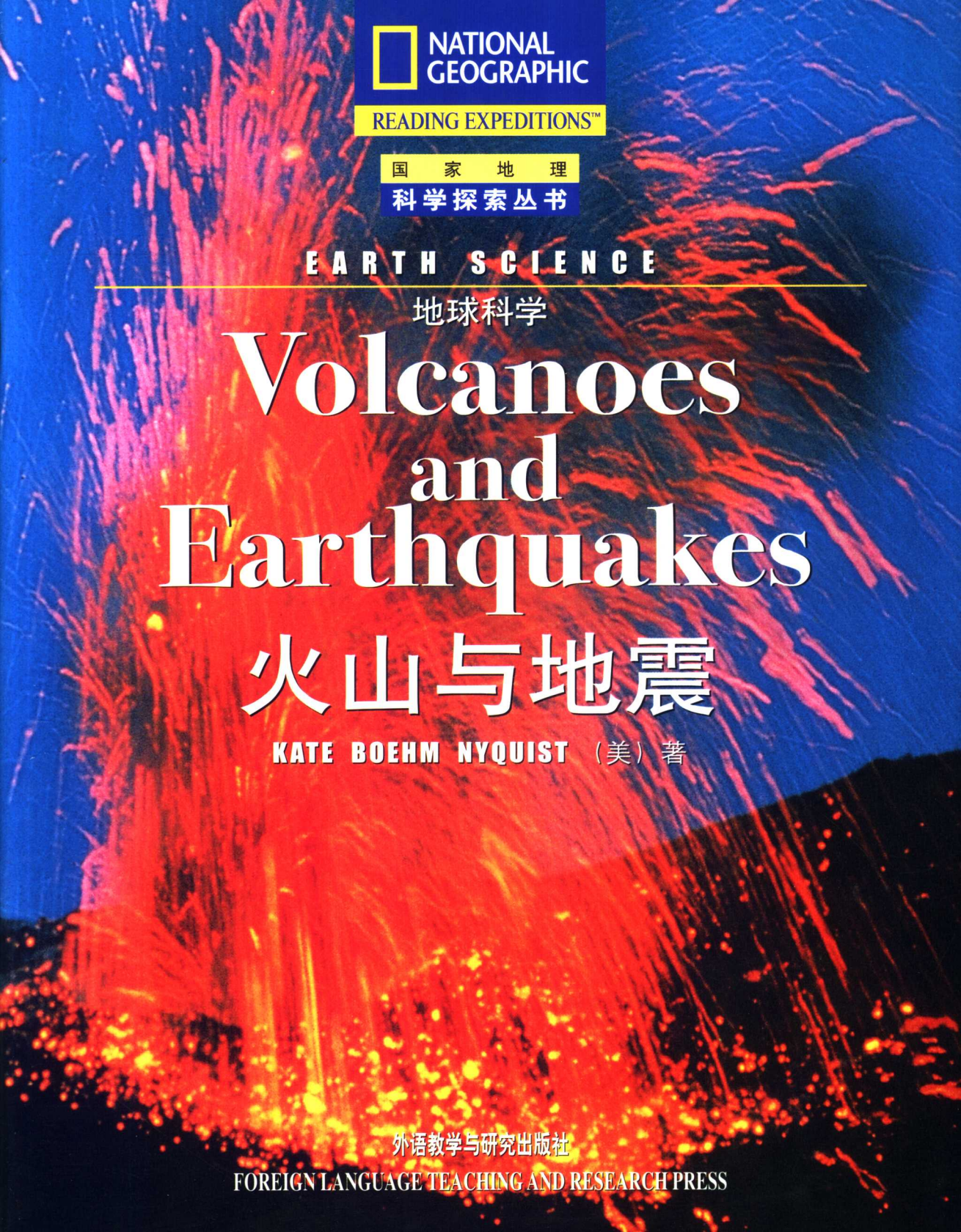
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EARTH SCIENCE
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