МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ОБРАЗОВАНИЮ

КУРГАНСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ

КАФЕДРА ИНОСТРАННЫХ ЯЗЫКОВ
ЕСТЕСТВЕННОНАУЧНЫХ СПЕЦИАЛЬНОСТЕЙ

АНГЛИЙСКИЙ ЯЗЫК

ГЕОГРАФИЯ

Методические указания
по развитию навыков перевода и
реферирования текстов на английском языке
для студентов младших курсов
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Методические указания ориентированы на обучение студентов специальности «География» - 020401. Методические указания ставят своей целью обучить студентов навыкам перевода и реферирования текстов по специальности, делать сообщения и обсуждать темы, используя самые употребительные языковые средства и основные географические термины.

The Comoro Islands

The Comoro Islands are an archipelago of four islands and several islets located in the western Indian Ocean about ten to twelve degrees south of the Equator and less than 200 miles off the East African coast. They lie approximately halfway between the island of Madagascar and northern Mozambique at the northern end of the Mozambique Channel. The archipelago is the result of volcanic action along a fissure in the seabed running west-northwest to east-southeast. The total area of the four islands is 2,034 square kilometers.

The four major islands are Ngazidja, Mwali, Nzwani, and Mayotte (Maore). Ngazidja is the largest and the youngest island in the archipelago. It is the most westerly of the islands, lying 188 miles from Mozambique. Ngazidja has an active volcano that rises to a height of 2,361 meters above sea level. Mwali, 28 miles south-southeast of Ngazidja, is the smallest of the islands with a central mountain range that rises 790 meters above sea level. Nzwani lies about twenty-five miles easterly of Mwali, has a central peak that rises 1,575 meters above sea level. It also has several swift running streams that cascade down to long, sandy beaches. Forty-four miles to the southeast of Nzwani is Mayotte (Maore), the oldest of the islands. It is almost surrounded by a barrier reef and is fairly flat with slow meandering streams and mangrove swamps.

THE URAL MOUNTAINS

Ural Mountains is a mountain chain in Russia, extending 2,400 km from its northern boundary at the Arctic Ocean to its southern limits at the steppes of Kazakhstan, traditionally separating the continents of Europe and Asia. The chain is divided roughly into four main divisions: the Polar, Northern, Middle, and Southern Urals. The Polar Urals (above latitude 64° North) are treeless arctic tundra. The Northern Urals (latitude 64° North to latitude 61° North) constitute a distinct craggy, treeless, narrow range with crests averaging 300 to 500 m in height. This range contains the highest Ural crest, Gora Narodnaya. Other Northern peaks include Mount Sablya, Telpos-Iz, and Isherim. The only trees in the area are sparse growths of larch (a type of pine tree).

Numerous plateaus, characterized by broad, flat, marshy valleys, extend in a southwestern direction from the southern limits of the Northern Urals. The entire Middle Ural region (latitude 61° North to latitude 60° North) is covered with dense coniferous forests. A succession of northeastern mountain chains marks the northern boundary of the Middle Urals. The southern boundary is marked by numerous hills of 300 to 600 m separated by deep ravines. The Konzhakovskiy Kamen, 1,571 m high, is the highest peak of both the northern and southern portions of the Middle Urals. Dense forests, rich soils, and fertile valleys cover the entire area.

South of the Middle Urals (latitude 55° North to latitude 51° North) are three parallel mountain chains called the Southern Urals. The first of these, the Urals proper, is a low chain ranging in height from 670 to 850 m. To the west, a higher range, containing many rivers, reaches a height of 1,594 m and is paralleled farther west by an equally high range. All three ranges are heavily wooded with plant life and contain rich pasturelands. The Urals continue from latitude 51° North toward the Volga River and, under the name of Obshchiy Syrt, comprise a system of plateaus reaching 460 m in height and 320 km in width. South of the Ural River, the Ural chain appears as a group of independent ranges.

The Ural region has extensive deposits of iron ore and coal in close proximity, as well as rich deposits of chromium, manganese, copper, zinc, bauxite, platinum, silver, and gold. Just to the east of the Urals is a major oil-producing area.

