate.

All the three basic groups of rocks can evolve from one to another. This concept is named as a **rock cycle** showing the interrelationships between Earth's internal and external processes and how three types of groups are related.



IGNEOUS ROCKS

Magma is simply molten rock below the surface; the same material at the surface is called **lava.**

All igneous rocks derive from magma, but **two separate processes** account for their origin: (1) magma or lava cools and crystallizes to form minerals, (***intrusive or extrusive igneous rocks***) or (2) pyroclastic materials such as volcanic ash are consolidated, forming solid masses from the previously loose particles (***pyroclastic rocks***).

The most common types of Magmas and Their Characteristics

Type of Magma	Silica Content (%)	Sodium, potassium and aluminium	Calcium, iron and magnesium
Magma Tipi	**Silis İçeriği (%)**	**Sodyum, Potasyum ve Alüminyum**	**Kalsiyum, Demir ve Magnezyum**
Ultramafik	<45	↓	IArtar ↑ (Increases)
Mafik	45–52		
Ortaç	53–65		
Felsik	>65	Artar	

(Increases)

How hot are magma and lava?

Erupting lavas generally have temperatures in the range of 1000^{o} C to 1200^{o} C, although a temperature of 1350^{o} C was recorded above Hawaiian lava lakes (lavas with mafic composition). However, the temperatures of felsic lavas forming lava domes are lower, such as 900^{o} C.

Viscosity of lava

All liquids have the property of **viscosity,** simply **resistance to flow.** Viscosity of water is very low, so it is highly fluid and flows readily.

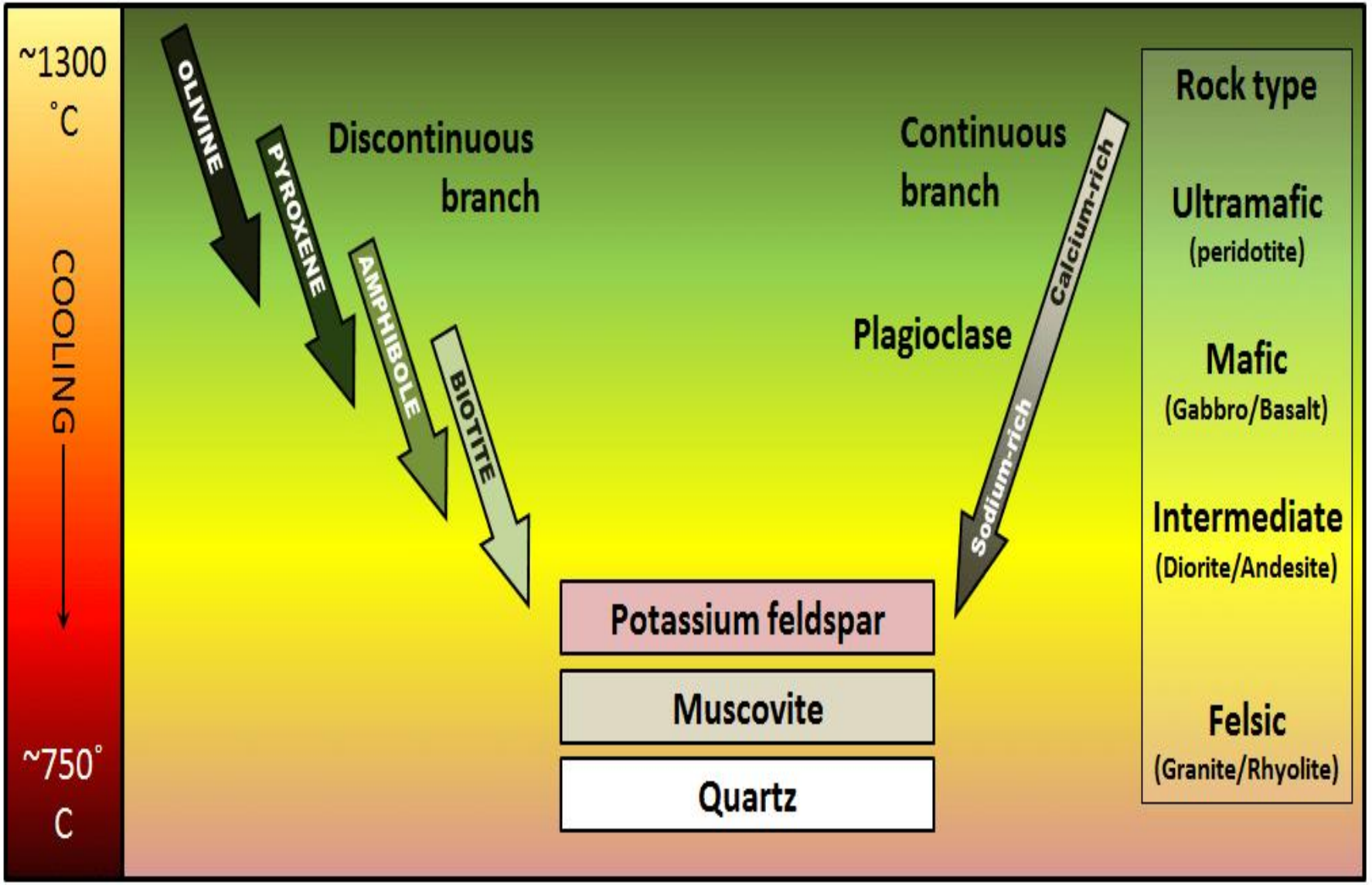
Viscosity of lava is controlled by two factors: **temperature** and **silica content.**

Hot magma or lava **moves more readily** than cooler magma or lava.

Silica content strongly controls magma and lava viscosity. With increasing silica content, numerous networks of silica tetrahedra form and retard flow.

Mafic magma and lava with 45-52% silica have fewer silica tetrahedra networks and as a result are **more mobile than felsic** magma and lava flows.

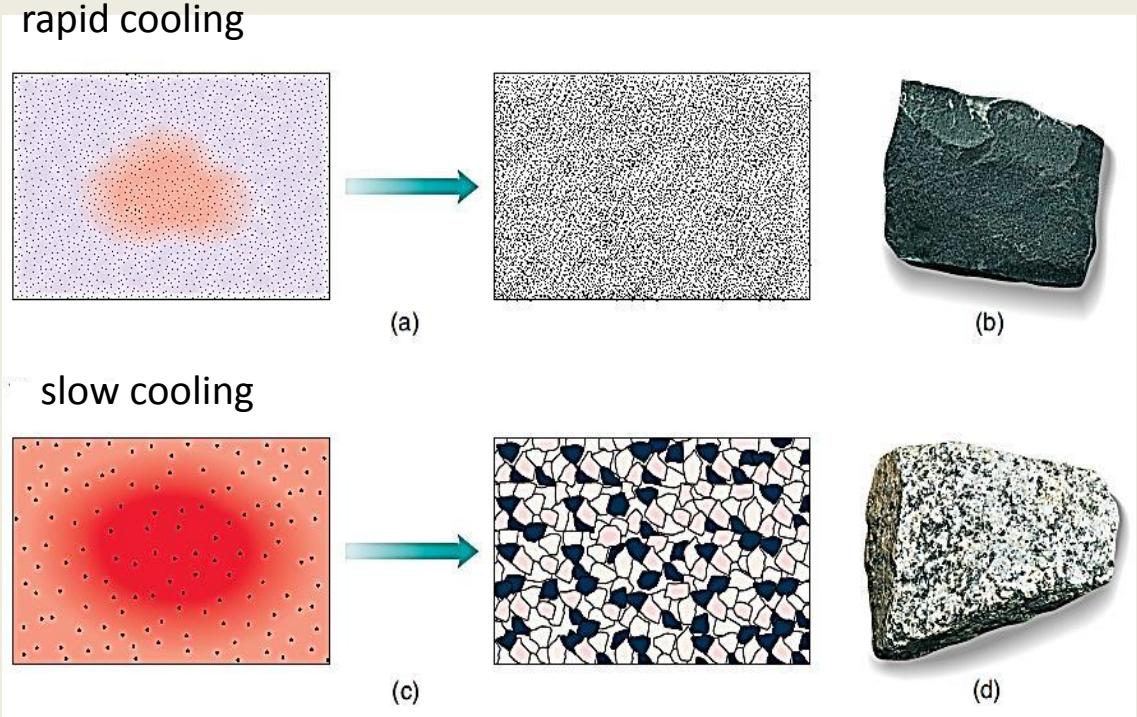
Bowen's Reaction Series



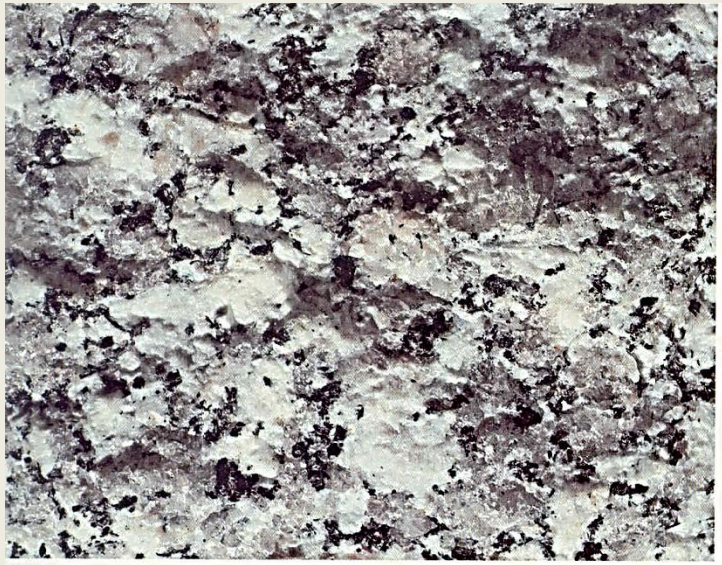
CHARACTERISTICS OF IGNEOUS ROCKS

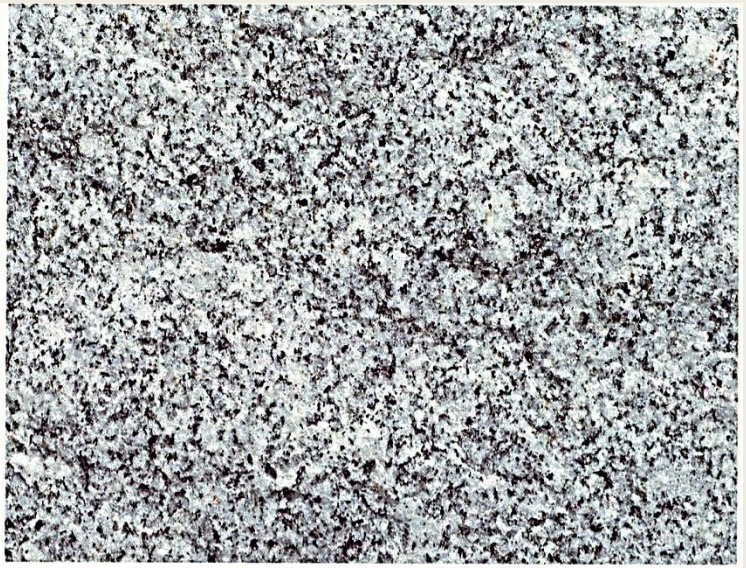
Igneous rock textures

The term **texture** refers to the ***size, shape, and arrangement of mineral grains*** composing igneous rocks. **Aphanitic** rocks, with **aphanitic texture**, are extrusive igneous rocks that cooled so quickly that crystal growth was inhibited. The crystals are so fine that individual minerals cannot be distinguished with the naked eye.