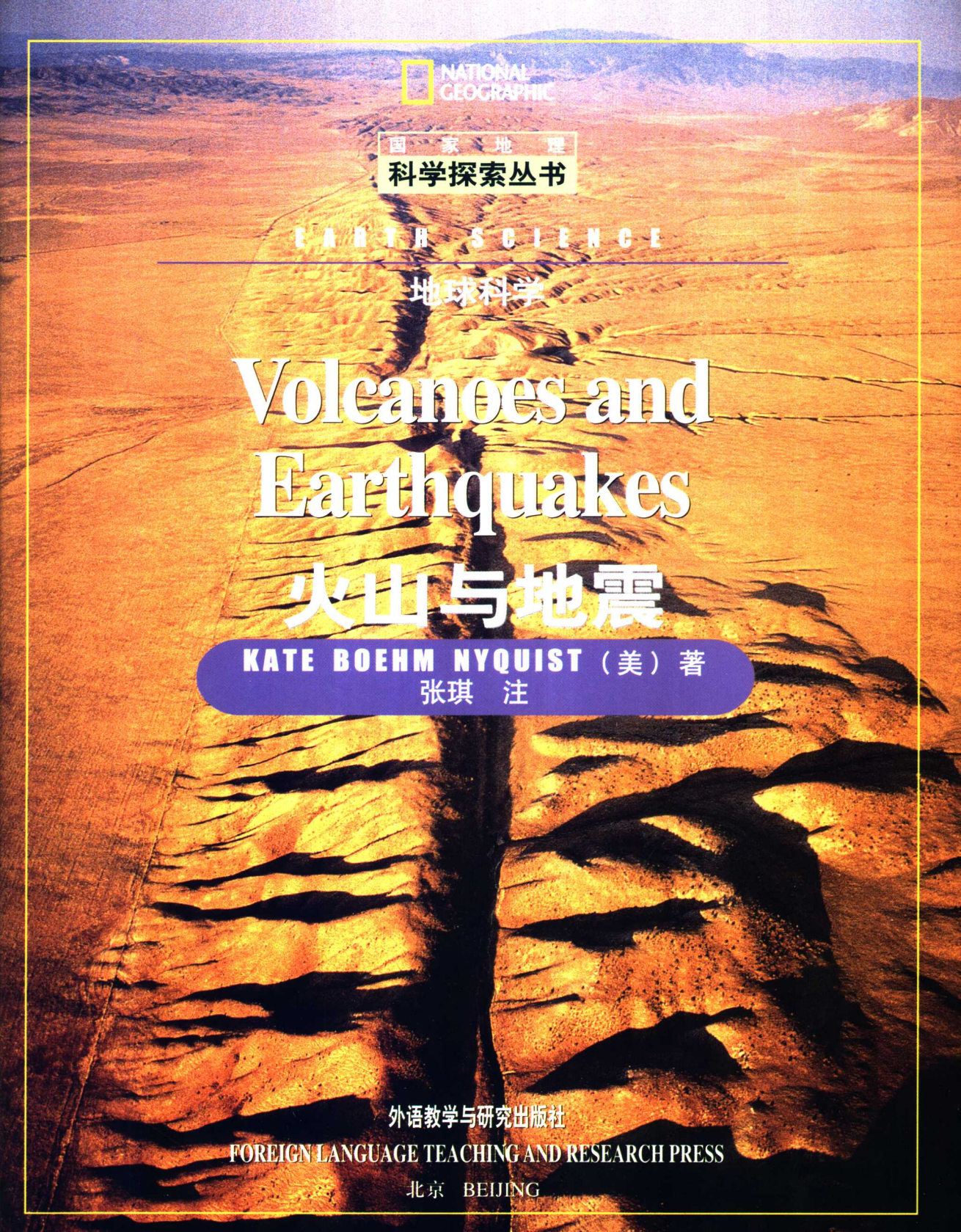
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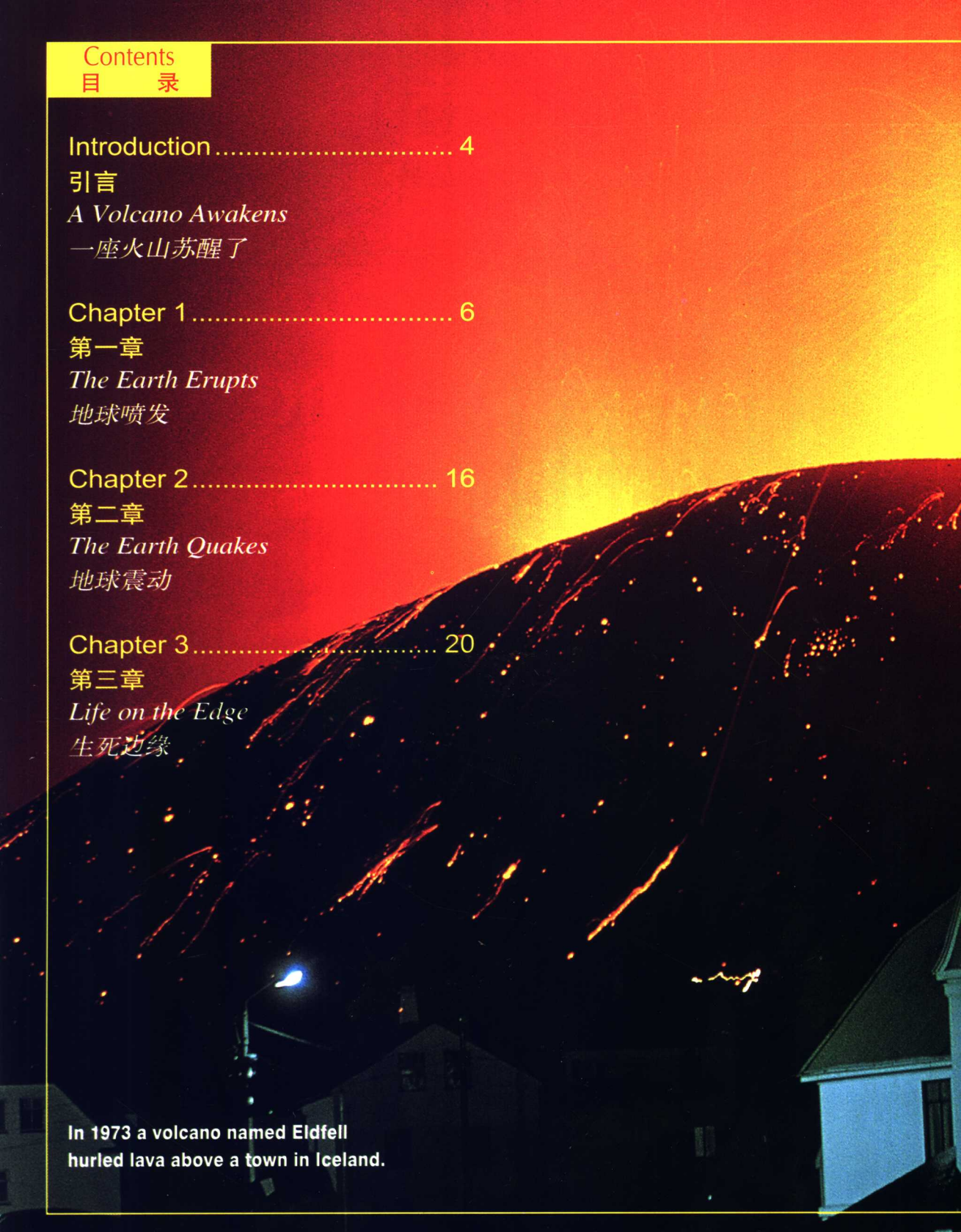
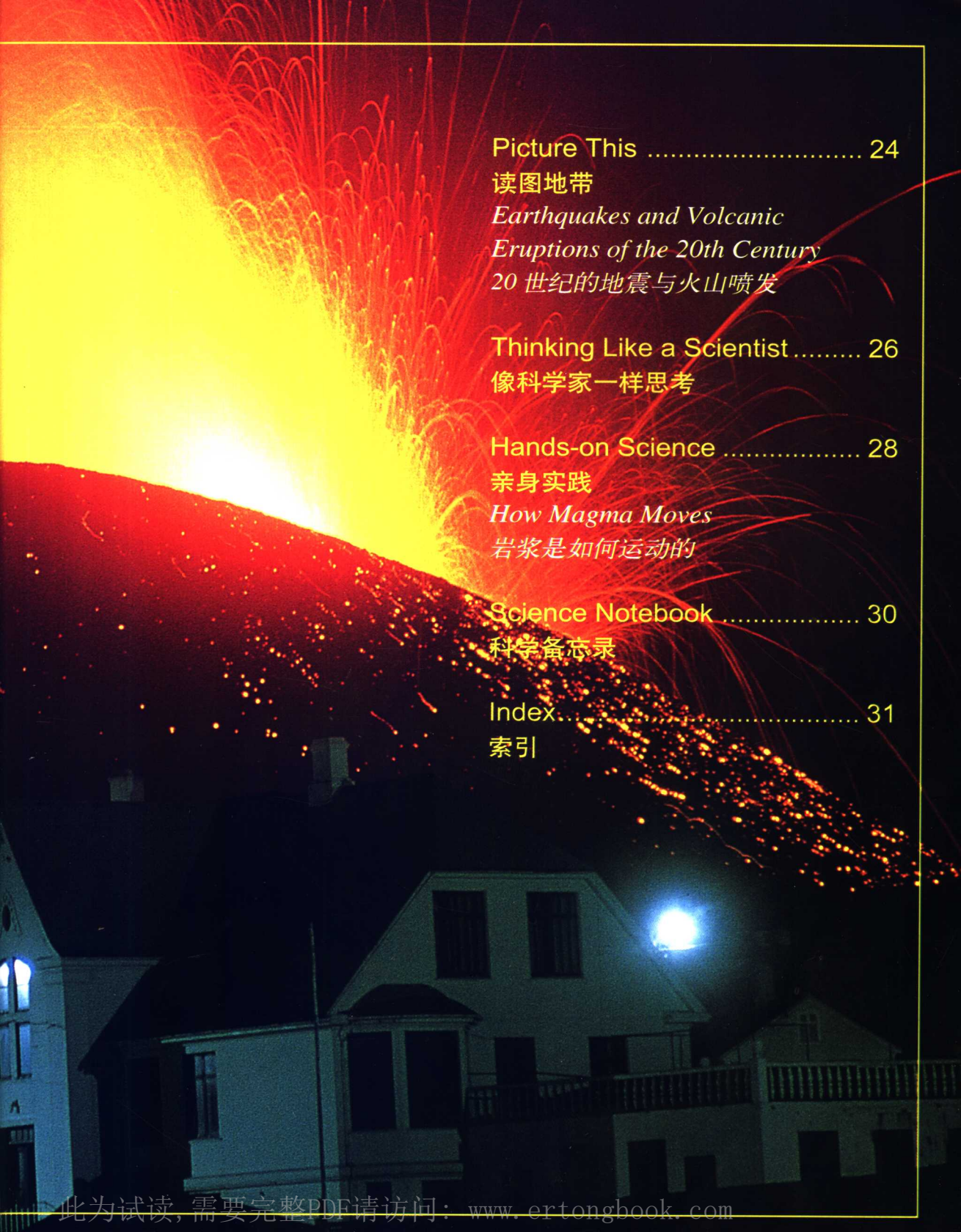


