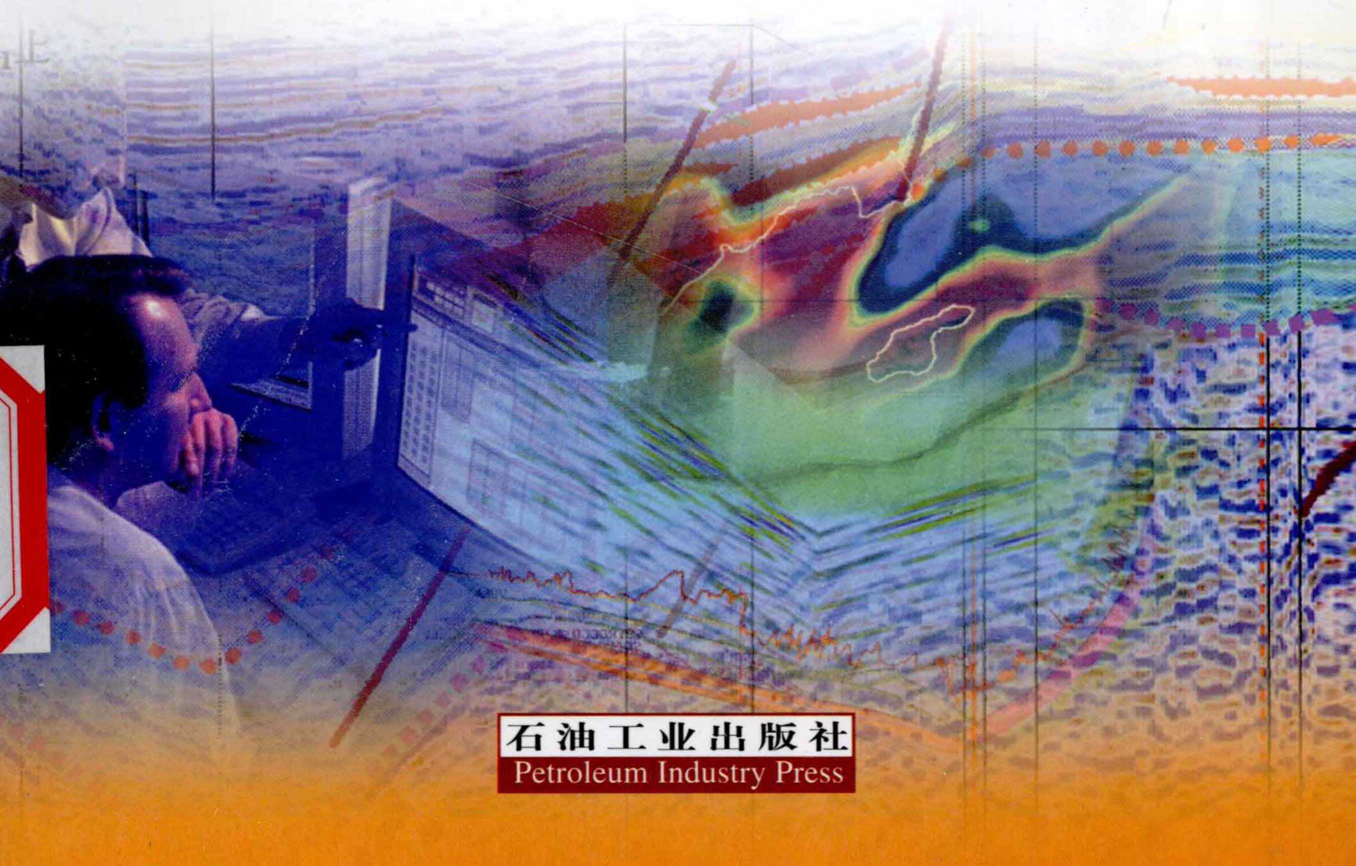
高等院校石油天然气类规划教材

English for Resource Prospecting Engineering

资源勘查工程专业英语

张树林　黄文辉　白国平　主编



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内 容 提 要

本书包括地球科学概论、沉积岩与沉积相、构造地质与板块构造、油气成藏机理、油气田勘探与资源评价、油气田开发地质及煤田地质等基本内容。全书共3个单元63课，每课由课文、词汇及难句翻译三部分组成，涵盖最新油、气、煤地质研究主要内容。