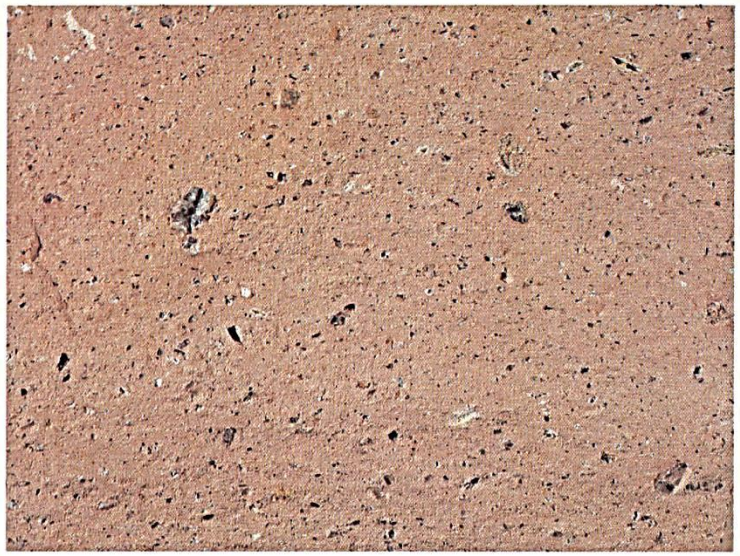


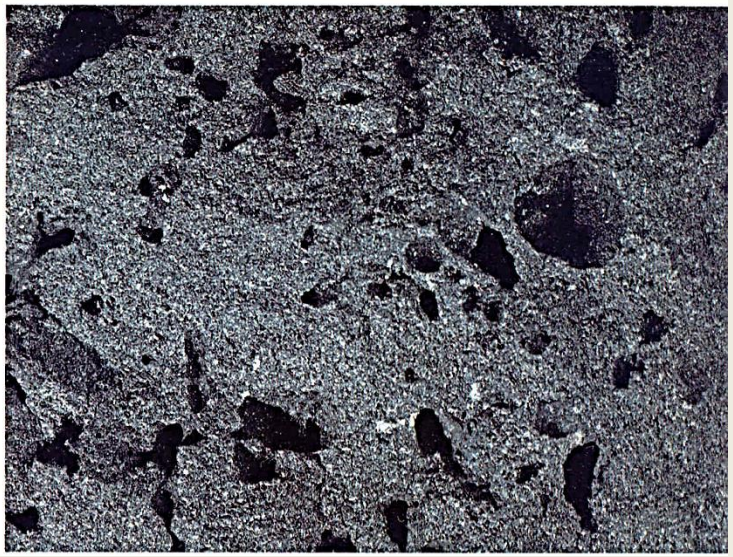
With slow cooling, relatively large mineral grains form, thus yielding a coarse grained or, **phaneritic texture**.