In 1973 a volcano named Eldfell hurled lava above a town in Iceland.



A Volcano Awakens

一座火山苏醒了

There was panic[1] in the streets. It was an August afternoon in Pompeii[2], Italy, in A.D. 79. Bits of burning rock and flaming[3] cinders[4] rained down on frightened[5] citizens[6] as they rushed for shelter[7]. There was no place to hide. Mount Vesuvius[8]—the volcano that was supposed[9] to sleep forever—was erupting[10] in fury[11].

1. panic	*n.*	惊慌，惊恐
2. Pompeii		庞培(意大利南部古城)
3. flaming	*adj.*	灼热的
4. cinder	*n.*	火山灰
5. frightened	*adj.*	受惊的
6. citizen	*n.*	市民，公民
7. shelter	*n.*	遮蔽物
8. Mount Vesuvius		维苏威火山
9. suppose	*v.*	推想，猜想
10. erupt	*v.*	喷发
11. fury	*n.*	狂怒

he next morning, the wealthy[1] Roman[2] trading[3] town of Pompeii was buried[4]. A cloud of ash and poisonous[5] gases had poured[6] down the mountain, killing everyone. The beautiful houses were covered with rubble[7]. The busy city was gone, destroyed[8] by forces[9] from within Earth.

The town of Pompeii was preserved[10] at a moment in time because the ash cloud covered everything at once. Pompeii remained[11] buried for hundreds of years until it was rediscovered[12] in the 1700s. Today scientists still uncover treasures[13] that give us information about the people of Pompeii and what they were doing on the last day of their lives.

Before A.D. 79 there were warning signs that Mount Vesuvius was going to blow[14]. Earthquakes had shaken the area around the mountain for at least 15 years. Yet no one connected the earthquakes with the growing danger inside the volcano.

This is a book about the forces inside Earth that sometimes change its exterior[15]. Some changes take place slowly over time. Other changes happen quickly through the violent[16] shaking of an earthquake or the explosive[17] eruption of a volcano. How do these changes happen? Read on to find out how our planet[18] rocks and rolls[19].

1.	wealthy	*adj.*	富有的		
2.	Roman	*adj.*	罗马的		
3.	trading	*n.*	贸易		
4.	bury	*v.*	埋葬；掩埋		
5.	poisonous	*adj.*	有毒的		
6.	pour	*v.*	倾泻；涌流		
7.	rubble	*n.*	瓦砾		
8.	destroy	*v.*	破坏；毁灭		
9.	force	*n.*	力量		
10.	preserve	*v.*	保留		
11.	remain	*v.*	保持		
12.	rediscover	*v.*	再发现；重新发现		
13.	treasure	*n.*	珍宝		
14.	blow	*v.*	喷发		
15.	exterior	*n.*	外表；外部		
16.	violent	*adj.*	猛烈的；粗暴的		
17.	explosive	*adj.*	爆炸的；爆发的		
18.	planet	*n.*	行星(此处指地球)		
19.	rock and roll		摇滚；剧烈震动		
20.	plaster	*n.*	灰泥		
21.	cast	*n.*	模子		
22.	resident	*n.*	居民		

Chapter 第一章 1

The Earth Erupts

地球喷发

It's been almost 2,000 years since Vesuvius buried Pompeii. Now another volcano rumbles[1] and shakes in Italy. Mount Etna[2], the most active volcano in Europe, towers[3] more than 3,310 meters (10,860 feet) above the island of Sicily[4]. More than 200 explosions[5] have been recorded since 1500 B.C.