本书为高等院校资源勘查工程及地质工程本科专业英语教材，也可供相关专业的师生以及从事油气田、煤田勘探开发工作的生产和科研人员参考。

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前　言

伴随着我国经济持续稳定的快速发展，国民经济对石油与天然气资源的需求日益增加。目前，中国油气资源对外依存度已超过50%。为了保证国民经济发展所需的油气资源供给，石油与天然气勘探开发必须立足国内、开拓海外。培养“懂专业，精外语”的复合型人才，让学生具备较强的专业英语听、说、读、写、译能力已成为现代高校国际化人才的重要培养目标之一。

多年来，全国高校资源勘查工程专业一直缺乏一套正式出版的专业英语统编教材。鉴于这种情况，石油工业出版社组织全国7所知名高校部分石油及地矿类专业英语骨干教师，于2009年11月在中国石油大学（北京）召开了资源勘查工程专业英语教材编审研讨会，结合各高校多年专业英语教学经验及专业英语教学发展趋势，讨论并制定了资源勘查工程专业英语教材编写大纲。

教材编写共分3个单元63课，涵盖了地球科学概论、沉积岩与沉积相、构造地质与板块构造、油气成藏机理、油气田勘探与资源评价、油气田开发地质及煤田地质等基本内容。第一单元为地质学基础（Basic Geology），共计31课，由东北石油大学、中国地质大学（北京）、西安石油大学编写；第二单元为油气地质学（Oil & Gas Geology），共计25课，由中国石油大学（北京）、西南石油大学、长江大学编写；第三单元为煤田地质学（Coal Geology），共计7课，由辽宁工程技术大学承担编写。最后，由张树林、黄文辉、白国平进行了统编统审。

本书作为本科生教材，在内容编写上，力求单词及词组覆盖面大，专业内容涉及面广，并反映国内外最新的油气地质研究新理论与新成果；在体系安排上，遵从专业课教学的系统性及完整性，遵循由浅入深、循序渐进的教学规律，实现专业英语教学与专业课教学相匹配。学生在学习专业英语的同时，又学习了专业知识，达到专业与外语相互促进提高的目的。

本教材是国内7所高校石油与地矿类专业英语教师多年教学成果的积累和心血的结晶，同时，在教材编写过程中参考了大量国内外相关教材、专著和文献。在此，编者对参与本书编写的教师、文中相关文献的作者，以及支持和帮助本教材出版发行的单位及领导表示衷心感谢。

由于水平有限，教材中难免会有不妥之处，敬请广大师生及读者批评指正，以便再版时修订。

编者

2010年6月

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Unit 1 Basic Geology

Lesson 1 Geology

Earth science (also known as geoscience, the geosciences or the Earth sciences), is an all-embracing term for the sciences related to the planet Earth. It is arguably a special case in planetary science, the Earth being the only known life-bearing planet. There are both reductionist and holistic approaches to Earth sciences. The formal discipline of Earth sciences may include the study of the atmosphere, oceans and biosphere, as well as the solid earth. Geology is generally categorized within the geosciences.

Geology (from the Greek, geo, "earth" and logos, "speech") is a natural science, which studies the geology science of the Earth's history, composition, and structure, and the associated processes. It draws upon chemistry, biology, physics, astronomy, and mathematics (notably statistics) for support of its formulations.

Geology is a very complex science. There are many branches of geology, which can be grouped under the major headings of physical and historical geology.

Physical Geology

Physical geology includes **mineralogy**, the study of the chemical composition and structure of minerals; **petrology**, the study of the composition and origin of rock; **geomorphology**, the study of the origin of landforms and their modification by dynamic processes; **geochemistry**, the study of the chemical composition of the Earth materials and the chemical changes that occur within the Earth and on its surface; **geophysics**, the study of the behavior of rock materials and in response to stresses and according to the principles of physics; **sedimentology**, the science of the erosion and deposition of rock particles by wind, water, or ice; **structural geology**, the study of the forces that deform the Earth's rocks and the description and mapping of deformed rock bodies; **economic geology**, the study of the exploration and recovery of natural resources, such as ores and petroleum; and engineering geology, the study of the interaction of the Earth's crust with human-made structures such as tunnels, mines, dams, bridges, and building foundations.

Historical Geology

Historical geology deals with the historical development of the Earth from the study of its rocks. They are analyzed to determine their structure, composition, and interrelationships and are examined for remains of past life. Historical geology includes **paleontology**, the systematic study of past life forms; **stratigraphy**, of layered rocks and their interrelationships; **paleogeography**, of the locations of ancient land masses and their boundaries; and geologic mapping, the superimposing of geologic information upon existing topographic maps.