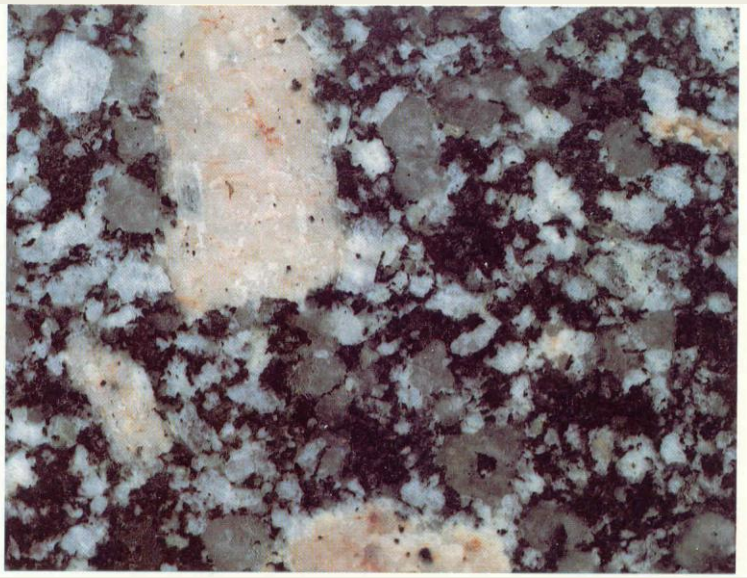
Phaneritic texture





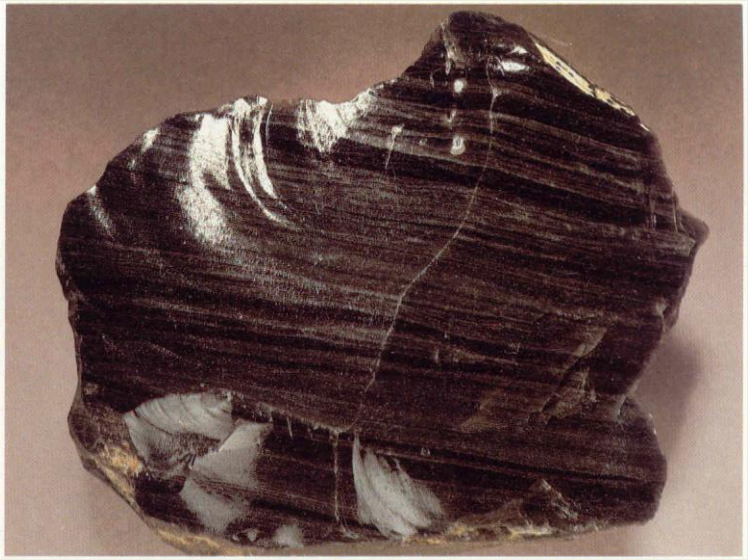
Aphanitic texture

Porphyritic texture



Porphyritic texture

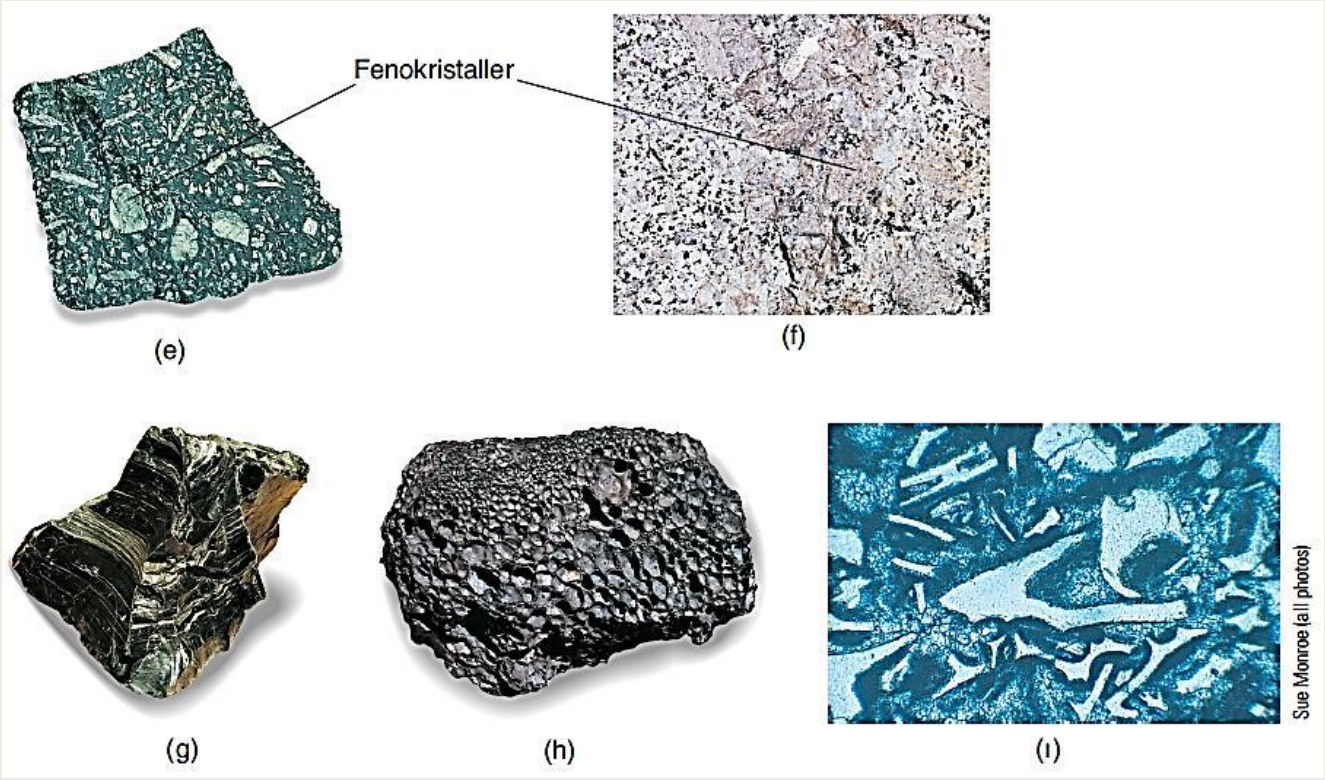
Glassy texture



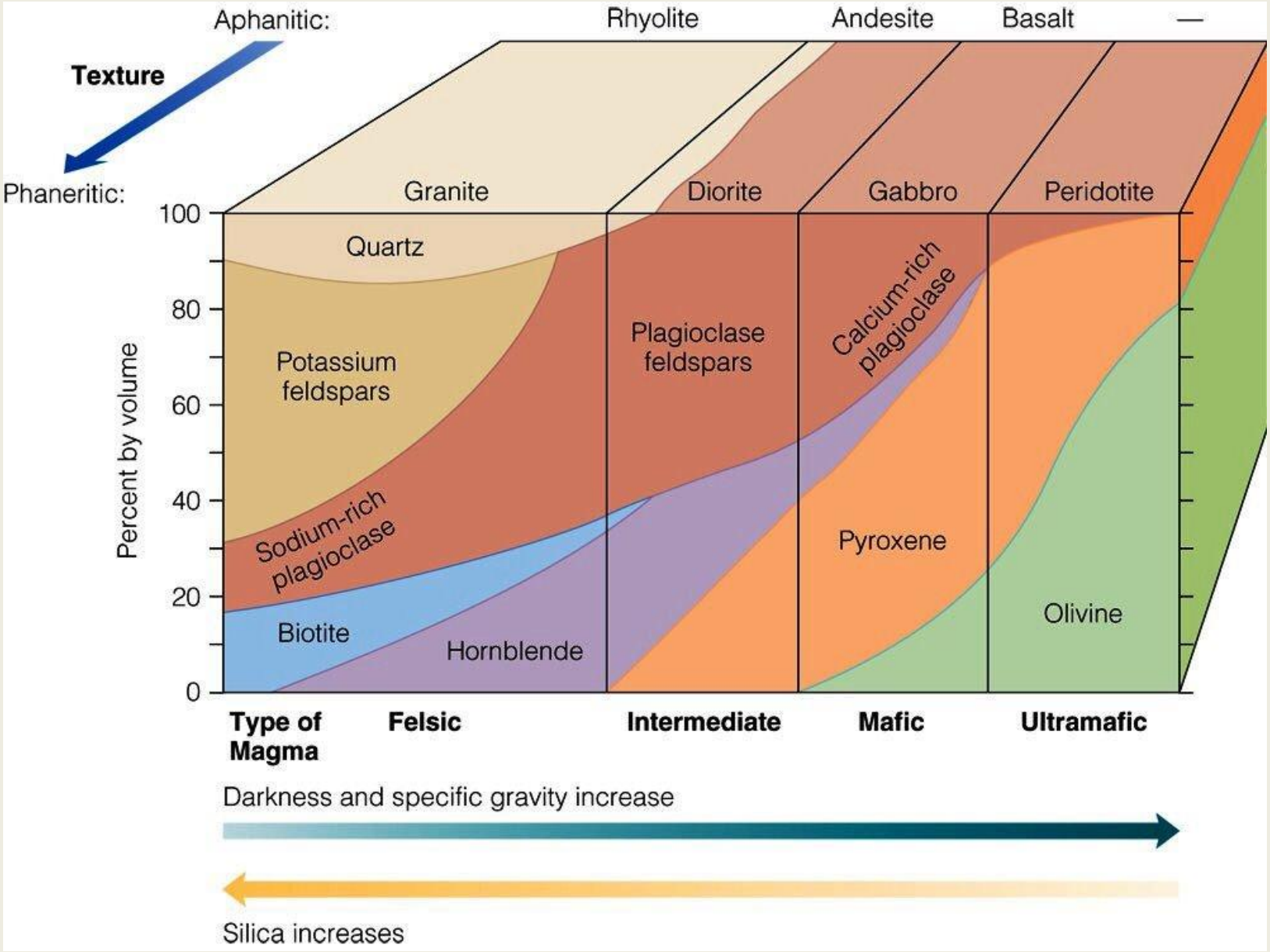
Obsidian

Pyroclastic texture

Pyroclastic texture

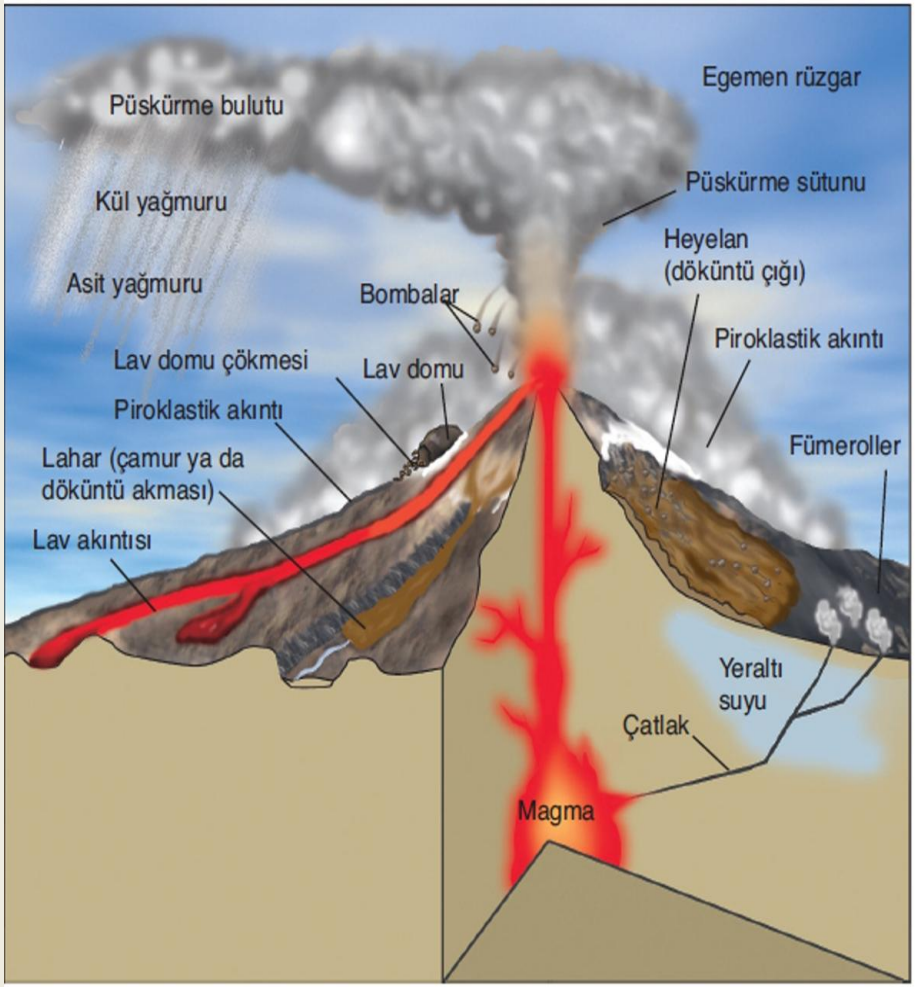


CLASSIFICATION OF IGNEOUS ROCKS



VOLCANISM

The term **volcanism** refers specifically to those **processes** whereby lava, gases and pyroclastic materials are extruded onto the surface or into the atmosphere.



About 550 volcanoes are presently ‘**active’**; that is they have erupted during historic time. Only 12 or so are erupting at any one time.

There are ‘**Dormant volcanoes’** that have not erupted during historic time but may do so in the future.

Some volcanoes have not erupted in historic time and show no signs of doing so again. These are named as **inactive** or **extinct volcanoes (Kızılcahamam and Hüseyin Gazi activities near Ankara)**.

There are three types of materials extruded from volcanoes, namely **volcanic gases**, **lava** and **pyroclastic materials**.

Volcanic gases

50-80% of all volcanic gases are water vapor. Lesser amount of carbon dioxide, nitrogen, sulfur gases, especially sulfur dioxide and hydrogen sulfide and very small amounts of carbon monoxide, hydrogen and chlorine are also emitted.

When magma rises toward to the surface, pressure is reduced and contained gases begin to expand. **In highly viscous felsic magma, expansion is inhibited and gas pressure increases, so explosion occurs producing pyroclastic material. In contrast, low-viscosity mafic magma allows expanding gases to escape easily. Accordingly mafic magma erupts rather quietly.**

Toxic gases (sulfur dioxide), which are released during eruption, will be very dangerous for humans. **The haze** resulting from the gas will lower the temperatures and cause crop failures.

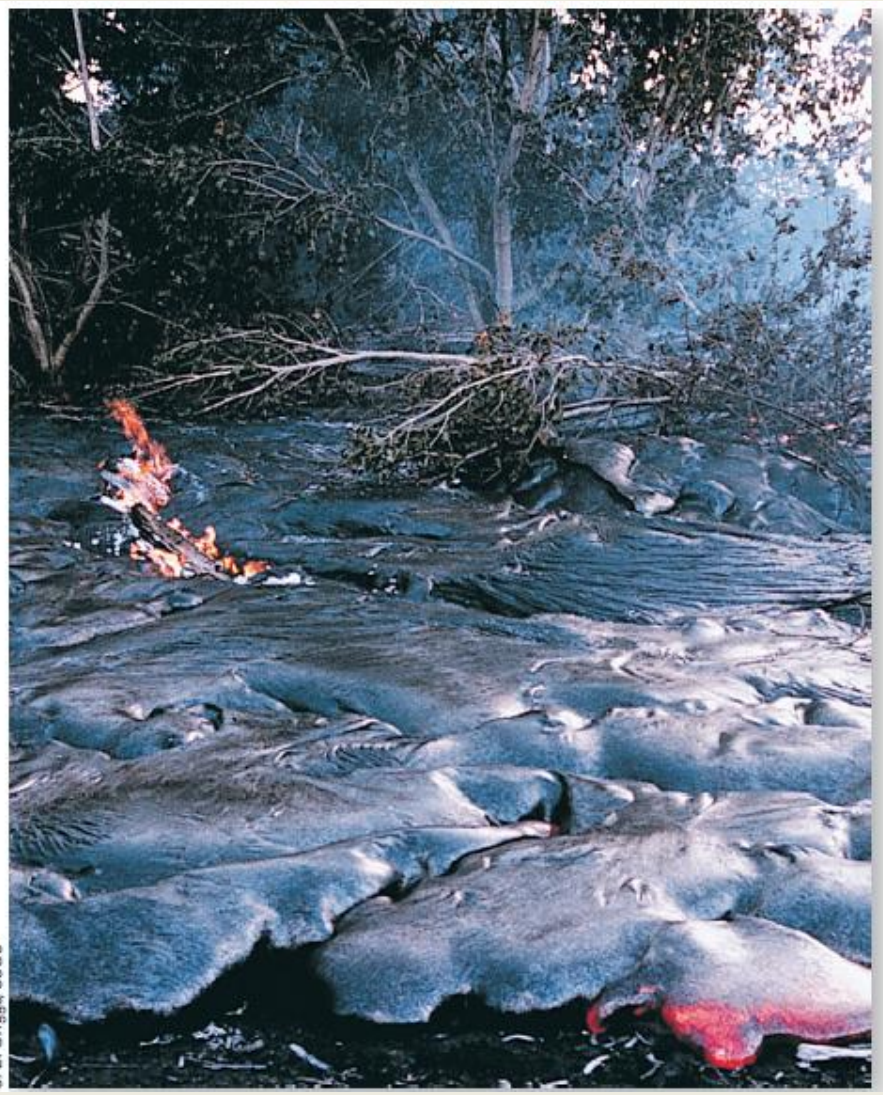
Lava flows

Lava is fluid magma that flows onto the Earth's surface; the word also describes the rock that forms when the magma solidifies. Lava with low viscosity may continue to flow as it cools and stiffens, forming smooth, glassy surfaced, wrinkled or "ropy" ridges. This type of lava is called **pahoehoe.**

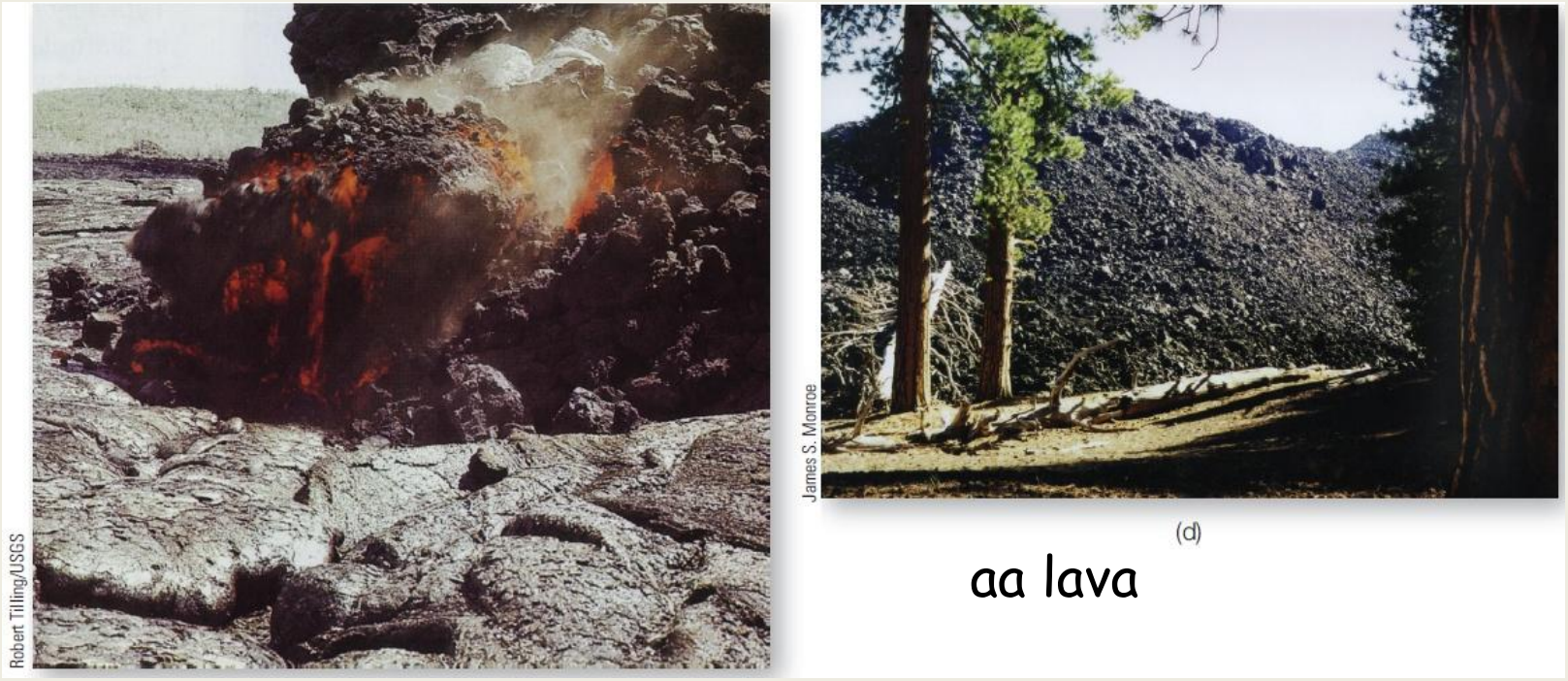
If the viscosity of lava is higher, its surface may partially solidify as it flows. The solid crust breaks up as the deeper, molten lava continues to move, forming **aa lava**, with a jagged, rubbly, broken surface.

When lava cools, escaping gases such as water and carbon dioxide form bubbles in the lava. If the lava solidifies before the gas escapes, the bubbles are preserved as holes called **vesicles**.

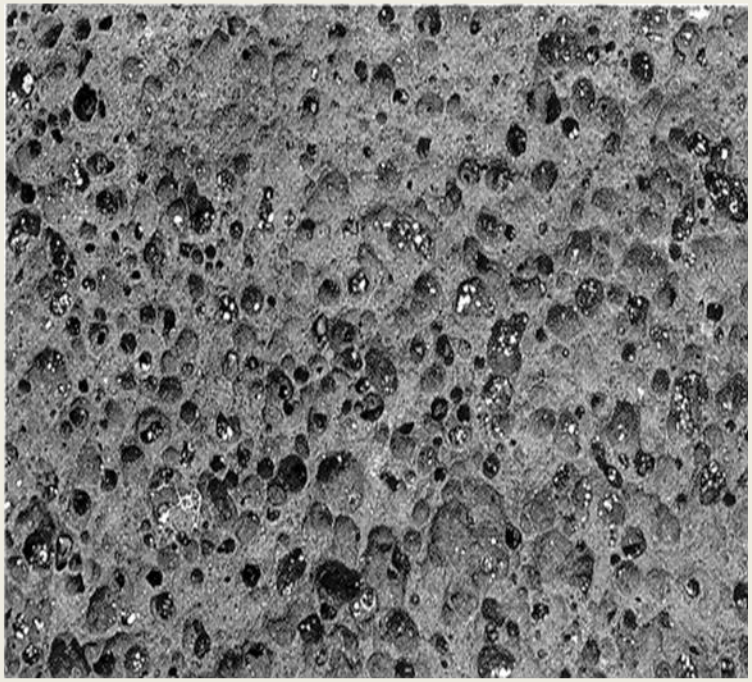
Hot lava shrinks as it cools and solidifies. The shrinkage pulls the rock apart, forming five- or six-sided cracks that grow as the rock continues to cool. As the lava continued to cool and solidify, the cracks grew downward through the flow. Such cracks, called **columnar joints**, are regularly spaced and intersect to form five- or six-sided columns.