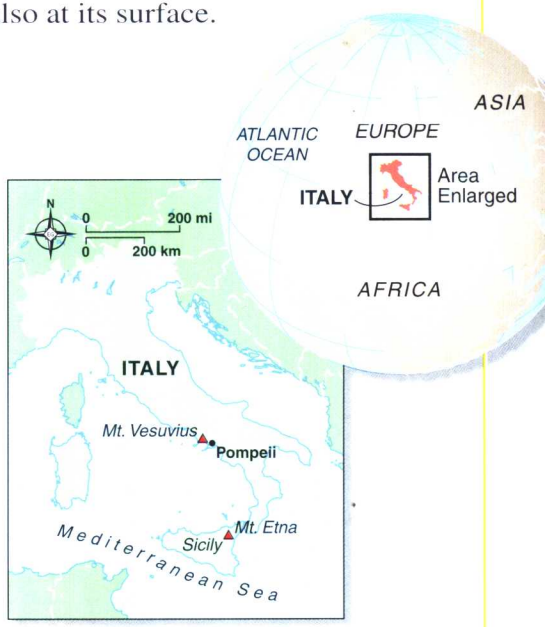
1.	rumble	*v.*	发隆隆声
2.	Mount Etna		埃特纳火山
3.	tower	*v.*	高耸；屹立
4.	Sicily		西西里岛
5.	explosion	*n.*	爆炸；爆发

Mount Etna erupted violently[1] during the summer of 2001. Smoke and ash shot thousands of meters into the air. Melted[2] rock reaching the surface[3] of Earth, called lava[4], spilled[5] from the volcano and crept[6] down the mountain. Airplanes dumped[7] thousands of liters[8] of water on the lava to try to cool it, so it would harden[9] and stop moving toward the cities below the volcano. People living in the area carried umbrellas to protect themselves from the constant[10] rain of ash and debris[11]. The airport nearby temporarily[12] closed because the thick layer[13] of ash on the runway[14] made it unsafe for planes to take off[15] or land. For weeks people in Sicily watched and waited as scientists swarmed[16] over the mountain to gather data.

Finally, Etna quieted down again before it caused too much damage[17]. Although some property[18] was lost, few people were forced to leave. The people who live around Mount Etna felt lucky—knowing the outcome[19] could have been much worse. They are used to the benefits[20] and threats[21] of an active volcano. In this agricultural region[22] they depend on the rich soil that eventually[23] comes from the lava. Yet they know that the next eruption could drive them from their homes.

Volcanoes are a hazard[24] that humans live with but cannot control. How and why do volcanoes erupt? The answer lies not only inside Earth but also at its surface.

1. violently *adv.* 猛烈地，强烈地
2. melt *v.* 使熔化
3. surface *n.* 表面
4. lava *n.* 熔岩
5. spill *v.* 溢出
6. creep *v.* 爬行，缓慢地行进
7. dump *v.* 倾倒
8. liter *n.* 升
9. harden *v.* 变硬，硬化
10. constant *adj.* 不断的
11. debris *n.* 岩屑
12. temporarily *adv.* 暂时地，临时地
13. layer *n.* 层
14. runway *n.* 跑道
15. take off 起飞
16. swarm *v.* 密集，云集
17. damage *n.* 损伤，破坏
18. property *n.* 财产，所有物
19. outcome *n.* 结局，后果
20. benefit *n.* 好处
21. threat *n.* 威胁
22. agricultural region 农业区
23. eventually *adv.* 最终，终于
24. hazard *n.* 危险
25. spew *v.* 喷出



Lava and smoke spew[25] from Mount Etna on July 25, 2001.

Layers Within Earth

Volcanoes form because of the action of magma[1], or hot, melted rock. Where does this magma come from? Let's look at the layers of Earth to find out.

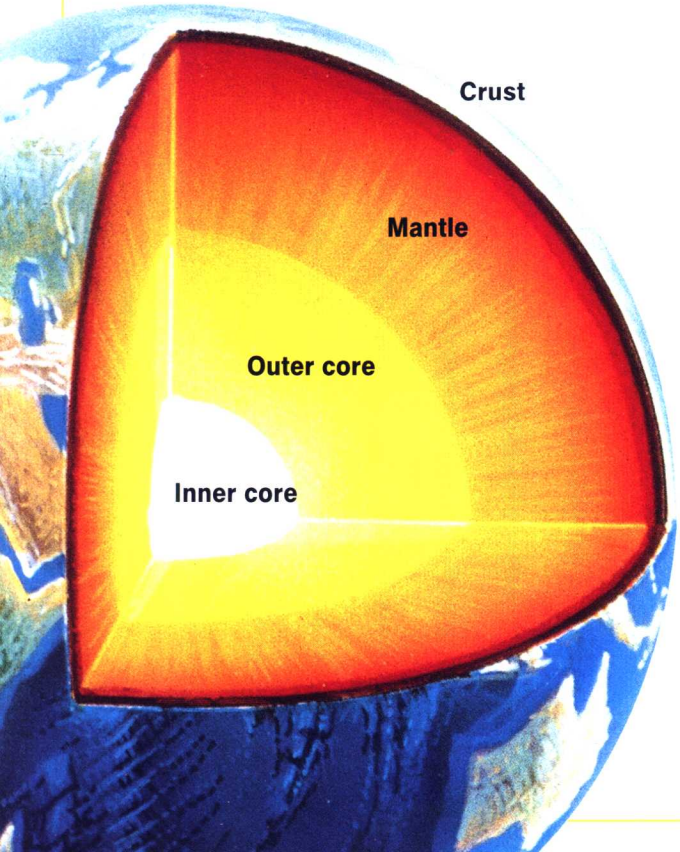
The ground that you stand on is the outermost[2] layer of the planet. Called the crust[3], this top layer includes not only the land you can see but also the land on the ocean floor[4]. The crust is not the same thickness everywhere on the planet.

The crust of the continents[5] is usually about 32 kilometers (20 miles) thick. The ocean crust is, on average[6], only 5 to 8 kilometers (3 to 5 miles) thick.

Even at its thickest point, the crust is still very thin compared with the next layer of Earth, called the mantle[7]. This middle layer of Earth is about 2,900 kilometers (1,800 miles) thick. This layer is where magma forms.