Historical geologists divide all time since the information of the earliest known rocks (about 4 billion years ago) into four major divisions: the **Precambrian**, **Paleozoic**, **Mesozoic**, and **Cenozoic** eras. Each, except the Cenozoic, ended with profound changes in the disposition of the Earth's continents and mountains and was characterized by the emergence of new forms of life. Broad cyclical patterns, which run through all historical geology, include a period of mountain and continent building followed one of erosion and, in turn, by a new period of elevation.

Early Geologic Studies

Observations on Earth structure and processes were made by a number of the ancients, including **Herodotus**, **Aristotle**, Lucretius, Strabo, and Seneca. Their individual efforts in the natural history of the Earth, however, provided no sustained progress. Their major contribution is that they attributed the phenomena they observed to natural and not supernatural causes. Many of the ideas expressed by these men were not to resurface until the **Renaissance**. Later, Leonardo da Vinci correctly speculated on the nature of fossils as remain of ancient organisms and on the role that rivers play in the erosion of land. Agricola made a systematic study of ore deposits in the early 16th century. Robert Hooke and Nicolaus Steno both made penetrating observations on the nature of fossils and sediments.

Evolution of Modern Geology

Modern geology began in the 18th century, when field studies by the French mineralogist J. E. Guttard and others proved more fruitful than speculation. The German geologist **Abraham Gottlob Werner**, in spite of the many errors of his specific doctrines and the diversion of much of his energy into a fruitless controversy (in which he maintained that origin of all rocks was **aqueous**), performed a great service for the science by demonstrating the chronological succession of rocks.

In 1795, the Scottish geologist James Hutton laid the theoretical foundation for much of the modern science with his doctrine of **uniformitarianism**, first popularized by the British John Playfair. Largely through the work of Sir Charles Lyell, this doctrine replaced the opposing one of **catastrophism**. Geology in the 19th century was influenced also by the work of **Charles Darwin** and enriched by the researches of the Swiss-American Louis Agassiz.

In the 20th century, geology has advanced at an ever-increasing pace. The unraveling of the mystery of atomic structure and the discovery of radioactivity allowed profound advances in many phases of geologic research. Important discoveries were made during the International Geological Year (1957 – 1958), when scientists from 67 nations joined force in investigating problems in all branches of geology. The systematic survey of the Earth's oceans brought radical changes in concepts of crustal evolution.

As a result of numerous flyby spacecrafts, geological studies have been extended to include **remote sensing** of other planets and satellites in the solar system and the Moon. Laboratory analyses of rocks samples brought back from the Moon have provided insight into the early history of near-Earth space. On-site analyses of Martian soil samples and photographic mapping of its surface have given clues about its composition and geologic history, including the possibility that Mars once had enough water to form oceans. Photographs of the many active volcanoes on Jupiter's Moon have provided clues about Earth's early volcanic activity. Geological studies also have been furthered by orbiting laboratories, such as the six launched between 1964 in the Orbiting Geophysical Observatory (OGO) series and the Polar Orbiting Geomagnetic Survey (POGS) satellite launched in 1990; remote-imaging spacecraft, such as the U. S. Landsat program (**Landsat 7**, launched in 1999, was the most recent) and French SPOT series (SPOT 4, launched in 1988, was the most recent in the program); and geological studies on **space shuttle** missions.

