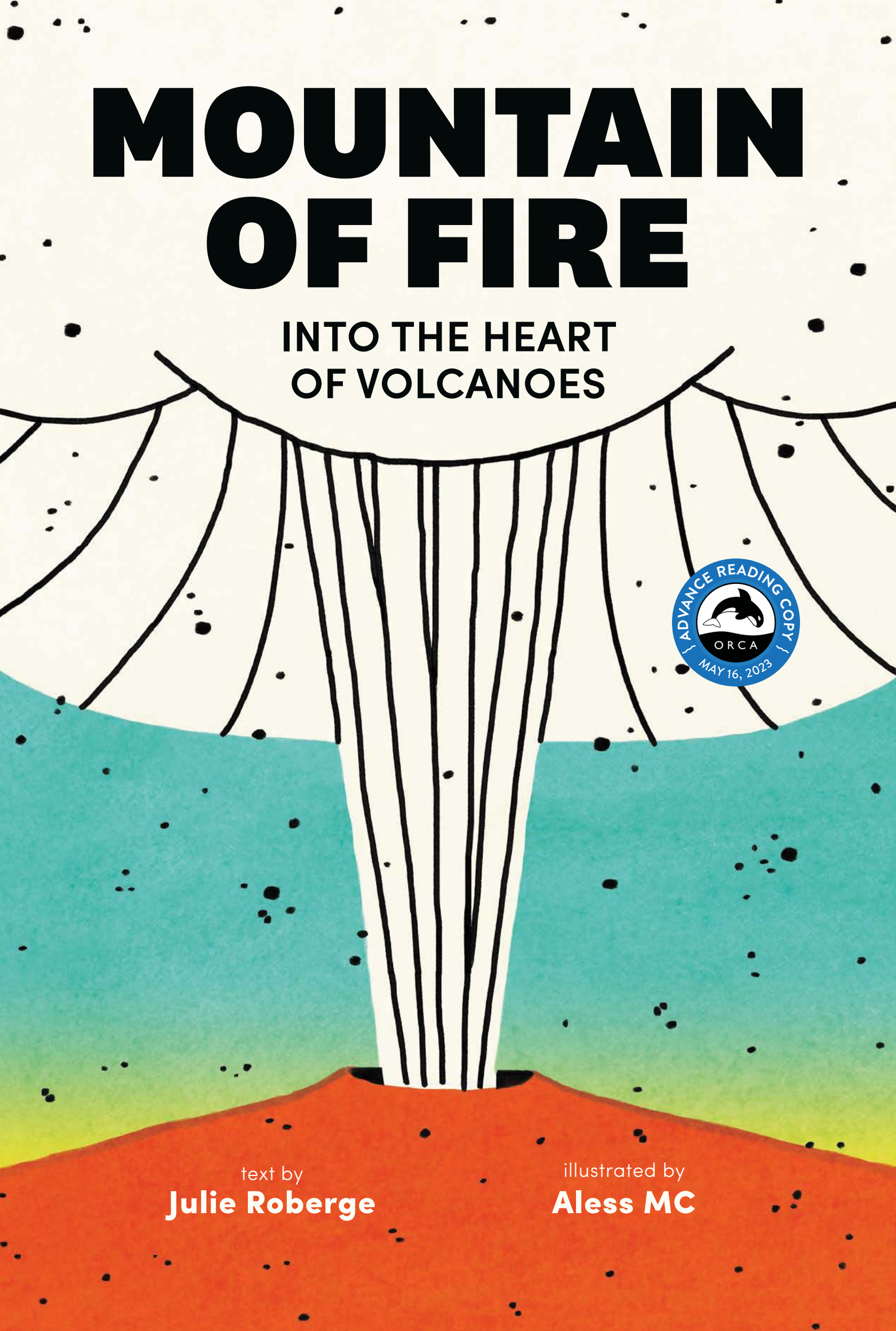
MOUNTAIN OF FIRE

INTO THE HEART OF VOLCANOES



text by
Julie Roberge

illustrated by
Aless MC

WHEN MONSTERS ROAR

Take a trip around the world (and beyond) to discover the science, myths and stories behind iconic volcanoes. Krakatoa. Kilimanjaro. Vesuvius. The destructive power of volcanoes has claimed more than 250,000 lives since the beginning of civilization. Whether as objects of worship or of terror, they have shaped our world and fed the human imagination. And they can be found just about everywhere, from ancient Pompeii to the geysers of Yellowstone to the bottom of the Pacific ocean and the surface of Jupiter. Teaming up with award-winning illustrator Aless MC, volcanologist Julie Roberge takes us on a journey to the heart of the earth to discover the most famous of these geological monsters.

JULIE ROBERGE has been studying volcanoes around the world for over 25 years. Nicknamed the "Ash Hunter," she is originally from Nicolet, Quebec, and is a professor and research scientist at the Polytechnic School of Mexico (Instituto Politécnico Nacional). Julie has been collecting rocks since she was young and it was the eruption of Mount St. Helens in 1980 that ignited her passion for volcanoes. Today she hunts the ashes of erupting volcanoes to look for magmatic inclusions, small balls of magma caught inside crystals that go from 1200 to 25 degrees Celsius to become glass droplets during an eruption. She lives in Mexico City.

ALESS MC is an illustrator and graphic designer based in Tiohtià:ke (Montreal). Her practice is based on communicating ideas in a simple and colorful way. Aless is inspired by traditional printing techniques, Franco-Belgian manga and comic strips, and also forms in nature and symbols in culture.

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FINAL BOOK WILL BE BIGGER
8.75 X 13"

MOUNTAIN OF FIRE
INTO THE HEART OF VOLCANOES

AUTHOR: **JULIE ROBERGE**
ILLUSTRATOR: **ALESS MC**
TRANSLATOR: **CHARLES SIMARD**

MAY 16, 2023

This nonfiction book introduces middle-grade readers to the science, history and legends of volcanoes around the world with bold illustrations and graphic design.

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KEY SELLING POINTS

- Introduces readers to the history, science and mythology of the world's most famous volcanoes.
- *Mountain of Fire* won the BolognaRagazzi Nonfiction Prize in 2022 in the original French language (as *Monstres Sacrés*).
- There are more than 1,500 active volcanoes in the world today, including almost 200 in Canada and the United States. Some of these active volcanoes continue to be a threat, like Eyjafjallajökull in Iceland, which grounded 100,000 flights in 2010, and Whakaari / White Island in Aotearoa, New Zealand, whose eruption led to the loss of lives in 2019.
- Julie Roberge is a volcanologist who has been studying volcanoes around the world for over 25 years and clearly explains the STEM themes behind how volcanoes work.
- Includes a world map of volcanoes and a glossary of important terms.

ABOUT THE AUTHOR

JULIE ROBERGE has been studying volcanoes around the world for over 25 years. Nicknamed the "Ash Hunter," she is originally from Nicolet, Quebec, and is a professor and research scientist at the Polytechnic School of Mexico (Instituto Politécnico Nacional). She did her bachelor's degree in geology at the University of Montreal, her master's degree at the University of Quebec at Chicoutimi and her doctorate at the University of Oregon. Julie has been collecting rocks since she was young and it was the eruption of Mount St. Helens in 1980 that ignited her passion for volcanoes. Today she hunts the ashes of erupting volcanoes to look for magmatic inclusions, small balls of magma caught inside crystals that go from 1200 to 25 degrees Celsius to become glass droplets during an eruption. She lives in Mexico City.

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MOUNTAIN OF FIRE

INTO THE HEART OF VOLCANOES

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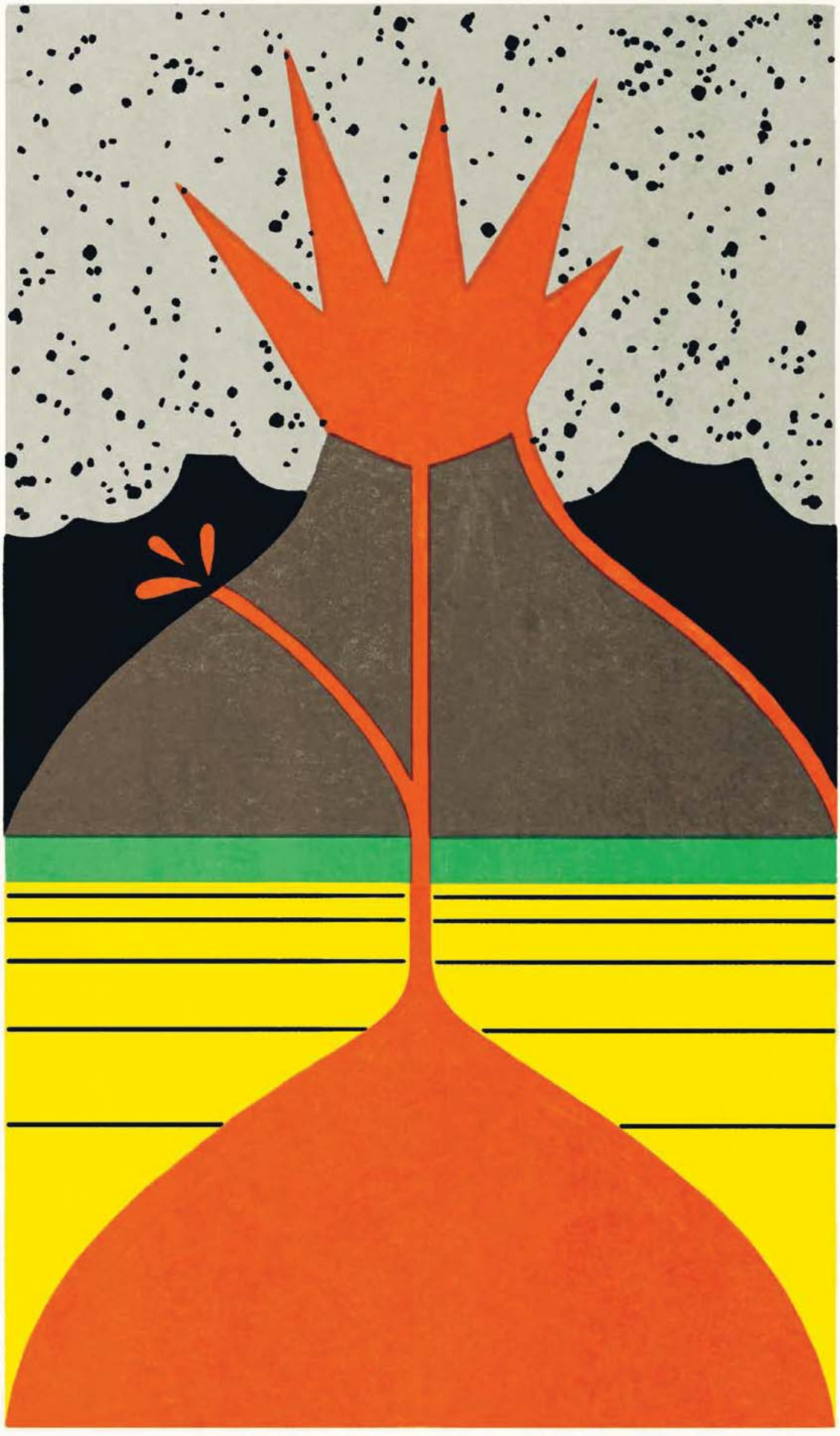


Introduction

FROM THE DEPTHS

A volcano is formed when a fracture in the ***earth's crust*** causes ***magma***—molten rock—to spew onto the earth's surface, forming a ***crater***.