The thickest layer of Earth, called the core[8], is right below the mantle. The outer core is so hot that scientists believe it is a liquid[9] layer of melted iron and nickel[10]. This layer is about 2,250 kilometers (1,400 miles) thick. The inner[11] core is about 1,300 kilometers (800 miles) thick and is even hotter. The temperature[12] can reach 6,000°C (10,832°F). Can you imagine[13] how hot the inner core of Earth must be if it's 100 times hotter than our worst summer day?

Earth's Layers



Movement at the Surface

How does magma get to the surface of Earth to form volcanoes? The answer may surprise you.

1.	magma	*n.*	岩浆
2.	outermost	*adj.*	最外面的；离中心最远的
3.	crust	*n.*	地壳
4.	ocean floor		洋底
5.	continent	*n.*	大陆
6.	on average		按平均值；通常
7.	mantle	*n.*	地幔
8.	core	*n.*	地核
9.	liquid	*n.*	液体
10.	nickel	*n.*	镍
11.	inner	*adj.*	里面的
12.	temperature	*n.*	温度
13.	imagine	*v.*	想像

The ground beneath[1] your feet feels firm[2]. It might seem there's no way that this solid[3] layer of Earth can be moving. But guess what! It's moving slowly all the time.

How do we know this? We can trace[4] the evidence[5] all the way back to the 1500s when explorers[6] first mapped the continents. People noticed then that the coastlines[7] of some continents seemed to fit together like pieces of a jigsaw puzzle[8]. This puzzle fit was one of the pieces of evidence that led to a new conclusion[9] about movement on Earth's surface. In 1912 a German scientist named Alfred Wegener[10] proposed[11] that millions of years ago there was only one huge land mass[12], or supercontinent[13]. He named the supercontinent Pangaea[14]. Wegener thought that about 200 million years ago, Pangaea split[15] into continents that eventually drifted[16] apart into the land masses we know today. Wegener's idea that continents can move became known as continental drift[17].

1. beneath	*prep.*	在……底下
2. firm	*adj.*	坚硬的，结实的
3. solid	*n.*	固体
4. trace	*v.*	追溯
5. evidence	*n.*	证据，迹象
6. explorer	*n.*	探险者
7. coastline	*n.*	海岸线
8. jigsaw puzzle		拼图玩具，七巧板
9. conclusion	*n.*	结论
10. Alfred Wegener		艾尔弗雷德·魏格纳(德国科学家，提出大陆漂移学说)
11. propose	*v.*	提出
12. land mass		地块，陆块
13. supercontinent	*n.*	超大陆
14. Pangaea	*n.*	联合古陆(假定的古代超大陆)
15. split	*v.*	分裂
16. drift	*v.*	漂流
17. continental drift		大陆漂移(说)

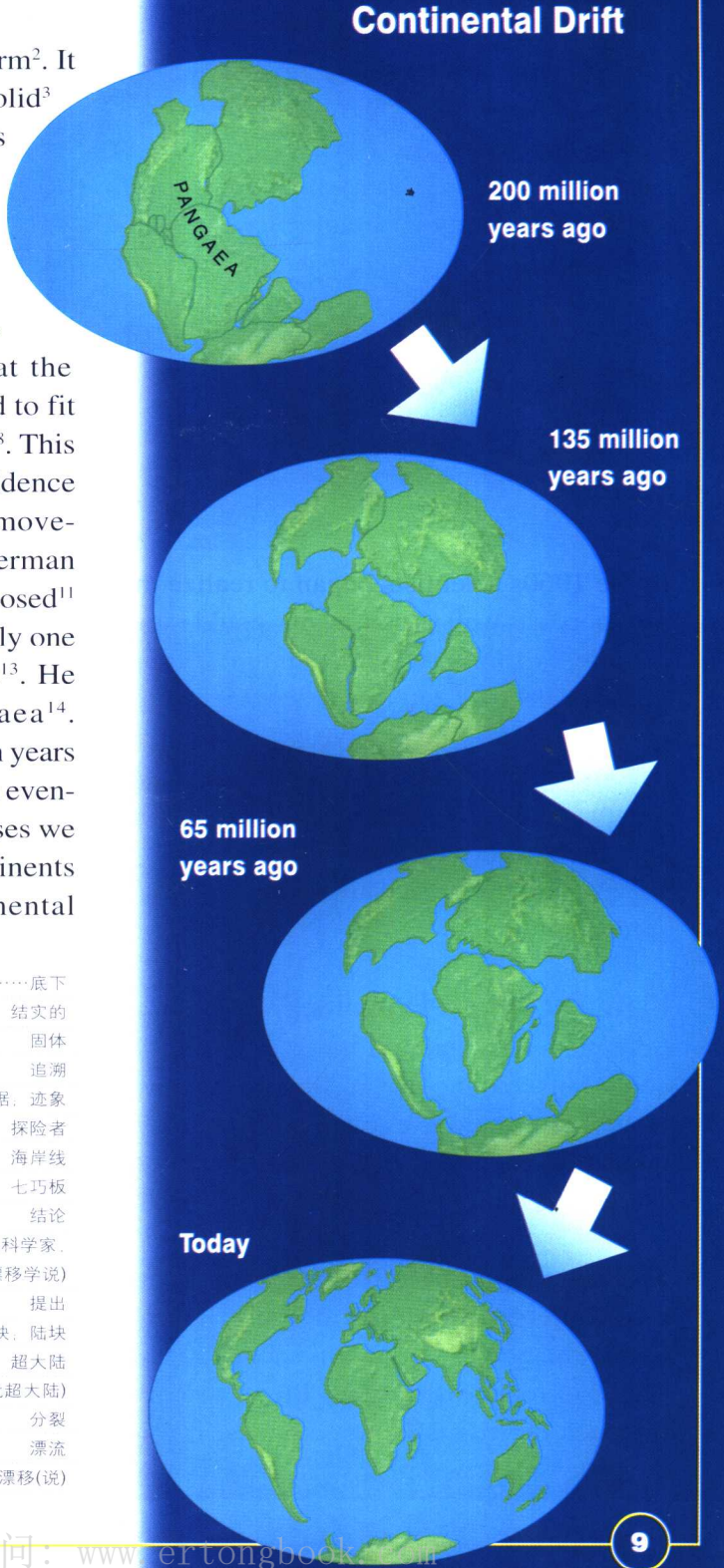
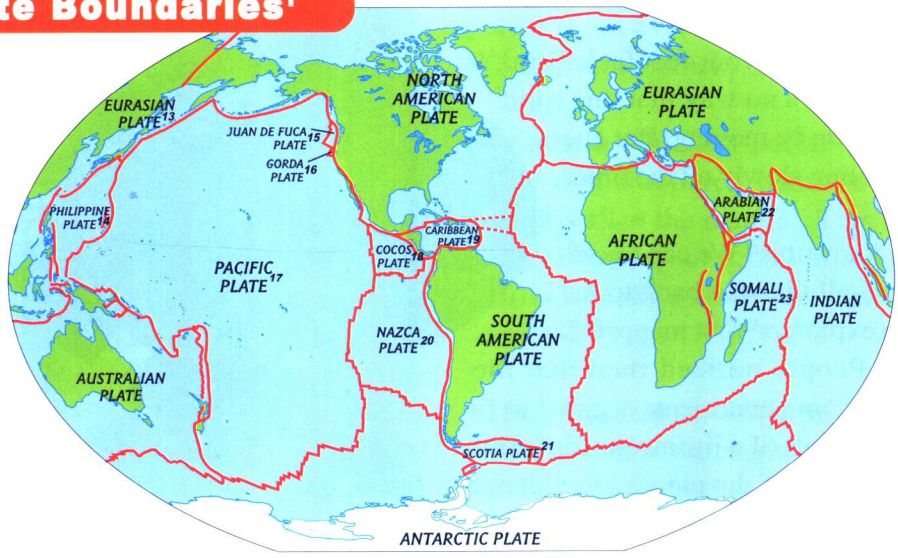


