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The Andean Volcanic Belt: Ecuador’s Volcanoes and the Ring of Fire

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Why does a small country like Ecuador have some of the most famous volcanoes on Earth? The answer lies under the Pacific Ocean. A giant ocean plate is sliding below South America, and the push builds mountains and melts rock.

This lesson follows that story step by step. It starts with the plates. Then it visits Chimborazo, the deadly 1985 eruption in Colombia, and Ecuador’s new UNESCO geopark.



Active Tungurahua above Baños de Agua Santa, Ecuador, January 2010. Photo: Hjvannes, CC BY-SA 3.0, via Wikimedia Commons.

Subduction: one tectonic plate sinks beneath another. Picture a heavy book sliding under a thin rug, which bunches up as it goes. Here the heavy ocean plate dives under South America. This matters because the sinking plate is what builds the Andes and feeds their volcanoes.

Ring of Fire: a path of volcanoes and earthquake zones around the Pacific Ocean. Think of a necklace of hot spots that runs for about 40,000 km. The Andes form the South American part of it. It matters because most of the world's volcanoes sit on this one path.

Equatorial bulge: Earth is slightly fatter at the Equator than at the poles. A spinning ball of dough spreads out around its middle in the same way. A mountain on the Equator stands farther out from the centre. This is why Chimborazo can beat Everest on one measure.

Lahar: a fast mudflow made of volcanic debris and water. It is like wet concrete rushing down a valley. Hot ash can melt snow and ice, and that water starts the flow. Lahars caused the worst deaths in the 1985 Colombian disaster.

Why are the Andes so volcanically active?

How does a sinking plate make Andean volcanoes?

The Nazca Plate is an ocean plate. It moves east towards South America at about **79 mm a year**. Where the two meet, the heavy ocean plate is forced down under the lighter continent. This is **subduction**. A deep ocean trench, the Peru-Chile Trench, marks the line.

Two things follow from this push:

- The squeeze folds the edge of South America. This builds the **fold mountains** of the Andes.
- Sea water is locked in the sinking plate. As the plate heats up, the water is freed. It lowers the melting point of the mantle above, and some rock melts into **magma**.

The magma rises and can erupt with great force. Such volcanoes often sleep for hundreds or thousands of years. Then they throw out ash and hot gas flows. The sticking of the plates also causes frequent earthquakes.

Sources: geolsoc.org.uk; education.nationalgeographic.org

Nazca Plate moves about 79 mm a year
Sinks under South America subduction
Water is freed mantle starts to melt
Magma rises Andean volcanoes

Quick check 1. Water released from the sinking Nazca Plate helps to make magma. *(True or False?)* See answer ↓

What is the Ring of Fire?

How big is the Ring of Fire?

The Ring of Fire is a path round the Pacific Ocean. It has many active volcanoes and frequent earthquakes. It is about **40,000 km** long.

The numbers are striking:

- About **75%** of Earth's volcanoes, over 450, lie on the ring.
- About **90%** of Earth's earthquakes happen along its path.

The Nazca Plate is one of the plates the ring follows. So the Andean belt is the South American section of the ring. Most of the ring is made of subduction zones, like the one under the Andes.

