

# Ev 200

1. Geohazards
2. Water, mineral and biological resources
3. Environmental **Energy Resources**

# Ev 200: Course outline

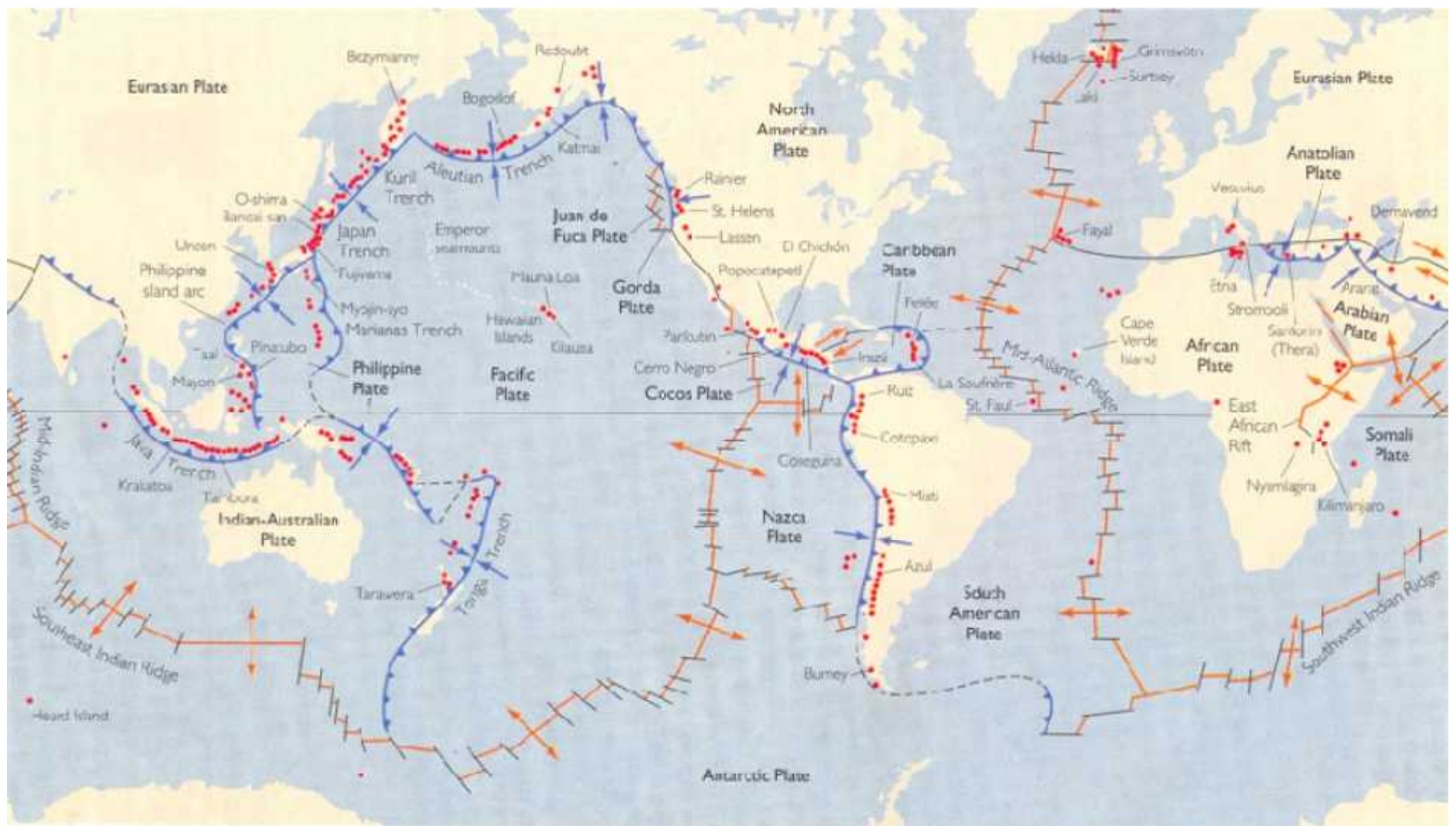
## 1. Geohazards

- Earthquakes
- **Volcanism**
- Landslides
- Atmospheric Geohazards
- Floods and Droughts

## 2. Water, mineral and biological resources

## 3. Environmental **Energy Resources**

- Renewable source
- Non- renewable sources
- Man's impact on the earth energy balance
- Energy Sources Management