There are approximately 1,500 ***active volcanoes*** on our planet, and at least 500 of those have erupted in recorded human history. And that's not including submarine volcanoes—more than 75 percent of all volcanic eruptions take place in the ocean.

Every second nearly 20 volcanoes erupt somewhere on earth. Every time one of these volcanoes wakes up, people can feel the ground shaking for miles around—which shows you how deeply connected volcanoes are to the earth.

Volcanoes are crucial to the proper functioning of the earth—they allow it to release the heat and pressure trapped under its crust. In a way, they act as its breathing system.

Volcanoes are complex. Their craters, while certainly very impressive, are only small visible parts of what takes place between the ***earth's mantle*** and its surface. Much like icebergs, volcanoes let us see just a small part of themselves.

Majestic and spectacular, volcanoes can also be very destructive. Throughout history, from the ***eruption*** of Mount Vesuvius that covered Pompeii in 79 CE to the Whakaari / White Island eruption in Aotearoa (New Zealand) in 2019, thousands of people have lost their lives as a result of volcanic eruptions. As the study of volcanology has evolved over the years, scientists have gained a better understanding of why and how eruptions happen and how potential disasters can be prevented.

Although all eruptions are governed by the same laws of physics, each one of them is unique. Let's discover some of the most famous volcanoes on a journey around the world to the heart of the earth and its mysteries...

MYTHS AND LEGENDS

Volcanoes have always fascinated people. Maybe it's because human beings appear so small and vulnerable next to them. Or maybe it's because volcanoes can be both good for the land around them and destructive to the people living near them.

Their power inspires respect and fear. No wonder volcanoes appear in so many myths and legends. In many cultures, volcanoes are considered homes of the gods or entrances to the underworld.

VULCAN

In Greco-Roman mythology, ***Vulcan*** (known as Hephaestus by the Greeks), the god of fire and blacksmiths, lived and worked under a volcano.

TONGARIRO

The Māori say that the volcanoes Taranaki and Ruapehu fought over the love of a third volcano, Tongariro. Today some people say that no one lives in the region between the two volcanoes because the Māori are afraid that Taranaki and Ruapehu might once again battle for Tongariro.

POPOCATÉPETL

In Mexico an Aztec legend tells the story of two lovers named Popocatépetl and Iztaccíhuatl, who died tragically and were turned into volcanoes. When the Popocatépetl volcano erupts, it is the warrior Popocatépetl expressing his undying love for the beautiful Iztaccíhuatl.

BROMO

In some places volcanoes are places of worship. In Indonesia, in the eastern part of the island of Java, stands Mount Bromo, a sacred volcano. Thousands of pilgrims go there each year to throw offerings into its crater and hold ceremonies to thank the gods for fertilizing the land.

AMERICAS

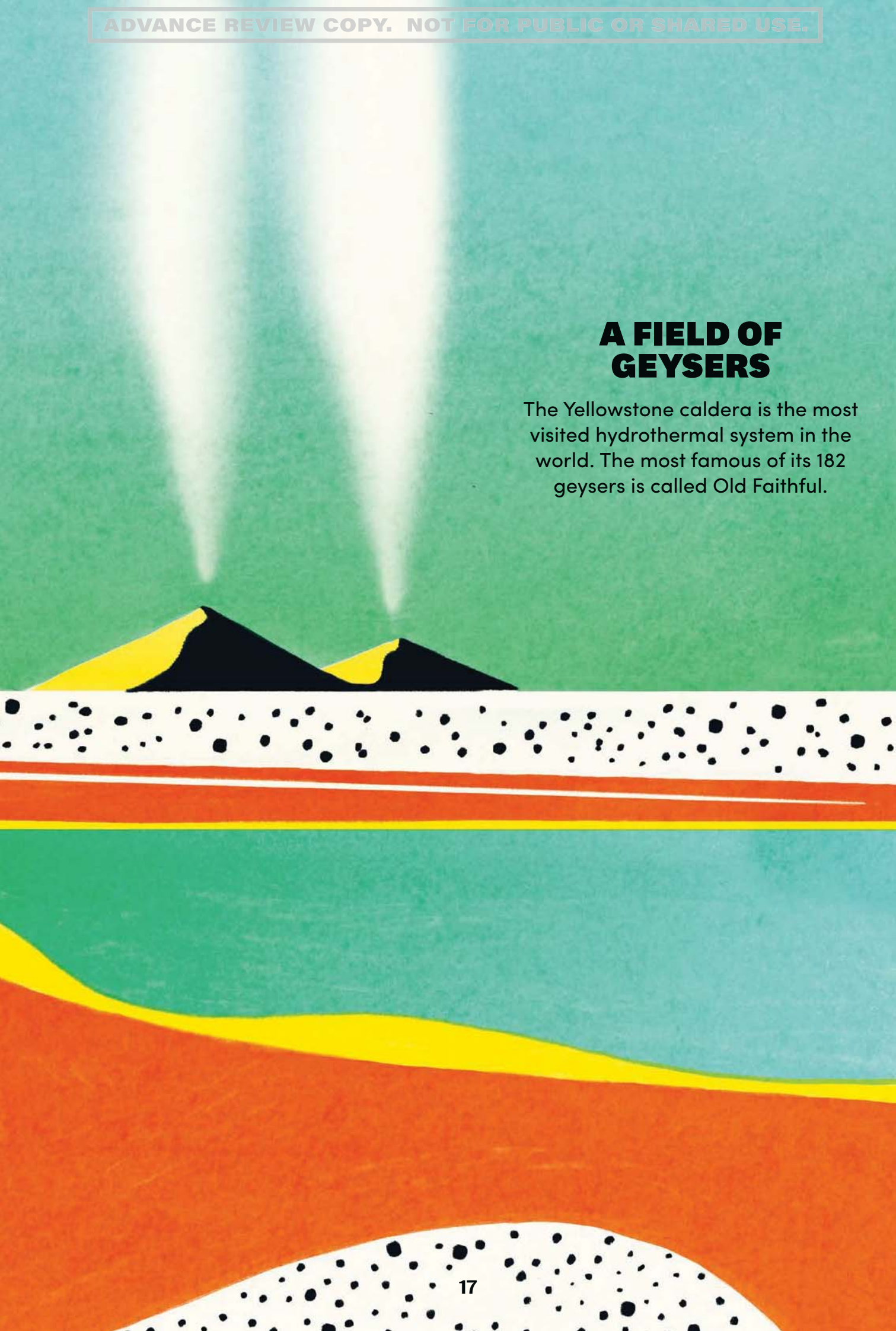
Yellowstone

United States

Yellowstone is the largest volcanic system in North America. It is called a ***caldera***, which means "cauldron" in Spanish. Calderas are depressions (holes) in the ground, rather than mountains, so volcanoes here are very different from the ones found in places like Hawai'i.

The enormous Yellowstone caldera is the result of the collapse of a huge portion of the earth's crust after three "super-eruptions" that took place millions of years ago and produced thousands of cubic miles of magma.

The vast ***magma chamber*** that feeds these super-eruptions also heats the groundwater above it, forming ***hydrothermal systems*** that create such features as ***geysers***.



A FIELD OF GEYSERS

The Yellowstone caldera is the most visited hydrothermal system in the world. The most famous of its 182 geysers is called Old Faithful.

Parícutin

Mexico

Let's travel south to Mexico! The Parícutin volcano was born on February 20, 1943. It is the youngest volcano in the Americas, something Mexicans are very proud of.

It is part of the vast Michoacán–Guanajuato volcanic field, which includes more than 1,400 volcanoes.

Parícutin is a ***monogenetic volcano***, which means that it erupted only once—although, in the case of Parícutin, that eruption lasted 11 years!

MIRACLE CHURCH

A lot of people remember the birth of Parícutin. It started with a small column of smoke, only a few feet high, in a cornfield. A few years later, the volcano had engulfed an entire village, leaving only the church steeple visible.

Cerro Negro

Nicaragua

A little farther south, in Nicaragua, is Cerro Negro. It's an ash cone that's about 1,640 feet (500 meters) high and surrounded by a ***lava*** field. It erupted for the first time in April 1850.

Cerro Negro's eruptions are very explosive and generally take place a few years to several decades apart. The last eruption happened in 1999, but the crater, which can be climbed, still emits smoke and gas.

VOLCANO BOARDING

Cerro Negro is well known among thrill seekers. On one of its flanks, you can try your hand (and feet) at volcano surfing. It's like snowboarding but on volcanic ash instead of snow!

Irazú

Costa Rica

Just below Nicaragua is Costa Rica. At an altitude of 11,260 feet (3,432 meters), Mount Irazú is the highest and most active volcano in the country. Its most recent eruption happened in 1994, but luckily it didn't cause much harm.

However, the ash emitted during a previous eruption, which took place from 1963 to 1965, caused serious damage in the Costa Rican capital of San José and the surrounding area.

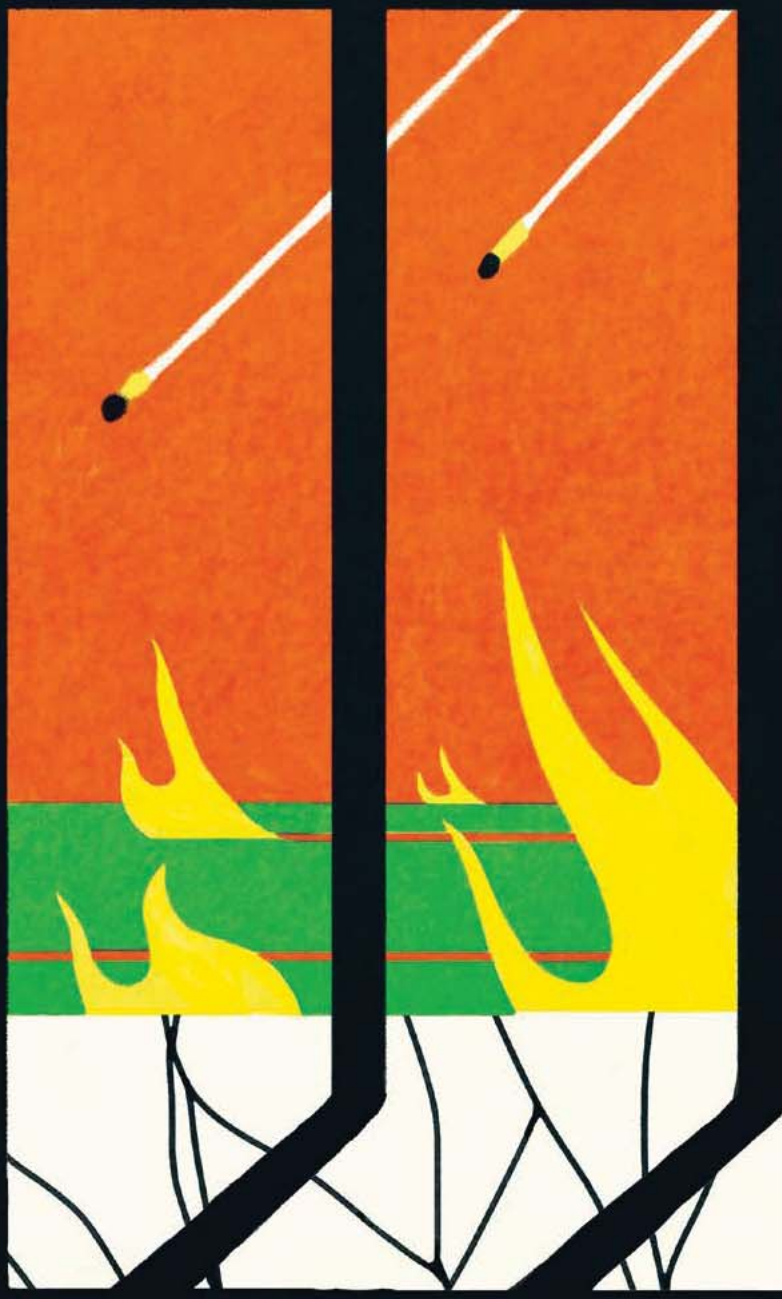
Mount Irazú's active crater has a beautiful ***acidic lake***, which varies in color from blue to green.