Plate Boundaries[1]



In the 1960s scientists began to realize that seafloors[2], as well as continents, could move. A series[3] of underwater mountains, called mid-ocean[4] ridges[5], was discovered. New crust forms at these ridges when magma pushes up through cracks[6] in the ridges. As magma cools, it hardens into solid rock. This new rock pushes the older rock material[7] to each side of the ridge causing the seafloor to spread apart.

Plate Tectonics[8] Explains It

Scientists now had evidence that both the continents and the ocean floor could move. Now they needed to explain how this movement could happen. In the 1960s the theory[9] of plate tectonics did just that.

The theory of plate tectonics says that Earth's crust, along with the solid upper[10] part of Earth's mantle, is broken into about 20 huge slabs[11] of rock called plates. Magma rises up between the edges of some plates, forcing the plates apart. The plates can move because they slide[12] over the hotter, softer rocks in the mantle beneath them.

Does this mean the continents we live on are actually moving all the time? Yes. Each continent on Earth is part of one or more plates

1. plate boundary		板块分界线
2. seafloor	*n.*	海底
3. series	*n.*	系列，连续
4. mid-ocean	*adj.*	海洋中部的
5. ridge	*n.*	山脊，山脉
6. crack	*n.*	裂缝
7. material	*n.*	物质
8. plate tectonics		板块构造学说
9. theory	*n.*	理论
10. upper	*adj.*	上面的
11. slab	*n.*	厚块
12. slide	*v.*	滑行，滑动
13. Eurasian Plate		欧亚板块
14. Philippine Plate		菲律宾板块
15. Juan de Fuca Plate		胡安·德富卡板块
16. Gorda Plate		戈达板块
17. Pacific Plate		太平洋板块
18. Cocos Plate		科科斯板块
19. Caribbean Plate		加勒比板块
20. Nazca Plate		纳斯卡板块
21. Scotia Plate		斯科舍板块
22. Arabian Plate		阿拉伯板块
23. Somali Plate		索马里板块

and moves with those plates. The movement of plates is very slow—only a few centimeters[1] a year—so we don't notice the motion[2]. But over millions of years, the action of the moving plates reshapes[3] continents and ocean floors.

Plates move away from each other, slide past each other, and even run into[4] each other. When this happens, there is action on Earth's surface.

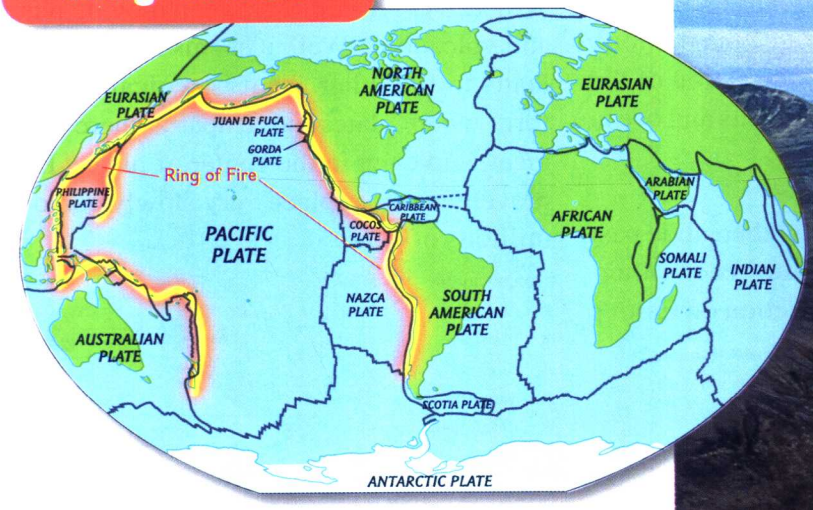
Where the Action Is

Is there a connection[5] between moving plates and volcanoes? Well, it seems that one often leads to the other. That is, volcanoes may form where plates move apart, where plates meet, and even in the center of plates. Plate movement takes place very slowly and over millions of years.

1.	centimeter	*n.*	厘米
2.	motion	*n.*	运动
3.	reshape	*v.*	使再成形；给……以新形式
4.	run into		撞上；偶遇
5.	connection	*n.*	联系
6.	Pinatubo		皮纳图博火山
7.	Philippines		菲律宾

Ash from Pinatubo's[6] 1991 eruption in the Philippines[7] covers a nearby village.

Ring of Fire



Plates Moving Apart

As plates move away from each other, cracks in Earth's crust can form. When magma rises through these cracks, volcanoes form along the edges of the plates. These volcanoes are called rift[1] volcanoes, and they usually form at the bottom of the ocean along mid-ocean ridges. Sometimes the new crust of a rift volcano builds up over so many years that it eventually rises above the water. A rift volcano near Iceland[2] rose above the Atlantic Ocean[3] in 1963. This volcano became the island of Surtsey.