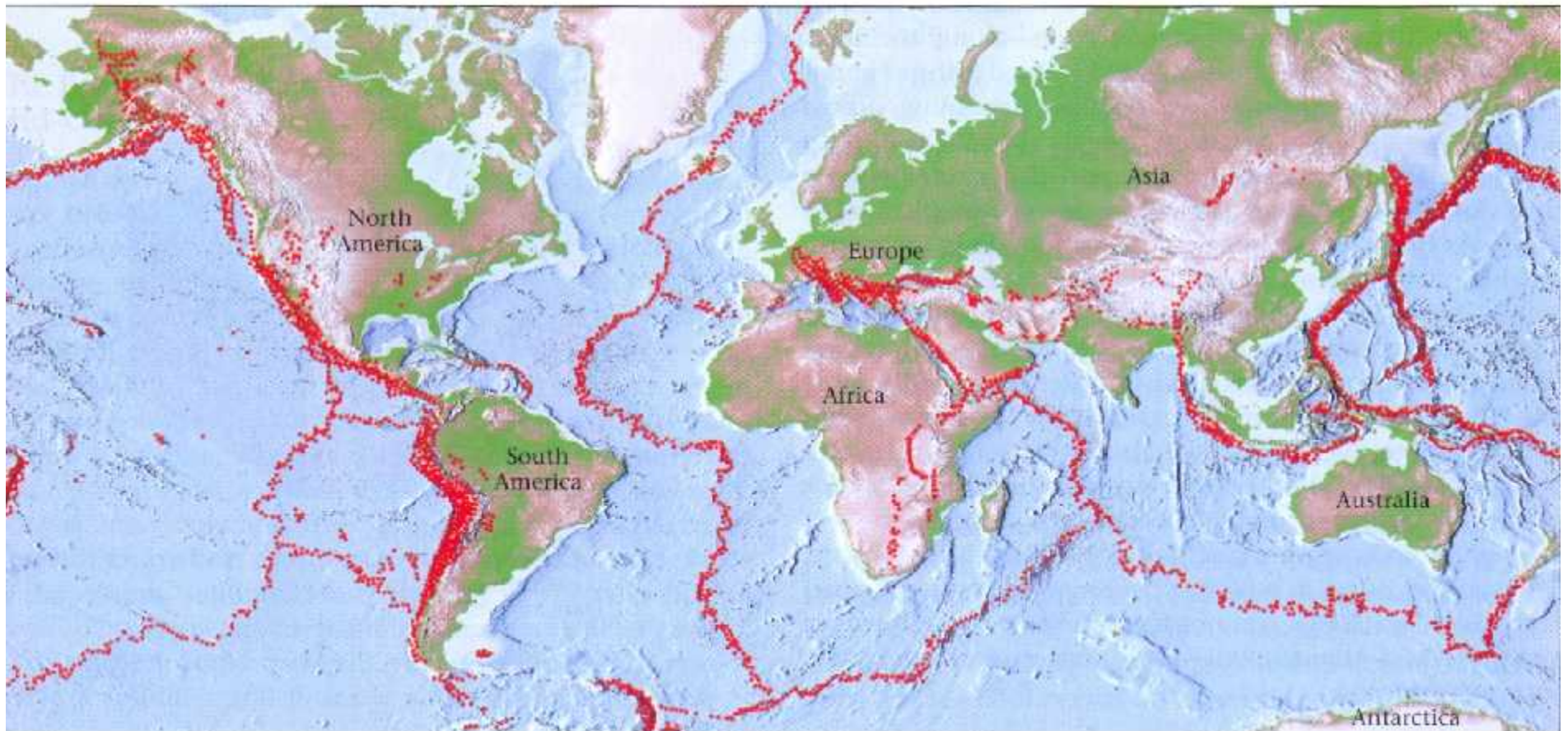


**FIGURE 5.27** The active volcanoes of the world are not distributed randomly on Earth's surface; they tend to be associated with the boundaries where plates collide or separate. Convergent boundaries are shown in blue, divergent boundaries in orange. Black lines are transform faults. Active volcanoes are marked by red dots.



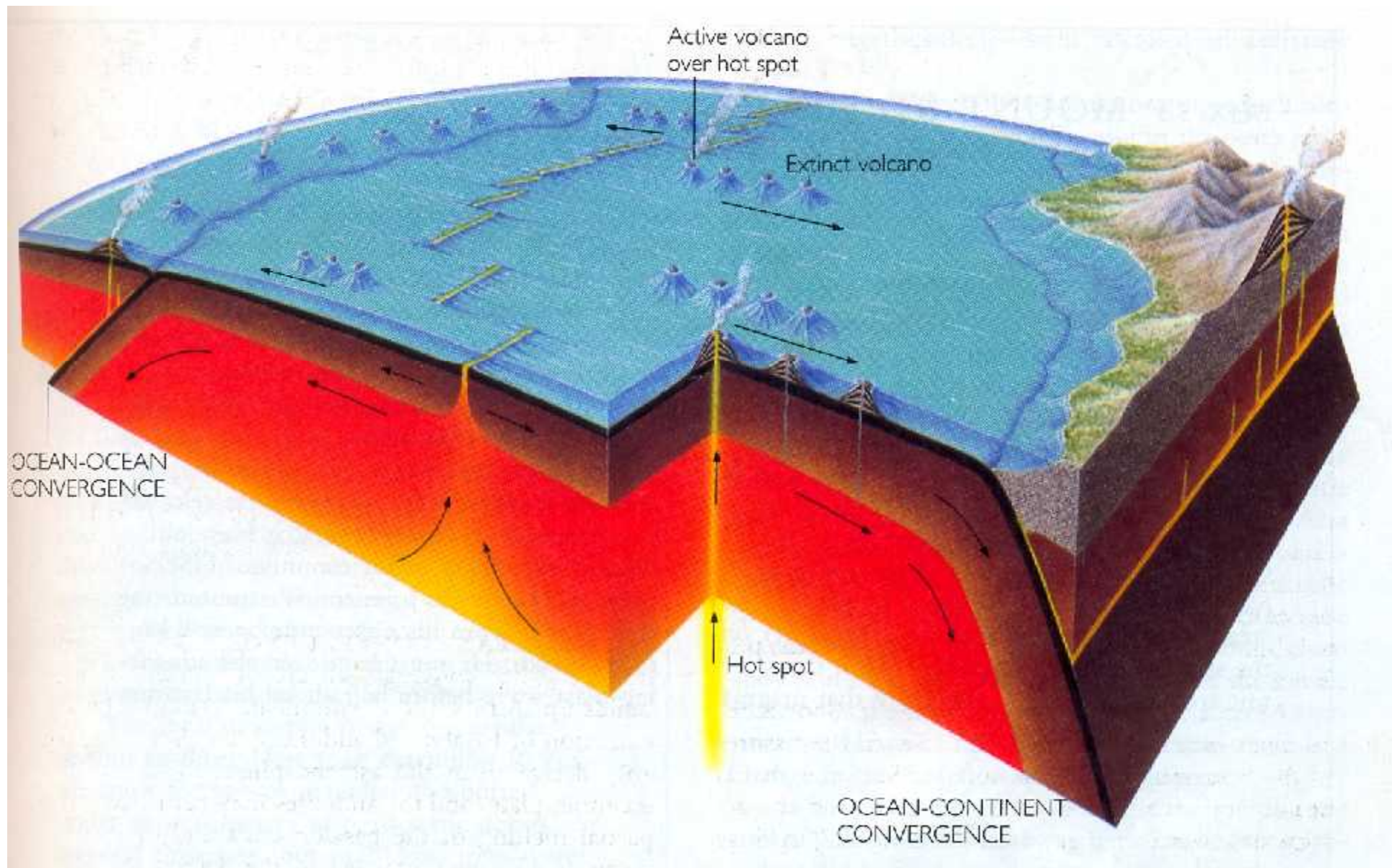
# Plate Tectonics: Earthquake & Volcanic belts