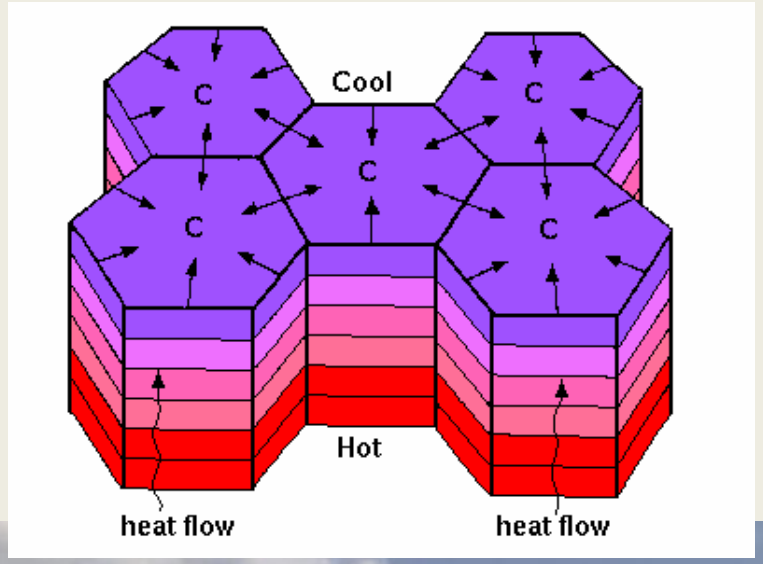
Pahoehoe lava.

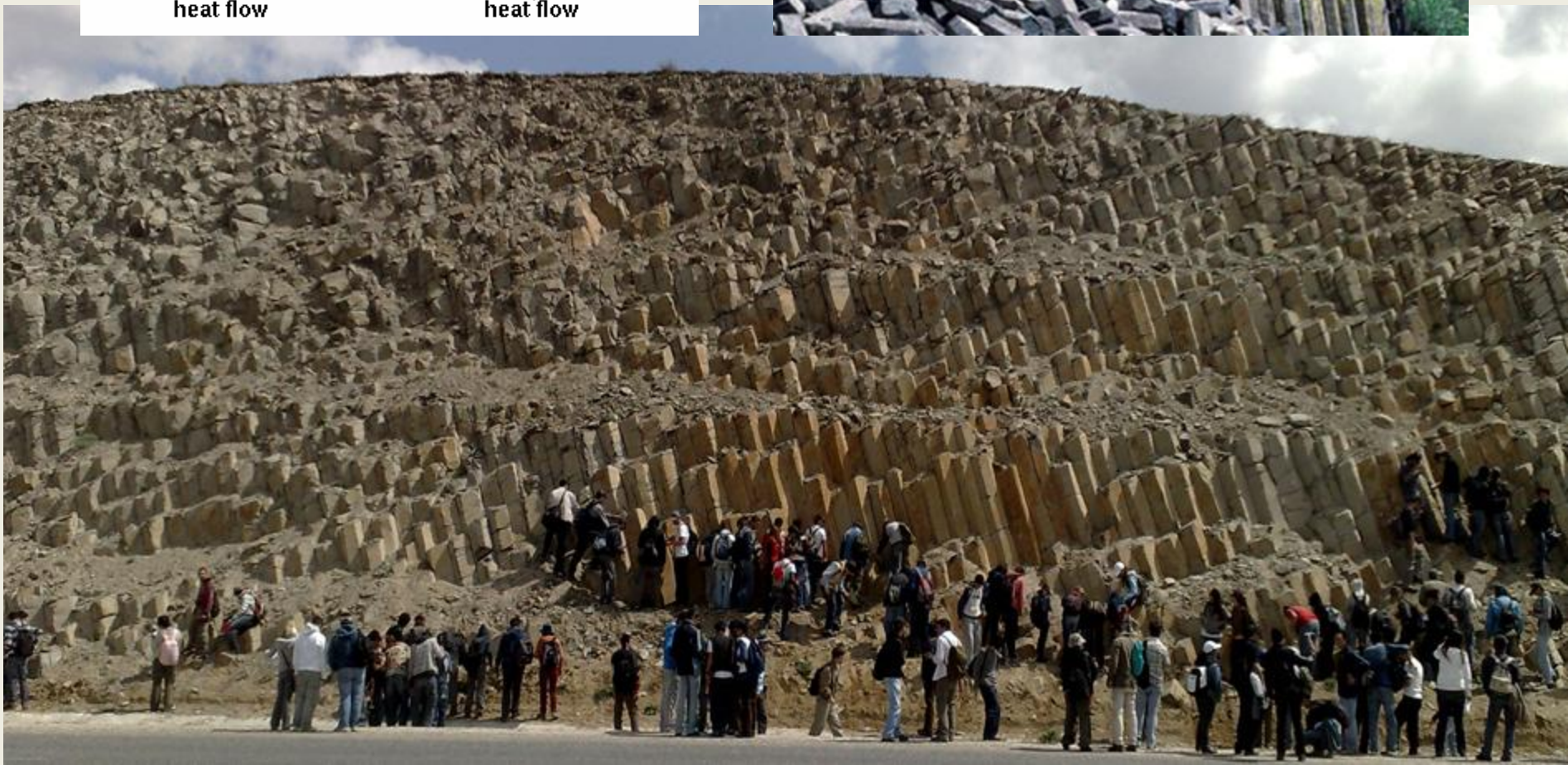


aa lava

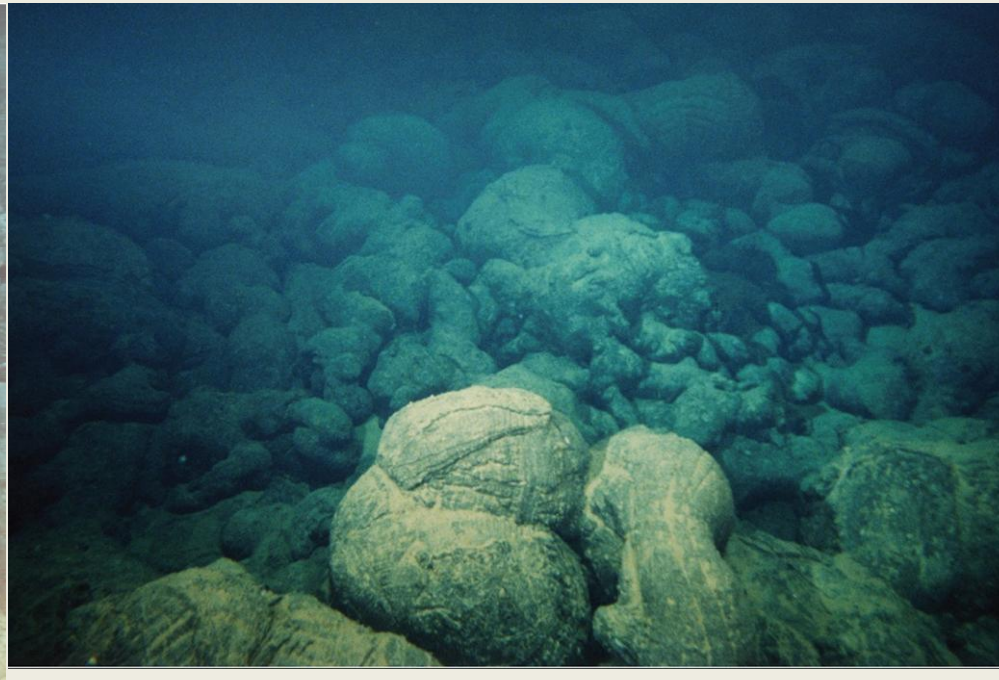


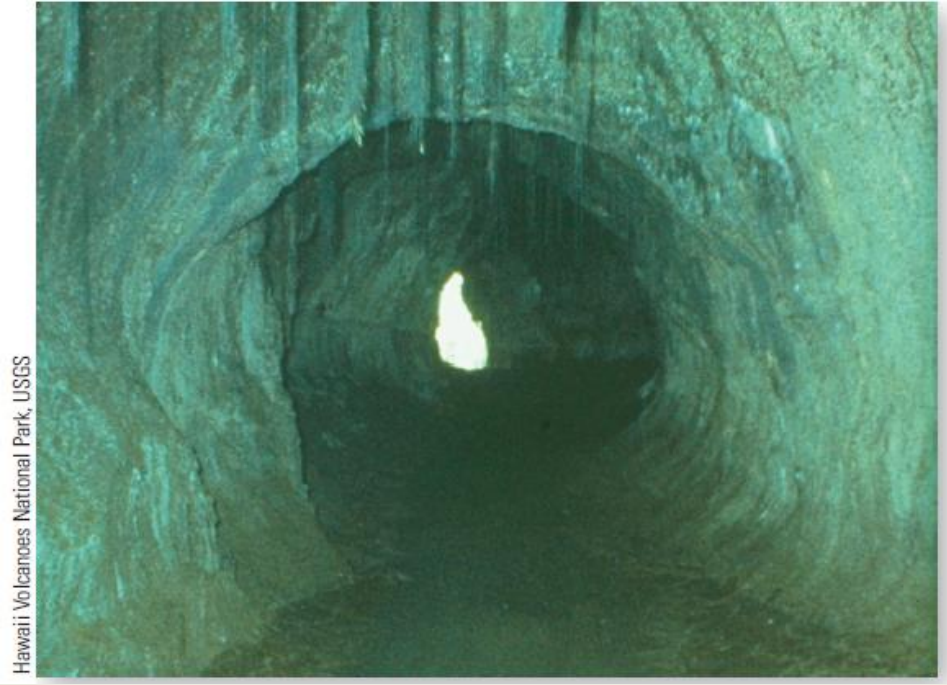
vesicles


Cool
C
C
C
C
C
Hot
heat flow
heat flow

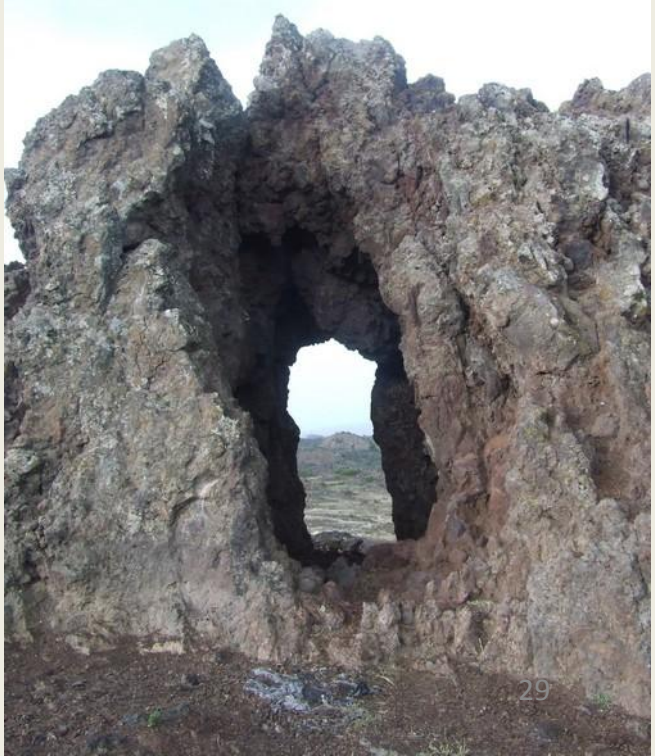


When basaltic magma erupts under water, the rapid cooling causes it to contract into pillow-shaped structures, called **pillow lava.** Pillow lava is abundant in oceanic crust, where it forms as basaltic magma oozes onto the sea floor at the mid-oceanic ridge.





The hollow beneath a lava flow is named as **lava tube** in which hot lava flows. As the eruption ceases, the tube drains leaving an empty tunnel-like structure.



Pyroclastic Materials

If a volcano erupts explosively, it may eject both liquid magma and solid rock fragments. A rock formed from particles of magma that were hurled into the air from a volcano is called a **pyroclastic rock**. The smallest particles, called **volcanic ash**, consist of tiny fragments of glass that formed when liquid magma exploded into the air (less than 2.0 mm). **Lapilli** vary in size from 2 to 64 millimeters. Still larger fragments called **volcanic bombs** or **blocks** (>64 mm).

Volcanic bomb (on the left ~ 20 cm). Lapilli (on the upper right). Ash (on the lower right).

