

## **Aleutian Islands: A Bridge from the Old World to the New World**

**Your Home Base:**

**Makushin Volcano**

Latitude: 54°N

Longitude: 167°W

The Aleutian Islands are a chain of more than 300 small volcanic islands forming part of the Aleutian Arc in the Northern Pacific Ocean, occupying an area of 6,821 sq mi (17,666 km<sup>2</sup>) and extending about 1,200 mi (1,931 km) westward from the Alaska Peninsula toward the Kamchatka Peninsula. Crossing longitude 180°, they are the westernmost part of the United States (and by one definition the easternmost!). Nearly all the archipelago is part of Alaska and usually considered as being in the "Alaskan Bush", but at the extreme western end the small, geologically-related, and remote Commander Islands are in Russia. The islands, with their 57 volcanoes, are in the northern part of the Pacific Ring of Fire. The Alaska Marine Highway passes through the islands.

The islands, known before 1867 as the Catherine Archipelago, comprise five groups (east to west): the Fox, Islands of Four Mountains, Andreanof, Rat, and Near island groups. The great majority of the islands bear evident marks of volcanic origin, and there are numerous volcanic cones on the north side of the chain, some of them active. The coasts are rocky and surf-worn, and the approaches are exceedingly dangerous, the land rising immediately from the coasts to steep, bold mountains.

As a result of underwater volcanic eruptions, the two recently formed volcanic islands of Bogoslof and Grewingk now lie a little bit west of Unalaska. These new islets (very small islands) formed in the past 250 years, with Bogoslof appearing in 1796 and Grewingk following nearly a century later in 1883. In 1906 a new volcanic cone rose between the islets of Bogoslof and Grewingk, near Unalaska, followed by another in 1907. These cones were nearly demolished by an explosive eruption on September 1, 1907.

Makushin Volcano (5,691 feet (1,735 m)) located on Unalaska Island, is not quite visible from within the town of Unalaska, though the steam rising from its cone is visible on a (rare) clear day. Because of the location of the islands, stretching like a broken bridge from Asia to America, many anthropologists believe they were a route of the first human occupants of the Americas.

far from Antarctica!

formed here include gold, silver, tin, copper, platinum, lead, and zinc.

**Continue your research on the Internet:**

- [http://volcano.und.nodak.edu/vwdocs/volc\\_images.html](http://volcano.und.nodak.edu/vwdocs/volc_images.html)

# Aleutian Islands

Bering  
Sea

Alaska

of Sydney <http://postcard.pics-sydney.com>

Unimak

## Andes Mountains Maps



Topographic contour map of the Andes.

SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)



Shaded relief map of the Andes.

SOURCE: Geodynamics Database software.

## Baja California, Mexico: Across the Gulf

**Your Home Base:**

**Tres Virgenes Volcano**

Latitude: 28° N    Longitude: 113°W

Baja California looks like a piece of Mexico that is leaving, but hasn't quite broken off yet! It is an 800-mile long peninsula, separated from the rest of Mexico by the Gulf of California. Baja California is known as a botanist's paradise, due to all the strange forms of cactus and the hundreds of other rare forms of plant life. Baja has a hot and dry climate, with almost 600 miles of desert which receives very little rainfall. But one also finds tropical lagoons along the coasts, and irrigated cotton fields and sugar cane fields in the south.

Baja California is home to the harsh Sierra Juarez mountain range, and the Sierra San Pedro Martin mountains. There are also many barren mountainous islands along the gulf coast, such as the Cedros Island Mountains.

Baja California also is known to have occasional earthquakes – although not nearly as many as Southern California in the U.S. However, if you were to swim down into the Gulf of California, you might find that earthquakes along the

bottom of the gulf happen all the time! Geologists believe that the same system of faults that cause earthquakes in Los Angeles also created the Gulf of California.

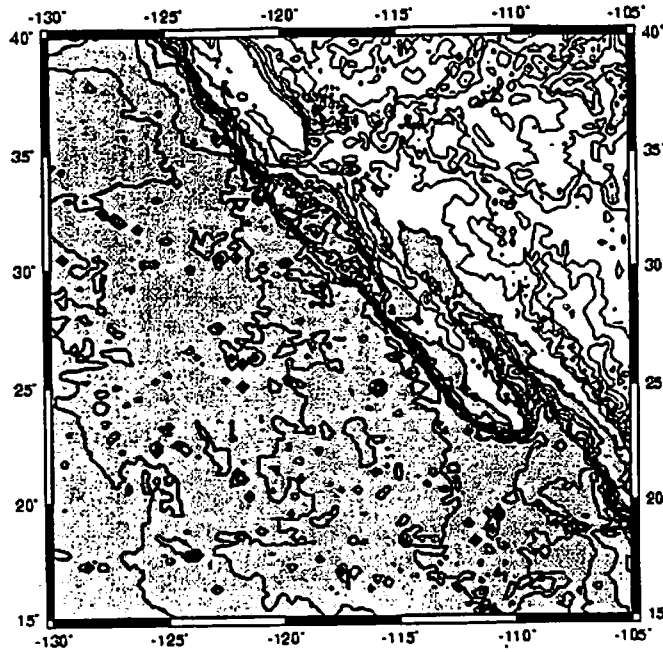
As two plates of the earth's crust slide past each other, Baja has separated from the rest of the continent. This kind of fault in the earth's crust – called a "transform fault" – creates great friction that causes many earthquakes, like those in the Gulf of California. The two colliding plates have also caused some volcanic activity on the peninsula. Mesas and plateaus, a large part of Baja's geologic appearance, have been formed as a result of erupting volcanoes. But not all of Baja's mountains are volcanic. In fact, *Tres Virgenes* volcano is the only active volcano on the Baja peninsula, rising 6,365 feet above sea level.

What will happen to Baja California in the future, as the plates continue to move? What shape do you think it will have 20,000 years from now? And what will become of the Gulf of California?

### Continue your research on the Internet:

- <http://math.ucr.edu/~ftm/bajaPages/Geology.html>
- [http://volcano.und.nodak.edu/vwdocs/volc\\_tour/mex/2Tres\\_Virgenes.html](http://volcano.und.nodak.edu/vwdocs/volc_tour/mex/2Tres_Virgenes.html)

# Baja California Map



Topographic contour map of Baja California

SOURCE: Create-a-map web site: [http://www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)



Shaded relief map of Baja California

SOURCE: Geodynamics Database software.

## **Galapagos Islands: UNESCO World Heritage Site**

**Your Home Base: Santa Cruz Island, Charles Island Research Station**

**Latitude 0\*40' S Longitude -90\* W**

The **Galápagos Islands** (official name: *Archipiélago de Colón*; other Spanish names: *Islas de Colón* or *Islas Galápagos*) are an archipelago of volcanic islands distributed around the equator in the Pacific Ocean, 972 km (525 nmi) west of continental Ecuador. It is a UNESCO World Heritage site: **wildlife is its most notable feature.**

The Galápagos islands and its surrounding waters are part of a province, a national park, and a biological marine reserve. The principal language on the islands is Spanish. The islands have a population of around 23,000.

The islands are geologically young and famed for their vast number of endemic species, which were studied by Charles Darwin during the voyage of the *Beagle*. His observations and collections contributed to the inception of Darwin's theory of evolution by natural selection. Darwin noticed that mockingbirds differed between islands, though he thought the birds now known as Darwin's finches were unrelated to each other and did not bother labelling them by island. The Englishman Nicolas Lawson, acting Governor of Galápagos for the Republic of the Equator, met them on *Charles Island* and as they walked to the prison colony told him that tortoises differed from island to island.

The group consists of 15 main islands, 3 smaller islands, and 107 rocks and islets. The islands are volcanic in origin. The oldest island is thought to have formed between 5 million and 10 million years ago. The youngest islands, Isabela and Fernandina, are still being formed, with the most recent volcanic eruption in April 2009 where lava from the volcanic island Fernandina started flowing both towards the island's shoreline and into the center caldera.

Santa Cruz is the island that hosts the largest human population in the archipelago at the town of Puerto Ayora. The Charles Darwin Research Station and the headquarters of the Galápagos National Park Service are located here. The GNPS and CDRS operate a tortoise breeding center here, where young tortoises are hatched, reared, and prepared to be reintroduced to their natural habitat. The Highlands of Santa Cruz offer an exuberant vegetation and are famous for the lava tunnels. Large tortoise populations are found here.



## The Hawaiian Islands: Giants on the Ocean Floor

**Your Home Base:** Kilauea Volcano, Hawaii  
Latitude: 19°N Longitude: 155°W

At 8:05 a.m. on February 1, 1996, the summit of Kilauea volcano began to inflate rapidly. Earthquakes indicated that magma was moving towards the surface inside Kilauea. The magma reached within a few hundred meters of the surface, as observers reported the sound of cracking rocks near Halemaumau Crater. Clouds of sulfur dioxide gas spouted from Kilauea. The flow of magma inside the mountain increased the pressure in the *Pu'u O'o* cone of the volcano, causing lava to shoot 10 meters into the air!

Hawaiian volcano lava usually bubbles out quietly to form lava rivers or lakes, or spouts a few hundred feet in the air in a fiery fountain, much more gently than eruptions like Surtsey or Mount St. Helens. Only rarely does a Hawaiian volcano throw out rock and high clouds of ash. Hawaiian lava is thin and flows quickly, up to 35 miles per hour! This fast lava is called *pahoehoe*. Fire fighters sometimes spray water on *pahoehoe* lava to slow it down.

The long underground tube system in the coastal area sends lava flowing right into the ocean, creating steam clouds as

flows of hot lava enter the cool sea. Hawaii is constantly changing as eruptions add acres of new land to the islands. Old lava flows are quickly weathered by the waves into rocks and black sand.

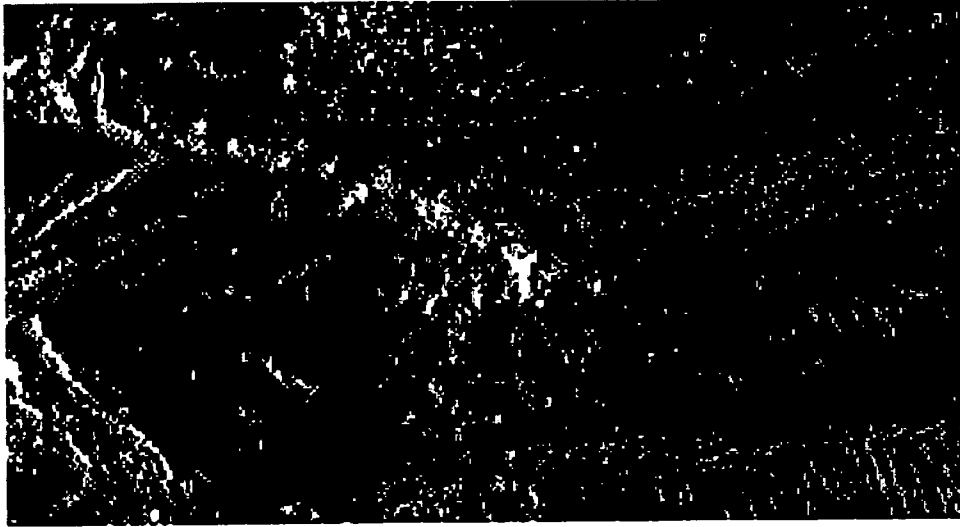
Unlike the many volcanoes around the edges of the Pacific ocean known as the "Ring of Fire," the Hawaiian volcanic islands are in the *middle* of the Pacific plate. A million years ago, a "hot spot" under earth's crust pushed magma up through the floor of the Pacific ocean. Over the years, eruption followed eruption, and thin layers of lava hardened, one on top of another. Thousands of eruptions built mountains high enough to reach up from the deep sea bottom, and appear above sea level as islands.

Kilauea is the youngest of the volcanoes on the Island of Hawaii, and lies at the southeast end of the Hawaiian chain. Most of the volcano is below sea level. Kilauea is in the shield-building stage, and is one of the most active volcanoes on Earth. Over 90 percent of the surface of Hawaii is covered by lava less than 1,000 years old!