CHEMICAL REACTION

An acidic lake forms in the crater of a volcano when gases emitted from magma under the crater come into contact with the lake's water and dissolve in it.

Mount Pelée

Martinique



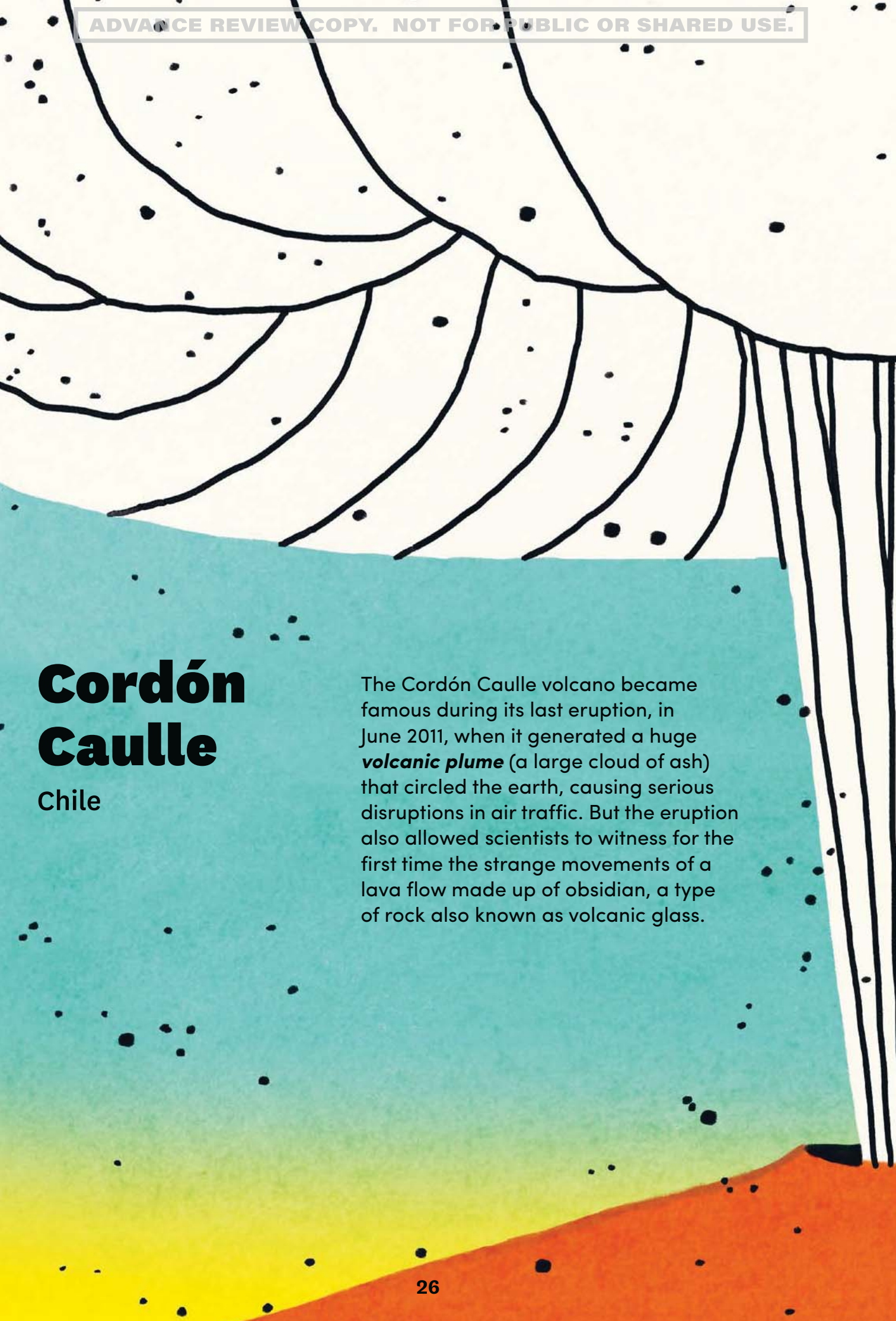
Mount Pelée, located at the northern tip of the island of Martinique (an overseas territory of France), rises to 4,583 feet (1,397 meters). Martinicans call the volcano the Great Lady of the North. It is the most active volcano in the Lesser Antilles region of the Caribbean, and more than 20 major eruptions have happened at Pelée over the past 5,000 years.

The most devastating eruption of the 20th century was in 1902. It completely destroyed the town of Saint-Pierre, killing its 30,000 inhabitants.

This eruption is often cited as an example when talking about Peléan eruptions, which are characterized by strong explosions and ***pyroclastic flows*** (dense mixtures of gas and fragments of hot volcanic rock).

SAVED BY PRISON BARS

There were only two survivors of the 1902 eruption. Ludger Sylbaris was the more famous of the two. He was in prison for fighting when the volcano erupted. He was in a tiny, semi-underground isolation cell with no windows and only a very narrow slit in the door. Sylbaris was rescued a few days after the eruption. He was severely burned, but he lived to tell the tale of how he survived the eruption and later toured the United States with the Barnum & Bailey Circus.



Cordón Caulle

Chile

The Cordón Caulle volcano became famous during its last eruption, in June 2011, when it generated a huge ***volcanic plume*** (a large cloud of ash) that circled the earth, causing serious disruptions in air traffic. But the eruption also allowed scientists to witness for the first time the strange movements of a lava flow made up of obsidian, a type of rock also known as volcanic glass.

Obsidian doesn't turn solid right away. It stays soft for a while. As a result, at the end of Cordón Caulle's eruption in April 2012, the thick layer of lava continued to flow until the beginning of the following year.

Cordón Caulle is a complex system of fissures with an active ***geothermal*** zone, the largest in the southern part of the Andean Volcanic Belt. Its 1960 eruption is almost as well known as its 2011–2012 eruption. It happened two days after the strongest earthquake in recorded history, magnitude 9.5 on the Richter scale, in the city of Valdivia, Chile.

EUROPE

Iceland, a Volcanic Island

Iceland is the only place in the world where you can walk on two ***tectonic plates***—at the same time! The island country is located on the Mid-Atlantic Ridge, a 9,942 mile (16,000 kilometer) crack in the bottom of the Atlantic Ocean, where the Eurasian and North American plates split up, causing earthquakes and forming volcanoes.

The North American plate is in the western part of Iceland, farther from the country's volcanic areas, and the Eurasian plate is in the east. The Mid-Atlantic Ridge and the island of Iceland were formed 20 to 25 million years ago, when there were many active volcanoes.

Eyjafjallajökull

This volcano's name is not easy to pronounce (AY-yah-FEEAH-la-EEAH-kuh-tl)! Eyjafjallajökull is a ***subglacial volcano*** (located under a huge glacier) located in the southern part of Iceland.

In 2010 Eyjafjallajökull paralyzed European air traffic for days. The culprit was its enormous volcanic plume (a cloud composed of water vapor, volcanic gases and ash), which can cause aircraft engines to fail.

Laki

The eruption that gave birth to Laki, or Lakagígar, is considered the largest lava eruption of all time. It began in June 1783 and went on until the beginning of February 1784, producing an estimated 3.4 cubic miles (14 cubic kilometers) of lava over an area of 218 square miles (565 square kilometers).

The enormous amount of ash that Laki created obscured the sun for several months. The poisonous gases emitted during the eruption killed hundreds of thousands of sheep and cattle, causing a famine that killed a fifth of Iceland's population.

The eruption also caused major disruptions to the climate of northern Europe. Some think it was one of the triggers of the 1789 French Revolution!

Auvergne Volcanoes

France

The Auvergne volcanoes, also known as the Chaîne des Puys, form a mountain chain made up of cones of cinder (ash), ***maars*** (craters filled by lakes) and lava domes (small mountains with a volcanic origin) in the Massif Central region of France. The chain emerged about 70,000 years ago and stabilized about 12,000 years ago.

This land of volcanoes is known for its rivers and lakes, but also for its myths and legends. The evil animals and demonic creatures that populate its stories are said to still inhabit its many mountains and lakes.

A CITY BURIED BY THE GODS

The famous Lac Pavin was formed during the last geological activity of the Auvergne volcanoes, about 6,000 years ago. The name of the lake comes from the Latin word *pavens*, which means "fearing" or "trembling with fear." According to legend, at the bottom of Lac Pavin's waters lie the remains of a city submerged by the wrath of the gods.

Mount Stromboli

Italy

Mount Stromboli, affectionately nicknamed the Lighthouse of the Mediterranean, is a spectacular volcano. Its nighttime eruptions spit out fountains of molten rock from its lava-filled central crater, creating a breathtaking spectacle that attracts many visitors.

Stromboli can be found in Italy's Aeolian Islands. Just over 1 mile (2 kilometers) across and standing 3,000 feet (900 meters) above sea level, it is one of the most active volcanoes on earth. Stromboli has erupted almost continuously for the past 2,000 years.

STROMBOLIAN ERUPTION

Most of Stromboli's eruptions are small gas explosions that throw incandescent drops of lava above the crater, like fireworks. When this type of eruption happens in other volcanoes, it's called a Strombolian eruption.

Mount Vesuvius

Italy

Mount Vesuvius is one of the most famous volcanoes in the world. It is located on the west coast of Italy and overlooks the city and Gulf of Naples. The cone of Vesuvius, active throughout recorded history, emerged from the remains of the ancient Mount Somma around 17,000 years ago.

Vesuvius has produced eight explosive eruptions over the past 17,000 years, often accompanied by large pyroclastic flows.

Its most famous eruption is the one that buried the city of Pompeii in the year 79 CE.