**FIGURE 2.31** The locations of most earthquakes fall in distinct bands. These earthquake belts define the positions of the plate boundaries.





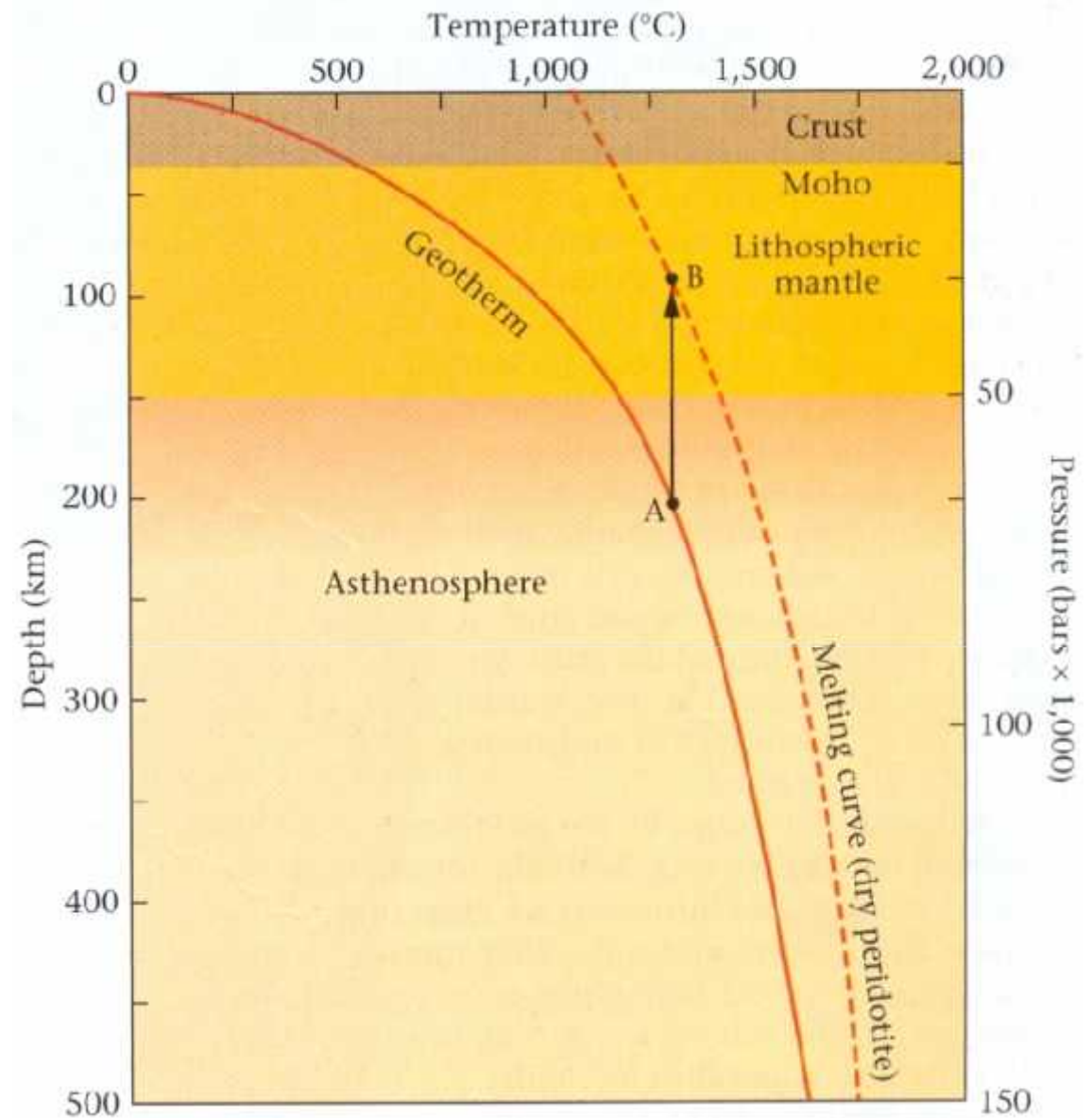
# Volcanism



# Volcanism

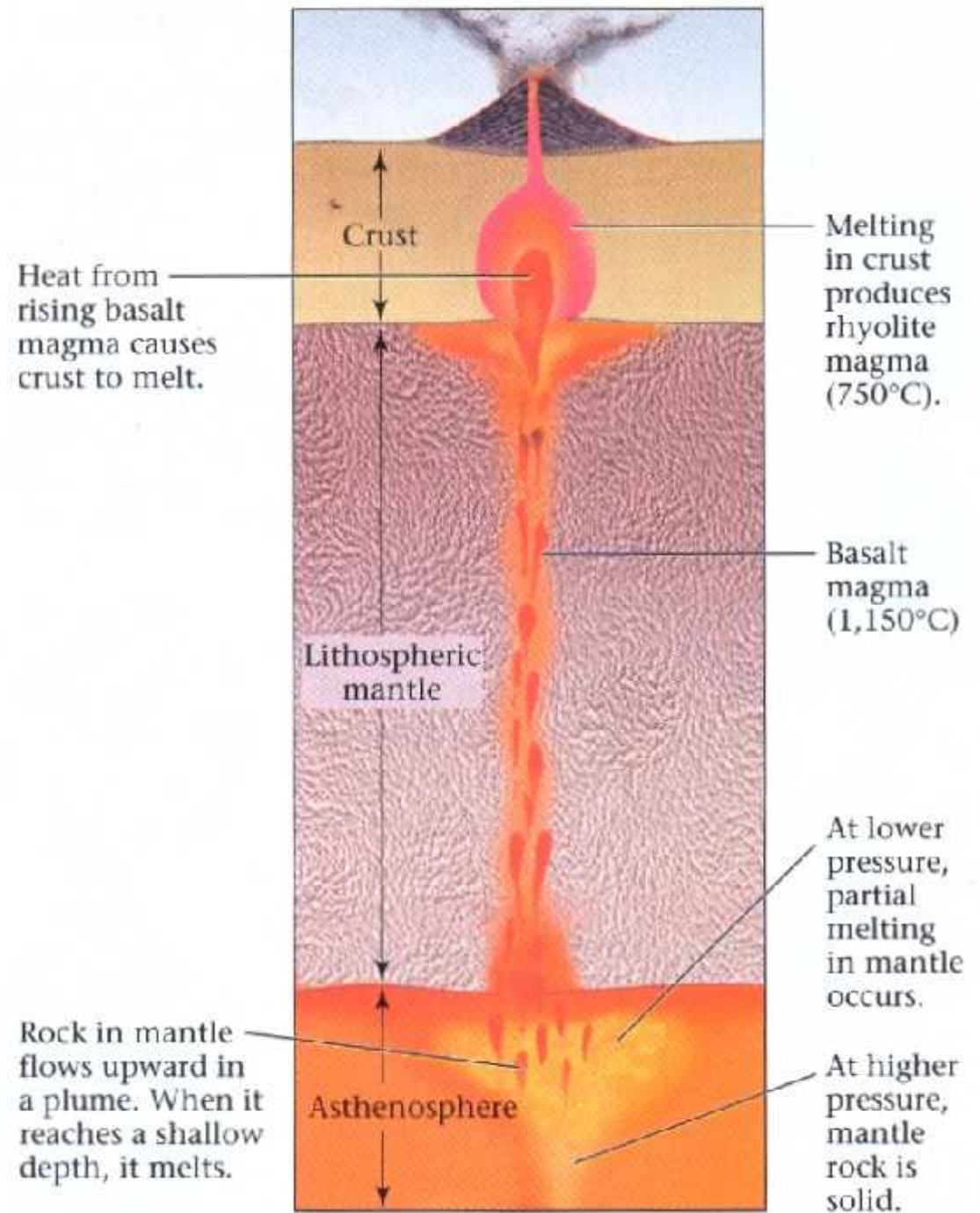
## Generation of melt

1. Decompressional melting
2. Addition of fluids, ( $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ) to the mantle which lowers melting point of mantle rocks
3. Injection of hot materials in the crust that result into melting of crustal rocks