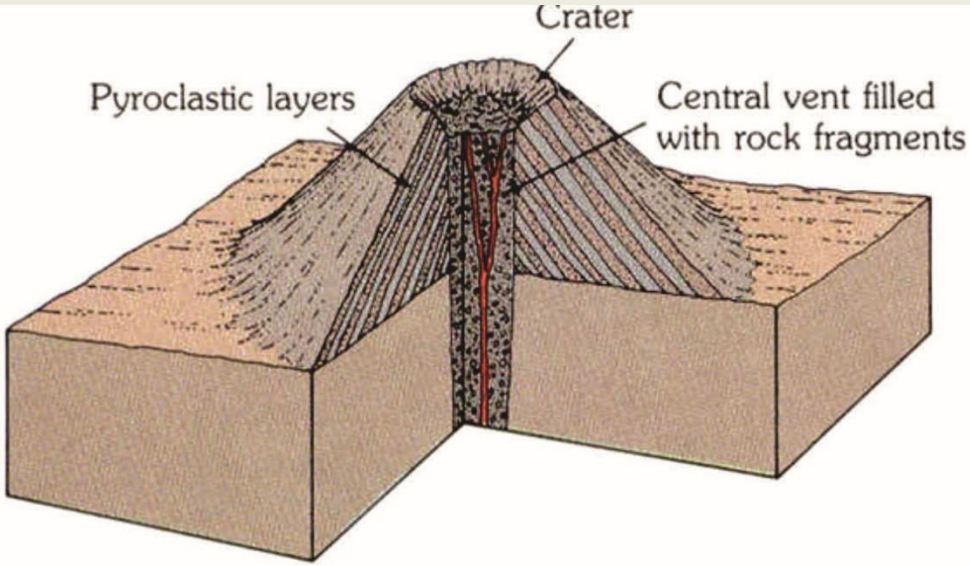
Pinatubo, Philippines (June 1991)

VOLCANO

A **volcano** is a hill or mountain that forms around a vent (fissure) where lava, pyroclastic materials and gases erupt.

Types of volcanoes: Cinder cones, composite volcanoes (stratovolcanoes), shield volcano, volcanic dome and caldera.

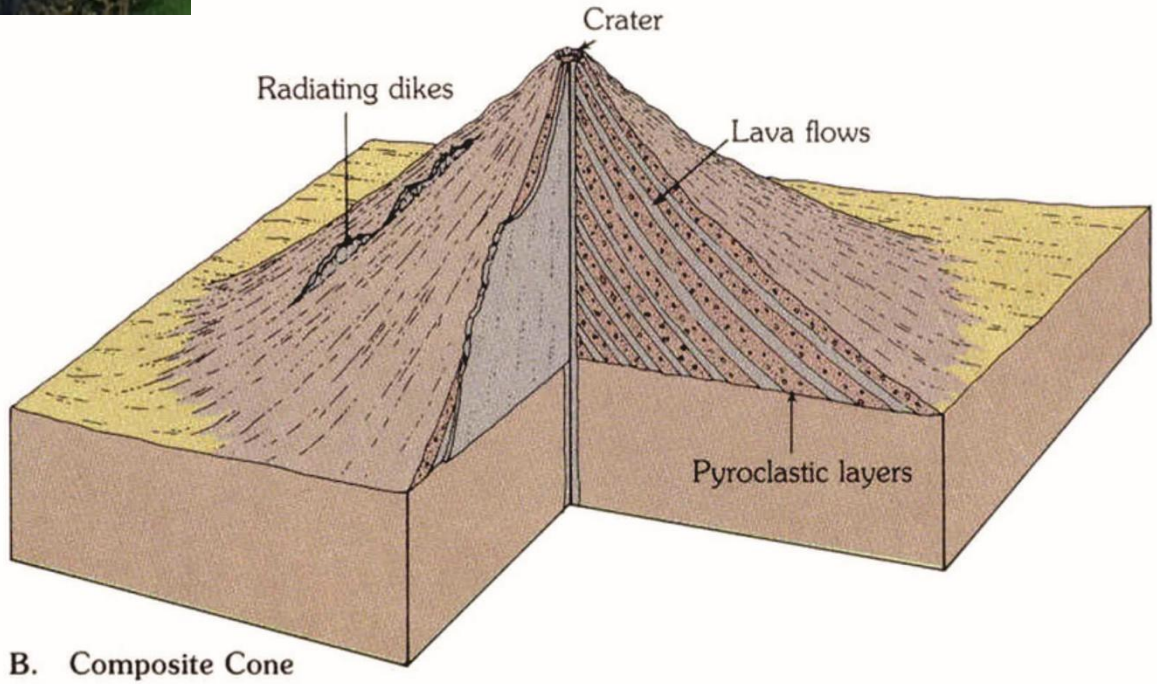
Cinder cones are small, steep sided volcanoes made up of pyroclastic materials.



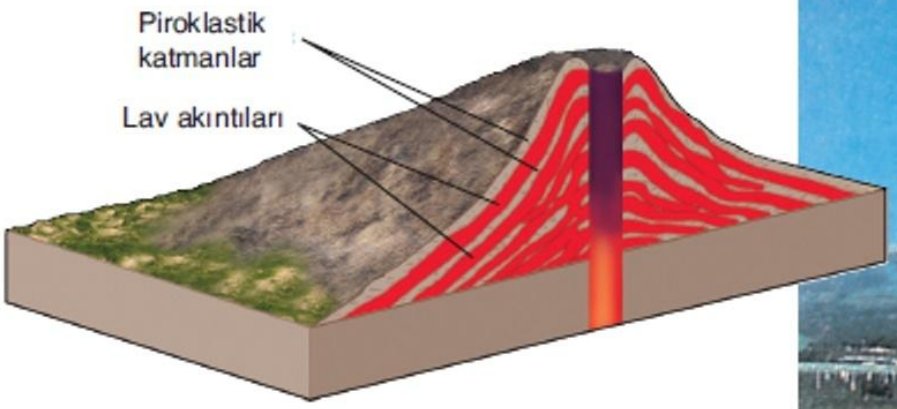
A. Cinder Cone

Composite Volcanoes (Stratovolcanoes)

Pyroclastic layers as well as lava flows, both of intermediate composition are found in composite volcanoes. They are steep-sided near their summits, perhaps as much as 30 degrees, but slope decreases toward the base.



B. Composite Cone



(a)

R. Solkowski/Consulting Geologists, Vancouver, WA

(b)

Sue Monroe

(c)

Courtesy of Wayne E. Moore

(d)

St. HELEN VOLCANO
18 May 1980

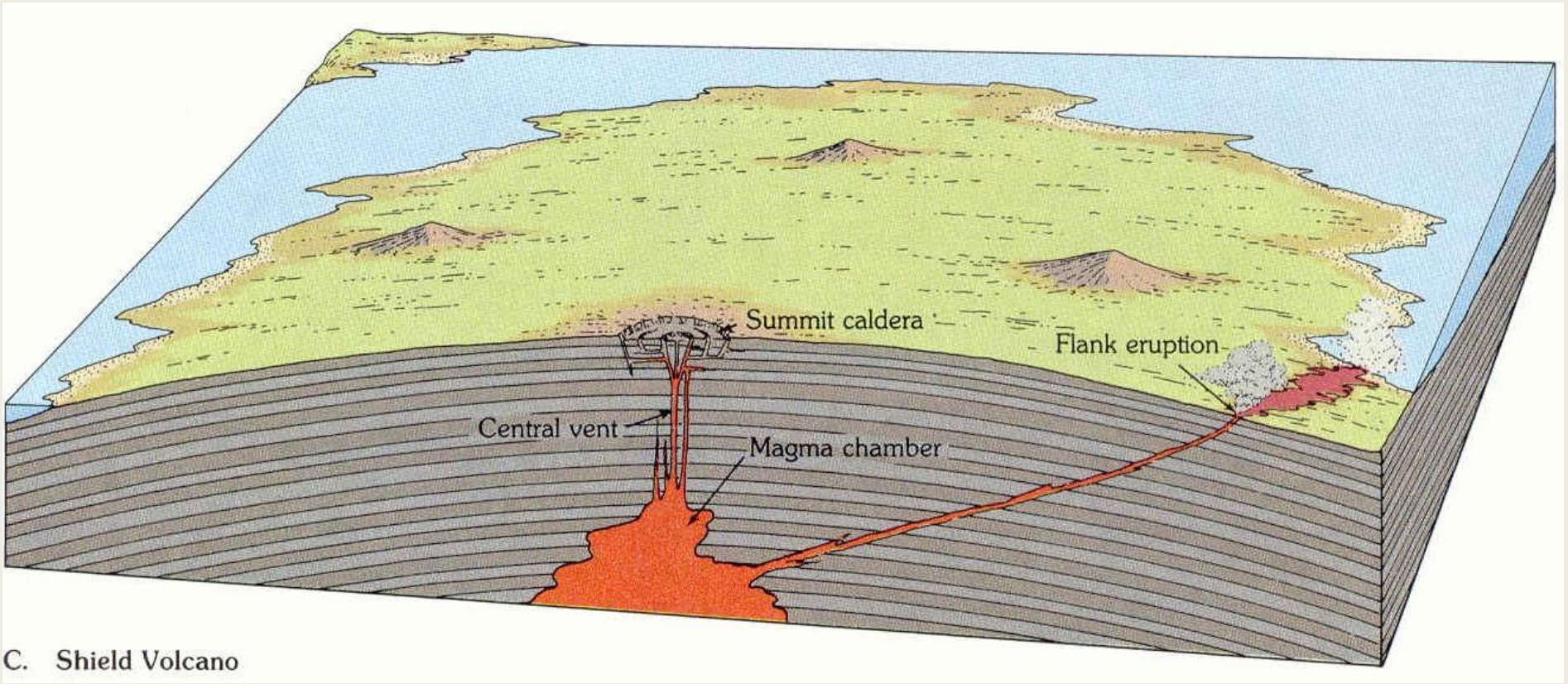
St. HELEN VOLCANO BEFORE/AFTER ERUPTION

Elevation before eruption: 2950 m

Elevation after eruption: 2549 m

Shield Volcanoes

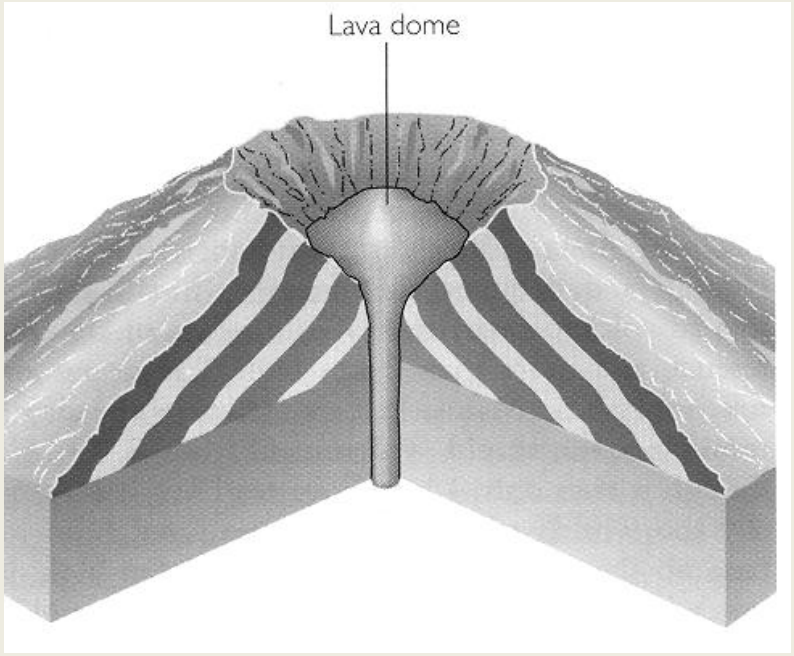
Shield volcanoes resemble to the outer surface of a shield lying on the ground with the convex side up. They have low, rounded profiles with gentle slopes ranging from 2 to 10 degrees. They are mostly composed of low-viscocity mafic lava flows, so the flows spread out and form thin layers (Example: Karacadağ volcano near Diyarbakır).