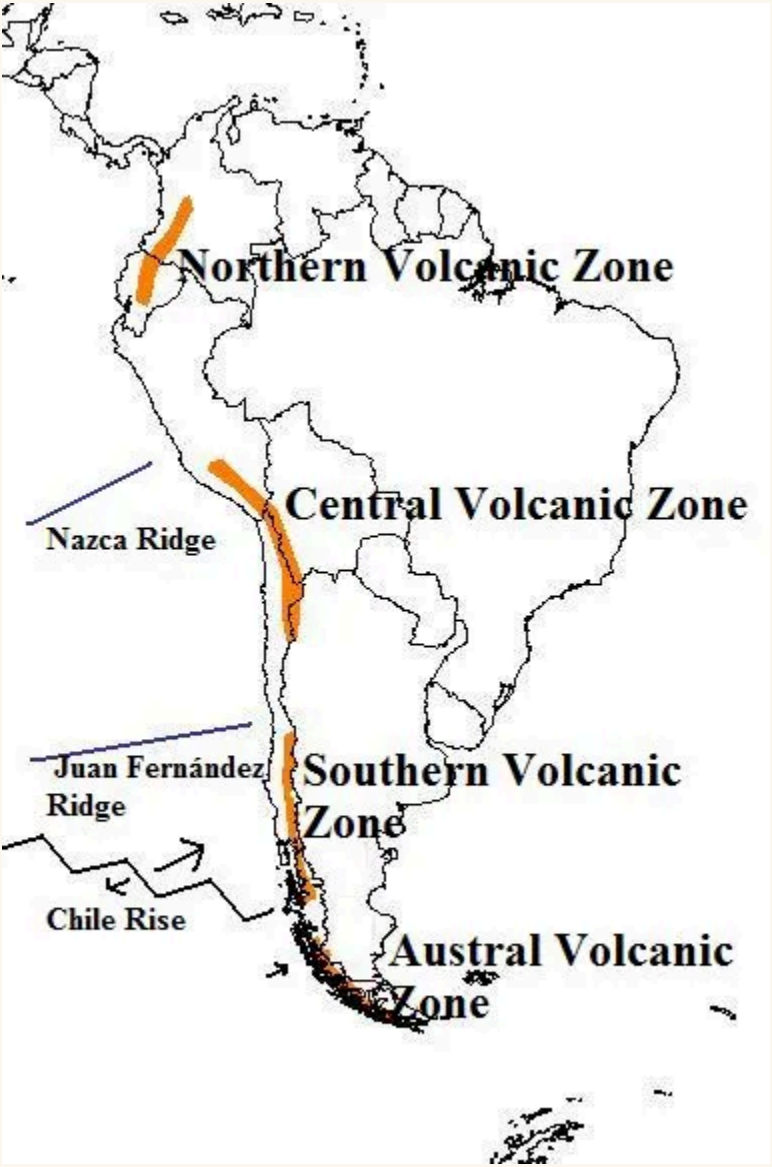
One stretch is different. Between the Pacific and North American plates, the plates slide sideways past each other. This is a transform boundary. It makes many earthquakes but is not a subduction zone.

Sources: education.nationalgeographic.org; geolsoc.org.uk

Boundary type	What the plates do	Example
Subduction zone	One plate is pushed under another and its rock melts	Nazca Plate under South America (the Andes)
Transform boundary	Plates slide sideways past each other	Pacific Plate and North American Plate

Quick check 2. About 75% of Earth’s volcanoes lie along the Ring of Fire. *(True or False?)* See answer ↓

Why is Chimborazo farther from Earth's centre than Everest?



The four segments of the Andean Volcanic Belt, separated by volcanic gaps. Map: Chiton magnificus, public domain, via Wikimedia Commons.

Which peak is farthest from the Earth's centre?

Mount Everest is the highest point above sea level, at 8,848 m. But height above sea level is not distance from Earth's centre. Earth is not a perfect sphere. It is thicker at the Equator, because the planet spins.

Chimborazo in Ecuador lies just one degree south of the Equator, where the bulge is greatest. Its summit is 6,268 m above sea level.

Yet it is over **2,072 m farther** from the centre than the top of Everest. Everest lies nearly 28 degrees north of the Equator, so it gets less help from the bulge.

There are three different records, so keep them apart:

- **Everest:** highest above sea level.
- **Chimborazo:** farthest from the Earth's centre.
- **Mauna Kea** in Hawaii: tallest from base to peak, at more than 10,210 m.

Sources: oceanservice.noaa.gov; amusingplanet.com

> **Quick check 3.** The summit of Mount Everest is the farthest point on Earth's surface from the Earth's centre. *(True or False?)* See answer ↓

Think it through: why does standing on the Equator put a mountain farther from the centre?