The Pompeii tragedy proved to be important to the development of volcanology. Witnessing the eruption from across the bay, author Pliny the Younger described it in a letter. It was likely the very first detailed, written description of a volcanic eruption in history. The tall, umbrella-shaped column of ash Pliny the Younger saw that day was later called a Plinian eruption.

THE DAY THAT POMPEII...

The eruption of Mount Vesuvius caused heavy ash to fall on Pompeii, which in turn caused buildings to collapse. It was followed by violent pyroclastic flows that buried Pompeii along with the port city of Herculaneum.

Vesuvius is still very active, and despite the fact that its last eruption happened in 1944, it still represents a danger to the cities that surround it, including the beautiful city of Naples.

ASIA

Mount Fuji

Japan

Mount Fuji (or Fujisan) is the tallest and most famous volcano in Japan. Its perfectly conical shape makes it the archetypical volcano and a powerful symbol for the country.

Rising 12,389 feet (3,776 meters) above the surrounding plain, Mount Fuji has erupted at least 16 times since the year 781 CE. On its north side, huge lava flows have blocked the drainage of the Misaka Mountains, forming the Fuji Five Lakes, a popular destination for tourists.

The last confirmed eruption of Mount Fuji took place in 1707, when its ash fell as far as Tokyo, more than 62 miles (100 kilometers) away.

SACRED MOUNTAIN

Each year hundreds of thousands of Japanese climb up Mount Fuji's trails. It is a sacred mountain, especially for followers of Shintoism, who believe that nature is inhabited by spirits. The Shinto spirit of Mount Fuji is the goddess Sengen-sama, who, if shown respect, prevents the volcano from erupting.

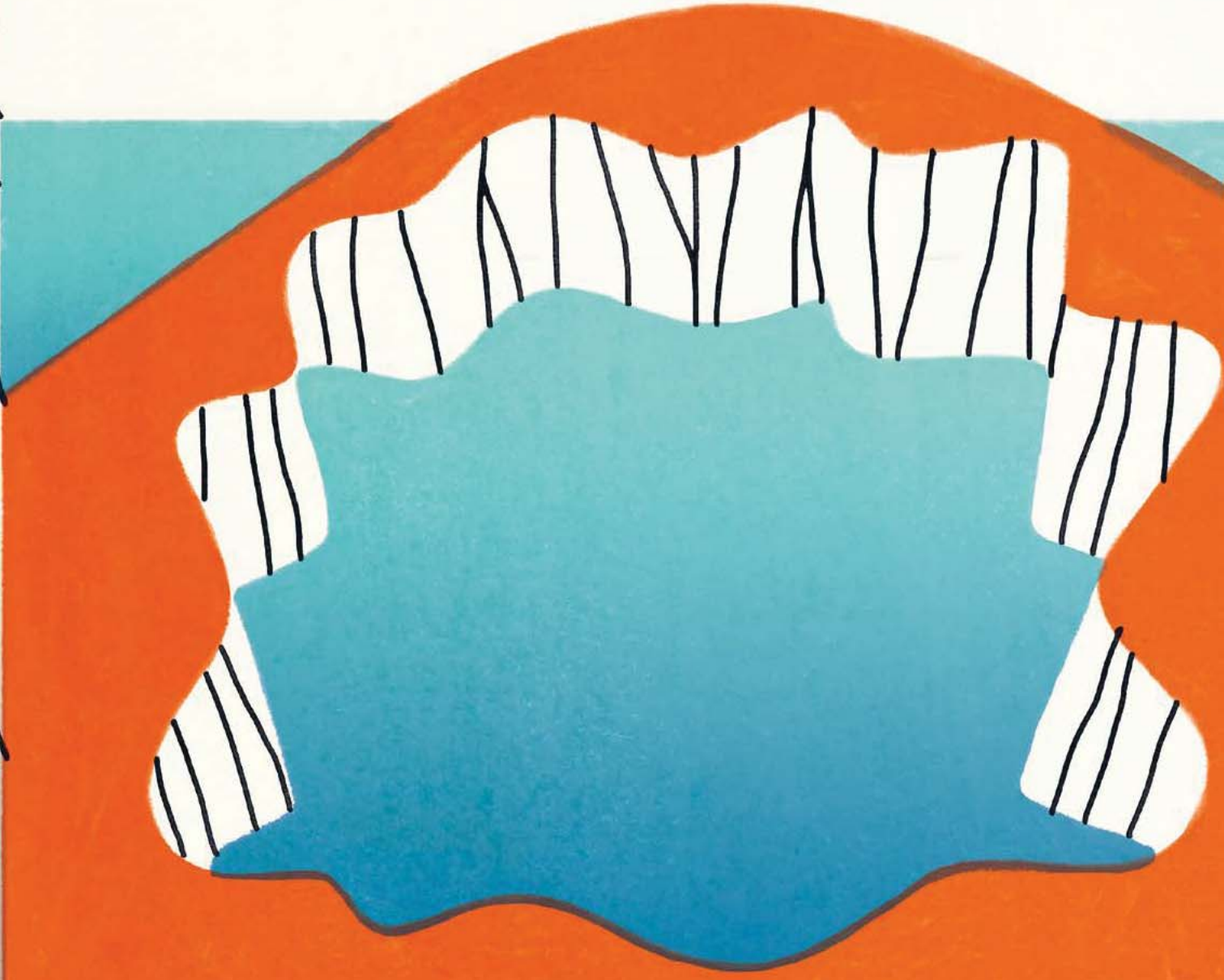
Mount Pinatubo

Philippines

Mount Pinatubo, located on the island of Luzon in the Philippines, rose to fame in 1991 when a violent eruption ripped 850 feet (259 meters) off its summit. It was the second largest eruption of the 20th century. Before the 1991 eruption, the volcano stood 5,725 feet (1,745 meters) high, but today only rises to 4,875 feet (1,486 meters) above sea level.

Although the eruption in 1991 killed hundreds of people and caused extensive damage, monitoring and evacuation efforts in the days leading up to the eruption saved tens of thousands of lives.

After the 1991 eruption, calm returned to the region. But the Pinatubo volcano is still active and could erupt again. Its moods are closely monitored by local authorities and scientists.



Krakatoa

Indonesia

Krakatoa, located in the Sunda Strait between the Indonesian islands of Java and Sumatra, rivals Vesuvius for the title of world's most famous volcano.

It is a caldera-type volcano (*caldera* means "cauldron" or "depression") that may have been formed during a super-eruption in the year 416 AD. It's 4.4 miles (7 kilometers) wide. Krakatoa's 1883 eruption was one of the first to be scientifically documented. The sound made during the final explosion was reportedly heard over more than 10 percent of the earth's surface.

After a period of rest of less than 50 years, a new eruptive cone, called Anak Krakatau (meaning "child of Krakatoa"), emerged in the caldera formed in 1883. Several eruptions have taken place there since 1927, the latest in 2022.

KILLING WATERS

Krakatoa's eruption in 1883 is the second largest in the history of Indonesia. It killed more than 36,000 people and destroyed nearly 200 towns and villages on the surrounding coastlines. Most of these catastrophes were caused by the huge tsunamis that followed the eruption.

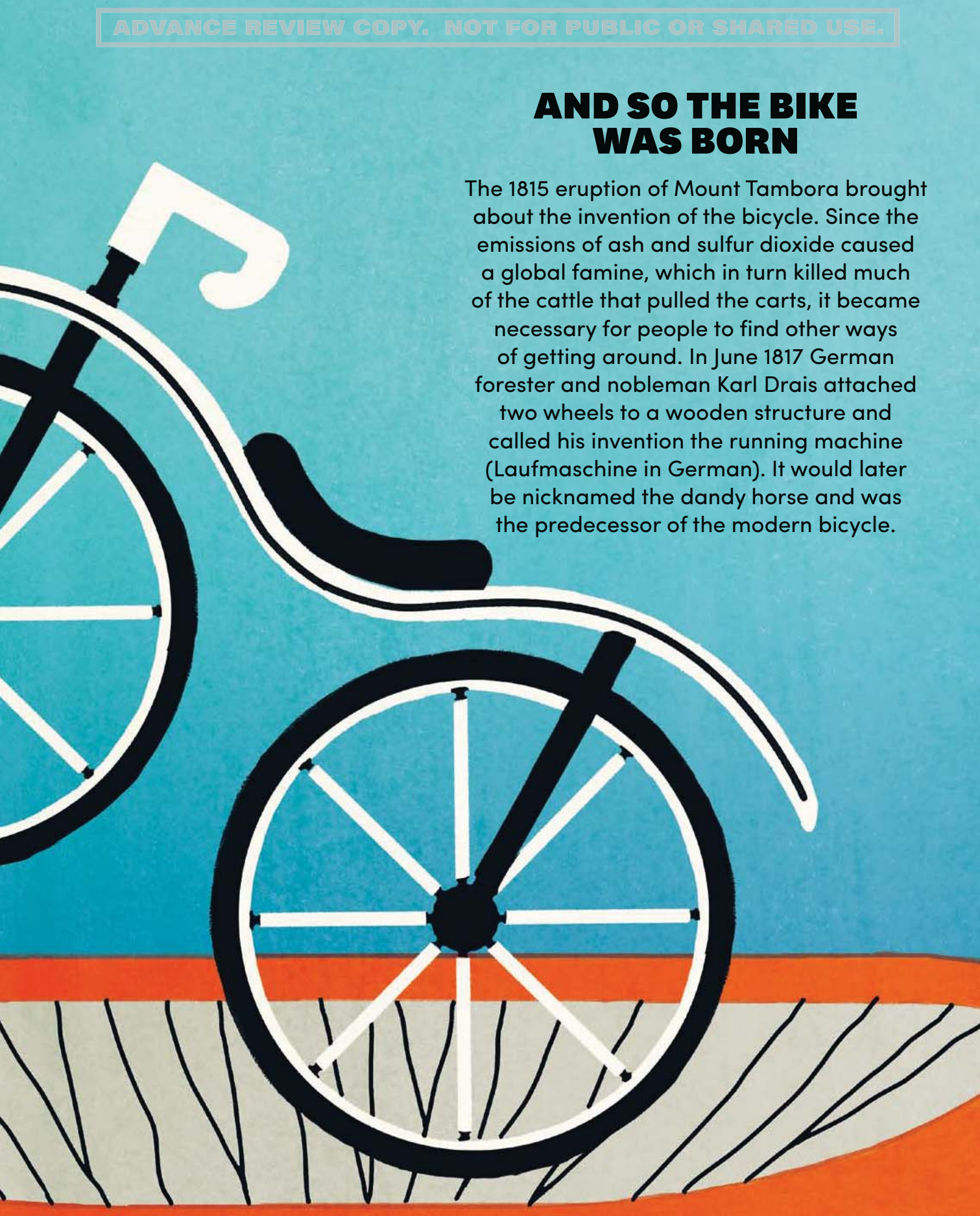
Mount Tambora

Indonesia

Mount Tambora is a huge volcano known for its 3.7 mile (6 kilometer) wide caldera. It forms the 37 mile (60 kilometer) wide Sanggar Peninsula in the northern part of the island of Sumbawa, Indonesia.