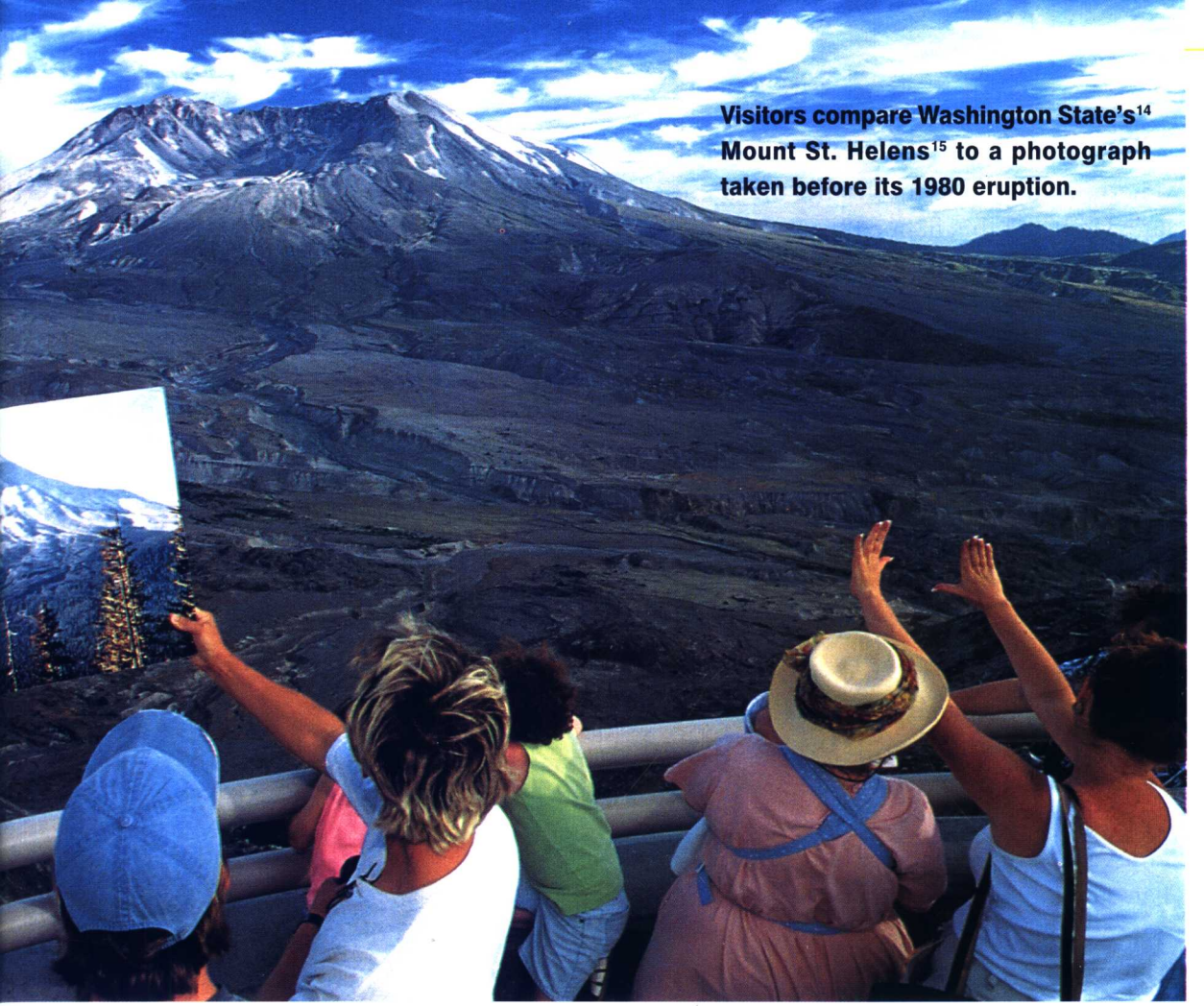
More than 80 percent[4] of the active volcanoes in the world are found around the plates that form the floor of the Pacific Ocean. This ring of volcanoes is known as the Pacific Ring of Fire.

Plates Crashing[5] Together

When two plates collide[6], or come together, several things can happen. If there is a continent on both sides of the plates, the crust of the continents can bend and wrinkle[7]. (Think about the bending and wrinkling of metal[8] when two cars collide.) This wrinkling can eventually form mountains. The Himalayas[9] was formed this way. This range includes the highest mountains in the world.

If there is a continent on one plate and an ocean floor on the other plate when the plates collide, a volcano can form. This is because

(注释见第 13 页)



Visitors compare Washington State's[14] Mount St. Helens[15] to a photograph taken before its 1980 eruption.

the ocean plate slides under the continental plate. As the plate slides deep into the mantle, the rock melts to form magma. Pressure[10] then forces the magma through weak spots[11] in the crust. In time, the magma can break through a hole, or vent[12], in Earth's crust. At the surface, the magma is called lava, which cools and hardens into rock. With many eruptions, the lava, along with cinders and ash, piles up and up until the volcano becomes a mountain.

1.	rift	*n.*	裂缝
2.	Iceland		冰岛
3.	Atlantic Ocean		大西洋
4.	percent	*n.*	百分数
5.	crash	*v.*	猛撞
6.	collide	*v.*	碰撞
7.	wrinkle	*v.*	皱起
8.	metal	*n.*	金属
9.	Himalayas		喜马拉雅山脉
10.	pressure	*n.*	压力
11.	spot	*n.*	地点
12.	vent	*n.*	火山口
13.	Washington State		华盛顿州
14.	Mount St. Helens		圣海伦斯火山

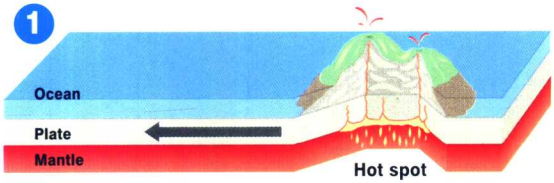
Activity Underneath[1] the Plates

Not all volcanoes form at the edges of plates. Sometimes they pop up[2] in the middle of a plate. How can this happen?