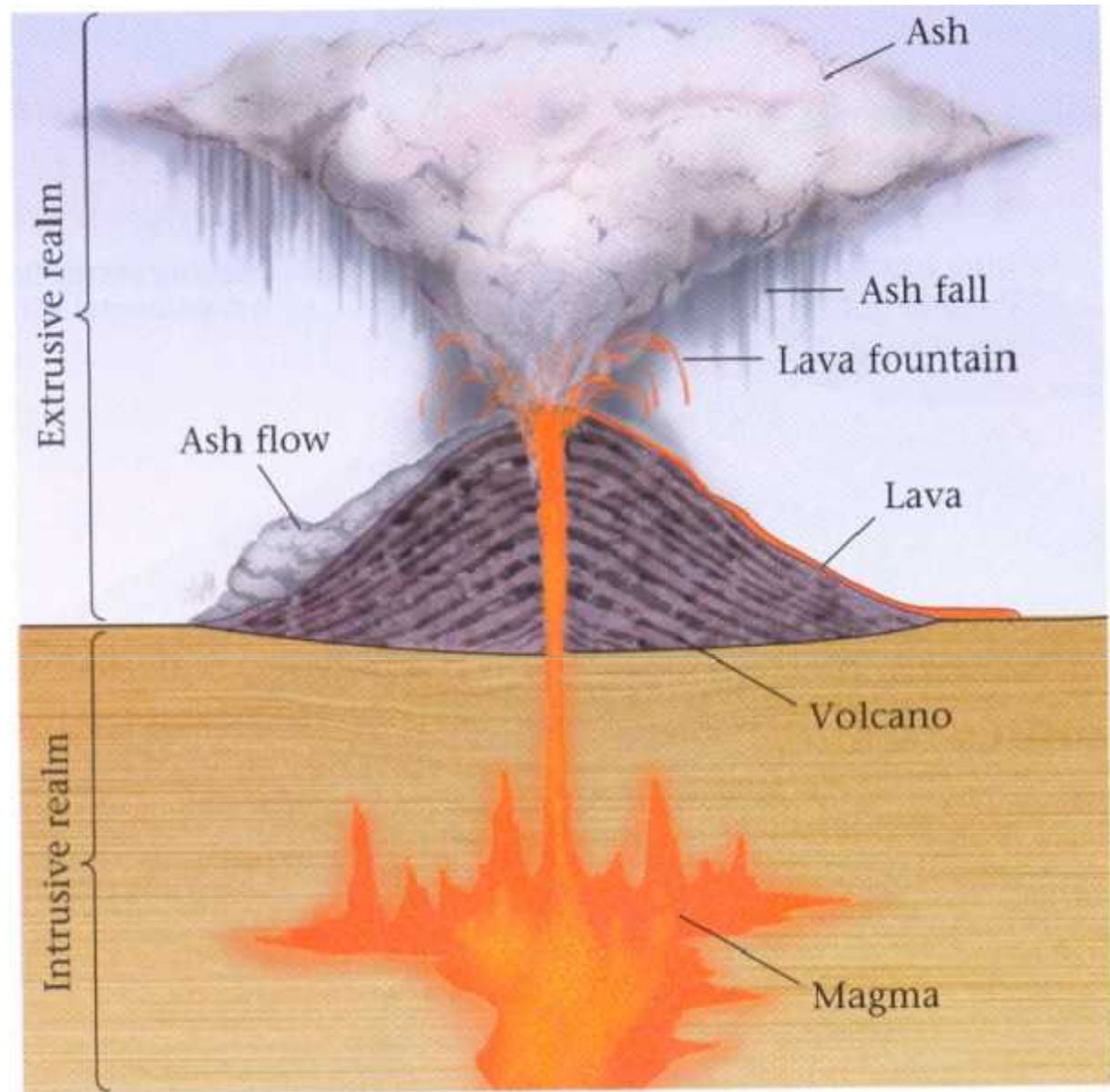
Decompressional melting

# Volcanism





# Volcanism

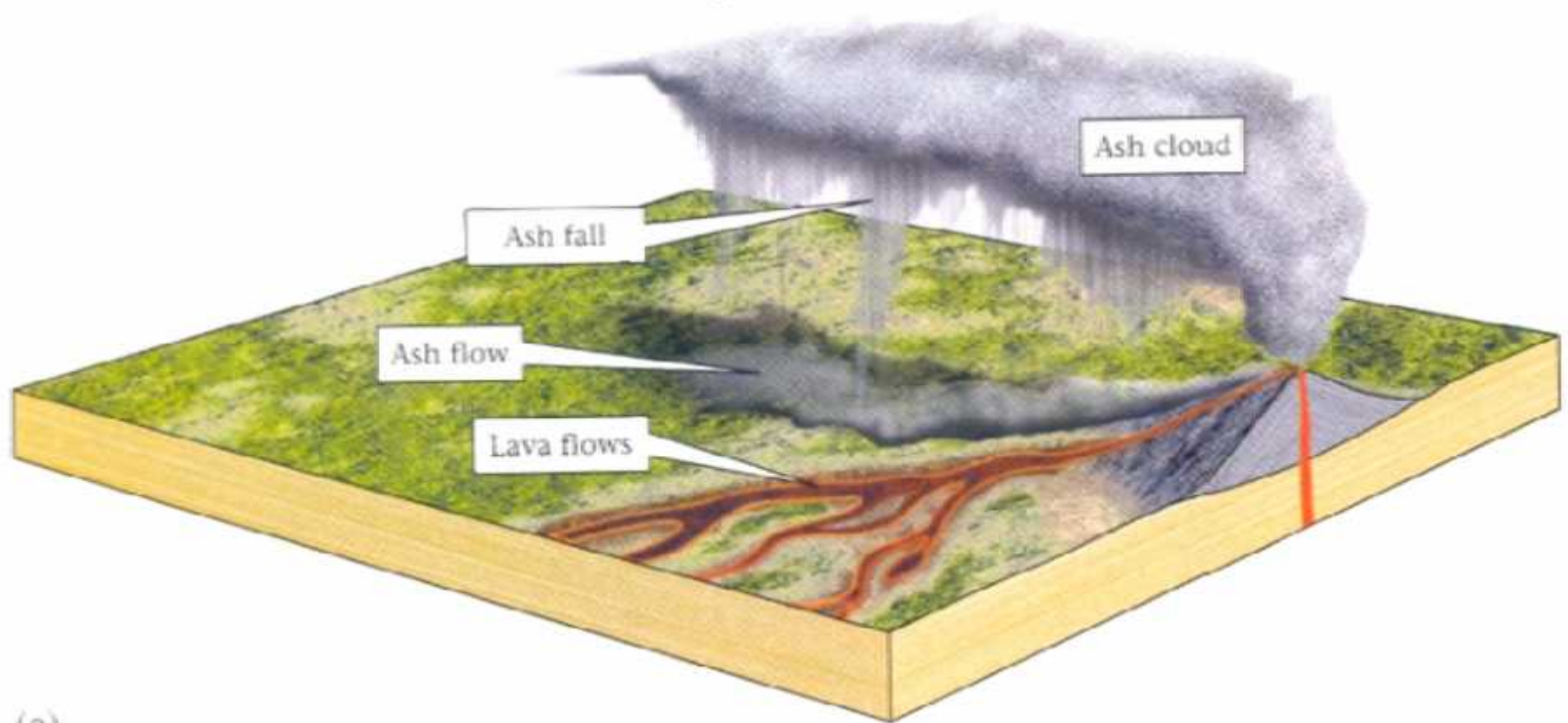


**FIGURE 4.2** Extrusive igneous rocks, namely ash and lava, form above the Earth's surface, while intrusive rocks develop below. Melt that erupts from a volcano is lava, while underground melt is magma.



# Volcanism

**FIGURE 4.7** Types of volcanic extrusion. (a) Ash falls sprinkle down from clouds of ash blown high in the atmosphere. Ash flows behave like avalanches cascading down the side of the mountain. Lava flows are streams of liquid. (b) This photo shows a cliff face in Yellowstone Park, Wyoming. The dark layer in this picture is a lava flow. It flowed over ash layers and was buried by more ash layers. Notice that the flow contains vertical cracks that break it into columns. These cracks are columnar joints.



# Volcanism

Lava fountains in a crater of a volcano on Hawaii and a river of lava streams out



# Volcanism





# Volcanism



# Volcanism: Krakatoa eruption 1883





# Volcanism: Krakatoa eruption 1883

The 1883 explosion of the volcano Krakatoa, in the strait between Java and Sumatra, was one of the greatest ever witnessed. Now almost completely submerged, Krakatoa was then a small island formed from a group of volcanic cones in an ancient caldera. The caldera, 6 km across, was a remnant of a collapsed prehistoric andesitic stratovolcano. On August 27, after many smaller explosions, Krakatoa blew its top in a phreatic explosion with the energy of 100 million tons of TNT (5000 times greater than the nuclear explosion that destroyed Hiroshima). It is believed that much of the energy was provided by the violent expansion of hot steam after the walls of the volcano first ruptured, letting seawater into the magma chamber. The result can be viewed as the biggest steam-boiler explosion and the loudest noise in recorded history.