C. Shield Volcano

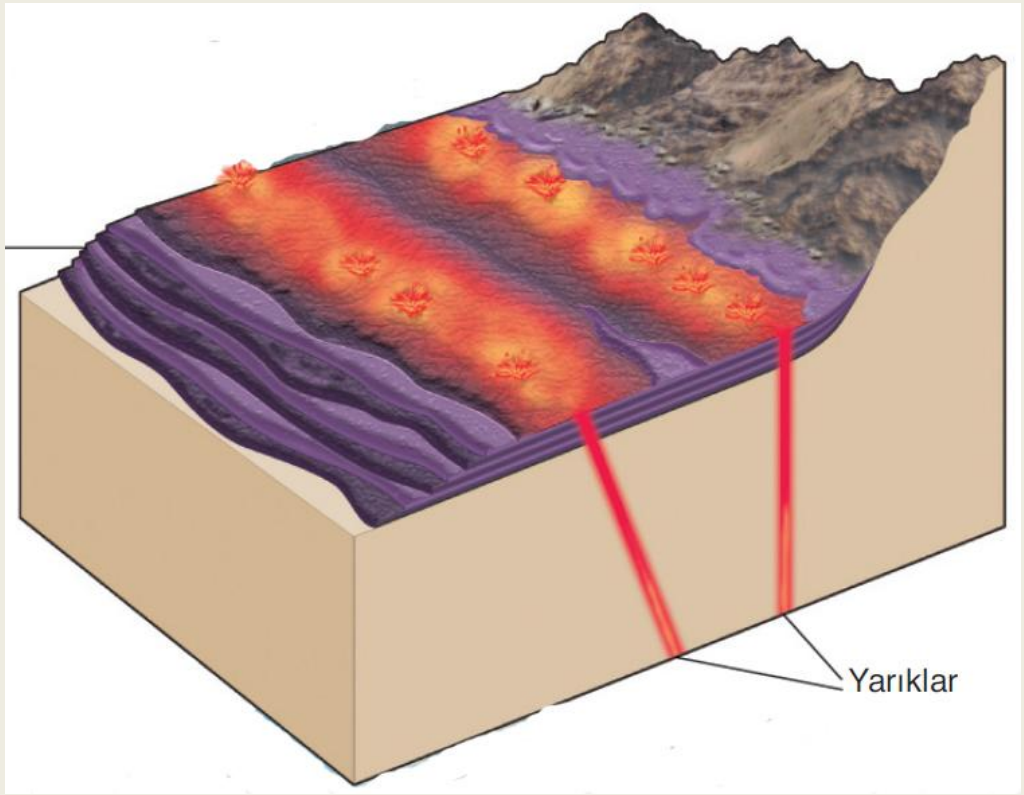
Lava Domes

Lava domes, also known as volcanic domes and plug domes, are steep sided, bulbous mountains that form when viscous felsic magma, occasionally intermediate magma, is forced toward the surface. Because felsic magma is so viscous, it moves upward very slowly and only when the pressure from below is great.



Fissure Eruptions

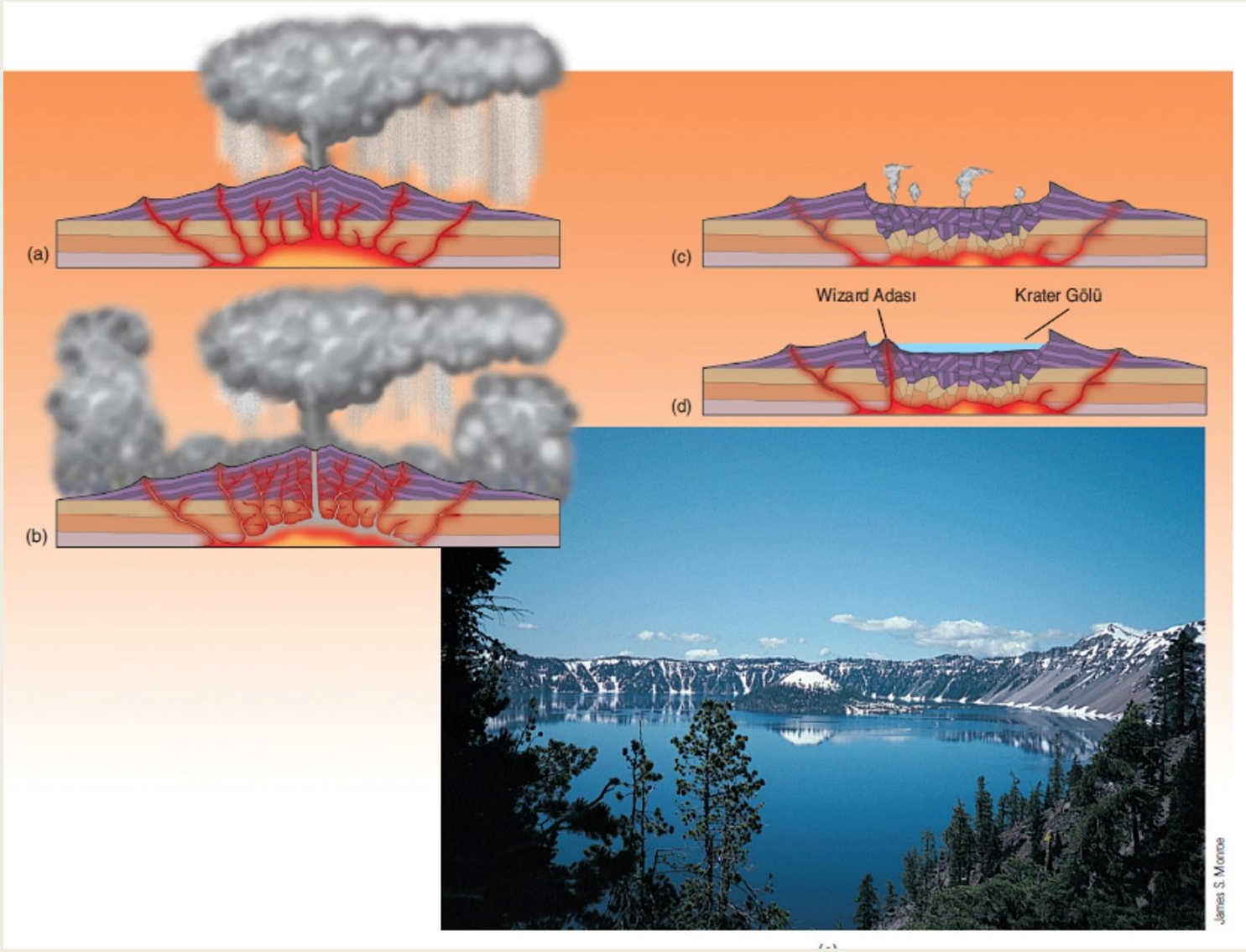
Rather than being erupted from a central vent, these flows issued from long cracks or fissures. Lava erupted from these fissures (yarık) was so fluid (had such low viscosity) that it simply spreads out, covering vast areas and building up a **basaltic plateau**, which is simply a broad, flat and elevated area underlain by basalt.



Crater and Caldera

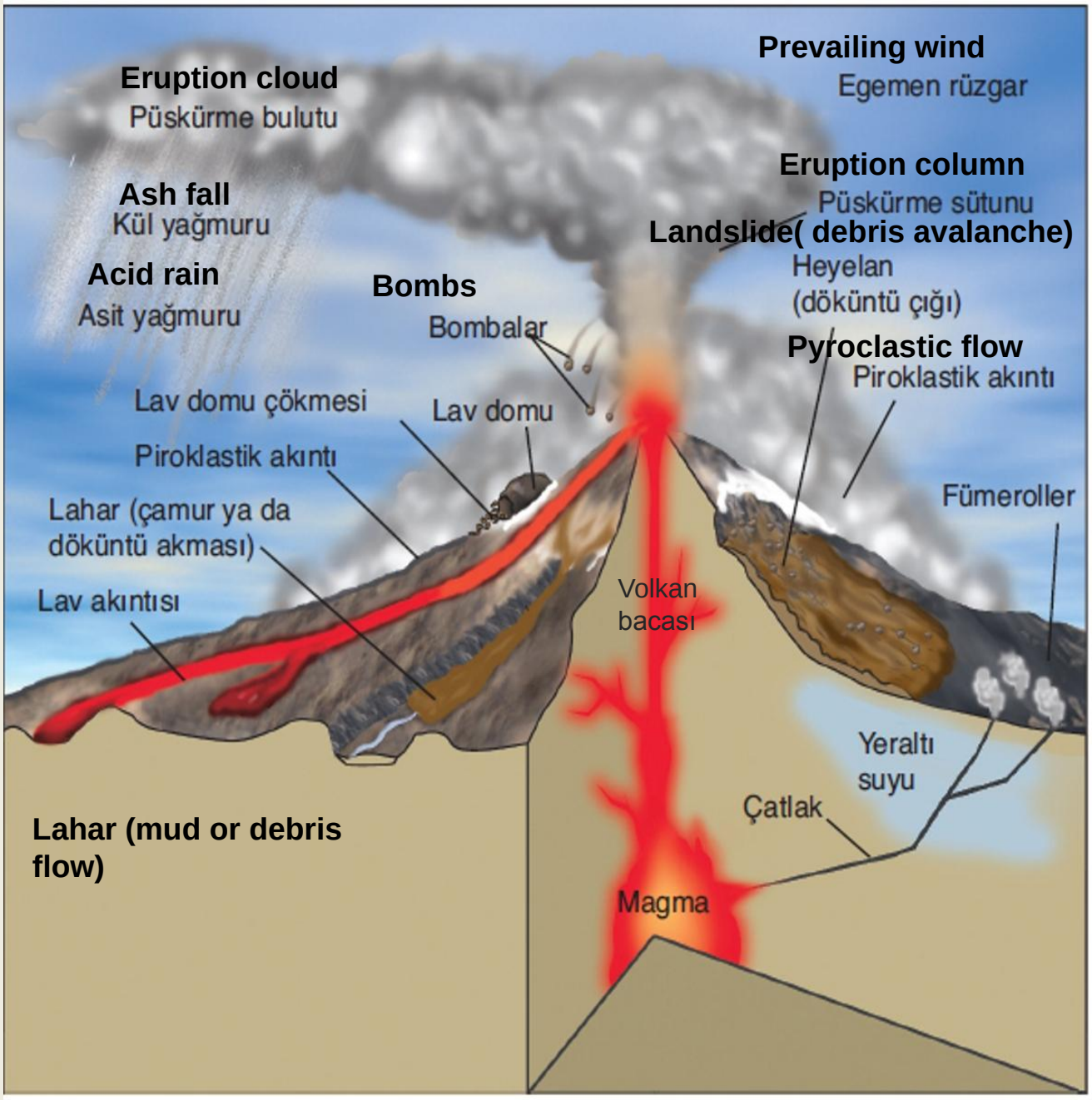
Most volcanoes have a circular depression known as a crater at their submit.

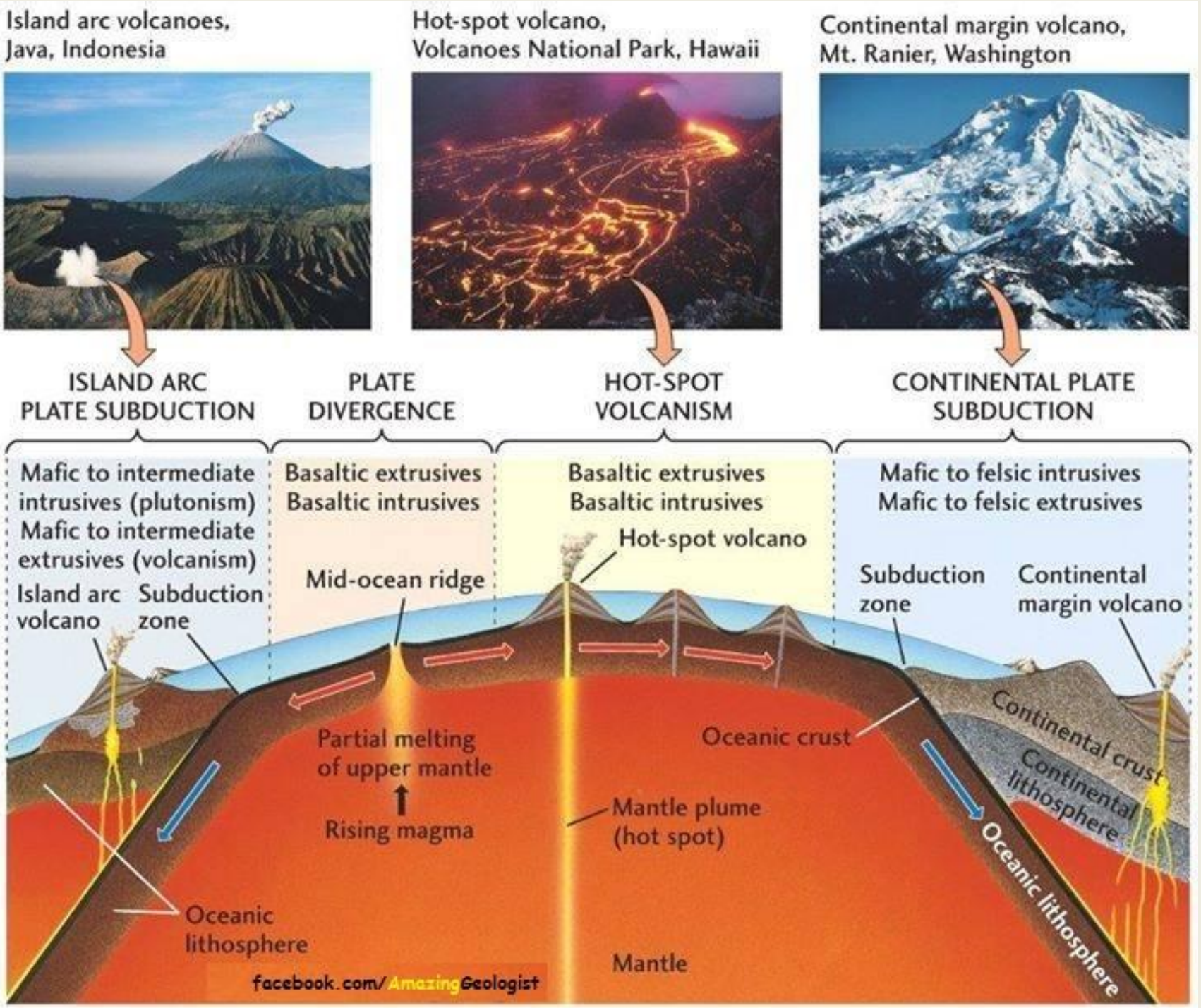
Calderas are huge structures that form following voluminous eruptions during which part of a magma chamber drains and mountains summit collapse.