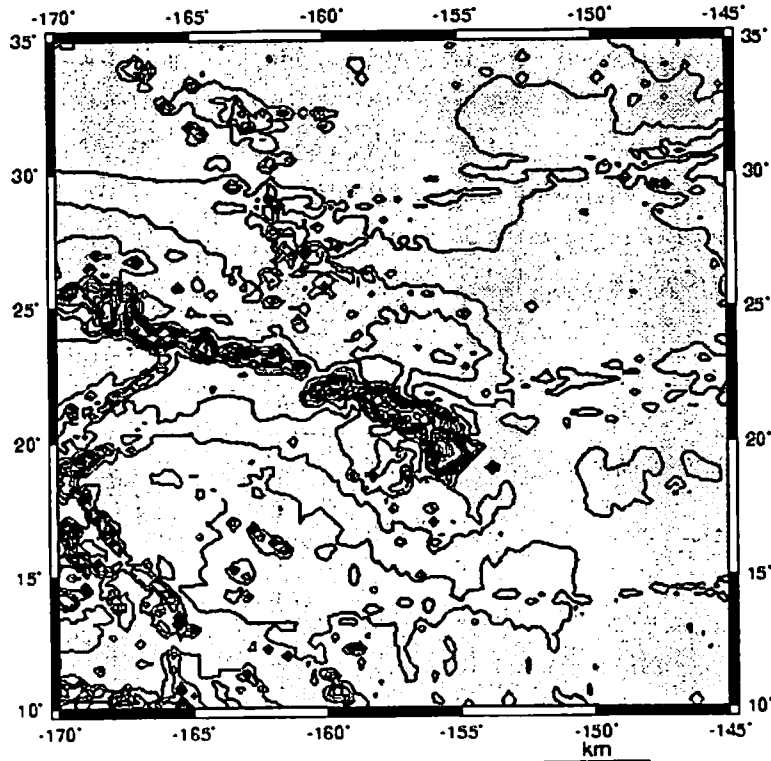
### Continue your research on the Internet:

- [http://volcano.und.nodak.edu/vwdocs/volc\\_images/volc\\_images.html](http://volcano.und.nodak.edu/vwdocs/volc_images/volc_images.html)
- <http://www.volcanostore.com/pages/info.html>

# Hawaiian Islands Maps



Shaded physical map of the Hawaiian Islands on the floor of the Pacific Ocean.  
SOURCE: Geodynamics Database software.



Topographic contour map of Hawaii, showing a string of volcanic islands  
(including some underwater ones).

SOURCE: Create-a-map web site: [http://www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)



## The Himalayas: Highest and Still Growing!

<b>Your Home Base:</b>	<b>Mount Everest</b>
	Latitude: 27°N      Longitude: 86°E

Why climb it? “Because it’s there?” was the classic answer of British mountaineer George Mallory, who disappeared into the clouds near the top on his fatal second attempt to climb Mt. Everest in 1924. Twenty-nine years later, New Zealander Edmund Hillary and Tenzing Norgay Sherpa made it to the summit from Nepal. Since then, more than 550 climbers from some 20 countries have reached the top of the highest peak in the world, Mt. Everest.

The ten highest mountains in the world can all be found in the Himalayas. The colossal structure of the Himalayas is the result of a major event in the history of the Earth: the collision between two continents. About 40 million years ago, India collided with Asia, pushing up some of the highest peaks on the earth. Earthquakes regularly occur, providing evidence that mountain building is still going on. At last record, Mt. Everest is still growing 3 centimeters per year.

This collision of plates enveloped the oceanic floor and caused the land to buckle and bend. Parts of the ocean floor

were split off and pushed upward, adding to the mountain range. Geological evidence shows that the top of the Mt. Everest was once the bottom of an ocean. At the summit you will find Mesozoic marine fossils that are about 65 million years old. These sedimentary rocks also erode easily, making that 3 centimeter growth even out.

“Home of the snows” is the name given to the Himalayas by the Nepalese. This “home” forms a mountainous wall between India and Asia. The most characteristic features of the Himalayas are their great height, complex geological structure, snowcapped peaks, large valley glaciers, deep river gorges, and rich vegetation.

This “wall” is a very effective climatic barrier. The warm Indian monsoon winds come and are blocked from the north, consequently making the Plateau of Tibet one of the coldest and driest places on Earth. The warm, moist monsoon winds drop heavy rains on India.

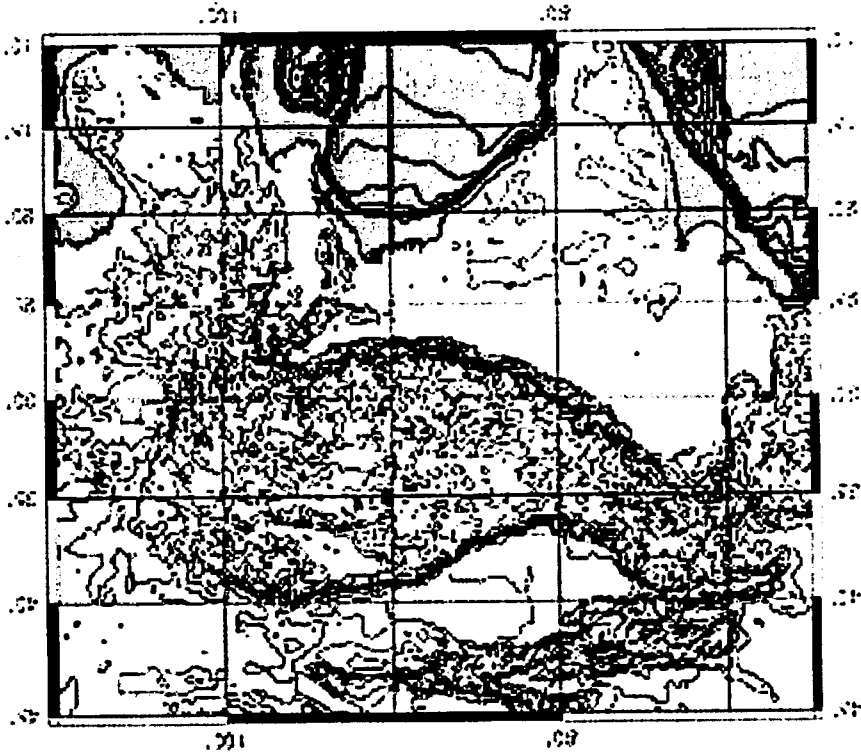
**Continue your research on the Internet:**

- <http://www.mnteverest.net/history.html>

# Himalayas Maps



Shaded physical map of the Himalayas  
SOURCE: Shaded Relief Map of the World web site  
<http://maps.esri.com/srmap/srmap.html>



Topographic contour map of the Himalayas  
SOURCE: Create-a-map web site,  
[http://www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## Iceland: The Land of Ice and Fire

**Your Home Base:** Reykjavic, Iceland  
Latitude: 65°N Longitude: 21°W

The icy landscape of Iceland's Vatnajokull (vatna=water, jokull=glacier) belies the country's volcanic heart. This active volcanic island with its cold sub-arctic climate has a unique blend of landscapes. Vatnajokull is Europe's second largest ice sheet. It stretches over 8,538 sq. km in the southeast of Iceland. In places it rises to over 2,000 m. high, and the ice can be as as 1,000 m. thick. Volcanic hot spots under the ice sheet cause the ice to melt, creating large lakes and rivers.

Occasionally, the volcanoes erupt and send streams of water, ice and boulders cascading over the surrounding landscape. Iceland is well know for its thermal springs and geysers, which are often found side by side with the glaciers themselves. They provide a source of heat for the Icelanders in a country that has no other natural sources of energy to combat the cold conditions.

Volcanic activity is associated with Iceland's location on the northern edge of the Mid-Atlantic ridge. Along the ridge

new crust wells up as two plates of the earth's surface move apart. Occasionally this activity forms new land above sea level. Iceland was formed in this way, and new islands are still appearing.

In 1963, an area of the sea near Iceland began to smoke. An undersea volcano was exploding and a new island was being formed. The island was named Surtsey after the ancient Norse god of fire. Ten years later another explosion occurred near Iceland on the island of Heimaey. Within six hours of the eruption, more than 5000 people were taken off the island to safety. Hundreds of buildings had burned down and dozens more had been buried in advancing lava. A year after the volcano stopped erupting, people of Heimaey came back to reclaim their island with its new 735-foot volcano.

**Continue your research on the Internet:**

- <http://volcano.und.nodak.edu>

## Iceland Maps



Shaded physical map of Iceland and the ocean floor around it.  
Greenland and northwestern Europe are on either side.

SOURCE: Geodynamics Database software



Topographic contour map of Iceland and the ocean floor around it.

SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## Japan: Hazard Zone, Land of Mountains

**Your Home Base:**            **Mt. Fuji, Japan**  
   Latitude: 35°N    Longitude: 140°E

On September 1, 1923, Japan experienced its most devastating earthquake. In a matter of minutes 100,000 people were dead and over 300,000 buildings had been destroyed. So great was the force of the earthquake that the floor of the bay split. The south coast was lifted by nearly 2 m (6.6 ft) and the north coast was correspondingly depressed. In places the land moved horizontally up to 4 m (13 ft) either side of a fault. Even in distant Tokyo the land was raised 10 cm (4 in) and moved horizontally 20 cm (8 in).

All this pushing and shifting of the crust has made Japan a land of mountains. Japan's numerous volcanoes and frequent earthquakes are evidence of the ever changing rocks under this country. Of Japan's 200 volcanoes and volcanic groups, 60 have been active in recorded history.

The most famous of these mountains is Mt. Fuji (12,389 feet; 3,776). This famous volcanic cone is the highest peak in Japan. This sacred mountain has been dormant since 1707. Mount Asama in central Honshu and Mount Sakurajima in southern Kyushu are well-known active volcanoes.

Disturbances off shore generate seismic sea waves that travel at great speeds. They start at about 1 m (3.3 ft) high and increase in height to 30 m (100 ft) as they approach the shallow shore line. This rumbling and movement also help create massive landslides on the islands of Japan, leaving steeply sloped mountains and gravel-covered surfaces.

The islands of Japan are the exposed tops of massive undersea ridges that rise from the floor of the Pacific Ocean on the eastern edge of the Asian continental shelf. The islands lie between the Japan Deep and the Sea of Japan. The Japan Deep, to the east, is a north-south trench that plunges to a depth of 28,000 feet (8,500 meters) in the Pacific. The Sea of Japan, which reaches depths of 10,000 to 12,000 feet (3000 to 3700 meters) is on the west.

This geologically young and unstable land is dominated by mountains and little low land. This creates a landscape of great variety and beauty, and gives Japanese life a small-scale compactness. As a result of this density of people and resources, devastation occurs often on this evolving island.

**Continue your research on the Internet:**

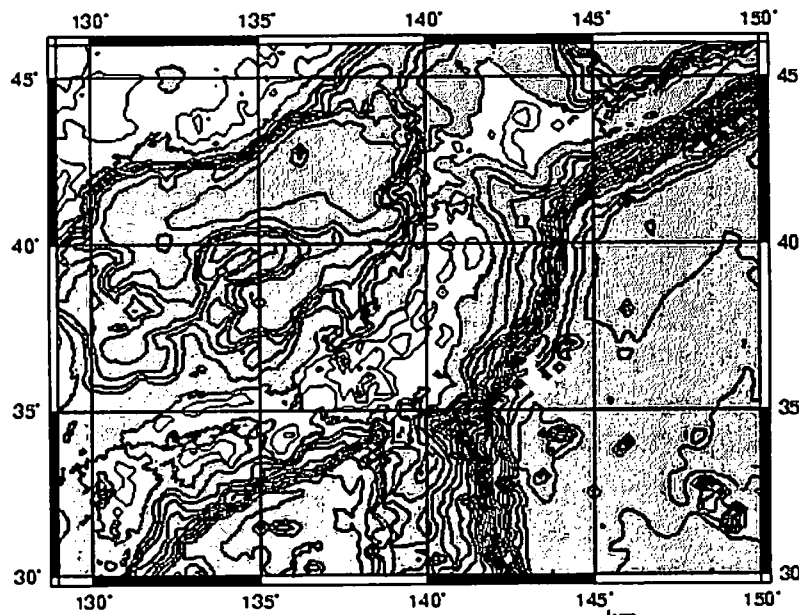
- <http://volcano.und.nodak.edu>

# Japan Maps



Shaded physical map of Japan and the ocean floor around it.  
Mt. Fuji is circled.

SOURCE: Geodynamics Database software



Topographic contour map of Japan and the ocean floor around it.

SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## The Java Trench: the Shadow of Indonesia

**Your Home Base:**

**Mount Gunung Kerinci**

Latitude: 2°S      Longitude: 102°E

For three months, the people of Batavia had worried about rumblings and puffs of ash coming from a tiny, mountainous island in the Sunda Strait. On August 26<sup>th</sup>, 1883, the people got their answer. The small island, known as Krakatoa, began to explode in one of the most powerful eruptions of all time. Eruption after eruption resounded from the island, continuing for two days! Seismic sea waves (called "tsunamis") caused by undersea earthquakes battered the coasts of Java and Sumatra. At 10:02 am on August 27<sup>th</sup>, the entire island of Krakatoa blew up, as a column of rock and fire blasted up into the sky. In only a few seconds, the whole 2,600-foot-high mountain was destroyed. The enormous tsunami waves terrified the people of the coastal towns, and when the waters finally quieted, 36,000 residents of the coastal towns had been killed.