Show the idea

Earth spins, so it bulges around its middle. The ground at the Equator is already farther from the centre than the ground at the poles. A mountain there starts from that higher base, so its summit can beat a taller peak elsewhere.

What happened at Nevado del Ruiz in 1985?

How did one eruption kill more than 23,000 people?

Nevado del Ruiz is a snow-capped volcano in Colombia, about 130 km from Bogotá. It is one of the northernmost volcanoes of the Andean belt. It rises more than 5,300 m above sea level and is capped by glaciers.

On 13 November 1985, a little after 9 p.m., it erupted.

Experts did not call it a large eruption. But the heat melted snow and ice on the summit. The water mixed with rock and mud to form three **lahars**. They raced down the slopes at about 30 km an hour.

Less than three hours after the eruption, the mudflows reached the town of Armero. Some stood nearly 30 m high. Three quarters of the town's 28,700 people died. Estimates for Armero alone range from 20,000 to 24,000. In all, lahars killed more than 23,000 people.

Sources: earthmagazine.org; history.com

Quick check 4. The Nevado del Ruiz disaster of 1985 was caused by lava alone. *(True or False?)* See answer ↓

Was the disaster a surprise?

Not really. The volcano had been stirring for almost a year. Climbers saw gas coming from the crater in November 1984. Earthquakes were felt nearby. Emergency planning began in early 1985.

But warnings did not turn into action. The region's only seismograph broke in February 1985. Scientists believed a full eruption was possible and urged people to leave. Their worries were largely ignored.

Ruiz had killed before.

A lahar in 1595 killed 636 people. Mudflows in 1845 killed more than 1,000. After 1985, the United States launched the **Volcano Disaster Assistance Program**. It helps countries watch risky volcanoes. Scientists now know that a small eruption on a snow-capped volcano can send lahars many tens of kilometres.

Sources: earthmagazine.org; nap.nationalacademies.org

Quick check 5. A small eruption on a snow-capped volcano can still threaten people many kilometres away. *(True or False?)* See answer ↓

Think it through: why was a modest eruption so deadly for Armero?

Show the explanation

The danger was the meltwater, not the lava. The water picked up ash, rock and soil and became a mudflow. Armero sat in a river valley below, right in its path.

What is the Tungurahua Volcano Geopark?

Which geoparks did Ecuador gain in 2025?

In April 2025, UNESCO's office in Ecuador announced two new Global Geoparks. They are **Napo Sumaco** and **Volcán Tungurahua**. The announcement came on 11 April. Imbabura had been named in 2019.

A geopark is an area where sites of top geological value are managed as a whole. Protection, education and sustainable development go together. The label lasts four years and is then reviewed.

Here are the main facts about the Tungurahua geopark:

- It covers about **2,397 km²**.
- Tungurahua volcano rises to 5,023 m. It lies 140 km south of Quito.
- The area has 6 volcanoes, including the active Tungurahua and El Altar.
- Its rocks record more than 417 million years of geological history.
- Twenty geosites are marked for visits and study.
- It covers five cantons: Penipe, Patate, Pelileo, Baños de Agua Santa and Guano.

Parks inside it include Llanganates and Sangay National Parks. Ecuadorian press reported formal accreditation at a global geoparks conference in Temuco, Chile.

Sources: expreso.ec; primicias.ec

> **Quick check 6.** Napo Sumaco and Tungurahua were announced as UNESCO Global Geoparks in April 2025. *(True or False?)* See answer ↓

What do examiners ask about the Andean belt?

What has been asked, and what to remember?

UPSC CSP 2026 asked a country question: Tungurahua Volcano, declared a UNESCO Global Geopark in 2025, lies in which country? The answer is Ecuador. See the question.

Watch for three traps:

- “Everest is farthest from the centre.” Wrong. Chimborazo is.
- “The 1985 disaster was lava.” Wrong. It was lahars.
- “Tungurahua is in Peru or Bolivia.” Wrong. It is in Ecuador.