The explosion was heard in Australia, nearly 2000 km away. Volcanic ash fell over an area of some 700,000 km<sup>2</sup>. Almost total darkness settled on Jakarta, 150 km away, when the dust blotted out the Sun's rays. Fine dust rose to the stratosphere and drifted around the Earth, lowering Earth's mean annual temperature a few degrees for the next year or so by blocking 13 percent of the Sun's light from reaching Earth. The explosion also generated a *tsunami*, or giant sea wave, that reached a height of almost 40 m, destroying 295 coastal towns as far as 80 km away and drowning 36,000 people. The tsunami was recorded on tide gauges as far away as the English Channel. After the eruption, most of Krakatoa disappeared, leaving in its place the current 300-m-deep, water-covered basin.



# Volcanics: Vesuvius eruption 79 AD



# Volcanism: Vesuvius eruption 79 AD

The catastrophic eruption of Mt. Vesuvius occurred on the afternoon of August 24, 79 AD. Because Vesuvius had been dormant for approximately 800 years, it was no longer even recognized as a volcano.

The cities of Pompeii, Herculaneum, Stabiae and Oplontis are famous for having been lost, in the eruption of Mount Vesuvius, which buried them in superheated pyroclastic material that has solidified into volcanic tuff.

# Volcanism: Vesuvius eruption 79 AD

City of Pompeii





# Volcanics: Vesuvius eruption 79 AD

Pompeii



# Volcanism: Vesuvius eruption 79 AD



Streets of Pompeii



# Volcanism: Vesuvius eruption 79 AD



Some of the dead at Pompeii. Ash covered their bodies and made a mold or negative which archaeologists filled in with plaster many centuries later.



# Volcanism: Vesuvius eruption 79 AD

A skeleton known as Ring lady



# Volcanism : Vesuvius eruption 79 AD



The area around the Vesuvius volcano is now densely populated.

# Volcanism

## Volcanic Gases and Ashes on Weather and climate





# Volcanism

## **Volcanic Gases and Ashes on Weather and climate**

Water vapour is the main constituent of volcanic gas (70-95 Percent), followed by carbon dioxide, sulphur dioxide, and traces of nitrogen, hydrogen, carbon monoxide, sulphur and chlorine. Every volcanic eruption releases enormous amount of these gases.

When a large explosive eruption takes place, fine dust and aerosols enter the stratosphere. It takes only about two weeks for the ash and aerosols to circulate the planet. Particles stay suspended into the stratosphere for many months to years, because they are above the weather and do not get washed away by rainfall.