Indonesia is a string of volcanic islands between Australia and the main Asian continent. More than 200 active volcanoes occupy these heavily populated islands. Volcanologists (scientists who study volcanoes) call Indonesia an "island-arc volcano chain." Volcanic islands

like Krakatoa often are found right next to a deep underwater valley called a "trench," which runs right next to the island-arc volcano chain. If you were to travel underwater from an Indonesian island, you would come to one of the deepest places in any ocean – the incredible Java Trench.

A trench like the Java Trench forms where two plates are colliding under the ocean. As the thinner, denser plate dives under its neighbor into the earth's hot magma, part of the melting crust turns into volcanic magma and then erupts. As this denser, heavier plate descends, it forms a trench that can be 60 miles wide, 1000 miles long, and several miles deep. The Java Trench is one of a series of trenches that can be found all around the Pacific Ocean. They are the underwater shadow of a system of volcanoes that has been called "The Ring of Fire," surrounding the Pacific Ocean.

What directions are the plates moving to form the Java Trench? What will happen to Indonesia as the plates continue to move? And what will be the future shape of the Java Trench?

**Continue your research on the Internet:**

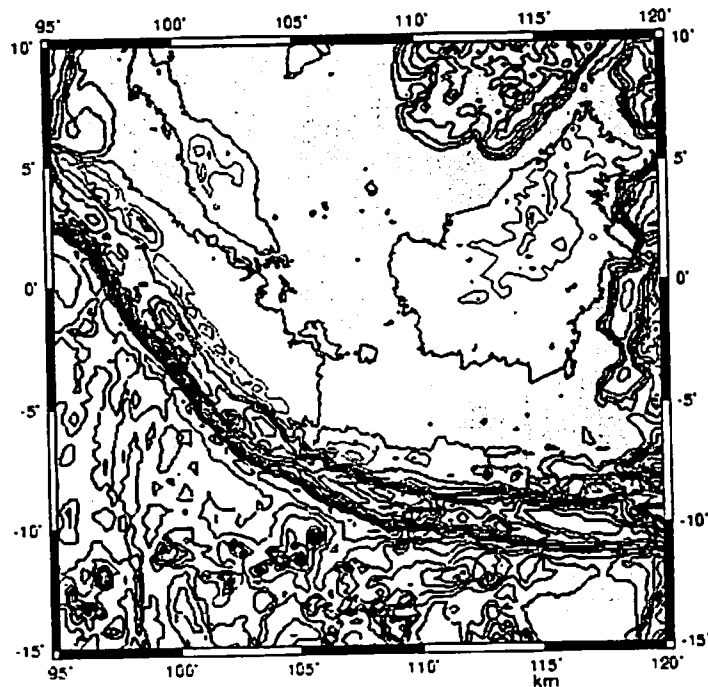
- XXXXXXXXXX

# Java Trench Maps



Shaded physical map of the Java Trench

SOURCE: Geodynamics Database software



Topographic contour map of the Java Trench.

SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)



# The Mariana Trench: Deepest Place on Earth

<b>Your Home Base:</b>	<b>The Challenger Deep</b> Latitude: 15°N    Longitude: 145°E
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If you go deep sea diving off the coast of the Mariana Islands some day, you could go a long way down! In fact, as you pass the beautiful fish and coral reefs, you might start to notice that the water becomes darker and colder as you go down. You would be swimming into the deepest ocean trench on earth.

You could never swim to the bottom of the Mariana Trench, of course. It's 11,033 meters below sea level! The temperature of the water in the deepest parts of the trench is only a few degrees above freezing: 39° Fahrenheit. Also, the pressure of all that water would weigh down on top of you and crush you — unless, of course, you could hold up 48 jumbo jets! And you wouldn't be able to see anything, because the bottom of the Mariana Trench is completely dark, out of reach of the sun's rays.

In fact, no person had ever been to the bottom of the Mariana Trench until 1968, when a special deep-sea submarine, called the *Challenger*, was built for just this purpose. The Challenger discovered a place far deeper than scientists had thought possible, a part of the Mariana Trench now named the Challenger Deep.

Since then, oceanographers have learned how to make maps of the ocean floors. They send sound waves bouncing off the ocean bottom, to find out how deep the oceans are. They have also discovered that there are actually animals that can live in the extreme cold and dark waters of the ocean deeps — like the eyeless Brotulid fish, “sea pigs,” echinoderms (sea cucumbers), and giant squid.

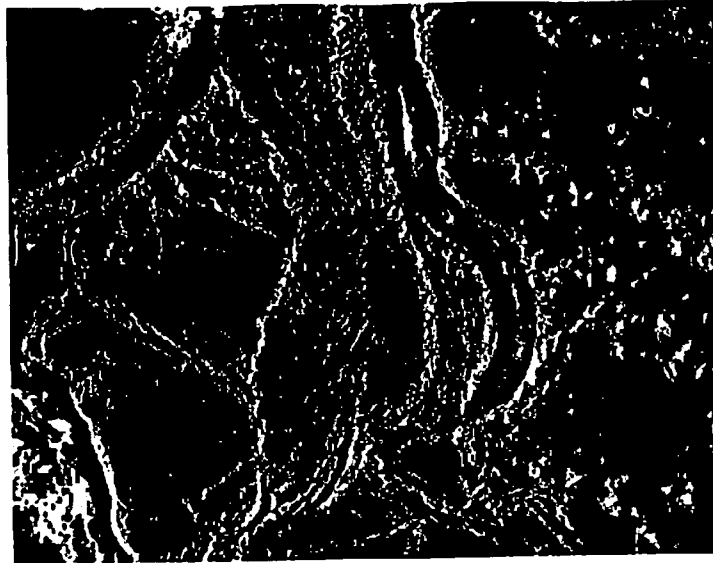
The Mariana Trench has other dangers, besides the temperature, the pressure, and the dark. Earthquakes and volcanoes are a hazard for living things, both in the trench and on the islands next to it. The earthquakes release some of the pressure that builds up where the plates of the earth rub against each other, as they do in the Mariana Trench. When one plate slides under another one, the rubbing causes friction that melts the bottom plate, forcing hot lava to shoot up in a volcanic eruption. The Mariana Islands were formed by these volcanoes.

How was the Mariana Trench formed? Which plates moved to create the deepest place on earth? And what will happen to the Mariana Trench as the earth's plates continue to move?

## Continue your research on the Internet:

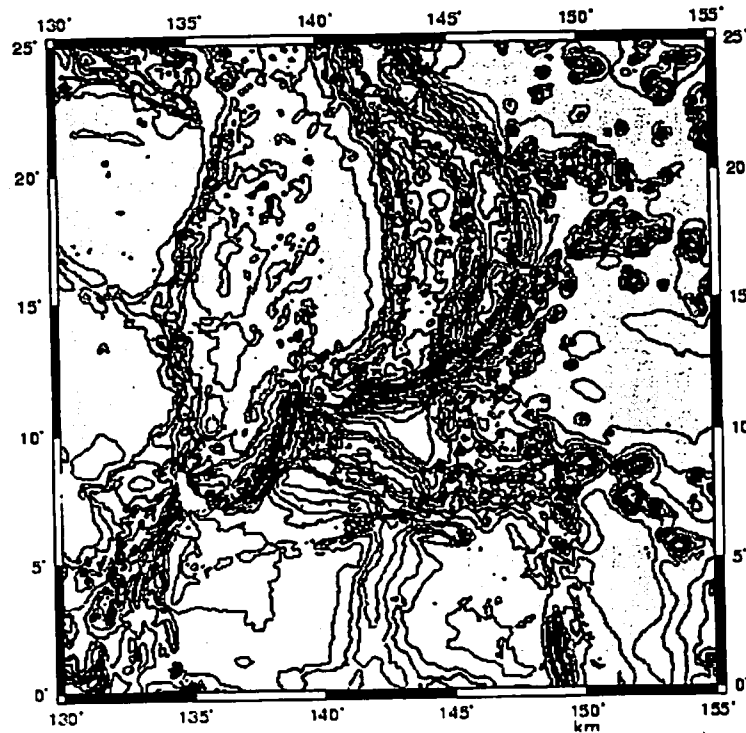
- [http://volcano.und.nodak.edu/vwdocs/volc\\_images/volc\\_images.html](http://volcano.und.nodak.edu/vwdocs/volc_images/volc_images.html)
- <http://www.ngdc.noaa.gov/mgg/image/mariana.mpg>

# Mariana Trench Maps



Shaded physical map of the Mariana Trench

SOURCE: Geodynamics Database software



Topographic contour map of the Mariana Trench.

SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## Mount Etna: the Pillar of Heaven

<b>Your Home Base:</b> <b>Catania, Italy</b> Latitude: 38°N      Longitude: 15°E
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Navigators in the fifth century BC considered Mount Etna to be the highest point on earth. The awe-inspiring volcano was termed the “pillar of heaven” by travelers on the Mediterranean Sea, who highly revered this “mountain of mountains.” This fiery volcano along the north coast of the island of Sicily has a long recorded history. Mount Etna has been active for more than 2.5 million years. The first recorded eruption was in 1500 BC. Since then, writers from ancient times up to the present have recorded more than 150 eruptions.

The base of Mount Etna is thickly populated. The rich soil formed from old lava has attracted farmers to plant vegetables, olives, grapevines, fruits, chestnut, oak, beech, and pine trees. With this dense population one would think fatalities from the volcano would be great, but eruptions occur near the summit and result in few fatalities. There have only been seven eruptions with reported fatalities. Etna’s most violent series of eruptions occurred in 1669, when millions of metric tons of lava poured from its crater.

The people of Catania unsuccessfully tried to divert the lava flow away from their city. The lava flow broke through the 18 meter high walls, and some 20,000 people were killed.

Etna’s geological history is long and complex. The oldest lava, exposed on the lowest part of the volcano, erupted 300,000 years ago. Some of this is pillow lava, which is found in submarine volcanoes – indicating Etna started underwater, and grew above sea level.

Etna sits on the boundary where the Eurasian plate meets the African plate, within sight of another huge volcano, Mount Vesuvius. These two plates are pushing against each other, forcing mountains to buckle up. Melting magma is released through weak spots in the earth’s crust, creating volcanoes like Mount Etna and Mount Vesuvius.

Why do two giant volcanoes, Mount Etna and Mount Vesuvius, sit so close to each other? In the future, as the earth changes, what will happen to Mount Etna and the Mediterranean Sea?

**Continue your research on the Internet:**

- [http://volcano.und.nodak.edu/vwdocs/volc\\_images/img\\_etna.html](http://volcano.und.nodak.edu/vwdocs/volc_images/img_etna.html)

# Mount Etna Maps



Shaded physical map of Italy and the Mediterranean, showing Mt. Etna (south) and Mt. Vesuvius (north).

SOURCE: Geodynamics Database software



Topographic contour map of Italy and the Mediterranean Sea.

SOURCE: Create-a-map web site: [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## Mount Popo: Smoking Mountain

**Your Home Base:**      **Mount Popocatepetl, Mexico**  
Latitude: 19°N      Longitude: 98°W

The morning of December 21st, 1994, a rain of ashes fell on the city of Puebla, Mexico. A gray ash cloud and a series of earthquakes indicated that Popocatepetl, the giant stratovolcano 30 miles away, was beginning to erupt after 50 years of silence. Moderate eruptions continued to spew ashes across the neighboring villages, and by the day after Christmas over 50,000 people had been evacuated to safety. Geologists from Mexico and the U.S. came together to study the eruption and try to predict what the great volcano would do next.

Popocatepetl, or "Popo," is the second highest volcano in Mexico, just 45 miles southeast of downtown Mexico City, the most populous city in the world. Popo's snow-capped peak stands 5,000 meters above sea level in central Mexico. It's name comes from the ancient Aztecs, who called it "Smoking Mountain." The volcano's crater is 612 meters across, and has steep walls leading down to the crater floor where volcanic gases rise around a small spatter cone. In recent years a small column of steam is often seen rising from Popo's summit crater.