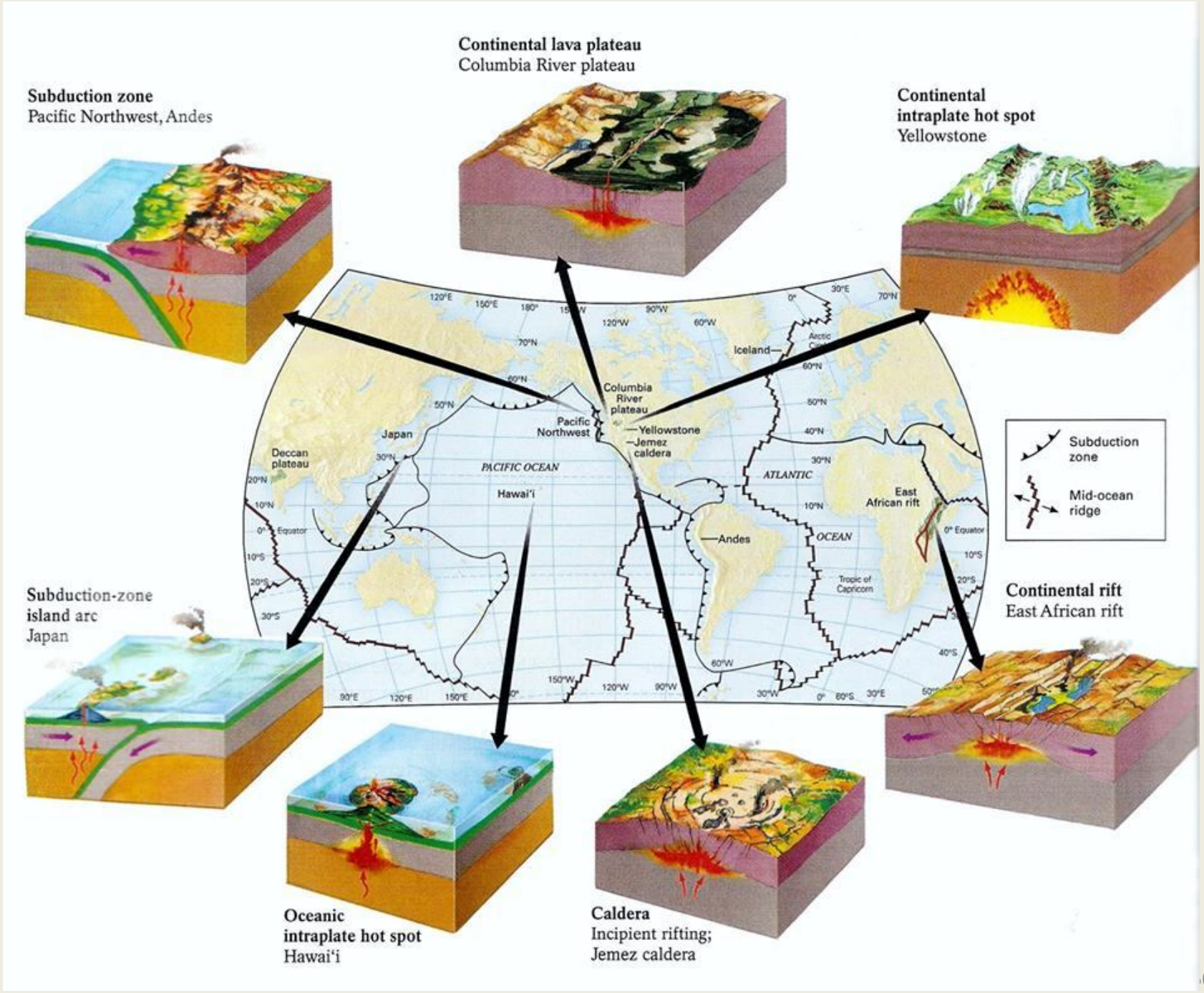

(a)
(b)
(c)
Wizard Adası
Krater Gölü
(d)
James S. Monroe

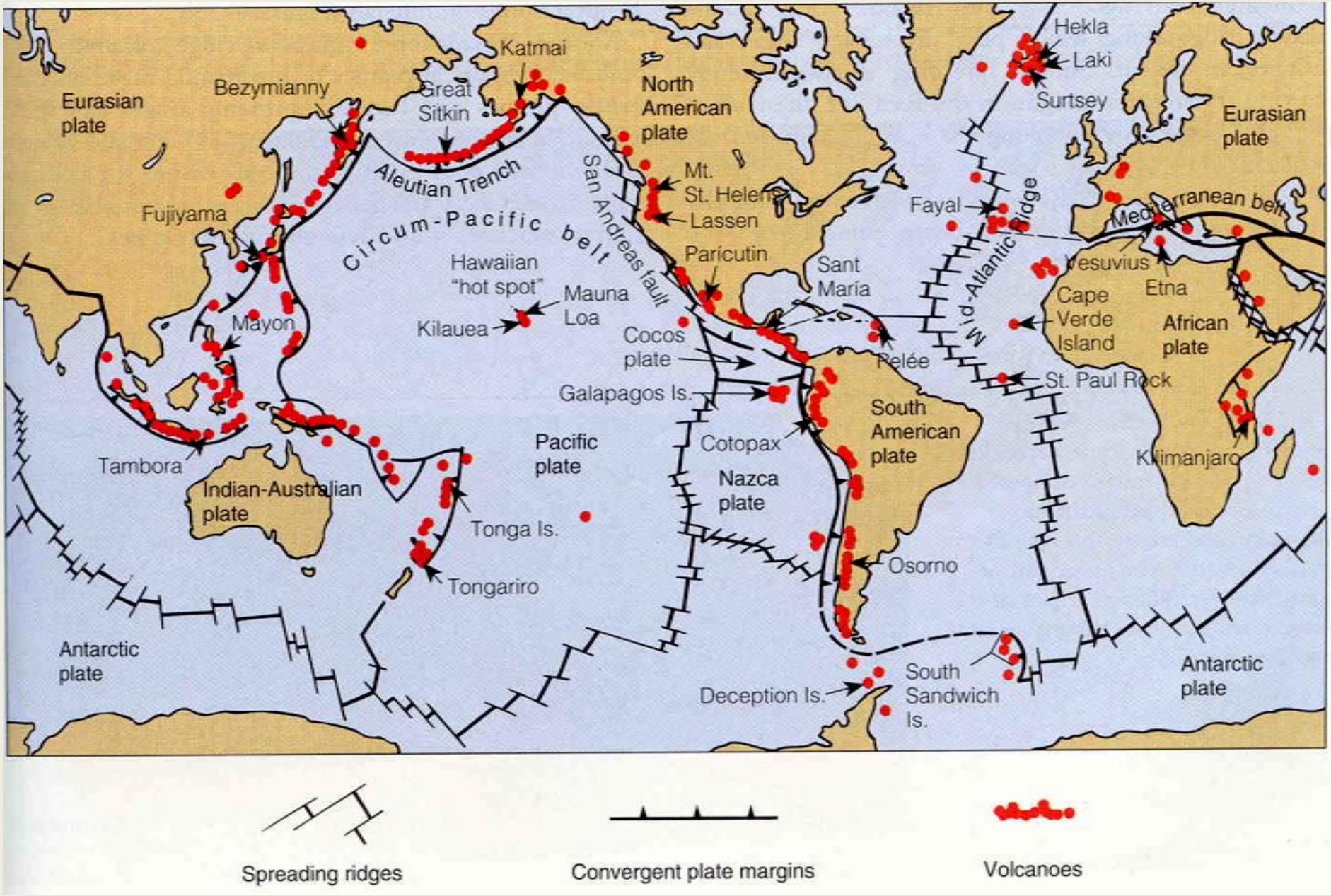
VOLCANIC HAZARDS

Volcanoes produce a variety of hazards that kill or injure people and destroy property.




Island arc volcanoes,
Java, Indonesia
Hot-spot volcano,
Volcanoes National Park, Hawaii
Continental margin volcano,
Mt. Ranier, Washington
ISLAND ARC
PLATE SUBDUCTION
PLATE
DIVERGENCE
HOT-SPOT
VOLCANISM
CONTINENTAL PLATE
SUBDUCTION
Mafic to intermediate
intrusives (plutonism)
Mafic to intermediate
extrusives (volcanism)
Basaltic extrusives
Basaltic intrusives
Basaltic extrusives
Basaltic intrusives
Mafic to felsic intrusives
Mafic to felsic extrusives
Island arc
volcano
Subduction
zone
Mid-ocean ridge
Hot-spot volcano
Subduction
zone
Continental
margin volcano
Partial melting
of upper mantle
Rising magma
Oceanic crust
Continental crust
Continental
lithosphere
Mantle plume
(hot spot)
Oceanic
lithosphere
Oceanic lithosphere
Mantle
facebook.com/AmazingGeologist


Continental lava plateau
Columbia River plateau
Subduction zone
Pacific Northwest, Andes
Continental
intraplate hot spot
Yellowstone
Columbia
River
plateau
Pacific
Northwest
Yellowstone
Jemez
caldera
Japan
Deccan
plateau
PACIFIC OCEAN
Hawai'i
Iceland
ATLANTIC
OCEAN
East
African rift
Andes
Tropic of
Capricorn
Equator
Subduction
zone
Mid-ocean
ridge
Subduction-zone
island arc
Japan
Continental rift
East African rift
Oceanic
intraplate hot spot
Hawai'i
Caldera
Incipient rifting;
Jemez caldera


Eurasian plate
Bezymianny
Katmai
Great Sitkin
North American plate
Hekla
Laki
Surtsey
Eurasian plate
Aleutian Trench
San Andreas fault
Mt. St. Helens
Lassen
Fujiyama
Circum-Pacific belt
Hawaiian "hot spot"
Mauna Loa
Kilauea
Paricutin
Fayal
Mid-Atlantic Ridge
Mediterranean belt
Vesuvius
Etna
Sant Maria
Cape Verde Island
African plate
Mayon
Cocos plate
Pelée
St. Paul Rock
Galapagos Is.
South American plate
Pacific plate
Cotopax
Tambora
Nazca plate
Kilimanjaro
Indian-Australian plate
Tonga Is.
Osorno
Tongariro
Antarctic plate
Deception Is.
South Sandwich Is.
Antarctic plate
Spreading ridges
Convergent plate margins
Volcanoes


Türkiye'nin volkanları ve son patladıkları yıllar
M.Ö.: Milattan önce
M.S.: Milattan sonra
Göllü Dağı
Yılı bilinmiyor
Acıgöl
M.Ö. 2000-3000 arası
Erciyes Dağı
M.Ö. 100.000
Manisa
Kula
M.Ö. 3000
Aksaray
Kayseri
Konya
Nevşehir
Karapınar
M.Ö. 10000
Hasandağ
M.Ö. 6200
Kars Platosu
Yılı bilinmiyor
Ağrı Dağı
M.S. 1840
Kars
Tendürek Dağı
M.S. 1840
Ağrı
Girekol Tepe
Yılı bilinmiyor
Bitlis
Van
Diyarbakır
Nemrut Dağı
M.S. 1441-1443
Şanlıurfa
Karacadağ
Yılı bilinmiyor
Süphan Dağı
M.Ö. 3000


MAKEDONYA
İstanbul
Çanakkale
YUNANISTAN
TÜRKİYE
Ege Denizi
İzmir
Aydın
Muğla
Rodos
Nisiros
Milos
Santorini
Girit
Akdeniz