Scientists think that in some places magma rises to the crust from deep within the mantle. These places are called hot spots[3]. As a plate moves over a hot spot, magma can melt through the plate and form a volcano. (Remember that Earth's crust is not very thick under the oceans.) If the volcano erupts many times, it can build up to form an island. Eventually, the plate moves. Since the island has become part of the plate, it moves with the plate. However, the hot spot under the plate stays in the same place. A second volcano can now form over the hot spot. If this volcano erupts many times, another island can form. Over time as the plate continues to move, it can take that island with it too. Then another volcano can form and grow into another island on the same hot spot. The chain[4] of Hawaiian Islands[5] formed this way over millions of years.

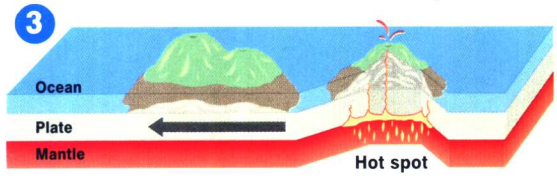
1.	underneath	*prep.*	在……下面
2.	pop up		突然爆发
3.	hot spot		热点
4.	chain	*n.*	一连串，一系列
5.	Hawaiian Islands		夏威夷群岛
6.	numerous	*adj.*	许多的
7.	continue	*v.*	继续
8.	process	*n.*	过程
9.	repeat	*v.*	重复

How Island Chains Form from Hot Spots

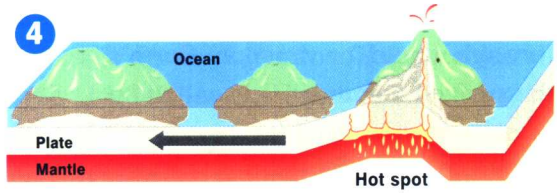


Magma from the hot spot rises through the plate. (The plate consists of the crust and solid, upper part of the mantle.) An island is formed after many eruptions.

As the plate moves, the volcano moves with it. The hot spot remains in the same place.



The first volcano stops erupting. A second volcano forms at the hot spot. After numerous[6] eruptions, another island is formed.



The plate continues[7] to move. The two islands travel away from the hot spot. The process[8] repeats[9] as another new volcano forms over the hot spot.

Thinking Like a Scientist: Predicting[1]

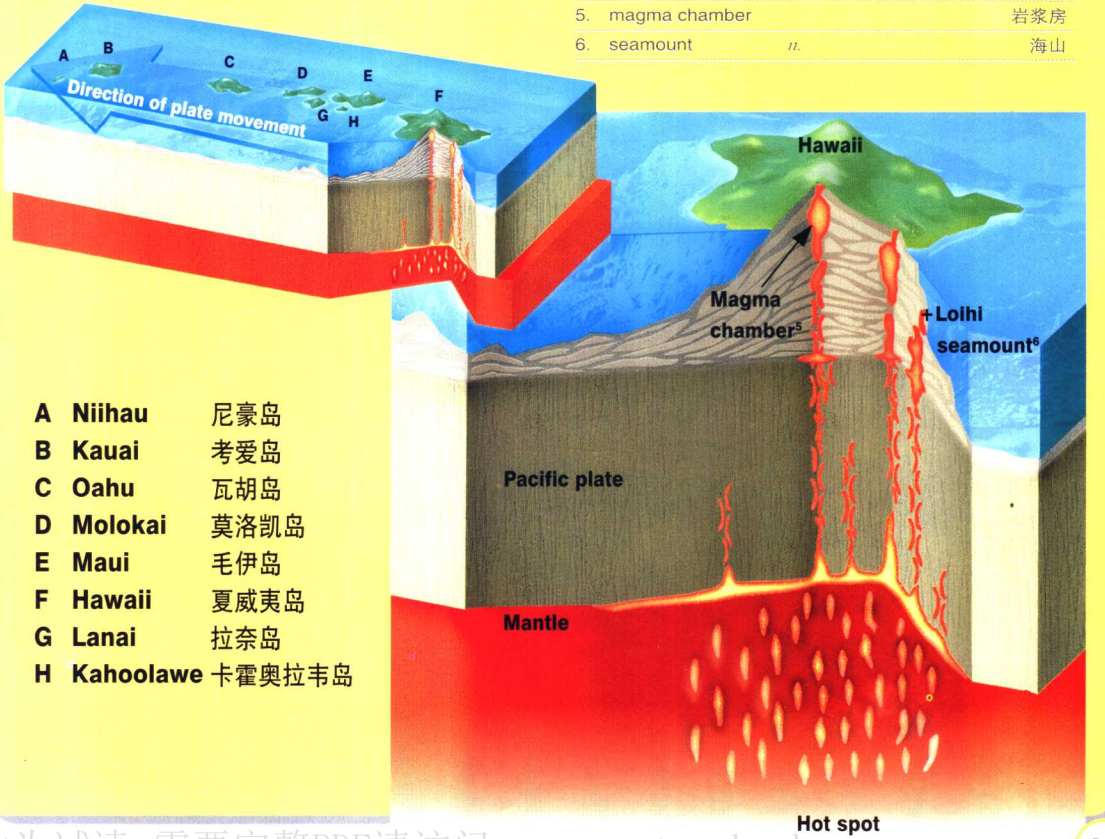
Sometimes it is helpful for scientists to make a prediction; that is, they form an idea about what will happen in the future. A prediction is more likely to be correct if it is based on information that comes from observing[2] what has happened in similar[3] situations[4].

The chain of Hawaiian Islands was formed over millions of years as the plate on which the islands now sit moved slowly over a hot spot. Look at the drawing below and see if you can make some predictions based on what you know about hot spots.

- **Which island in the chain do you think is the oldest? Why?**
- **What do you think will happen if Loihi continues to erupt and grow?**

1.	predict	*v.*	预测；预报
2.	observe	*v.*	观察
3.	similar	*adj.*	相似的
4.	situation	*n.*	形势；情况
5.	magma chamber		岩浆房
6.	seamount	*n.*	海山

Hawaii's Chain of Islands



A Niihau 尼豪岛
B Kauai 考爱岛
C Oahu 瓦胡岛
D Molokai 莫洛凯岛
E Maui 毛伊岛
F Hawaii 夏威夷岛
G Lanai 拉奈岛
H Kahoolawe 卡霍奥拉韦岛