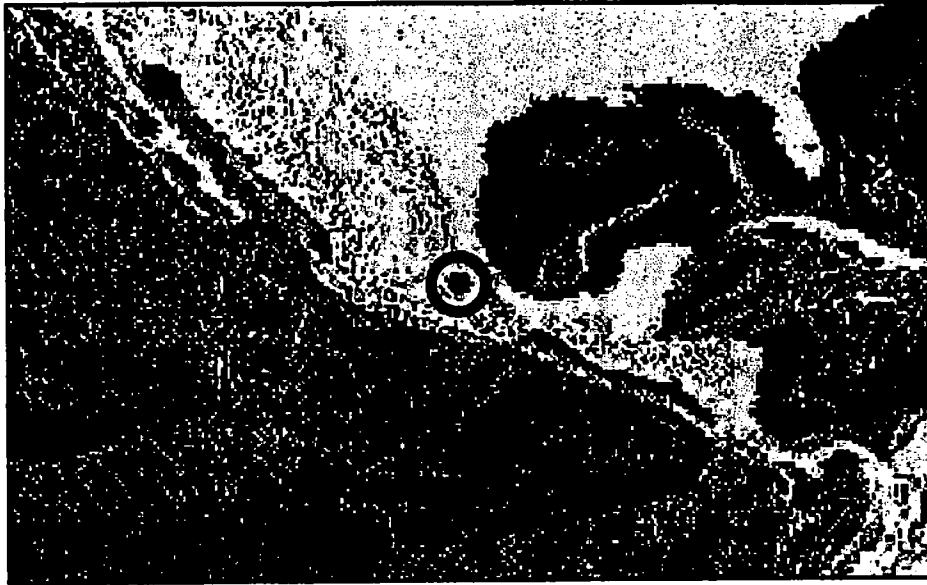
Popo is one of the most active volcanoes in Mexico. The Aztecs recorded eruptions of Popo in the years 1347 and 1354, and there have been at least 15 eruptions since the Spanish arrived in 1519. Most of the eruptions in the past 600 years have been relatively mild. However, geologists have found evidence that more destructive eruptions in 14,000 BC and in 23,000 BC threw large amounts of ash as far away as Mexico City, as well as causing avalanches. The last major Plinian eruptions were in 400 BC and 822 AD.

The evacuations around Christmas of 1994 may have been a practice run in preparation for a larger eruption that could affect up to 30,000,000 people. Volcanologists have tried to predict when another giant eruption like those of the past might occur, though volcanic activity does not occur in exact cycles. Geologists have studied mineral deposits around the volcano, which suggest that Popo has had these large eruptions every 1,000 to 2,000 years.

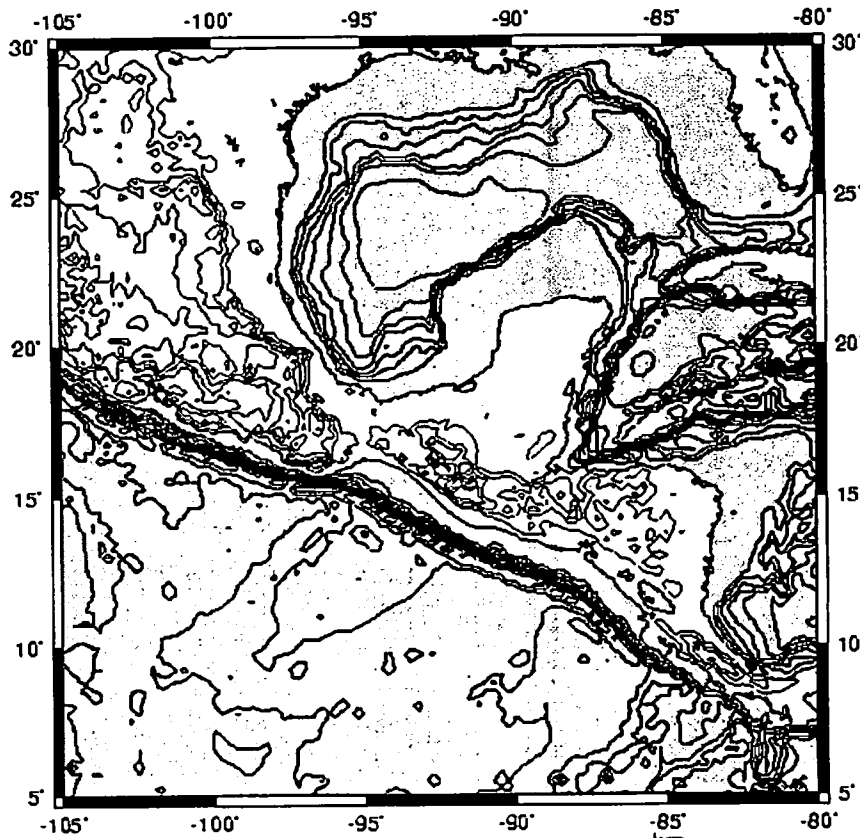
### Continue your research on the Internet:

- [http://volcano.und.nodak.edu/vwdocs/current\\_volcs/popo/popo.html](http://volcano.und.nodak.edu/vwdocs/current_volcs/popo/popo.html)

# Mount Popo Maps



Shaded physical map of Mexico. The red dot shows Mt. Popocatepetl.  
SOURCE: Geodynamics Database software.



Topographic contour map of Mexico.  
SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## Mount St. Helens: 10 Million Ton Blast

**Your Home Base:** Mount St. Helens, Washington  
Latitude: 46°N Longitude: 122°W

The widespread devastation caused by the Mount St. Helens eruption was due to the volcano's lateral blast. In other words, the magma erupted out of the side of the volcano, rather than the top, an unusual occurrence. Lateral blasts are typically more destructive because energy is directed horizontally across the countryside, rather than vertically into the air.

At 8:32 am on May 18, 1980, a magnitude 5.1 earthquake rocked Mount St. Helens, in southern Washington. A bulge, caused by magma welling into the mountain, developed on the volcano's north side, and the quake created a landslide, releasing this magma. The quake triggered the massive rock slide and debris avalanche, pressure release, and a huge pumice-and-ash eruption. The energy released in the eruption was equal to ten million tons of dynamite. Sixty-three people were killed and hundreds of millions of dollars of damage were caused by the blast. More than 200 homes and over 185 miles of roads were destroyed. The force of the eruption was so great that entire forests were blown down like match sticks.

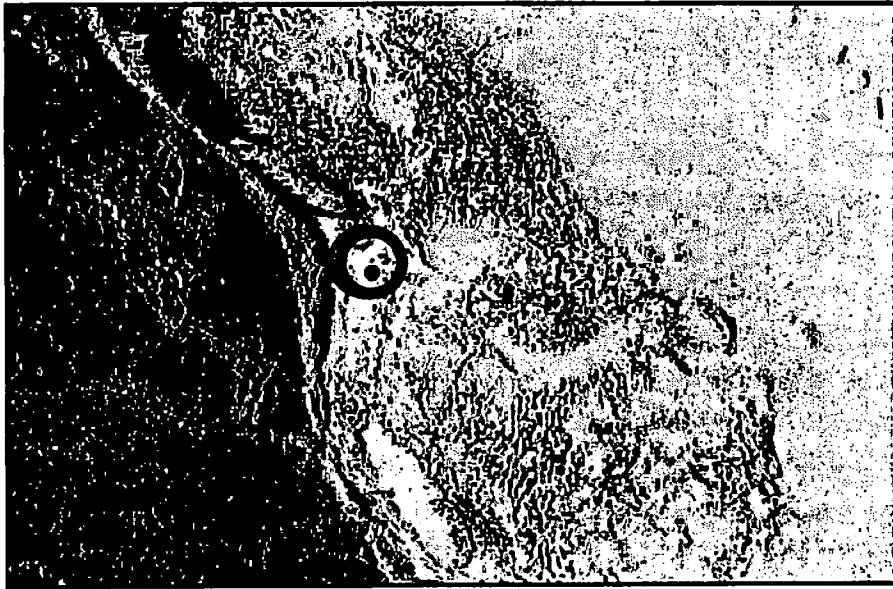
Mt. St. Helens is part of a range of snow-capped volcanoes known as the Cascades. The Cascade Range is located in the circum-Pacific volcano belt, which is one of the two most active areas of volcanism in the world. The Cascade Range extends for 700 miles (1120 km) from northern California upward through Oregon and Washington and into British Columbia.

The Cascade Range is along the edge of two plates. The large oceanic Pacific plate is sliding under the continental plate. The pressure generated is released in volcanoes like Mount St. Helens. Earthquakes happen often in this area, yet the volcanoes store up the energy to produce these massive blasts. Native Americans and early settlers in the Northwest had seen Mount St. Helens puff out some ashes, steam, and lava in the mid-1800s. Yet for more than a century, the mountain seemed quiet and peaceful.

### Continue your research on the Internet:

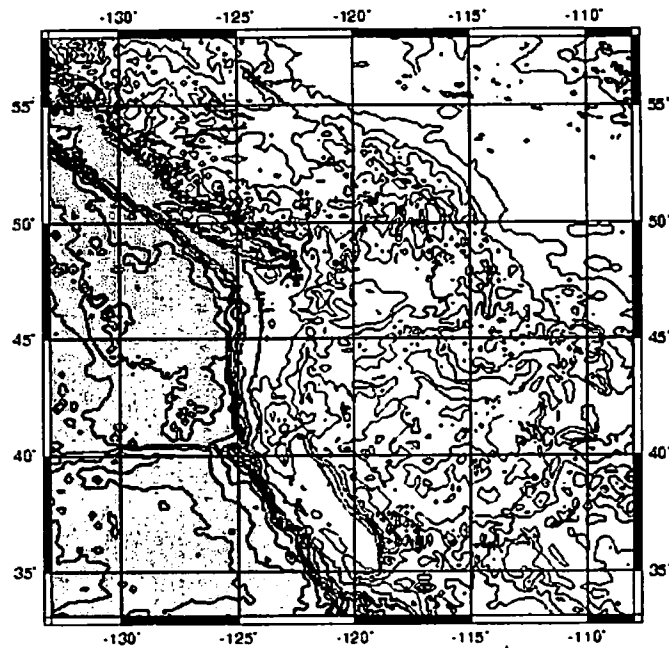
- <http://volcano.und.nodak.edu/vwdocs/msh>
- <http://www.halcyon.com/edpayne/mshnum.html>

# Mount St. Helens Maps



Shaded physical map of the Pacific Northwest USA, with Mt. St. Helens circled.

SOURCE: Geodynamics Database software



Topographic contour map of the Pacific Northwest USA and Canada.

SOURCE: Create-a-map web sit: [http://www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)



## Mount Vesuvius: Killer of Two Cities

**Your Home Base:**

**Naples, Italy**

Latitude: 41°N    Longitude: 14°E

August 23, AD 79: the sounds of flutes and tambourines fill the busy streets as the ground shakes and moves beneath the peoples feet. Cracks form in the walls of these magnificent Roman cities. At midday on August 24, Mount Vesuvius erupts, sending a cloud of ash and rock 12 miles in the air. After midnight, the cloud collapses, sending ash and hot gas down the mountain, killing the Herculaneans. A flow of hot ash, rock and pumice eventually buries the town. Early the next morning another surge killed the people of Pompeii. It, too, is followed by a flow of hot debris from the volcano. Herculaneum was covered by 65 feet (20 meters) of debris, while 12 feet (4 meters) fell on Pompeii.

This cataclysmic eruption buried these two roman cities where they stood. People and artifacts are frozen in time: Murals on the walls, families sharing a meal, a baby in a cradle, a dog chained to a post, fresh baked bread in the oven, and tools left on the ground. Both cities are now perfectly preserved archeological museums. Despite the detail, few human remains were found within either city. Archeologists speculated that many had

escaped the wrath of Vesuveus. In 1982, near the ancient sea wall, hundreds of skeletons of men, women and children were found huddled together as they had died almost two thousand years ago.

Vesuvius is an active volcano along the western coast of Italy. The last eruption was about 1000 years ago. Vesuvius is currently dormant but has blast into the skies of Italy. The most recent eruptions occurred in 1906, 1929, and 1944.

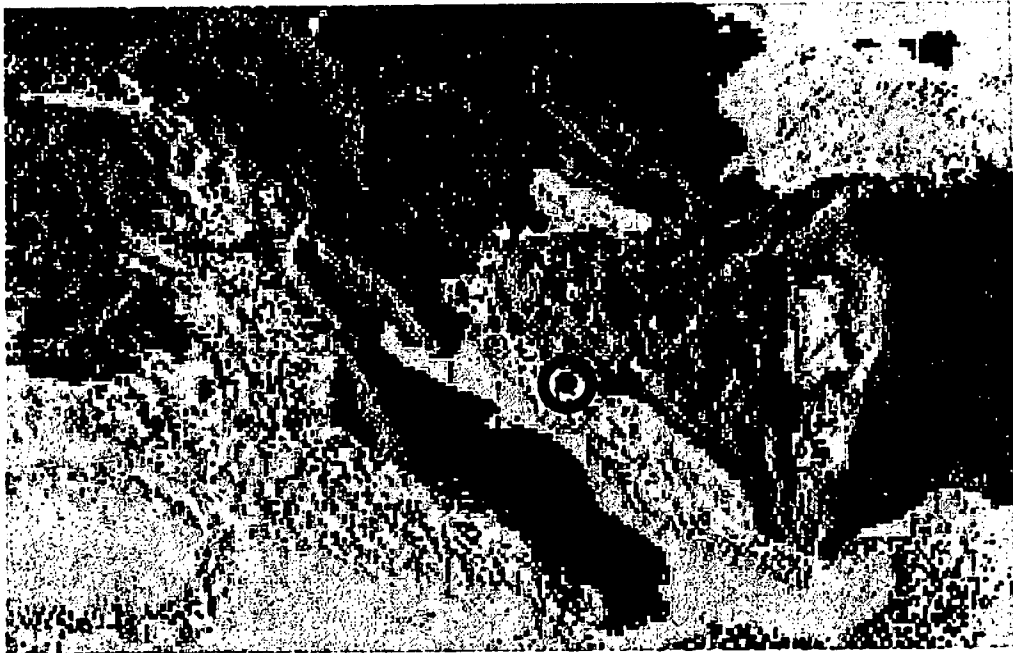
Vesuvius sits on the edge of where two plates of the earth's crust meet, within sight of Mt. Etna in Sicily. These two plates are melting, as the underwater plate slides under the continental plate. Melting magma is released through weak spots in the earth's crust, creating volcanoes like Mt. Vesuvius, killer of two cities.