In 1815 there was an eruption at Tambora that killed 92,000 people. So much volcanic material was ejected into the atmosphere, it caused a volcanic winter the following year. It was nicknamed the Year without a Summer. Temperatures dropped throughout the northern hemisphere, from the east coast of the United States all the way to China. The resulting crop failures led to widespread famine and the deaths of 200,000 people.

Many ***volcanologists*** consider the eruption of Mount Tambora in 1815 the most destructive volcanic event in recorded history. It is even said that the bad weather conditions the eruption caused may have led to Napoléon Bonaparte's defeat at the Battle of Waterloo.



AND SO THE BIKE WAS BORN

The 1815 eruption of Mount Tambora brought about the invention of the bicycle. Since the emissions of ash and sulfur dioxide caused a global famine, which in turn killed much of the cattle that pulled the carts, it became necessary for people to find other ways of getting around. In June 1817 German forester and nobleman Karl Drais attached two wheels to a wooden structure and called his invention the running machine (Laufmaschine in German). It would later be nicknamed the dandy horse and was the predecessor of the modern bicycle.

OCEANIA

Mauna Loa,
Lōʻihi,
Kīlauea
Hawaiʻi

Mount Ruapehu

Aotearoa (New Zealand)

Mount Ruapehu is a huge, 9,177 foot (2,797 meter) high stratovolcano and one of the most active volcanoes in Aotearoa (New Zealand). Its active crater has an acidic lake on its summit. There are at least five other craters on the summit and flank of Ruapehu that have been active in the past 12,000 years.

The volcano was last active in April 2019. The acidic lake's water temperature reached 111°F (44°C) in the main crater before returning to normal, 102°F (39°C), a few days later.

VOLCANOES IN LOVE

According to a Māori legend, Ruapehu was the name of a young bride who was unfaithful to her husband, Taranaki. The Taranaki volcano is said to be watching her in silence, the mist on its eastern flank a sign of his love for her, while Ruapehu, who remains in love with her husband, sometimes sighs.

Hawai‘ian Islands

Located in the Pacific Ocean, Hawai‘i is the United States’ 50th state and an archipelago of volcanic islands. In other words, it’s a land made up entirely of volcanoes. This trait gives it a unique beauty, both magnificent and wild. Many of the land’s legends feature Pele, goddess of fire, lightning and volcanoes, and they are cherished by Hawai‘ians.

HIGHER THAN EVEREST

Although it rises 13,796 feet (4,205 meters) above sea level, the Mauna Kea volcano has a secret hidden part. If you measure the mountain from its base (located deep under the ocean), it is actually closer to 33,497 feet (10,210 meters) high. That’s higher than Mount Everest’s 29,032 feet (8,849 meters)!

Mauna Loa

Mauna Loa is considered the largest volcano on earth in terms of mass and volume. It’s a giant ***shield volcano***, shaped like an enormous oval plate stretched out on the ground. It is located on the Big Island of Hawai‘i, which is made up of five volcanoes close to each other.

Lōʻihi Seamount

The Lōʻihi Seamount is an underwater volcano located 22 miles (35 kilometers) off the southeast coast of the island of Hawaiʻi. It is the youngest volcano in the Hawaiʻian–Emperor undersea mountain chain.

Its highest point is hidden about 3,199 feet (975 meters) below the surface of the sea. Lōʻihi's last eruption happened in 1996. Today its activity is limited to exhalations of low-temperature gas.

Lōʻihi will undoubtedly be the next Hawaiʻian island.

Hawai‘ian Islands

Kīlauea

The Kīlauea volcano, which overlaps the eastern flank of the enormous Mauna Loa shield volcano, is the most active volcano in the world. It has been erupting almost constantly since 1983. Kīlauea's lava flows have covered more than 39 square miles (100 square kilometers), destroyed nearly 200 houses and added brand-new coastlines to the island of Hawai'i.

The largest eruption in at least 200 years took place from April to September 2018 and caused the collapse of Kīlauea's crater floor.

THE HOME OF A GODDESS

According to Hawai'ian folklore, Kīlauea is the home of Pele, goddess of fire, lightning, dance, volcanoes and violence. She is worshipped with songs and offerings. Thin strands of volcanic glass carried by the wind are known as Pele's hair.

AFRICA

Mount Kilimanjaro

Tanzania

Mount Kilimanjaro is the highest mountain in Africa and rises 19,341 feet (5,895 meters) above sea level. It is called a "composite" volcano because it is made up of three volcanic cones named Kibo, Mawenzi and Shira.

While Shira is 2.5 million years old, Mawenzi and Kibo are younger. Their last volcanic activity was 450,000 years ago. Mawenzi and Shira are extinct, but Kibo is dormant and could erupt again.

VANISHING GLACIERS

Mount Kilimanjaro is one of the most studied volcanoes, not so much for its volcanic eruptions as for its surrounding glaciers and ice fields, which are shrinking at an alarming rate because of climate change.

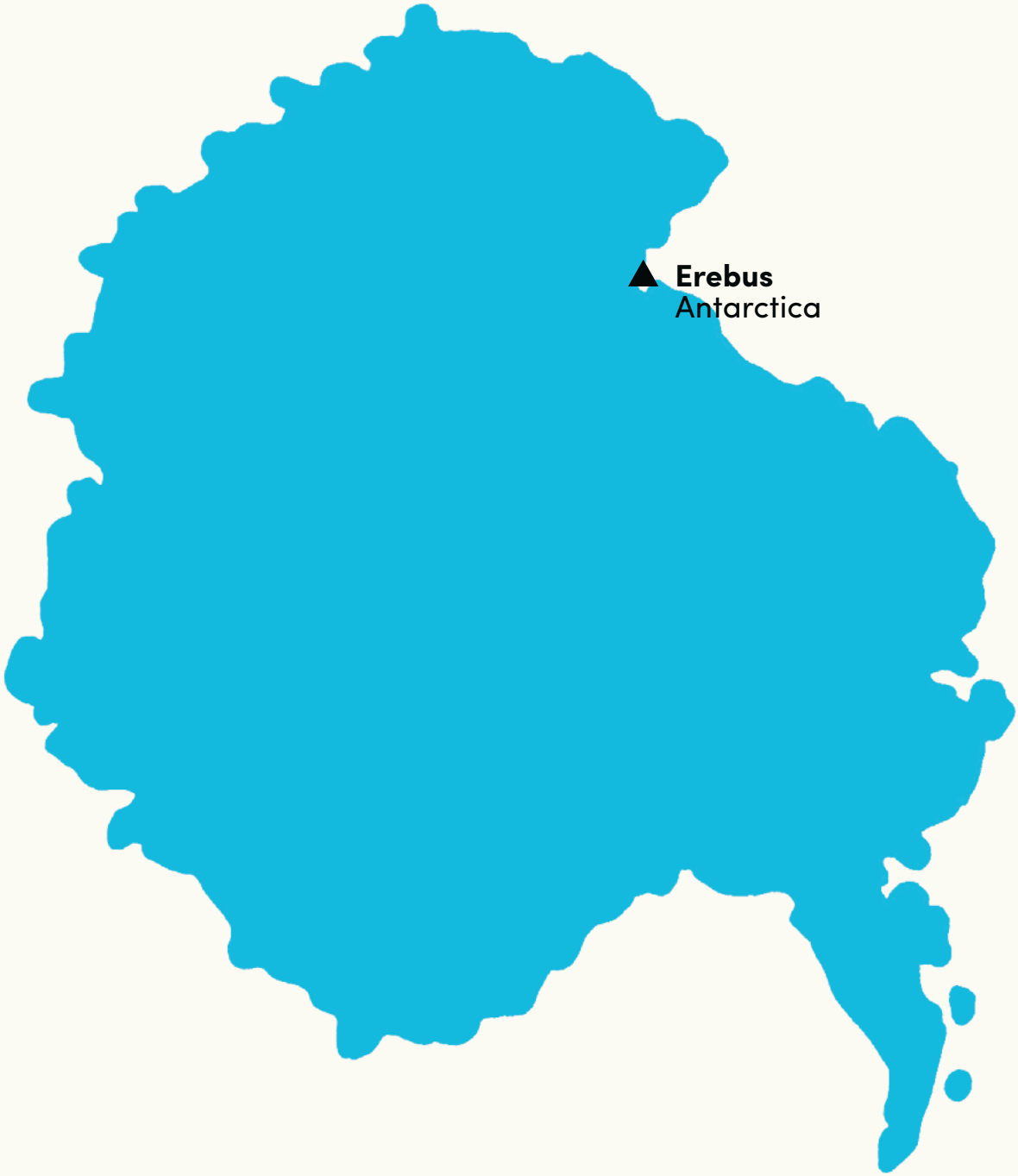
Piton de la Fournaise

Réunion

Piton de la Fournaise is in the western part of the Indian Ocean on the island of Réunion. Like the island of Hawai'i, it is a shield volcano, made up of three calderas that were formed 250,000, 65,000 and 5,000 years ago.

Piton de la Fournaise is also one of the most active volcanoes in the world, with more than 150 eruptions since the 17th century, most of which included hazardous lava flows. The Piton's eruption in June 2019 ejected spectacular ***lava fountains*** and flows. It erupted again in 2021.

But since it is located in an uninhabited region of Réunion, Piton de la Fournaise is one of the world's least dangerous volcanoes.