# Volcanism

## Volcanic Gases

The correlation between volcanic eruptions and changes in weather and climate is receiving increasing attention. For instance, the 1982 eruption of El Chichon in southern Mexico and the 1991 eruption of **Mount Pinatubo (Philippines) injected sulphurous gases into the stratosphere**, 10 km above the Earth.

Through various chemical reactions the gases formed an aerosol (a collection of small droplets suspended in air) of tens of millions of metric tons of sulphuric acid droplets. The aerosol can absorb solar radiation and cool the surface of the Earth for as long as a year.

# Volcanism

The eruption column  
of Mount Pinatubo  
(Philippines) on June  
12, 1991,





# Volcanism

## Volcanic Gases

Scientists observed that the eruption of **Mount Pinatubo**, **one of the largest explosive eruptions of the century**, led to a **global cooling** of as much as  $0.5^{\circ}\text{C}$  in 1992.

For similar reasons the debris lofted into the stratosphere during the 1815 eruption of Mount Tambora in Indonesia cooled the Northern Hemisphere and resulted in a very cold summer in 1816. Crop losses and food shortages caused great suffering in that "year without a summer".

# Volcanism

## Volcanic Gases

Iceland 2010

Land of Fire and Ice



# Volcanism

## Volcanic Gases

Lava spraying high into the air draws crowds of tourists to Iceland's Eyjafjallajökull volcano on March 27, 2010.





# Volcanism

## Volcanic Gases

From a different angle, Eyjafjallajökull's "lavafall" appears unobstructed by billowing steam, revealing the glowing yellow ribbon cascading down the rocky gorge on March 26, 2010.



# Volcanism

## **Volcanic Gases**

A small airplane passes a fountain of lava rising from Iceland's Eyjafjallajökull volcano on March 26, 2010.



# Volcanism

## Iceland Volcano

In the distance, lava also bursts skyward during the eruption, which has now lasted for almost two weeks. The last volcanic eruption in Iceland's Eyjafjallajökull glacier region took place in 1821 and continued for roughly two years, according to the Associated Press.





# Volcanism

Like an ocean wave lapping the shore, a cooling lava flow from the Eyjafjallajökull volcano rolls across the ground near a line of tourists on March 27, 2010.

## Iceland Volcano

Geologists are unsure how much longer the Iceland eruption might last. "I hope the eruption continues for a while, because it is very good for business," Ingi Thor Jakobsson, manager of the nearby Hotel Ranga, told the AFP news service.



# Volcanism

White trails of steam roll across a vast expanse of cooling lava flows from the ongoing eruption of Iceland's Eyjafjallajökull volcano on March 30, 2010.

## Iceland Volcano

A tourist stands within feet of red-hot lava, hidden by a shell of new rocks that formed as the substance cooled.



# Volcanism

Tourists smile for the camera near a cooling lava flow from Iceland's Eyjafjallajökull volcano on March 27, 2010.

## Iceland Volcano

A popular hiking trail up to the volcano was recently reopened, local police officer Adolf Arnason told the AFP news service.

"There are quite a lot of people hiking. [Tourists are] not letting a 12-hour hike stop them from getting a little closer to the eruption," Arnason said.





# Volcanism

## **Iceland volcano**

## Land of Fire and Ice

People stand silhouetted as lava spurts from Iceland's Eyjafjallajökull (pronounced AY-uh-full-ay-ho-kul) volcano on March 30, 2010—part of the ongoing eruption that started on March 21. (See more pictures of the Iceland volcano eruption.)

Bursting to life after 190 years, the glacier-capped volcano has drawn swarms of tourists eager to witness proof of Iceland's reputation as the land of fire and ice. Police estimate that more than 25,000 onlookers have visited Eyjafjallajökull since the volcano started erupting, according to the Reuters news service.

But tourists and residents still have reason to be wary: On Wednesday officials reported that the Iceland volcano eruption had opened a new fissure about 980 feet (300 meters) long that's spewing lava. Geologists think the new vent means that volcanic activity will start appearing farther north, endangering a wildlife reserve that's a popular tourist attraction, Reuters reported.

Published April 2, 2010

# Volcanism

**Volcanic ash poses double threat to airline engines;  
Daily News, London**

Flights across much of Europe are being cancelled on a second day of massive disruption caused by drifting ash ejected from a volcano in Iceland.

## Volcanic Gases



Volcanic ash from Iceland's Eyjafjallajökull volcano, pictured Wednesday 14, 2010, resulted in canceled flights in Europe today.

# Volcanism

## Volcanic Gases

### Iceland Volcano Ash Plume Prompts Health Worries

A car drives through ash fallen from the Eyjafjallajökull volcano plume on April 16, 2010.