New Words and Phrases

1. mineralogy [minəˈrælədʒi] *n.* 矿物学
2. petrology [piˈtrɔlədʒi] *n.* 岩石学
3. geomorphology [ˌdʒiːəumɔːˈfɔlədʒi] *n.* 地貌学
4. geochemistry [ˌdʒiːəuˈkemistri] *n.* 地球化学
5. geophysics [ˌdʒiːəuˈfiziks] *n.* 地球物理学
6. sedimentology [sedimənˈtɔlədʒi] *n.* 沉积学
7. structural geology 构造地质学
8. economic geology 经济地质学（矿床学）
9. paleontology [ˌpælionˈtɔlədʒi] *n.* 古生物学
10. stratigraphy [strəˈtigrəfi] *n.* 地层学
11. paleogeography [ˌpæliəudʒiˈɔgrəfi] *n.* 古地理学
12. Precambrian [priːˈkæmbriən] *n.* & *adj.* 前寒武纪（的）
13. Paleozoic [pæliəˈzəuk] *n.* & *adj.* 古生代（界）（的）
14. Mesozoic [ˌmesəuˈzəuik] *n.* & *adj.* 中生代（界）（的）
15. Cenozoic [ˌsiːnəˈzəuik] *n.* & *adj.* 新生代（界）（的）
16. Herodotus [hiˈrɔdətəs] 希罗多德（约公元前485—约公元前425），希腊历史学家
17. Aristotle [ˈæristɔtl] 亚里士多德（公元前384—公元前322），古希腊哲学家、科学家
18. Renaissance [rəˈneisəns] *n.* 文艺复兴（时期）
19. Abraham Gottlob Werner 亚博海姆·歌特劳博·维尔纳（1749—1817），德国地质学家、矿物学家，水成论创立者
20. aqueous [ˈeikwiəs] *adj.* 含水的，似水的
21. uniformitarianism [ˌjuːnifɔːməˈtɛəriənizəm] *n.* 均变论
22. catastrophism [kəˈtæstrəfizəm] *n.* 灾难论
23. Charles Darwin 查尔斯·达尔文（1809—1882），英国博物学家，进化论创立者

24. remote sensing　遥感
25. Landsat [ˈlændsæt]　*n.*（美国）地球资源（探测）卫星
26. space shuttle　航天飞机

Translations of Difficult Sentences

（1）Broad cyclical patterns, which run through all historical geology, include a period of mountain and continent building followed one of erosion and, in turn, by a new period of elevation.

贯穿整个地质历史最主要的循环模式是，一个时期的造山和造陆，随后是一个时期的侵蚀，接着是一个新时期的抬升。

（2）Their individual efforts in the natural history of the Earth, however, provided no sustained progress.

然而，他们的个人努力并没有使地球的自然历史研究获得持续进步。

（3）Later, Leonardo da Vinci correctly speculated on the nature of fossils as remain of ancient organisms and on the role that rivers play in the erosion of land.

后来，列奥纳多·达·芬奇正确地推测了化石是古代生物的遗体以及河流对陆地的剥蚀作用。

Lesson 2 The Earth

In geology and **astronomy**, the Earth is the fifth largest planet of the **solar system** and the only planet definitely known to support life. **Gravitation** forces have molded the Earth, like all **celestial bodies**, into a spherical shape. However, the Earth is not an exact sphere, being slightly flattened at the poles and bulging at the **equator**, which means that the equatorial diameter of 12,756km is larger than the polar diameter of 12,714km. The mass of the Earth is 6×10^{24}kg. The **altitude** of the surface features range from 11km below to 9km above sea level, and 70% of the surface is covered with liquid water, which makes it unique in the solar system. Additional, Earth has an atmosphere reaching several hundred km into space, consisting of 78% nitrogen, 21% oxygen, 1% other gases including carbon dioxide and water vapour. Earth is the only planet in our solar system to have large quantities of free oxygen in its atmosphere.

Knowledge of the Earth's interior has been gathered by three methods: by the analysis of earthquake waves passing through the Earth; by analogy with the composition of **meteorites**; and by consideration of the Earth's size, shape, and density. Research by these methods indicates that the Earth has a zoned interior, consisting of **concentric** shells differing from one another by size, chemical makeup, and density. The planet Earth is made up of three main shells: the very thin, **brittle** crust, the mantle, and the core; the mantle and core are each divided into two parts. Although the core and mantle are about equal in thickness, the core actually forms only 15 percent of the Earth's volume, whereas the mantle occupies 84 percent. The crust makes up the remaining 1 percent.