Why do two giant volcanoes, Mount Etna and Mount Vesuvius, sit so close to each other? In the future, as the earth changes, what will happen to Mount Vesuvius, Italy, and the Mediterranean Sea?

### Continue your research on the Internet:

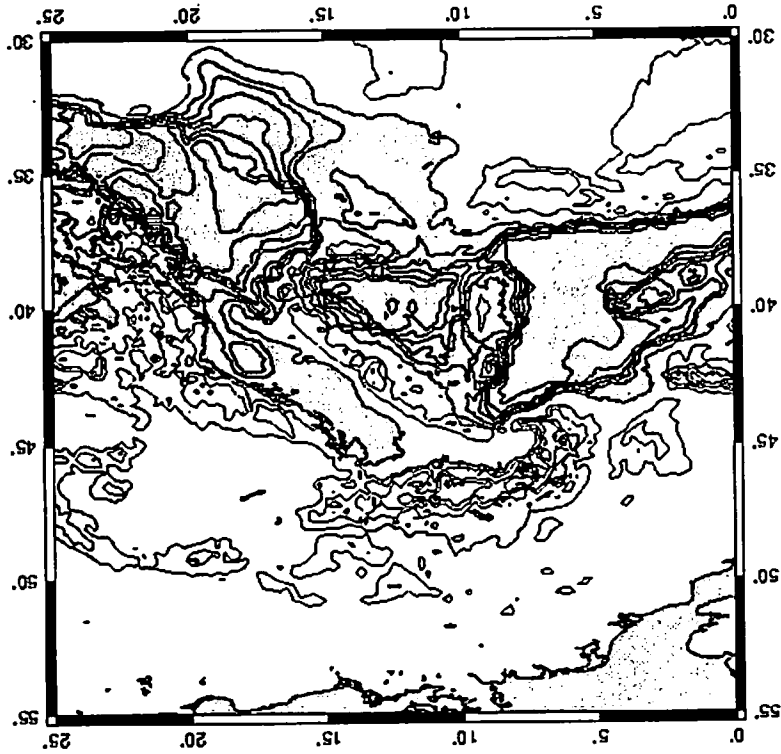
- <http://www.geo.mtu.edu/~boris/VESUVIO.html>
- <http://earthview.sdsu.edu/412b/vesuvius/vesuvius.html>

# Mount Vesuvius Maps



Shaded relief map of Italy, with Mt. Vesuvius circled.

SOURCE: Geodynamics Database software



Topographic contour map of Europe, North Africa and the Mediterranean Sea.

SOURCE: Create-a-map web site: [www.aquarius.geomat.de/omc/make\\_map.html](http://www.aquarius.geomat.de/omc/make_map.html)

EARTH STRUCTURE: MOUNT VESUVIUS

## New Zealand: the Land of Volcano Blasts

**Your Home Base:** Mount Cook, New Zealand  
Latitude: 43°S Longitude: 170°E

More spectacular natural events occur in New Zealand than almost anywhere else in the world. Over 400 volcanoes have been active there in the past 10,000 years. That is at least four times more than any other country on earth. The eruptions occur three to four times as often as most volcanoes, and are much more explosive. The Mt. Tarawera blast in 1886 was thirty times larger than the eruption at Mt. Saint Helens!

Besides being a haven for volcanic activity, New Zealand is the home to many endangered species. The only reptile survivor of the dinosaur age, the *tuatara*, makes its home on an island of New Zealand. Oversized, primitive species have also survived due to the lack of predators, including Archie's Frog, flesh-eating snails, and the *cacapo*, a huge nocturnal parrot who cannot fly.

Why is New Zealand such a unique place? 80 million years ago the continents were in completely different locations on earth. As the plates of the earth's crust moved, Africa and South America split off from the giant land mass known as Gondwana, and Antarctica and Australia followed. As Australia moved north, a group of islands, now known as New

Zealand, took its own course. Plants and animals that could not survive anywhere else flourished in this isolated land.

The movement of the plates continues to change the landscape of New Zealand. On North Island, there is a row of volcanoes stretching southward from White Island at the Bay of Plenty. This is known as the Taupo volcanic zone. Small eruptions occur every year, reminding us that the plates are still moving!

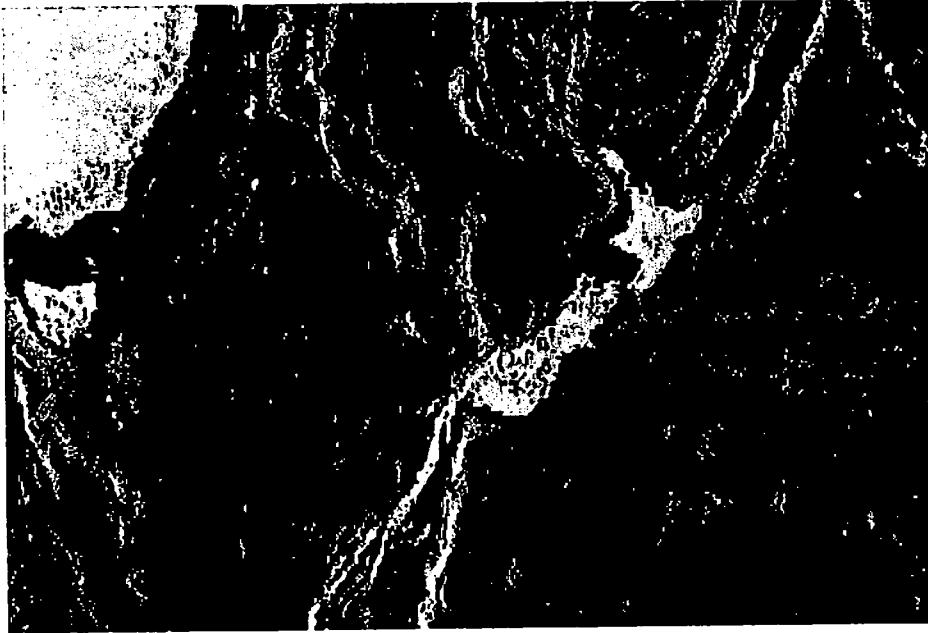
The Southern Alps mountains follow the line of the Alpine Fault, one of the most famous fault lines in the world. A fault is a place where two plates meet. On one side of the Alpine Fault is the plate carrying India and Australia. On the other side of the fault is the Pacific sea floor plate. The oceanic plate slides down beneath New Zealand, creating friction under the islands as the crust moves as much as a quarter of an inch a year. Eventually the mantle melts into liquid rock, shooting out of the earth as lava from volcanoes.

What do you think will happen to New Zealand as the earth's plates continue to move? Which way will the islands go, and what will become of them?

**Continue your research on the Internet:**

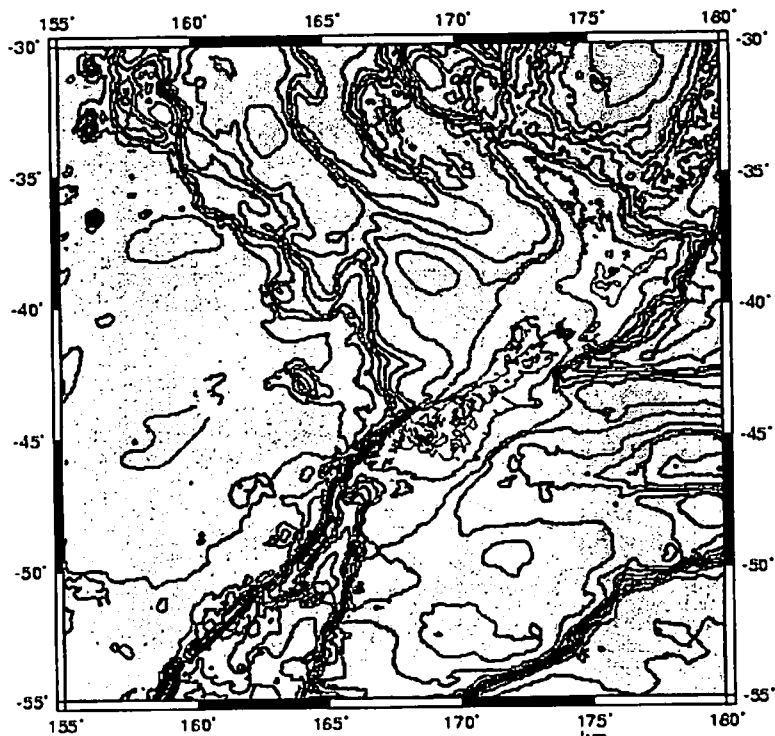
- XXXXXXXXXX

# New Zealand Maps



Shaded relief map of New Zealand.  
Australia can be seen to the west.

SOURCE: Geodynamics Database software



Topographic contour map of New Zealand

SOURCE: Create-a-map web site: [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## The African Rift Valley: The Next Great Ocean?

<b>Your Home Base:</b>	Mount Kilimanjaro
	Latitude: 3°S      Longitude: 37°E

Mountain climbers know that Mt. Kilimanjaro's gentle slopes become steep and treacherous at an altitude of 13,000 feet (4 kilometers). They also know that if they reach the highest peak, called Kibo, they will find themselves in an icy mile-wide crater, surrounded by sulfuric steam. This is because Africa's greatest mountain is also a dormant stratovolcano.

Kilimanjaro is one of about 20 volcanoes running along the southern end of the great African Rift Valley. A **rift valley** is a place where the earth's crust pulls apart and cracks, allowing hot magma to rise to the surface. This can cause volcanoes to form and erupt. The rising magma can also heat ground waters into hot springs, which create warm salty lakes like Lake Bogoria in the East African Rift, home to huge flocks of flamingoes that feed on the algae of the lake.

The rift in eastern Africa has already pulled Saudi Arabia off of the African continent, where the Red Sea is growing as the African and Arabian plates

gradually slide away from each other. Geologists believe that the Horn of Africa may eventually break off from the African plate as well, allowing the Indian Ocean to flood the Rift Valley and create a new giant ocean.

A similar rift may have formed the Atlantic Ocean about 200 million years ago, pushing apart the continents of Europe, Africa, and the Americas!

Rifts like the African Rift Valley form in the earth's crust along "spreading centers," where two plates slide apart, and rising magma hardens into new crust. In undersea rifts, like the one in the middle of the Atlantic ocean, a mid-ocean ridge is formed as the sea floor spreads apart. Millions of years in the future, the spreading center now under Africa may be under a mid-ocean ridge in a new African ocean!

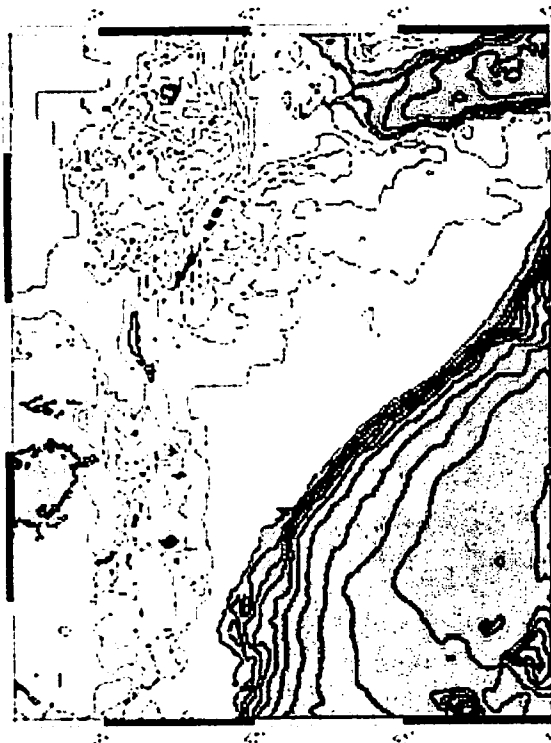
### Continue your research on the Internet:

- <http://pubs.usgs.gov/publications/text/preface.html>
- <http://www.erols.com/pmnet/jambo/location/rvalley.html>

## African Rift Valley Maps



Shaded relief map of the Rift Valley.  
Mt. Kilimanjaro is circled  
(Lake Victoria does not appear on this map.)  
SOURCE: Geodynamics Database software.