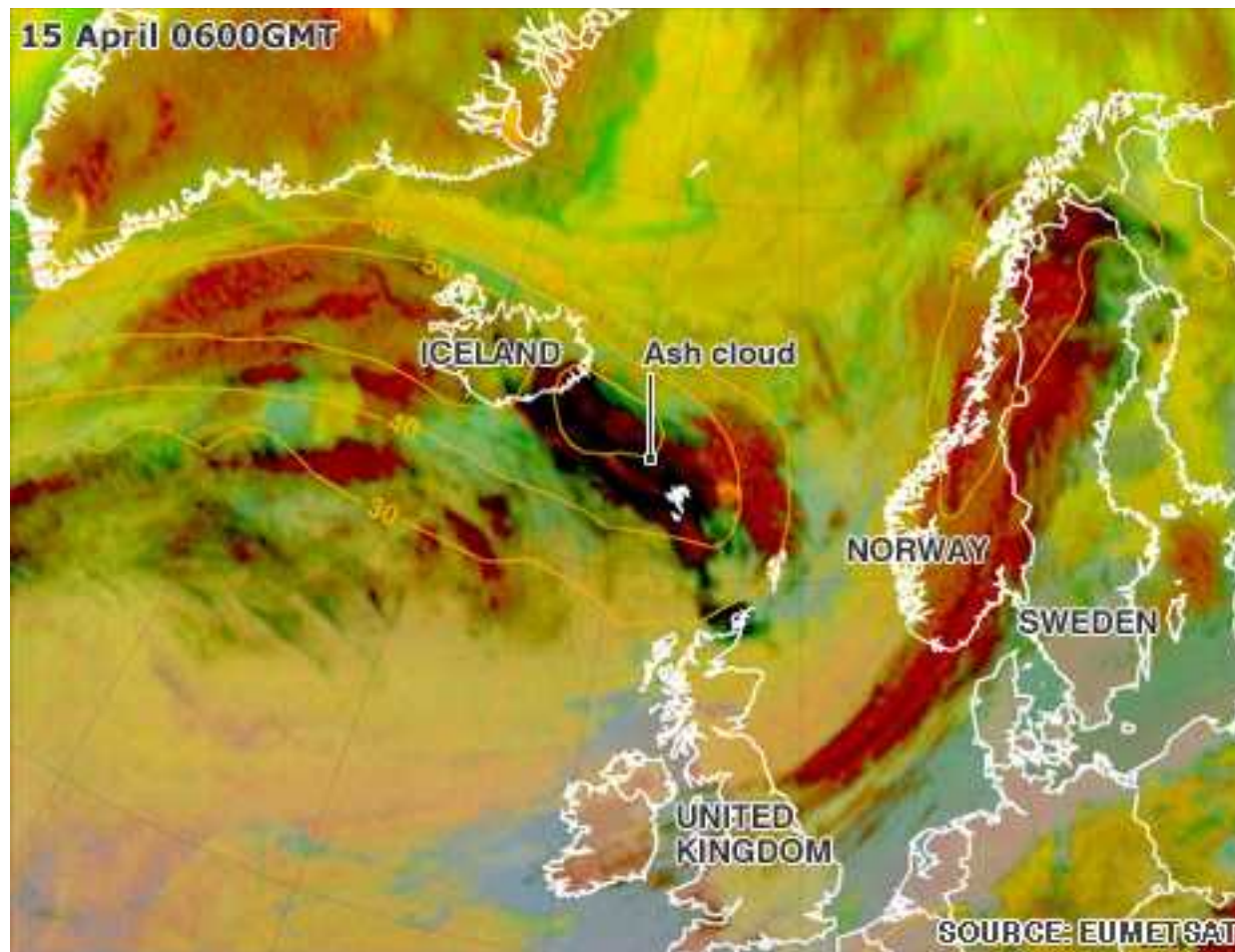




# Volcanism

## Volcanic Gases

The eruption in Iceland on Wednesday sent ash kilometres into the air. Satellite images show the cloud as brownish-black as ice particles mingle with ash.



Extent of Iceland volcano ash cloud

# Volcanism

## Volcanic Gases

People in the Eyjafjallajökull area were evacuated, but the spread of the ash cloud raised concerns for air traffic controllers in nearby countries.



Extent of Iceland volcano ash cloud

# Volcanism

## Volcanic Gases

By 1800GMT, the whole of the UK is expected to be affected and the Air Traffic Control Service (Nats) has banned flights from UK airspace



Extent of Iceland volcano ash cloud



# Volcanism

## Volcanic Gases

Meteorologists say that as the cloud spreads it will dissipate and lose intensity - but as the eruption continues, so does the ash cloud.



Extent of Iceland volcano ash cloud

# Volcanism

## Volcanic Gases

The situation is not expected to improve overnight as the ash cloud spreads. It is unclear when flights will be allowed to resume.



Extent of Iceland volcano ash cloud

# The beauty of Volcanoes

Volcanoes contribute to our well-being in many ways:

- Soils derived from volcanic materials are exceptionally fertile because of the mineral nutrients they contain.
- Emissions of volcanic rock, gases, and steam are also sources of important industrial materials and chemicals, such as pumice, boric acid, ammonia, carbon dioxide, and some metals.
- Seawater circulating through fissures in the ocean-ridge volcanic system is a major factor in the formation of ores.



# The beauty of Volcanoes

- The thermal energy of volcanism is being harnessed in more and more places. Most of the houses in Reykjavik, Iceland, are heated by hot water tapped from volcanic springs.
- Geothermal steam, originating in water heated by contact with hot volcanic rocks below the surface, is exploited as a source of energy for the production of electricity in Italy, New Zealand, the United States, Mexico, Japan, and the former Soviet Union.

# The beauty of Volcanoes

## Hot Springs and Geysers



**FIGURE 5.26** Geyser Hot Springs, in the Black Rock Desert of northwestern Nevada, periodically spews forth hot water and steam. Between eruptions, hot water presumably fills underground cavities. Further heating converts some of the water into steam, generating the pressure that forces the discharge. *Stephen Trimble.*