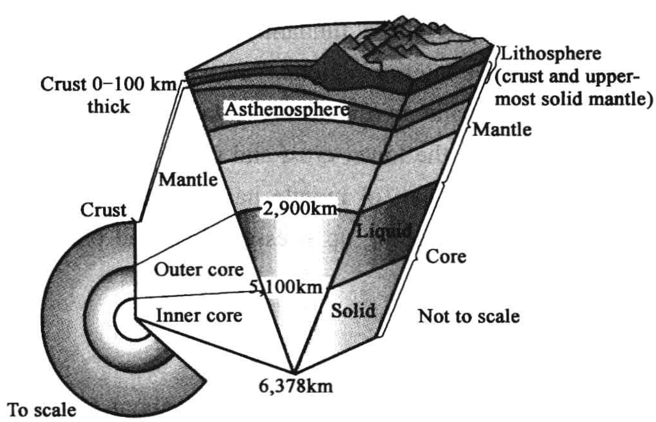

Figure of The Earth's Layers

The Earth's Crust and the Moho

Because the crust is accessible to us, its geology has been extensively studied, and therefore much more information is known about its structure and composition than about the structure and composition of the mantle and core. Within the crust, **intricate** patterns are created when rocks are redistributed and deposited in layers through the geologic processes of eruption and intrusion of lava, erosion, and consolidation of rock particles, and solidification and recrystallization of porous rock. By the large-scale process of plate tectonics, about twelve plates, which contain combinations of continents and ocean basins, have moved around on the Earth's surface through much of geologic time. The edges of the plates are marked by concentrations of earthquakes and volcanoes. **Collisions** of plates can produce mountains like the **Himalayas**, the tallest range in the world. The plates include the crust and part of the upper mantle, and they move over a hot, yielding upper mantle zone at very slow rates of a few centimeters per year, slower than the rate at which fingernails grow. The crust is much thinner under the oceans than under continents.

The boundary between the crust and mantle is called the **Mohorovicic discontinuity** (or **Moho**); it is named in honor of the man who discovered it, the Croatian scientist Andrija Mohorovicic. No one has ever seen this boundary, but it can be detected by a sharp increase downward in the speed of earthquake waves there. The explanation for the increase at the Moho is presumed to be a change in rock types. Drill holes to penetrate the Moho have been proposed, and a Soviet hole on the Kola Peninsula has been drilled to a depth of 12km, but drilling expense increases enormously with depth, and Moho penetration is not likely very soon.

The Earth's Mantle

Extending to a depth of about 2,900km, the mantle probably consists of very dense (average about 3.9g/cm^3) rock rich in iron and magnesium minerals. Although temperatures increase with depth, the melting point of the rock is not reached because the melting temperature is raised by the great confining pressure. At depths between about 100km and about 200km in the mantle, a plastic zone, called the **asthenosphere**, is found to occur. Presumably the rocks in this region are very close to melting, and the zone represents a fundamental boundary between the moving **crustal plates** of the Earth's surface and the interior regions. The molten **magma** that intrudes upward into crustal rocks or issues from a volcano in the from of **lava** may owe its origin to **radioactive** heating or to the relief of pressure in the lower crust and upper mantle. Similarly, it is thought that the heat energy released in the upper part of mantle has broken the Earth's crust into vast plates that slide around on the plastic zone, setting up stresses along the plate margins that result in the formation of folds and faults.

The Earth's Core

Though to be composed of iron and nickel, the dense (about 11.0g/cm^3) core of the Earth lies below mantle. The abrupt disappearance of direct **compressional** earthquake waves, which cannot travel though liquids, at depths below about 2,900km indicates that the outer 2,200km of the core are molten. It is thought, however, that the inner 1,260km of the core are solid. The outer core is thought to be the source of the Earth's magnetic field: In the "**dynamo theory**" advanced by W. M. Elasser and E. Bullard, tidal energy or heat is converted to mechanical energy in the form of currents in the liquid core; this mechanical energy is then converted to electromagnetic energy, which we see as the magnetic field.

The Earth's Age

The Earth is estimated to be 4.5 billion to 5 billion years old, based on radioactive dating of **lunar** rocks and meteorites, which are thought to have formed at the same time. The origin of the Earth continues to be controversial. Among the theories as to its origin, the most prominent are **gravitational condensation hypotheses**, which suggest that the entire solar system was formed at one time in a single series of processes resulting in the accumulation of diffuse **interstellar** gases and dust into a solar system of discrete bodies. Old and now generally discredited theories invoked extraordinary events, such as gravitational disruption of a star passing close to the sun or the explosion of a companion star to the sun.