Topographic map of the Rift Valley.  
Can you find Mt. Kilimanjaro?  
SOURCE: Create-a-map web site: [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

## Saint Helena Island: Alone in the Atlantic

<b>Your Home Base:</b>	<b>St. Helena Island</b>
	Latitude: 16°S    Longitude: 6°W

“In the middle of nowhere” – that would be one way of describing St. Helena, a tiny island in the very middle of the Atlantic Ocean. The European emperor Napoleon Bonaparte spent the last years of his life as a prisoner on this lonely island (1815 until 1821), halfway between Africa and South America. St. Helena is 1,950 km away from the closest land! Like Napoleon, Zulu prisoners of war from southern Africa were often exiled to St. Helena – the tiny island in the middle of the ocean – to make sure they would never escape.

But for those who have explored *beneath* the waves, there is a different story to tell! St. Helena is really not just a tiny piece of land – it is a gigantic volcanic mountain, towering 4,224 meters high from the ocean floor. The island has huge jagged peaks, with names like “The Barn” and “Castle Rock.” In fact, there is very little flat land anywhere on the island – most of the land is very steep and rocky, following the long ridge that extends across the island and down into the ocean. The coast of St. Helena has beautiful cliffs that tower 300 meters above the water, where many ships have been wrecked by the violent Atlantic “rollers”

(waves), as they searched for flat places to land.

Geologists have studied the basalt rock of the island, and have learned that it came from volcanic eruptions of two big shield volcanoes at each end of the island: Flagstaff Hill in the north and Sandy Bay Valley in the south. The last time the island’s volcanoes erupted was more than six million years ago. Some scientists believe that the large and beautiful Sandy Bay Valley was formed in the *caldera*, or crater, of the southern volcano, while others argue that the valley was hollowed out by erosion.

St. Helena is not far from a long ridge of smaller underwater mountains that runs along the ocean floor, right up the middle of the Atlantic Ocean. Geologists believe that this mid-ocean ridge is created in the same way the St. Helena’s volcanoes were created – by magma, or melted rock, which rises up where the earth’s crust separates. This is called a *plate boundary*, and it can be found by following the line of earthquakes that happen along the middle of the Atlantic Ocean.

### Continue your research on the Internet:

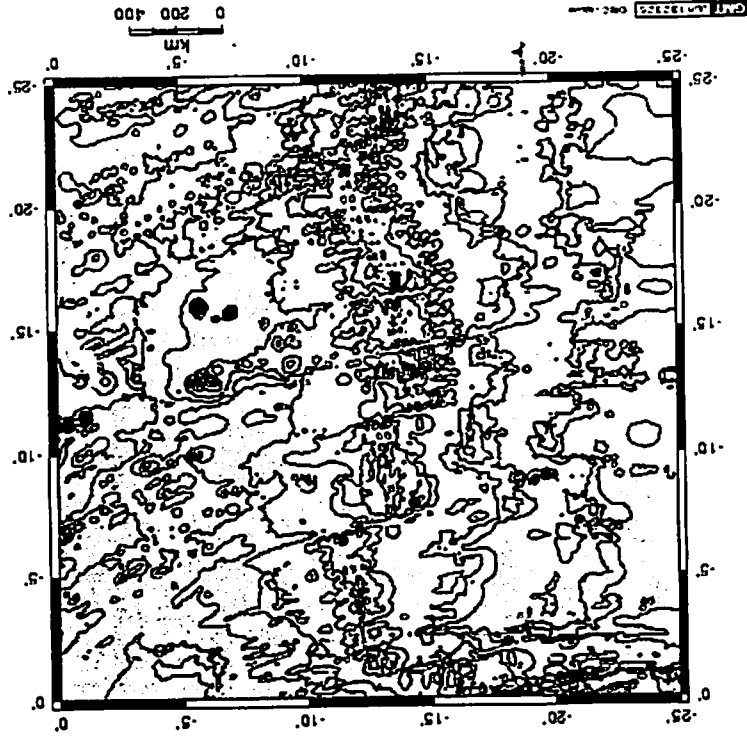
- <http://www.wndrland.demon.co.uk/>

# Saint Helena Island Maps



Shaded physical map of the Atlantic Ocean —  
St. Helena is circled.

SOURCE: Geodynamics Database software.



Topographic contour map of St. Helena and the Atlantic Ocean.  
SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)

EARTH STRUCTURE: ST. HELENA ISLAND



# Montserrat Volcano

**Your Home Base:**

Soufriere Hills Volcano, Montserrat, West Indies  
Latitude and Longitude: 16.7N, 62.2W

Eruptions from a crater that suddenly reawakened in 1995, after centuries, have tormented the tiny Caribbean island of Montserrat for almost three years.

Hot clouds of ash, showers of incandescent rocks, and boiling torrents of mud have destroyed villages, overwhelmed the capital, and shut down the main harbor and airport. Every aspect of a once leisurely life in the tropics has been disrupted, and there's still no end in sight. Soufriere Hills, a stratovolcano on the island of Montserrat, began erupting on July 18, 1995. This is the first recorded eruption of this volcano in historic time. The initial small eruption produced minor ash that spread around the island. Periods of intense seismic activity were associated with strong venting of steam and ash. The magma rising beneath the Soufriere Hills volcano on Montserrat is remelted material that was brought in conveyor-belt fashion from the Mid-Atlantic Ridge, mixed with sediments that were picked up along the way. The steam rising above the old volcano is for the most part multi-million year-old ocean water.

## A Broken Silence

Erupting in the early 1600s, Montserrat's volcano sat silent until July 18, 1995. Since then, activity has prompted three evacuations of the surrounding southern part of the island. About 3,200 residents now live on a crescent of land at the very north of the 39-square-miles British overseas territory. Of the 8,000 others who have fled, 3,000 are

in Britain, 3,000 in Antigua, and the remainder elsewhere.

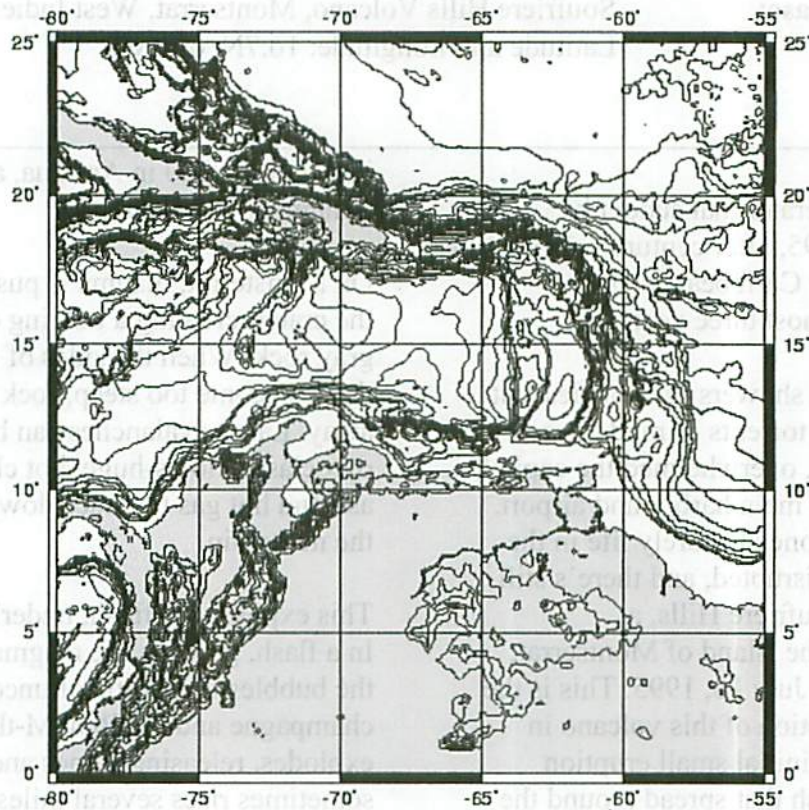
On Montserrat, magma is pushing up into the crater, creating a bulging dome of jagged gray rock. When the sides of the growing dome become too steep, rock avalanches fall away. Large avalanches can become deadly pyroclastic flows-huge, hot clouds of rock, ash and hot gas that race down the sides of the mountain.

This exposes the fresh, underlying magma. In a flash, gases in the magma expand like the bubbles in a bottle of uncorked champagne and KABOOM-the volcano explodes, releasing stones and hot ash that sometimes rises several miles into the air. Repeating the cycle again and again, dome growth and explosion have slowly escalated in scale at Soufriere Hills.

## A Question of Timing

When the lushly forested Soufriere Hills peak first sent an ash cloud skyward in July 1995, Montserratians were astonished. The peak had been quiet for almost 400 years. Exactly what sequence of events will follow is anyone's guess. There are a number of things that can happen, and they don't follow the same order every time at every volcano.

# Montserrat Maps



# The Kingdom of Tonga

**Your Home Base:**

Nuku'alofa, Tongatapu Group, Tonga  
Latitude and Longitude: 20 S, 177 W

The archipelago of "The Friendly Islands" was united into a Polynesian kingdom in 1845. It became a constitutional monarchy in 1875 and a British protectorate in 1900. Tonga acquired its independence in 1970 and became a member of the Commonwealth of Nations. It remains the only monarchy in the Pacific. It is located in the South Pacific Ocean, about two-thirds of the way from Hawaii to New Zealand. The archipelago consists of 1671 islands (38 inhabited).

The Kingdom of Tonga is the only Pacific country never colonized by Europeans. A king still rules absolutely from his place in the capital, Nukualofa. Of the 30 members of parliament, only nine are elected by the people. The other 21 are appointed by the king and nobles. Tongatapu is the government center, Haapai is noted for its beaches, and Vavau is one of the Pacific's top yachting centers.

The Kingdom of Tonga consists of four groups of islands, the Niua, Vavau, Haapai, and Tongatapu. The 500 km long chain is a mix of coral and volcanic islands southeast of Fiji. The length of the island chain is four times the size of Washington, DC.

The Tongan archipelago is thought to have been colonised around 3000 BC, but the earliest date verified by radiocarbon dating is about 1100 BC.