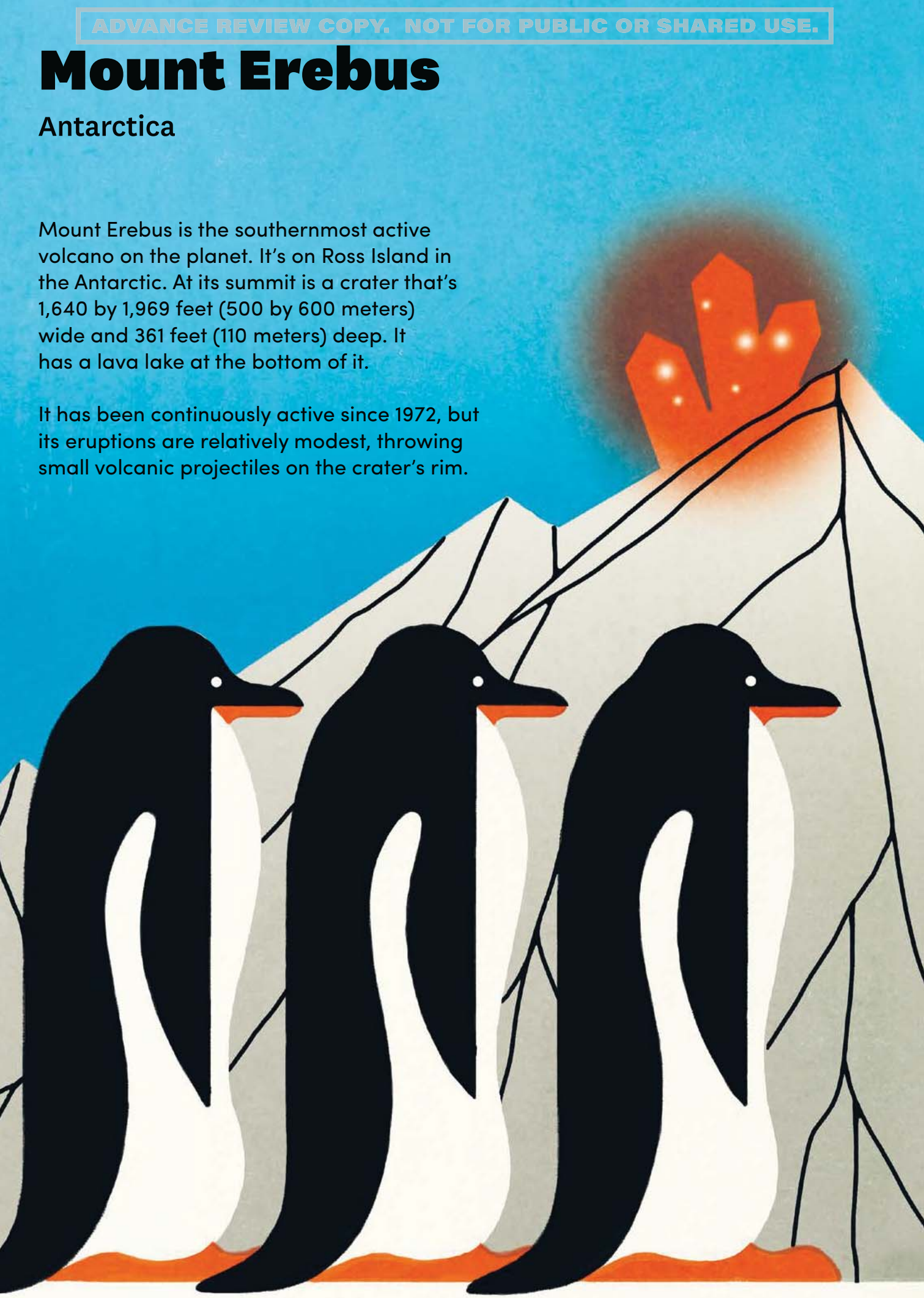
ANTARCTICA

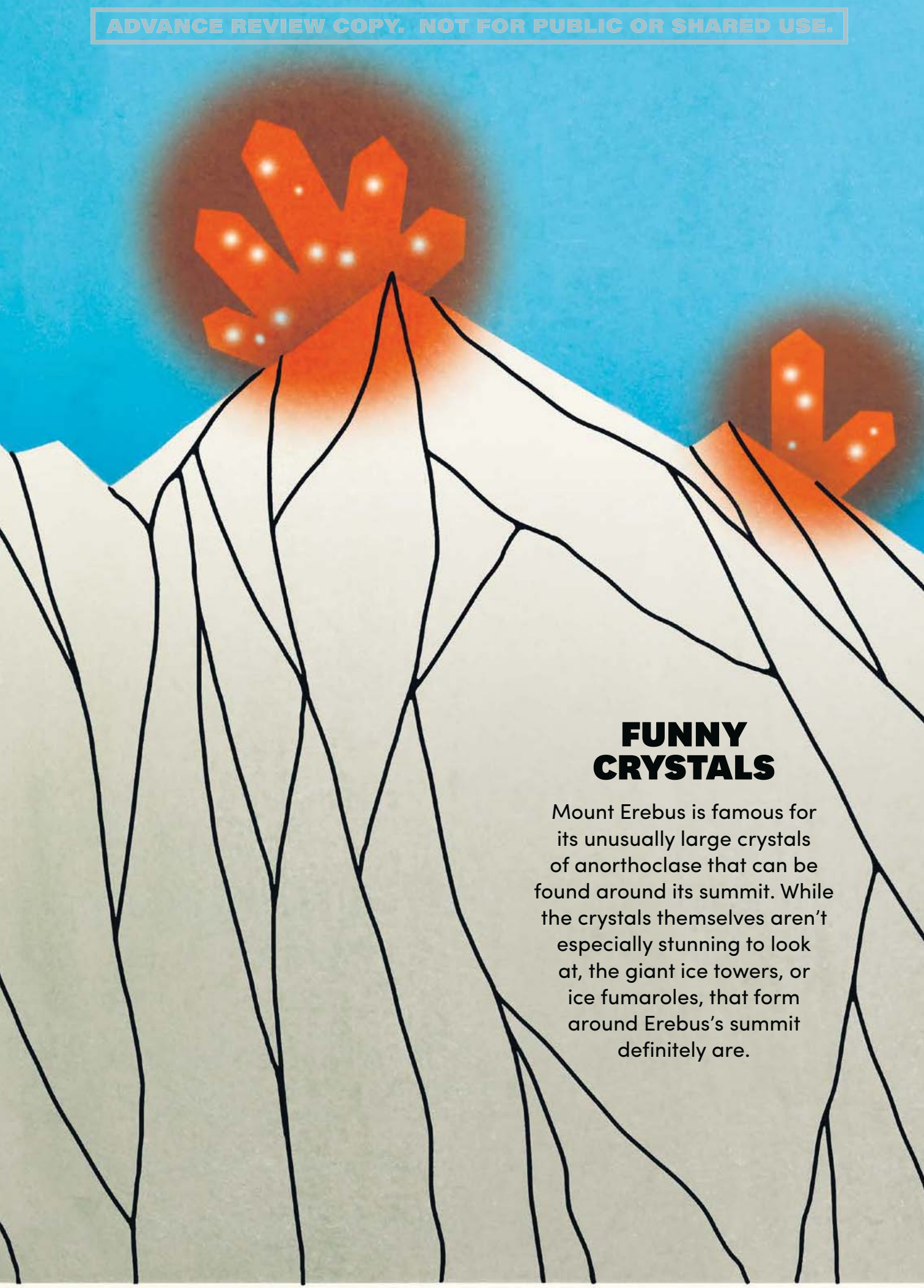
Mount Erebus

Antarctica

Mount Erebus is the southernmost active volcano on the planet. It's on Ross Island in the Antarctic. At its summit is a crater that's 1,640 by 1,969 feet (500 by 600 meters) wide and 361 feet (110 meters) deep. It has a lava lake at the bottom of it.

It has been continuously active since 1972, but its eruptions are relatively modest, throwing small volcanic projectiles on the crater's rim.