New Words and Phrases

1. astronomy [ə'strɔnəmi] *n.* 天文学
2. solar system *n.* 太阳系
3. gravitation [ˌgrɑvi'teiʃən] *n.* 地心吸力
4. celestial body 天体
5. equator [i'kweitə] *n.* 赤道
6. altitude ['æltitjuːd] *n.* （海拔）高度
7. meteorite ['miːtjətait] *n.* 陨石
8. concentric [kɔn'sentrik] *adj.* 同心的
9. brittle ['britl] *adj.* 易碎的
10. intricate ['intrikit] *adj.* 复杂的
11. collision [kə'liʒən] *n.* 碰撞
12. Himalayas [ˌhimə'leiəz] *n.* 喜马拉雅山脉
13. Moho ['məuhəu] *n.* 莫霍面 （Mohorovii discontinuity 莫霍不连续面）
14. asthenosphere [æs'θinəsfiə] *n.* 软流圈
15. crustal plate 地壳板块
16. magma ['mægmə] *n.* 岩浆
17. lava [lɑːvə] *n.* 熔岩
18. radioactive [ˌreidiəu'æktiv] *adj.* 放射性的
19. compressional [kəm'preʃənəl] *adj.* 压缩的，纵（波）的
20. dynamo theory （地磁场成因的）发电机理论
21. lunar ['ljuːnə] *adj.* 月亮的，月球的
22. gravitational condensation hypotheses （天体形成的）重力凝聚假设(也称吸积作用)
23. interstellar ['intə'stelə] *adj.* 星际的

Translations of Difficult Sentences

(1) Research by these methods indicates that the Earth has a zoned interior, consisting of

concentric shells differing from one another by size, chemical makeup, and density.

这些方法表明，地球的内部是分层的，它是由同心层组成的，这些圈层的大小、化学组成和密度各不相同。

（2） Although the core and mantle are about equal in thickness, the core actually forms only 15 percent of the Earth's volume, whereas the mantle occupies 84 percent.

虽然地核和地幔在厚度上是近似均等的，但地核只占地球体积的 15%，而地幔占了 84%。

（3） Within the crust, intricate patterns are created when rocks are redistributed and deposited in layers through the geologic processes of eruption and intrusion of lava, erosion, and consolidation of rock particles, and solidification and recrystallization of porous rock.

通过岩浆喷发和侵入、侵蚀、岩石颗粒的固结以及多孔岩石的凝固和重结晶等地质过程，岩石发生再分配并沉积成层，造成了地壳内部的复杂格局。

（4） Although temperatures increase with depth, the melting point of the rock is not reached because the melting temperature is raised by the great confining pressure.

虽然温度随着深度的增加而升高，但因为熔点随着巨大的围压而升高，岩石尚未达到熔点温度。

（5） The molten magma that intrudes upward into crustal rocks or issues form a volcano in the form of lava may owe its origin to radioactive heating or to the relief pressure in the lower crust and upper mantle.

侵入地壳岩层或以熔岩形成从火山中喷出的熔融的岩浆，可能是下地壳和上地幔中热辐射或压力释放的主要原因。

（6） The outer core is thought to be the source of the Earth's magnetic field: In the 'dynamo theory' advanced by W. M. Elasser and E. Bullard, tidal energy or heat is converted to mechanical energy in the form of currents in the liquid core; this mechanical energy is then converted to electromagnetic energy, which we see as the magnetic field.

外地核被认为是地球磁场的来源，根据 W. M. Elasser 和 E. Bullard 的“发电机理论”，潮汐能或者热能可以转化为液态核中流动形式的机械能，机械能再转化为电磁能，也就是我们所知道的磁场。

Lesson 3 Earthquakes and Volcanoes

Earthquakes

Earthquake is trembling or shaking movement of the Earth's surface. Most earthquakes are minor tremors. Larger earthquakes usually begin with slight tremors but rapidly take the form of one or more violent shocks, and end in vibrations of gradually diminishing force called **aftershocks**. The **subterranean** point of origin of an earthquake is called its **focus**; the point on the surface directly above the focus is the **epicenter**. The magnitude and intensity of an earthquake is determined by the use of scales, e. g. , the **Richter scale** and **Mercalli scale**.

Most earthquakes are causally related to **compressional stress** or **tensional stress** built up at the margins of the huge moving lithospheric plates that make up the Earth's surface. The immediate cause of most shallow earthquakes is the sudden release of stress along a fault, or fracture in the Earth's crust resulting in movement of the opposing blocks of rock past one another. These movements cause vibrations to pass through and around the Earth in wave form, just as ripples are generated when a pebble is dropped into water. **Volcanic eruption**, **rockfalls**, **landslides**, and explosions can also cause a quake, but most of these are of only local extent.