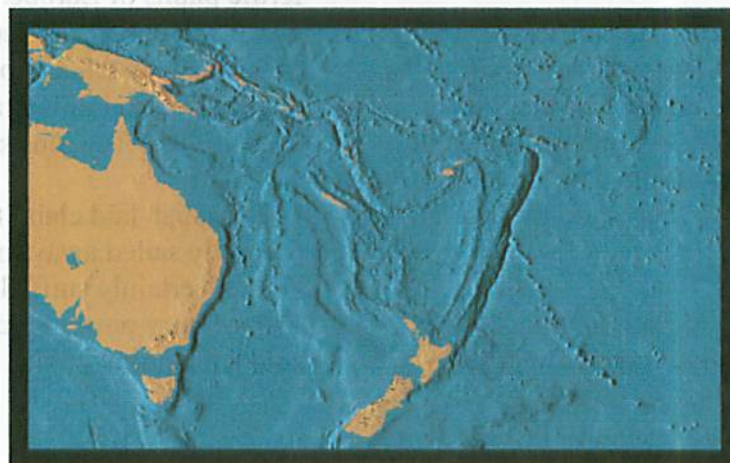
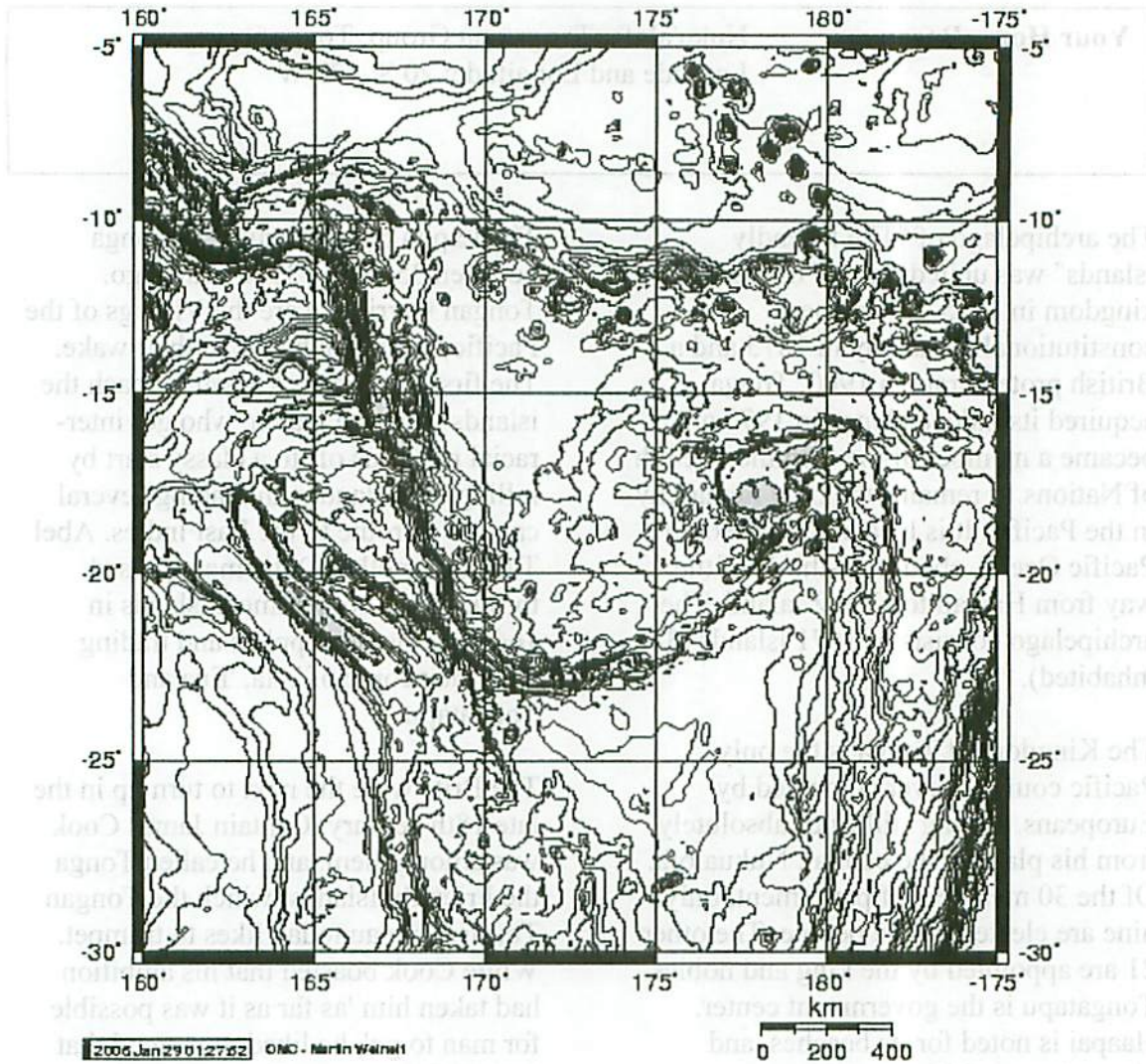
The Lapita people arrived in Tonga between 3500 and 3300 years ago. Tongan warriors were the Vikings of the Pacific, wreaking havoc in their wake. The first Europeans known to reach the islands were the Dutch, who got inter-racial relations off to a classy start by killing one islander and taking several captive en route to the East Indies. Abel Tasman, another Dutchman, passed through the southernmost islands in 1643, taking on supplies and trading with the people of 'Ata, 'Eua and Tongatapu.

The Brits were the next to turn up in the late 18th century. Captain James Cook was among them, and he called Tonga the Friendly Islands, which the Tongan Tourist Bureau today likes to trumpet. While Cook boasted that his ambition had taken him 'as far as it was possible for man to go', he liked to pretend that he hadn't gone very far at all really, likening Tonga to the most beautiful and fertile plains of Europe. Equally ironic was that Cook never knew that the friendliness extended to him was part of a failed plot to kill him and steal all the neat stuff the Tongans saw on his ships.

The Spanish laid claim to Vava'u then promptly sailed away for good. The French certainly sniffed around, but no 19th century power managed to set up a colonial administration.



# The Tonga Maps



# Easter Island: Mysterious Massive Statues

**Your Home Base:**

Cerro Terevaka, Easter Island, Chile

Latitude and Longitude: 27° 05' S 109° 20' W

Easter Island - Isla de Pascua in Spanish - is over 2,000 miles from the nearest population center, located in the South Pacific between Chile and Tahiti, making it one of the most isolated inhabited places on Earth. It is roughly triangular and covering only 64 square miles.

A triangle of volcanic rock in the South Pacific it is best known for the giant stone monoliths, known as Moai, that dot the coastline. Admiral Roggeveen, who came upon the island on Easter Day in 1722, named it Easter Island. Today, the land, people and language are all referred to locally as Rapa Nui.

It is now generally accepted that the islanders are of Polynesian origin. European contact with the island began with the visit of the Dutch admiral, Jacob Roggeven, on Easter Sunday 1722, who was followed by the British navigator James Cook in 1774 and the French sailor Le Perouse in 1786.

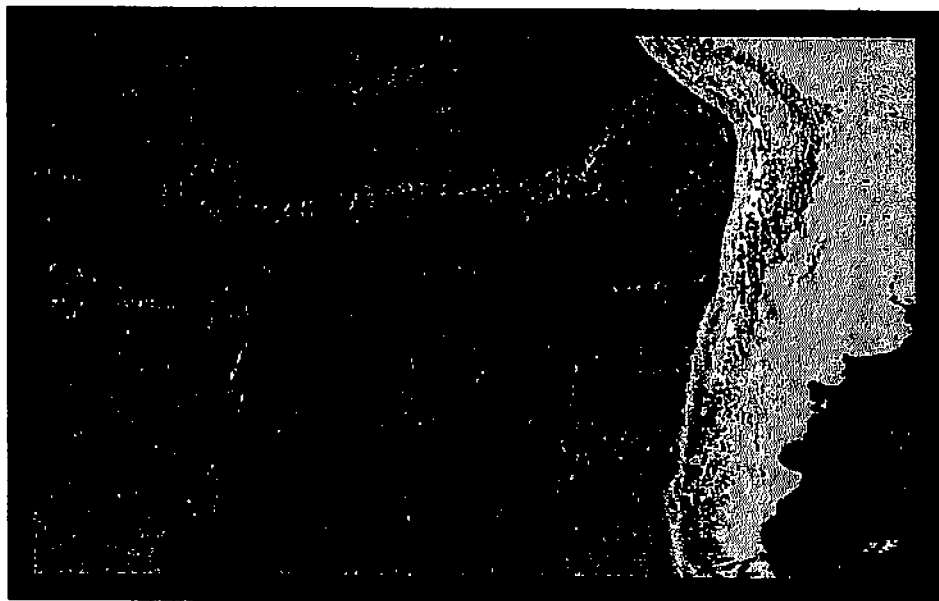
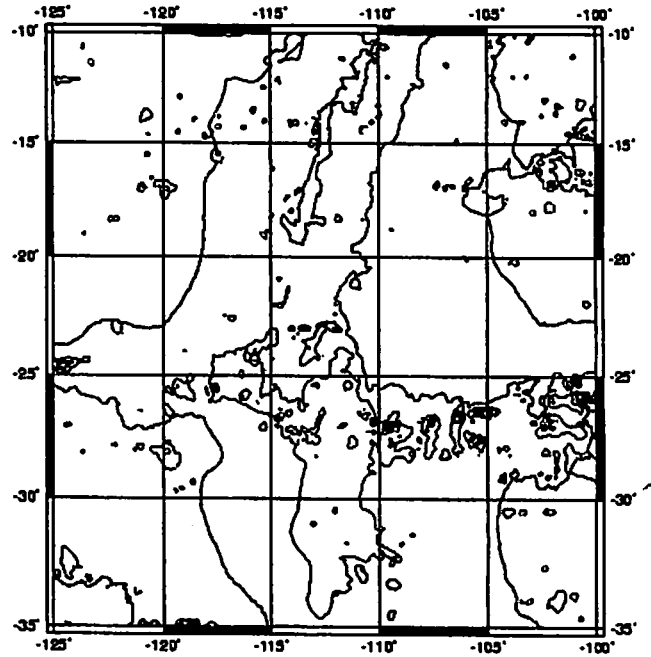
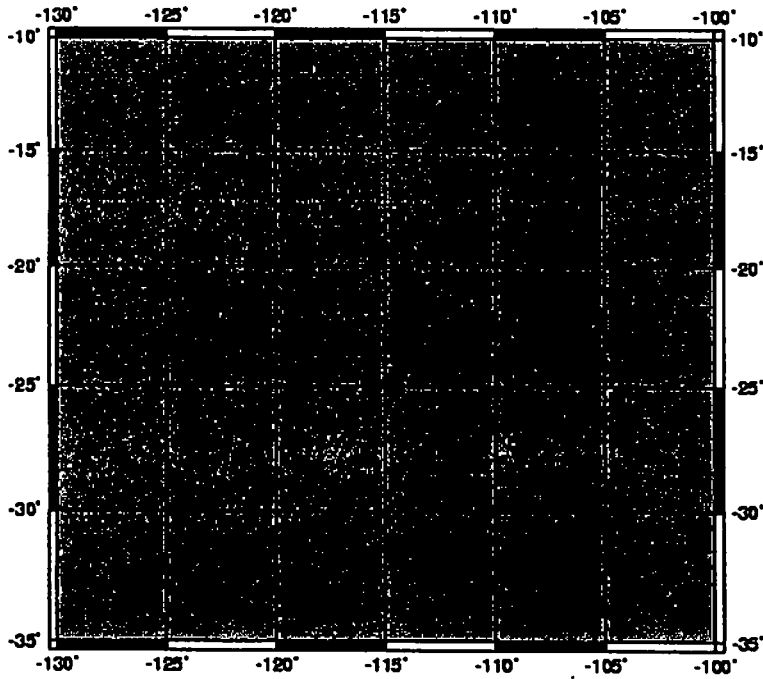
The main quarry for Easter Island's statues, this volcanic

crater is a virtual moai graveyard. The stone-faced giants lie in various states of production. Some are half carved, many are broken, and many seem to have been abandoned in mid-transport. Most remarkably, at the base of the quarry, moai stand half buried in the slope -- up to their chins and noses -- from years of erosion.

To some observers the quarry looks like a graveyard of stone giants. It's as if the production of moai was abruptly abandoned, leaving us a frozen snapshot in time so we can look closely at exactly how the moai were carved out of the available rock.



# Easter Island Maps



# Lake Nyos – The Killer Lake

**Your Home Base:**

Lake Nyos, Oku Volcanic Field, Cameroon

Latitude and Longitude: 6.25 N 10.50 E

At 9:30 p.m. on August 12, 1986, a cloudy mixture of carbon dioxide (CO<sub>2</sub>) and water droplets rose violently from Lake Nyos, Cameroon. As the lethal mist swept down adjacent valleys, it killed over 1700 people, thousands of cattle, and many more birds and animals. Local villagers attributed the catastrophe to the wrath of a spirit woman of local folklore who inhabits the lakes and rivers. Scientists, on the other hand, were initially puzzled by the root cause, and by the abrupt onset, of this mysterious and tragic event.

The disaster, however odd, wasn't unique. Two years earlier, Lake Monoun, 60 miles to the southeast, released a heavy cloud of toxic gas, killing 37 people. A third lake, Lake Kivu, on the Congo-Rwanda border in Central Africa, is also known to act as a reservoir of carbon dioxide and methane, a valuable natural gas that is gathered from the lake and used locally. These three lakes are the only ones in the world known to contain high concentrations of carbon dioxide in their waters.

Just like in a soda can, a lake's water can dissolve a large amount of CO<sub>2</sub> gas. In the cases of these volcanic lakes, volcanoes underneath produce gas that makes its way into the lake's water. At this point, the lake's lower water slowly become saturated with CO<sub>2</sub> until it reaches a critical and very unstable point. When it does, a violent trigger

such as a landslide, earthquake, explosion or volcanic activity may disturb the water sufficiently to cause a chain reaction that releases the accumulated CO<sub>2</sub> all at once. In the case of the 1986 eruption at Lake Nyos, landslides were the suspected triggers.