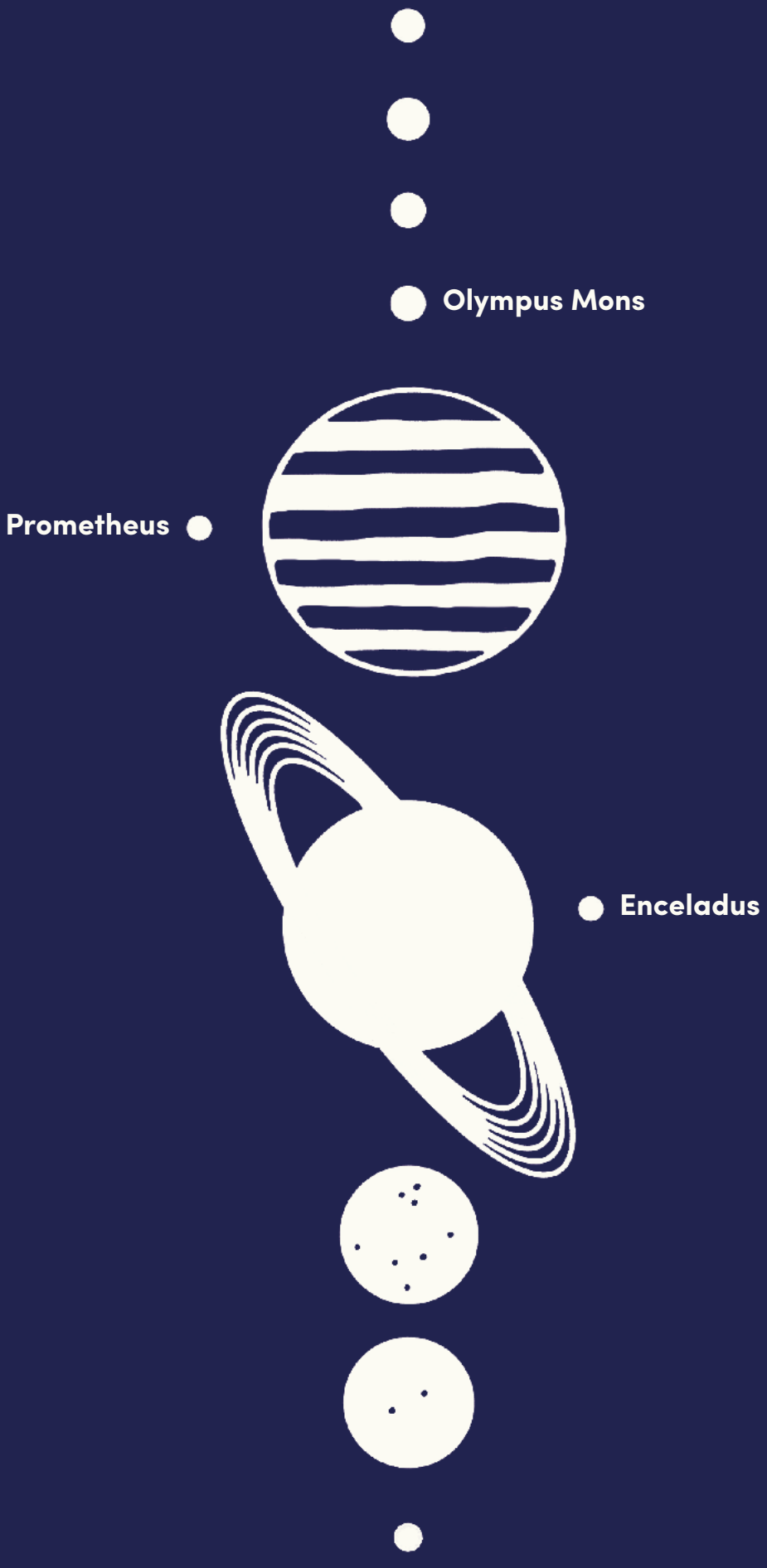




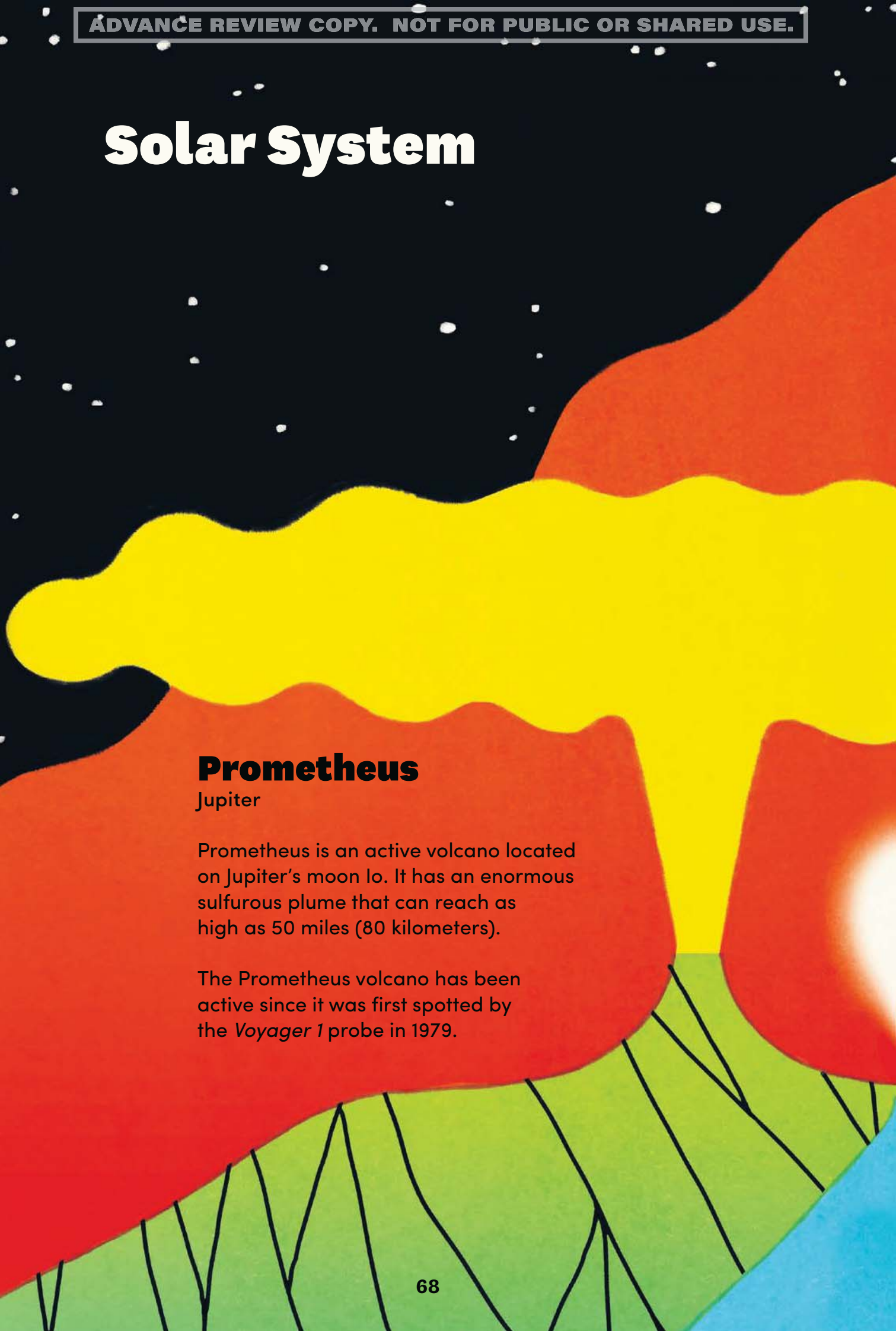
FUNNY CRYSTALS

Mount Erebus is famous for its unusually large crystals of anorthoclase that can be found around its summit. While the crystals themselves aren't especially stunning to look at, the giant ice towers, or ice fumaroles, that form around Erebus's summit definitely are.

ELSEWHERE IN THE SOLAR SYSTEM



Solar System



Prometheus

Jupiter

Prometheus is an active volcano located on Jupiter's moon Io. It has an enormous sulfurous plume that can reach as high as 50 miles (80 kilometers).

The Prometheus volcano has been active since it was first spotted by the *Voyager 1* probe in 1979.

Olympus Mons

Mars

Olympus Mons is a 16 mile (25 kilometer) high shield volcano—almost three times the height of Mount Everest! It is the largest volcano in our solar system.

Volcanoes on Mars are 10 to 100 times larger than those found anywhere on earth. Scientists link these enormous sizes to the fact that the Martian crust, which doesn't have tectonic plates, doesn't move like the earth's crust does.

Enceladus

Saturn

In 2006 the *Cassini–Huygens* space probe sent images of ice volcanoes located at the surface of Saturn's moon Enceladus. Instead of lava, these volcanoes are likely ejecting cold liquid or frozen gases such as water, ammonia or ***methane***.

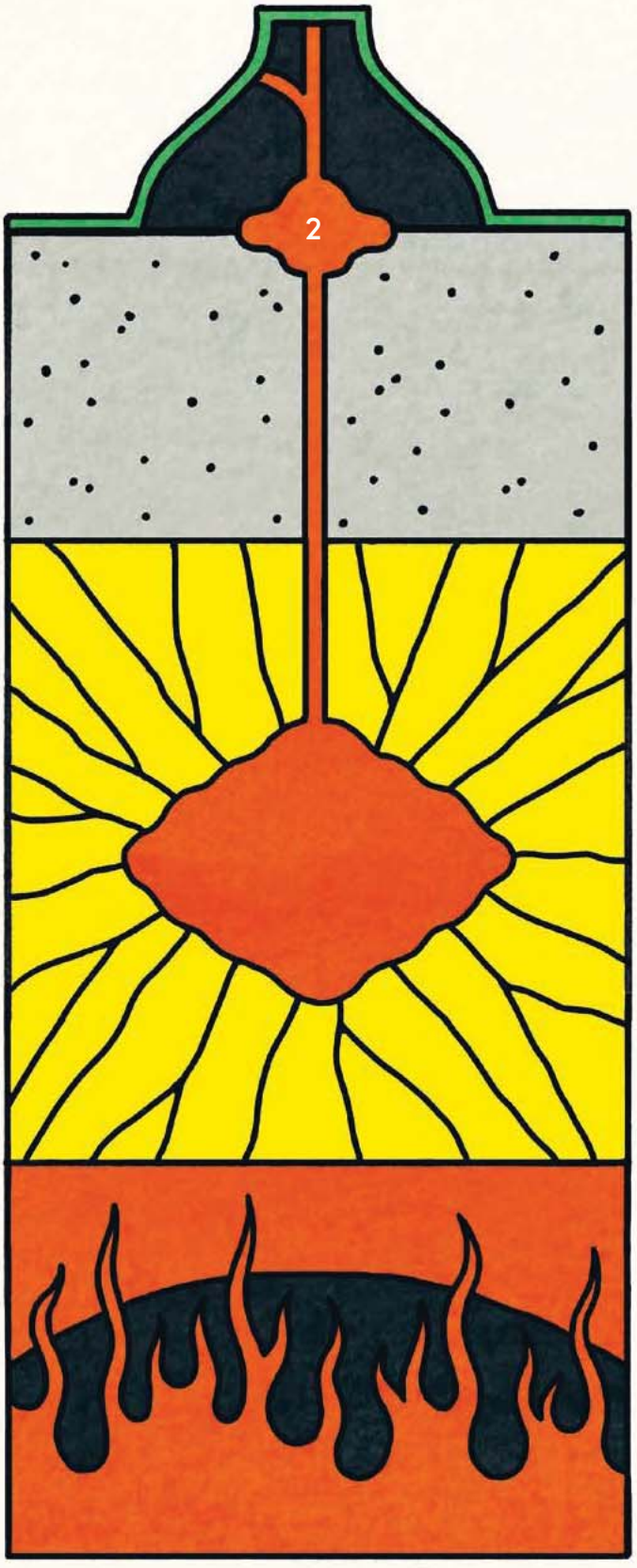
What Do I Know?

HOW AN ERUPTION WORKS

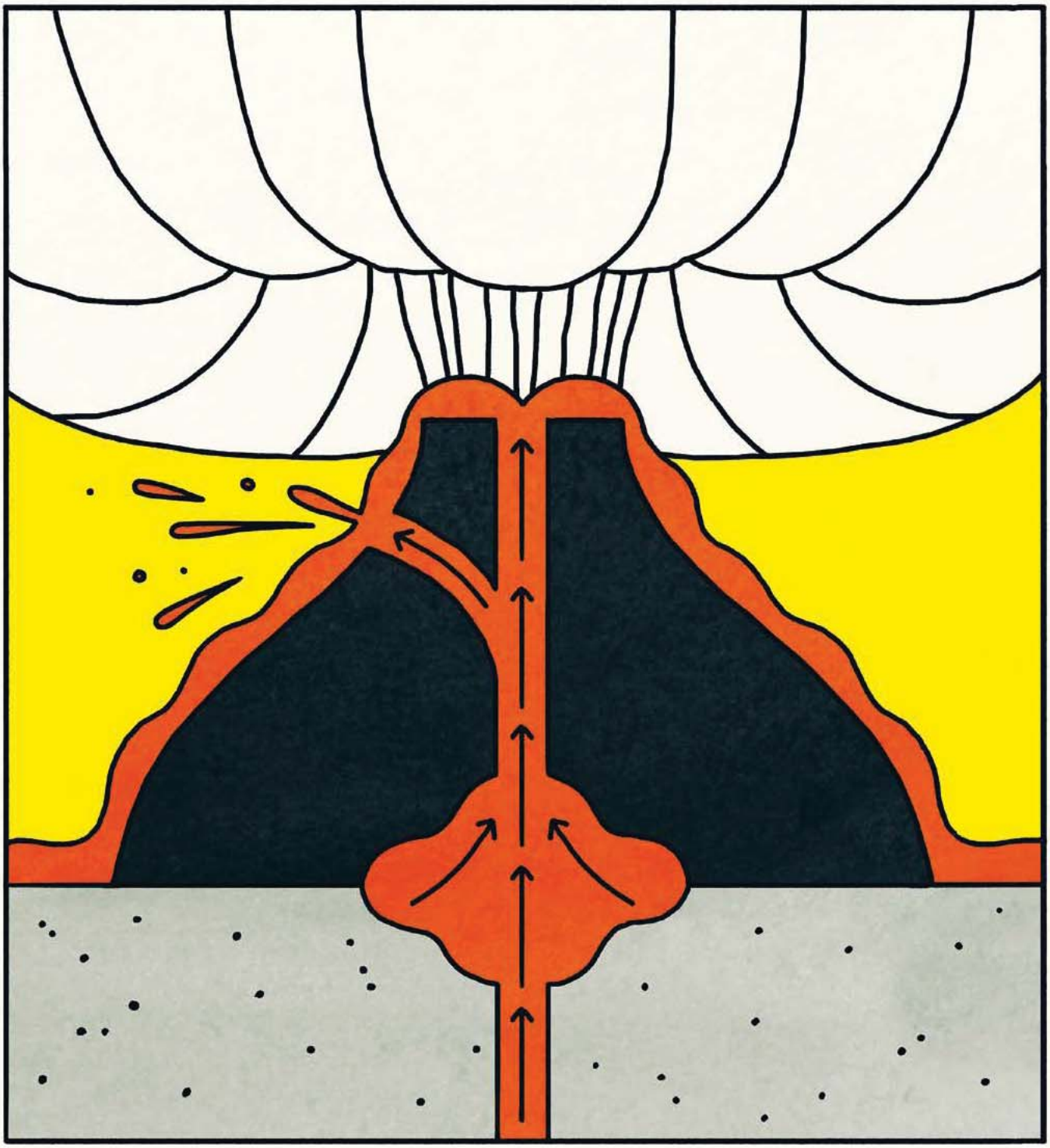
Deep inside the earth, the temperature and pressure are so high that the rocks forming the earth's mantle slowly melt, forming magma.

Magma is a viscous and thick liquid, much like honey. Because it's in liquid form, it's lighter than the solid rock that surrounds it, so it rises to the earth's crust, where it often gathers in magma chambers.