There are several types of earthquake waves including P, or **primary** waves, which are compressional and travel fastest; and S, or **secondary** waves, which are transverse, i. e. , they cause the Earth to vibrate perpendicularly to the direction of their motion. Surface waves consist of several major types and are called L, or long waves. Since the velocities of the P and S waves are affected by the changes in the density and **rigidity** of the material through which they pass, the boundaries between the regions of the Earth known as the crust, mantle, and core have been discerned by **seismologists**, scientists who deal with the analysis and interpretation of earthquake waves. **Seismographs** are used to record P, S and L waves. The disappearance of S waves below depths of 2,900km indicates that at least the outer part of the Earth's core is liquid.

The effects of an earthquake are strongest in a broad zone surrounding the epicenter. The extent of earthquake vibration and subsequent damage to a region is partly dependent on characteristics of the ground. For example, earthquake vibrations last longer and are of greater **wave amplitudes** in unconsolidated surface material, such as poorly compacted fill or river deposits; **bedrock** areas receive fewer effects. The worst damage occurs in densely populated urban areas where structures are not built to withstand intense shaking. There, L waves can produce destructive vibrations in buildings and break water and gas lines, starting uncontrollable fires.

Damage and loss of life sustained during an earthquake result from falling structures and flying glass and objects. Flexible structures built on bedrock are generally more resistant to earthquake damage than rigid structures built on loose soil. In certain areas, an earthquake can trigger **mudslides**, which slip down mountain slopes and can bury habitations below. A submarine earthquake can cause **tsunamis**, damaging waves that ripple outward from the earthquake epicenter and **inundate** coastal cities.

On average about 1,000 earthquakes with intensities of 5.0 or greater are recorded each year. Great earthquakes (intensity 8.0 or higher) occur once a year, major earthquakes (intensity 7.0 – 7.9) occur 18 times a year, strong earthquakes (intensity 6.0 – 6.9) 10 times a month, and moderate earthquakes (intensity 5.0 – 5.9) more than twice a day. Because most of these occur under the ocean or in underpopulated areas, they pass unnoticed by all but seismologists.

Volcanoes

Volcanoes are vents or fissures in the Earth's crust though which gases, molten rock, or lava, and solid fragments are discharged. The term volcano is commonly applied both to the vent and to the conical mountain built up around the vent by the erupted rock materials. Volcanoes are described as active, **dormant**, or extinct. The soil resulting from decomposition of volcanic materials is extremely fertile, and the ash itself is a good polishing and cleansing agent.

Volcanoes are found in association with mid-oceanic ridge systems and along **convergent plate boundaries**, such as around the Pacific Ocean's "Ring of Fire", the ring of plate boundaries associated with volcanic island arcs and **ocean trenches** surrounding the Pacific Ocean. Isolated volcanoes also form in the mid-oceanic area of the Pacific apparently unrelated to crustal plate boundaries. These sea mounts and volcanic island chains, such as the Hawaiian chain, may form from rising magma regions called hot spots.

More than 500 volcanoes known to have erupted on the Earth's surface since historic times, and many more have erupted on the ocean floor unobserved by humans. Fifty volcanoes have erupted in the United States, which ranks third, behind Indonesia and Japan, in the number of historically active volcanoes. Of the world's active volcanoes, more than half are found around the **perimeter** of the Pacific, about a third on mid-oceanic islands and in an arc along the south of the Indonesian island, and about a tenth in the Mediterranean area, Africa, and Asia Minor.

Evidence of **extraterrestrial** volcanic activity also has been found. **Space probes** have detected the remnants of ancient eruptions on Moon, Mars, and Mercury; these probably originated billions of years ago, since these bodies are no longer capable of volcanic activity. Triton (a satellite of **Neptune**), *Io* (a satellite of **Jupiter**), and **Venus** are the only bodies in the solar system besides Earth that are known to be volcanically active. The volcanic processes that occur in the outer portion of the solar system are very different from those in the inner part. Eruptions on Earth, Venus, Mercury, and Mars are of rocky material and are driven by internal heat. *Io*'s eruptions are probably sulfur compounds driven by tidal interactions with Jupiter. Triton's eruptions are of very volatile compounds, such as methane or nitrogen, driven by seasonal heating from the sun.

Terrestrial volcanic eruptions may take one or more of four chief forms, or phases, known as Hawaiian, Strombolian, Vulcanian, and Pelean. In the Hawaiian phase there is a relatively quiet effusion of **basaltic** lava unaccompanied by explosions or the ejection of fragments; the eruptions of Mauna Loa on the island of Hawaii are typical. The Strombolian phase derives its name from the