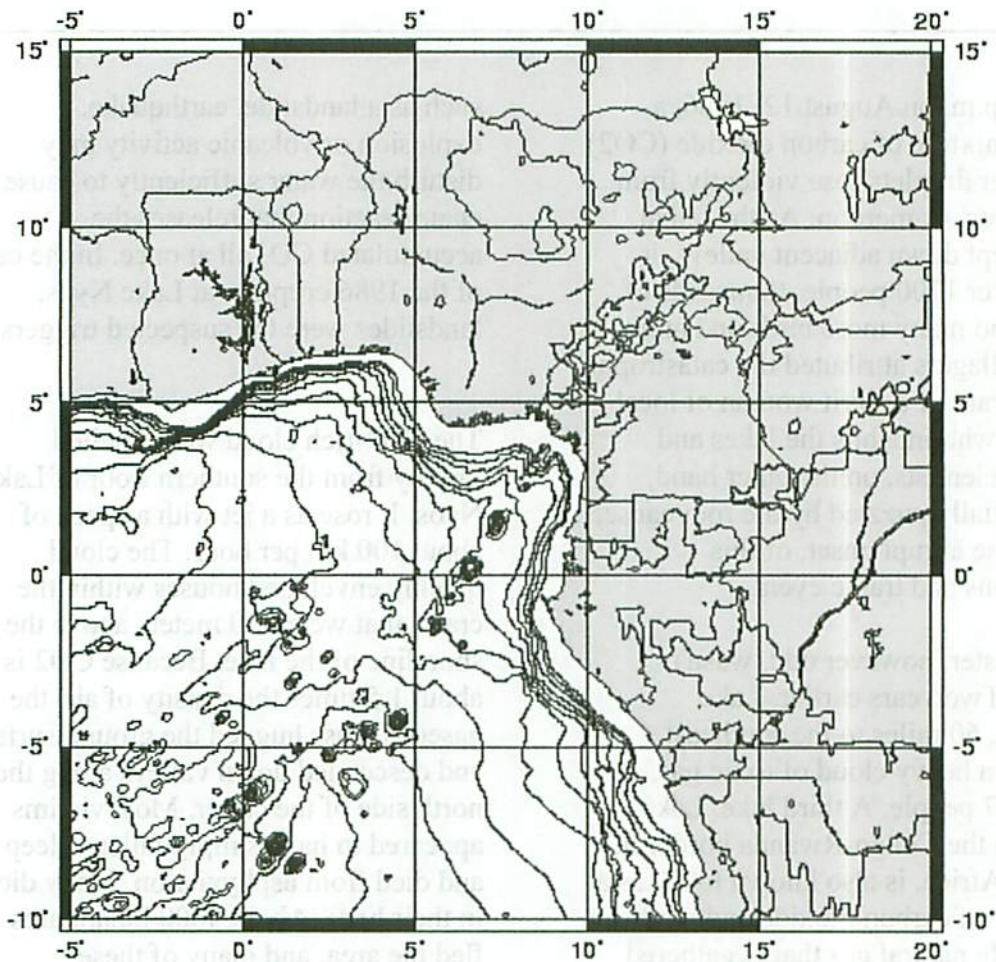
The CO<sub>2</sub>-rich cloud was expelled rapidly from the southern floor of Lake Nyos. It rose as a jet with a speed of about 100 km per hour. The cloud quickly enveloped houses within the crater that were 120 meters above the shoreline of the lake. Because CO<sub>2</sub> is about 1.5 times the density of air, the gaseous mass hugged the ground surface and descended down valleys along the north side of the crater. Most victims appeared to have simply fallen asleep and died from asphyxiation. Many died in their beds. About 4000 inhabitants fled the area, and many of these developed respiratory problems, burns, and paralysis as a result of the gases.

Efforts have been underway for several years to remove the gas from those lakes to prevent a build-up that could lead to another catastrophe. A team of French scientists began experimenting with siphons at Lake Monoun and Lake Nyos in 1990 in an attempt to slowly, and under control, remove the gas from the lakes. Despite this success, these lakes are still considered dangerous today.



# Lake Nyos - The Killer Lake

## Lake Nyos Maps



2006 Jan 29 10:34:28 OMC - MarIn Weinet





# Mt Pinatubo: Worldwide Effect

<b>Your Home Base:</b>	Mt Pinatubo, Luzon, Philippines Latitude and Longitude: 15.13° N, 120.35° E
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In early 1991, Mt. Pinatubo, a volcano north of Manila on the Philippine island of Luzon, had been dormant for more than 500 years. Few geologists would have guessed that it would produce one of the world's most explosive eruptions in the twentieth century. Indications of unrest started a few months before the June 1991 eruption, but the size and impact of the eruption were completely unexpected. During the June 12-15 eruptive climax, the top of the mountain was blown off, lowering the elevation by roughly 150 m. About 8 to 10 km<sup>2</sup> of material (Scott, et al., 1996) spewed out of the volcano onto the surrounding slopes.

Before the eruption, Mt. Pinatubo was a forested, deeply dissected and unimposing mountain on Luzon's Bataan Peninsula. Although the upper slopes were steep and not well suited for agriculture, the lower slopes were heavily populated and supported extensive rice fields. During the eruption, the upper slopes of the mountain suffered immediate destruction. The climactic explosions of June 14-16, 1991, blasted away the summit of Pinatubo, blew down surrounding forests, and rained hundreds of cubic meters of loose sand and gravel down on the mountain's upper slopes. Floods of hot volcanic slurries were responsible for long-lasting damage downslope.

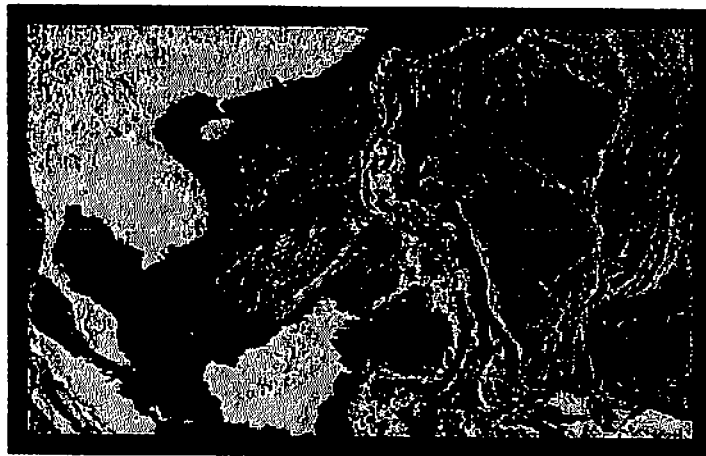
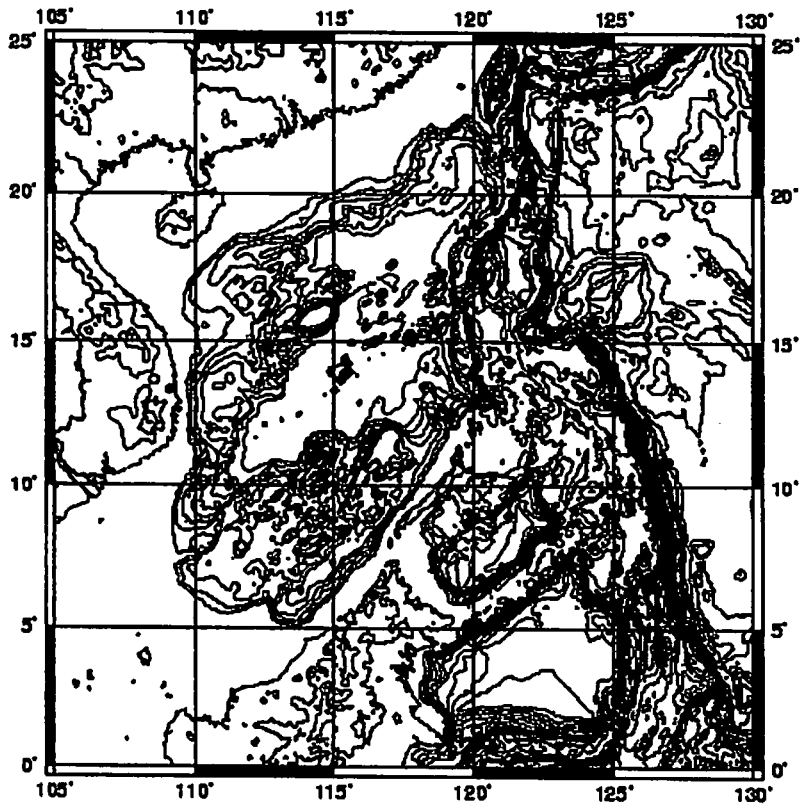
The eruption of Mt. Pinatubo in 1991 stands as the second largest eruption in the 20th Century (Mt. Novarupta, Alaska 1912 claims largest eruption fame). Ash deposits 5 cm (2 in) thick or more covered a land

area of about 4,000 square kilometers (1,544 square miles) burning crops and other plant life around Pinatubo. A typhoon struck the area after the eruption. The weight of the rain-saturated ash, earthquake shaking and strong winds, caused numerous roofs to collapse in the communities around the volcano, including at the two large U.S. military bases Clark and Subic Bay.

The effects of the eruption were not limited to the area around Pinatubo. The eruption of Mt. Pinatubo affected weather around the globe. Huge quantities of particles from Pinatubo's tall ash cloud was injected into the global wind system in the stratosphere. These particles affected the weather in two ways. Tiny aerosol droplets reflected sunlight away from Earth causing cooling at the surface. Scientists observed a maximum global cooling of about 1.5°C. Sunsets and sunrises were more brilliant because of the fine ash and gases high in the air. In addition, the aerosols from the eruption had a chemical effect that reduced the density of the ozone layer in the stratosphere. Until the ozone reforms, it cannot shield that portion of Earth as effectively from the sun.

More than 350 people died during the eruption, most of them from collapsing roofs. Disease that broke out in evacuation camps and the continuing mud flows in the area caused additional deaths, bringing the total death toll to 722 people. The event left more than 200,000 people homeless. Before the eruption, more than 30,000 people lived in small villages on the volcano.

# Mt Pinatubo Maps



# The Andes Mountains: World's Longest Mountain Range

**Your Home Base:**            **Mt. Aconcagua, Argentina**  
   Latitude: 33°S    Longitude: 70°W

Tucked away in the high reaches of the Andes mountains, along the border between Bolivia and Peru, lies one of the highest regions inhabited by people anywhere in the world. Here in the "altiplano" farmers raise sheep, llamas and alpacas, as they have for thousands of years. But unlike most farmlands, the altiplano is surrounded by jagged mountains, volcanic peaks that drop steeply down to deserts in some places, to rain forests in others, and along the Pacific coast, to a deep trench of the Pacific Ocean

The Andes are the longest mountain range in the world, stretching 7,250 kilometers down the southern half of the planet. The northern end of the Andes comes close to the warm equator, and the southern tip of the Andes stretches all the way to Patagonia, a cold semi-desert not far from Antarctica!

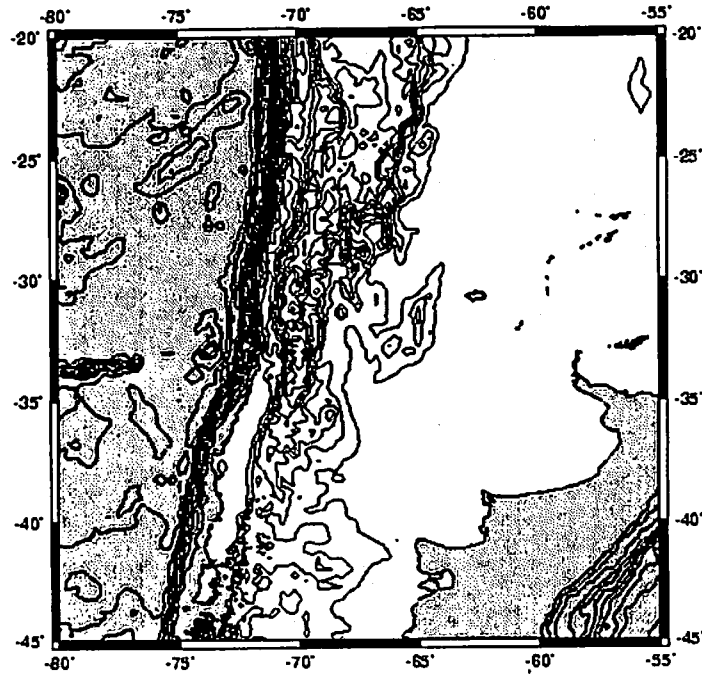
The name "Andes" comes from a native word whose meaning is unknown today. The tallest peak is Mt. Aconcagua, a giant volcano in Argentina towering 6,959 meters above sea level. The Andes mountains have been formed by one of the crustal plates of the Pacific ocean floor pushing slowly against the American continental plate. This pressure has caused the sedimentary rocks to bend and fold up into long ridges, called "sierras." Where the sedimentary rocks cracked, molten granite and igneous rocks erupted from below as volcanoes, caused by the oceanic plate melting from the friction and exploding to the surface.

Most of the highest mountains in the Andes are volcanoes, some still active, many dormant or extinct. Eruptions and strong earthquakes can cause landslides on the steep slopes. Rich minerals formed here include gold, silver, tin, copper, platinum, lead, and zinc.

**Continue your research on the Internet:**

- [http://volcano.und.nodak.edu/vwdocs/volc\\_images.html](http://volcano.und.nodak.edu/vwdocs/volc_images.html)

# Andes Mountains Maps



Topographic contour map of the Andes.

SOURCE: Create-a-map web site, [www.aquarius.geomar.de/omc/make\\_map.html](http://www.aquarius.geomar.de/omc/make_map.html)



Shaded relief map of the Andes.

SOURCE: Geodynamics Database software.