When there's a crack in the earth's crust, magma is able to ascend and eventually reach the earth's surface, causing an eruption.



1. Volcano
2. Magma chamber
3. Mantle
4. Magma
5. Core



Once it's on the surface, magma is called lava. Eruptions are either explosive or effusive, depending on how much gas is trapped in the magma—like gas in a soda bottle—and how easily it's able to escape. The thicker the magma, the more difficult it is for the gases to escape, and the more explosive the eruption is likely to be.

What Do I Know?

THE KRAFFTS, FOUNDERS OF VOLCANOLOGY

Nicknamed the Volcano Devils, Maurice and Katia Krafft were French volcanologists who dedicated their lives to documenting volcanic eruptions with spectacular photographs and films. The couple was known for how quickly they could spot eruptions in progress. Together they were able to witness up close more than 175 eruptions.

Their passion cost them their lives. They died on June 3, 1991, trapped by a pyroclastic flow (also called a pyroclastic cloud, a hot mixture of gas, ash and boulders) on Mount Unzen in Japan.

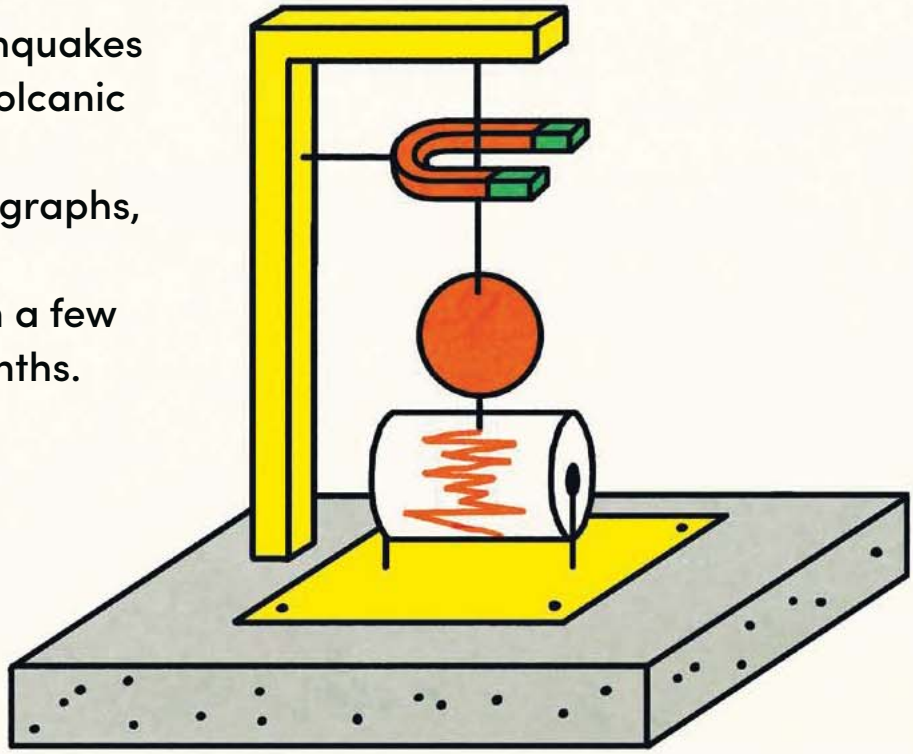
Nevertheless the Kraffts' work has helped raise awareness of the dangers of volcanoes and prevented more tragedies.

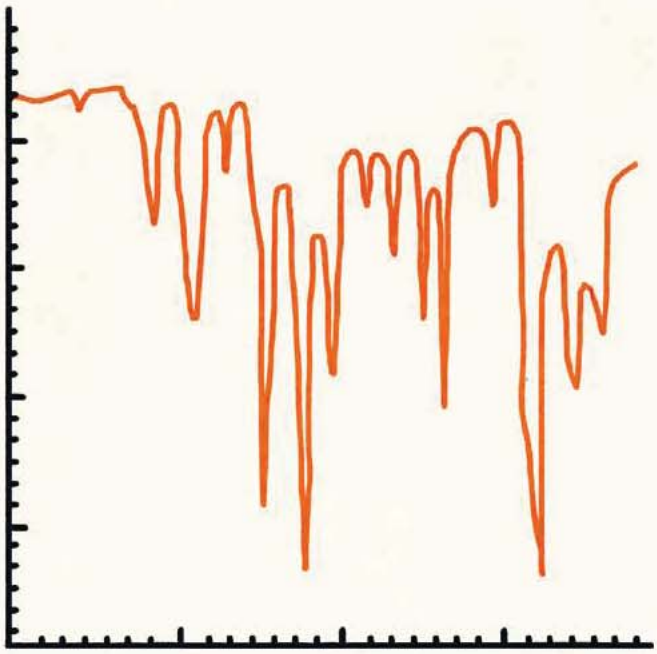
Maurice and Katia Krafft climbed half of the 500 active volcanoes that have erupted in recent human history.

What Do I Know?

VOLCANOES UNDER SURVEILLANCE

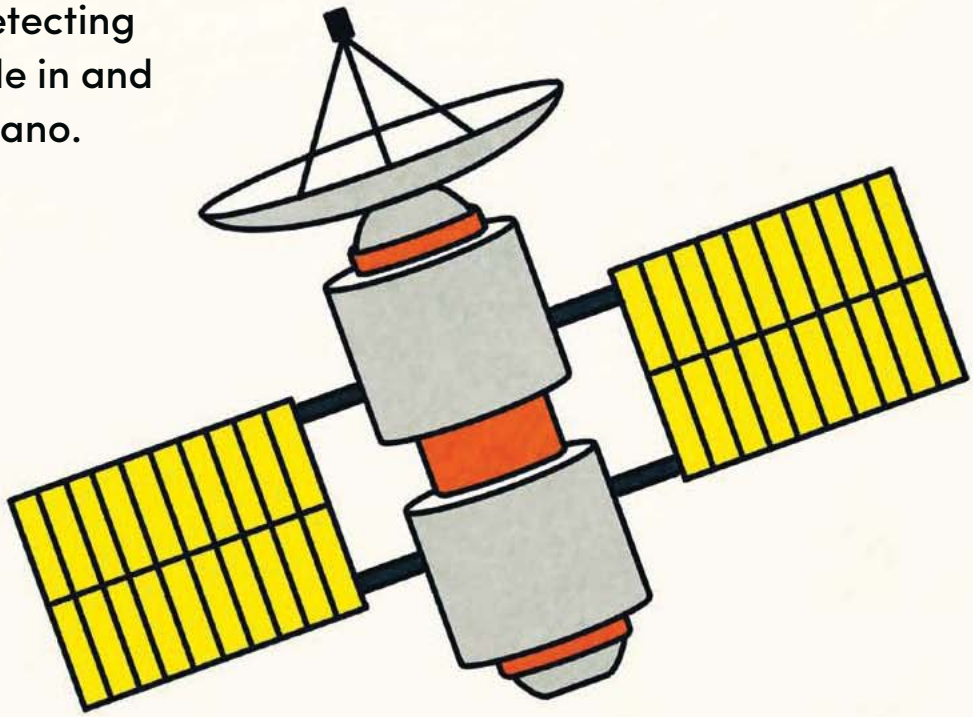
Volcano-tectonic earthquakes are warning signs of volcanic activity. These can be detected using seismographs, machines that record vibrations lasting from a few minutes to several months.





Changes in the concentrations of gases escaping from the crater of an active volcano may also indicate the possibility of an eruption. These can be measured using instruments like an infrared spectrometer, which measures the concentrations of sulfur and other gases emitted by a volcano.

Because it's often difficult and dangerous to measure the gases of a volcano that's about to erupt, scientists also use satellites equipped with special sensors capable of detecting heat and sulfur dioxide in and around an active volcano.



Lately volcanologists have started installing their spectrometers on drones, which can be flown directly into the gas plumes of an erupting volcano.

GLOSSARY

acidic lake
lake formed by gases like sulfur dioxide (SO_2), sulfur trioxide (SO_3) and hydrogen chloride (HCl) that bubble deep inside the earth, then rise to the surface and mix with the water at the center of a volcanic crater

active volcanoes
volcanoes that erupt regularly. Conversely volcanoes are said to be dormant if they have erupted recently (although by *recently* geologists usually mean in the last 10,000 years!) but remain calm for the moment.

caldera
large, cauldron-like hollow formed after the collapse of a magma chamber during a massive volcanic eruption

crater
a usually circular depression in the ground where the eruptive materials come out

earth's crust
thin, hard layer composed of continental and oceanic crust and representing less than 1 percent of the earth's volume

earth's mantle
layer of rock located between the earth's crust and outer core

eruption
the forceful discharge of steam and volcanic material from the earth's interior

geothermal
heat (*-thermal*) derived from the earth (*geo-*)

geysers
holes in the earth's surface that periodically eject a column of hot water and vapor

hydrothermal systems
sets of processes that distribute energy and mass in reaction to the circulation of water

lava
molten, fluid, very hot rock that reaches the surface of the earth through a volcanic vent

lava fountains
jets of lava ejected into the air by the rapid formation and expansion of gas bubbles in molten rock

maars
large, low-relief, water-filled volcanic craters produced by single explosions that occur when groundwater interacts with hot lava or magma

magma
molten, fluid, very hot rock under the earth's surface

magma chamber
magma-filled reservoir located under a volcano

methane
colorless, odorless and highly flammable gas composed of one carbon atom and four hydrogen atoms

monogenetic volcano
a volcano that erupts only once

pyroclastic flows
dense, destructive and very hot masses of ash, lava fragments and gases that flow down the sides of a volcano at high speed during a highly explosive eruption

shield volcano
a type of volcano composed almost entirely of fluid lava flows. It is named for its low profile, resembling a warrior's shield lying on the ground.

subglacial volcano
volcano located under a glacier

tectonic plates
huge, irregularly shaped slabs of solid rock sliding across the earth's mantle

volcanic plume
mixture of particles and hot gas emitted by a volcanic eruption

volcanologists
scientists (usually geologists) who study volcanoes

Vulcan
Roman god of fire and patron of blacksmiths

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JULIE ROBERGE has been studying volcanoes around the world for over 25 years. Nicknamed the "Ash Hunter," she is originally from Nicolet, Quebec, and is a professor and research scientist at the Polytechnic School of Mexico (Instituto Politécnico Nacional). She did her bachelor's degree in geology at the University of Montreal, her master's degree at the University of Quebec at Chicoutimi and her doctorate at the University of Oregon. Julie has been collecting rocks since she was young and it was the eruption of Mount St. Helens in 1980 that ignited her passion for volcanoes. Today she hunts the ashes of erupting volcanoes to look for magmatic inclusions, small balls of magma caught inside crystals that go from 1200 to 25 degrees Celsius to become glass droplets during an eruption. She lives in Mexico City.

ALESS MC is an illustrator and graphic designer based in Tiohtià:ke (Montreal). Her practice is based on communicating ideas in a simple and colorful way. Aless is inspired by traditional printing techniques, Franco-Belgian manga and comic strips, and also forms in nature and symbols in culture.