Nemrut Dağı

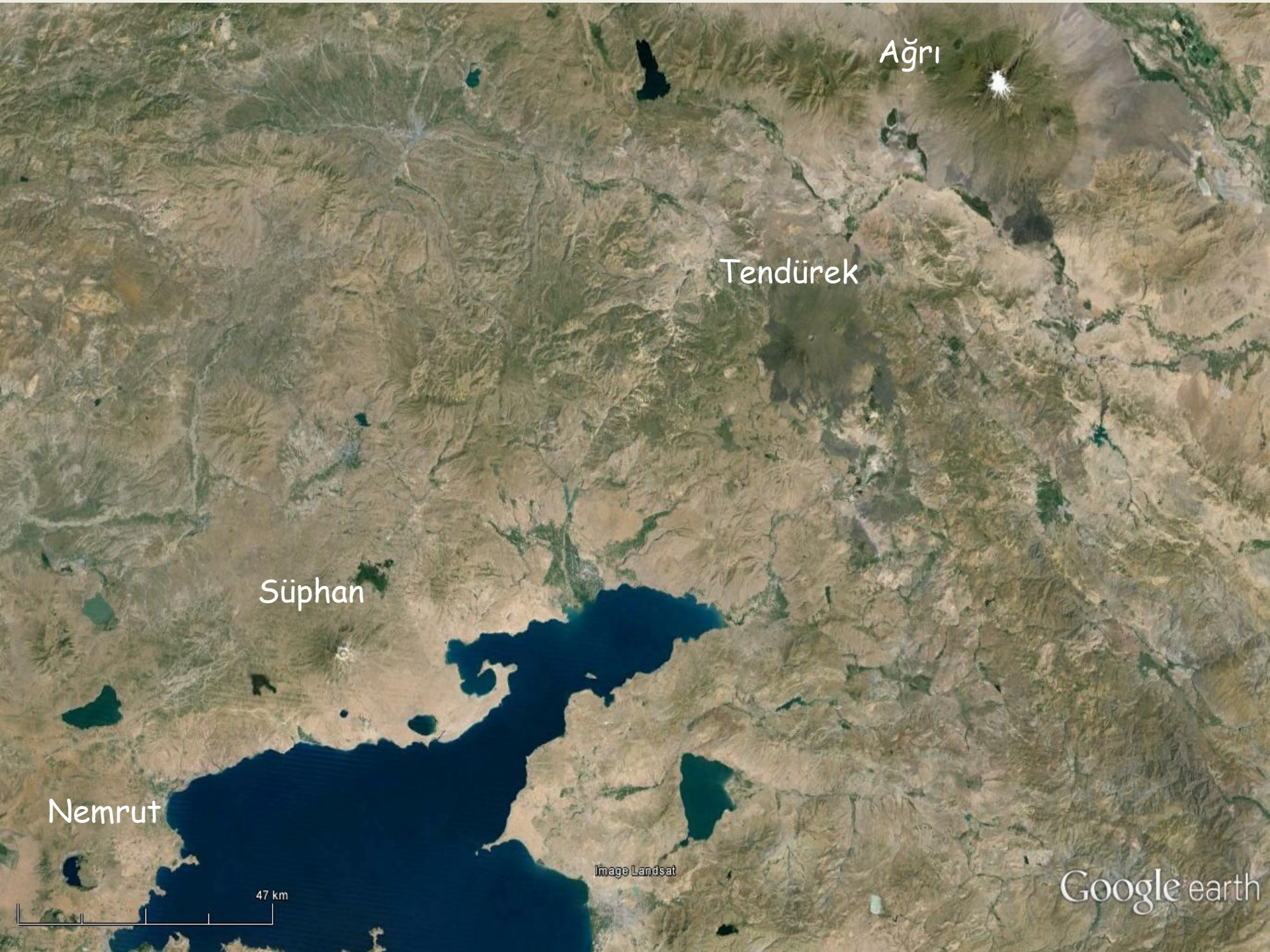

Ağrı
Tendürek
Süphan
Nemrut
47 km
Image Landsat
Google earth


Image © 2014 DigitalGlobe
© 2014 Cnes/Spot Image
Image Landsat
2742 m
Google earth


© 2014 Cnes/Spot Image
Image © 2014 CNES / Astrium
Image © 2014 DigitalGlobe
Image Landsat
15.0 km
Google earth


2080 m
© 2014 Cnes/Spot Image
Image © 2014 CNES / Astrium
Image © 2014 DigitalGlobe
Google earth


1687 m
Image Landsat
© 2014 Cnes/Spot Image
Image © 2014 CNES / Astrium
Image © 2014 DigitalGlobe
Google earth

Nemrut crater lake


ANADOLU

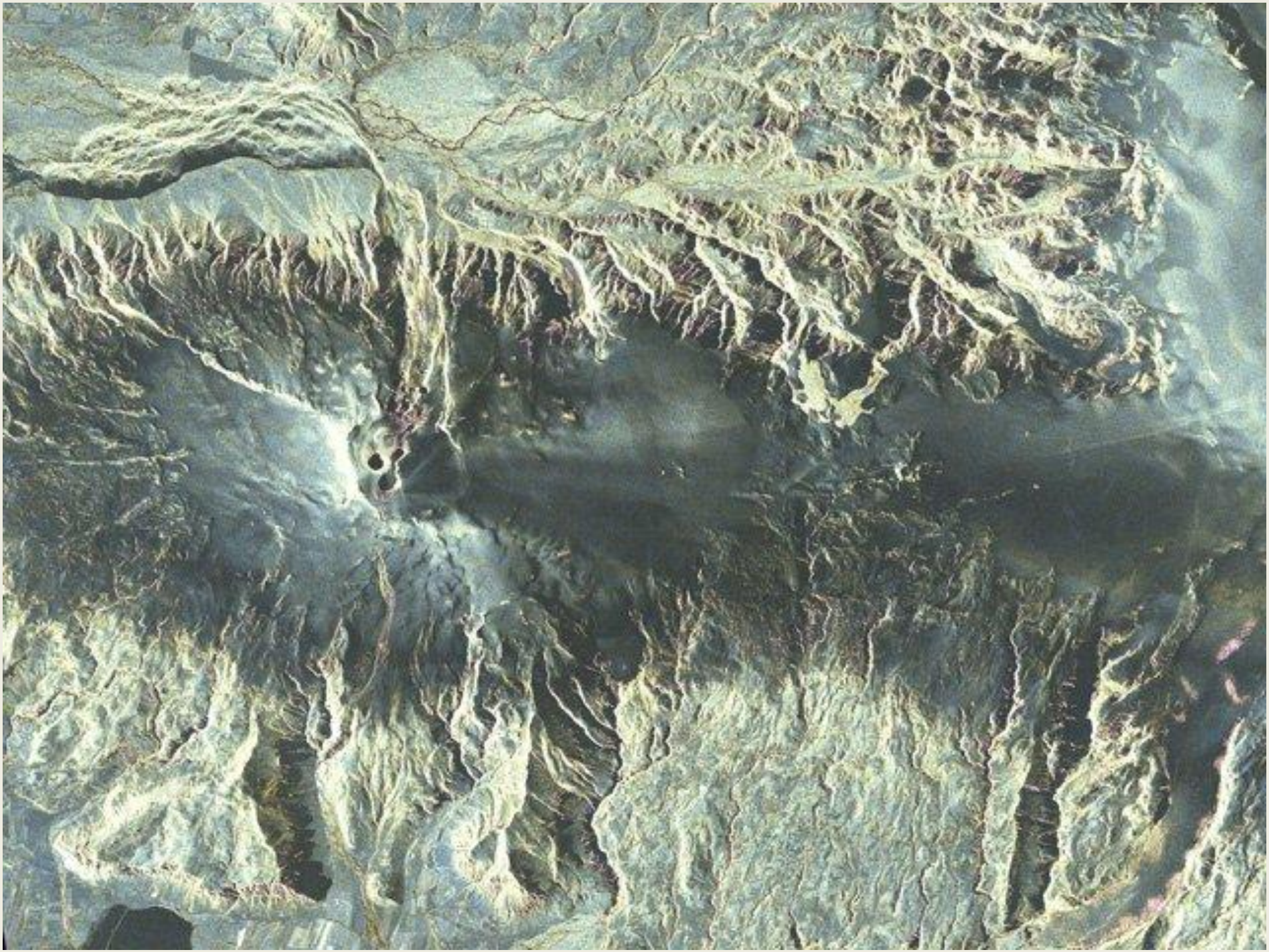

25 07 2012

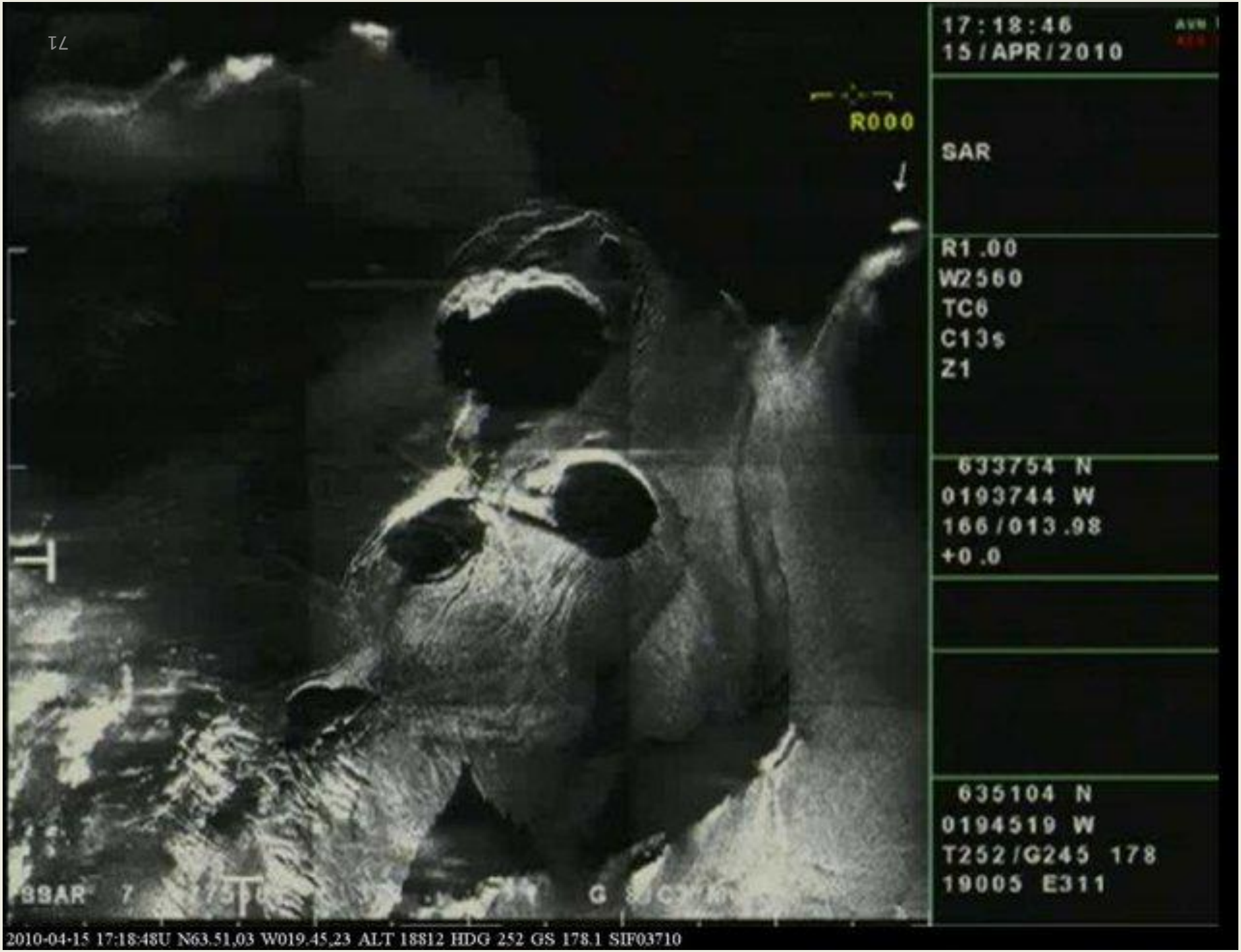
City of Pompei
Vesuve
23 August 79

Photo taken by
drone of Dr. Yürür

MÖ 1650-1450 yılları arasında püskürmeye başlayan volkan kısa sürede çökerek adanın 73 km^2lik bir alanının deniz altında kalmasına yol açmıştır. Çökme sonucunda oluşan tsunami ve takiben kül yağmuru Gritteki MİNOS uygarlığının yok olmasına neden olmuştur.

SANTORON / SANTORINI / THIRA

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15/APR/2010
R000
SAR
R1.00
W2560
TC6
C13s
Z1
633754 N
0193744 W
166/013.98
+0.0
635104 N
0194519 W
T252/G245 178
19005 E311
2010-04-15 17:18:48U N63.51.03 W019.45.23 ALT 18812 HDG 252 GS 178.1 SIF03710