Quick recall:

- Nazca Plate subducts under South America, about 79 mm a year.
- Ring of Fire: about 75% of volcanoes, about 90% of earthquakes.
- Chimborazo: 6,268 m, farthest from the Earth’s centre.
- Nevado del Ruiz, 13 November 1985: lahars killed over 23,000.
- Tungurahua and Napo Sumaco: geoparks announced April 2025.

Practice MCQs

1. At about what speed does the Nazca Plate move towards the South American Plate?

A. About 79 mm a year

B. About 7 m a year

C. About 79 cm a year

D. About 7 mm a year

See answer ↓

2. Why does a sinking ocean plate produce magma under the Andes?

A. The Earth's core heats the plate directly

B. Water in the plate lowers the melting point of the mantle above it

C. Friction alone melts the whole plate

D. The plate turns to gas and rises

See answer ↓

3. Which summit is the farthest point on Earth's surface from the Earth's centre?

A. Chimborazo, Ecuador

B. Mount Everest, Nepal and Tibet

C. Cotopaxi, Ecuador

D. Mauna Kea, Hawaii

See answer ↓

4. What caused most of the deaths after the 1985 Nevado del Ruiz eruption?

A. Lahars, or volcanic mudflows

B. Lava flows

C. Falling ash

D. Earthquakes

See answer ↓

5. Which area did the Tungurahua Volcano Geopark cover, according to Ecuadorian reports in 2025?

A. About 2,397 km²

B. About 23,970 km²

C. About 240 km²

D. About 239,700 km²

See answer ↓

6. Which two new UNESCO Global Geoparks did Ecuador announce in April 2025?

A. Napo Sumaco and Imbabura

B. Imbabura and Galápagos

C. Sangay and Cotopaxi

D. Napo Sumaco and Tungurahua Volcano

See answer ↓

Answer Key

1. **A.**
   The Nazca Plate moves east at about 79 mm a year. It sinks under South America in a process called subduction. This builds the Andes and feeds their volcanoes.
   Sources: Geological Society, the Andes · National Geographic, Ring of Fire.
   ↑ Q1
2. **B.**
   Sea water is locked in the ocean crust. As the plate sinks and heats up, the water is released. It lowers the melting point of the mantle above, so part of it melts into magma.
   Sources: Geological Society, the Andes · National Geographic, Ring of Fire.
   ↑ Q2
3. **A.**
   Earth bulges at the Equator. Chimborazo stands one degree south of the Equator. So its summit is farther from the centre than Everest's. Everest is still higher above sea level.
   Sources: NOAA, Chimborazo · Amusing Planet, Chimborazo.
   ↑ Q3
4. **A.**
   Heat from the eruption melted snow and ice on the volcano. The meltwater mixed with rock and ash and raced down the valleys as lahars. They buried Armero and killed more than 23,000 people.
   Sources: Earth magazine, Nevado del Ruiz · History.com, Nevado del Ruiz.
   ↑ Q4
5. **A.**
   Ecuadorian news reports give the geopark's area as about 2,397 square kilometres. The area includes protected areas such as Llanganates and Sangay National Parks.
   Sources: Expreso, geopark report · Vistazo, geopark report.
   ↑ Q5

6. **D.**
   UNESCO's office in Ecuador announced Napo Sumaco and Tungurahua Volcano on 11 April 2025. Imbabura had been named earlier, in 2019. Sources: Primicias, geopark report · Vistazo, geopark report.
   ↑ Q6

Quick-check answers

1. **True.** The freed water lowers the melting point of the mantle above, so some rock melts. ↑ 1
2. **True.** The ring holds over 450 volcanoes, about 75% of the world's total. ↑ 2
3. **False.** Everest is highest above sea level. Chimborazo's summit is farther from the centre because of the equatorial bulge. ↑ 3
4. **False.** The eruption melted snow and ice, and the lahars (mudflows) caused most of the deaths. ↑ 4
5. **True.** Melted ice makes lahars that can travel many tens of kilometres down river valleys. ↑ 5
6. **True.** UNESCO's office in Ecuador announced both on 11 April 2025. ↑ 6

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