THE CAUCASUS MOUNTAINS

Caucasus Mountains is a mountain range in Georgia, Armenia, Azerbaijan, and southwest Russia, considered a boundary between Europe and Asia. The range extends for about 1200 km from the Abşeron Peninsula on the southwestern shore of the Caspian Sea to the mouth of the Kuban' River on the northeastern shore of the Black Sea. The western region is drained by the Kuban' River and the eastern portion by the Kura River. Of the two principal chains within the Caucasus, the most northerly range has a number of peaks higher than about 4570 m above sea level. Elbrus, which has an altitude of 5642 m, is the highest peak in Europe. Other notable peaks include Dykh-Tau, 5,204 m; Koshtan-Tau, 5,144 m; and Kazbek, 5,037 m. The highest peaks of the western chain are about 3660 m above sea level. Geologically, the Caucasus Mountains belong to a system that extends from southeastern Europe into Asia. The mountains are composed of granite and crystalline rock. Some volcanic formations and many glaciers are found throughout the range.

The uplifting of the northern chain was begun during the Jurassic period. The western chain dates from the Tertiary period. The most important route through the range is a Georgian military highway from Vladikavkaz, Russia, on the northern side, to Tbilisi, Georgia, on the southern side. The chief minerals of the Caucasus Mountains are coal, copper, lead, manganese, and oil.

MOUNT ARARAT

Mount Ararat is a mountain in extreme eastern Turkey, near the border with Armenia and Iran. The mountain is almost completely isolated with an exception of northwest spur nearly 2,200 m high which merges with a long ridge. The mount is surrounded by elevated plains ranging from 800 to 1,400 m above sea level. The Mount Ararat rises in two peaks, known as Great Ararat (5,165 m) and Little Ararat (3,914 m). Above the 4,300-m level, Great Ararat is perpetually covered with snow. Vegetation consists for the most part of grasses.

THE ROCKY MOUNTAINS

Rocky Mountains or Rockies are a great chain of rugged mountain ranges in western North America, extending from central New Mexico to northeastern British Columbia, a distance of about 3220 km. The Great Basin and the Rocky Mountain Trench, a valley running from northwestern Montana to northern British Columbia, border the Rockies on the east by the Great Plains and on the west. The Rocky Mountains form part of the Great, or Continental, Divide, which separates rivers draining into the Atlantic or Arctic oceans from those flowing toward the Pacific Ocean. The Arkansas, Colorado, Columbia, Missouri, Río Grande, Saskatchewan, and Snake rivers rise in the Rockies.

The Rockies may be divided into four principal sections - Southern, Central, Northern, and Canadian. The Southern Rockies, which include the system's broadest and highest regions, extend from central New Mexico, through Colorado, to the Great Divide, or Wyoming, Basin, in southern Wyoming. This section, which includes Rocky Mountain National Park, consists chiefly of two northern-southern belts of mountain ranges with several basins, or parks, between the belts. The component parts include the Sangre de Cristo and Laramie mountains and the Front Range, in the east, and the San Juan Mountains and the Sawatch and Park ranges, in the west. The Southern Rockies include the chain's loftiest point, Mount Elbert (4399 m high), in central Colorado. More than 50 other peaks of the Rockies rising above 4267 m are in Colorado; these include Longs Peak (4345 m high) and Pikes Peak (4301 m high).

The Northern Rockies are in northern Idaho, western Montana, and northeastern Washington. They include the Sawtooth, Cabinet, Salmon River, and Clearwater mountains and the Bitterroot Mountains. The loftiest points in the section, which includes Glacier National Park, are Granite Peak (3901 m high) and Borah Peak (3859 m high).

The Canadian Rockies, located in southwestern Alberta and eastern British Columbia, consist of a relatively narrow belt of mountain ranges that terminates at the Liard River lowland in northeastern British Columbia. The peaks of the section, which takes in Banff, Jasper, Kootenay, Waterton Lakes, and Yoho National Parks, include Mount Robson (3954 m high), Mount Columbia (3747 m high), and The Twins (3734 m high). Slopes generally are very steep, and there are numerous glaciers.

The Rocky Mountains are a geologically complex system with jagged peaks as well as almost flat-topped elevations. The Rockies were formed mainly by crustal uplifts in comparatively recent times, during the late Cretaceous and early Tertiary periods, and later were reshaped by glaciation during the Pleistocene Epoch. Today the Rockies receive moderate amounts of precipitation, most of which occurs in the winter. Lower levels are covered chiefly by grassland, which gives way to extensive forests, principally of conifers. Above the woodland is a zone of grasses and scattered shrubs. Most peaks have little vegetation around the summit, and some have a year-round cap of snow and ice.

The Rockies are sparsely populated for the most part and contain few cities. The principal economic resources of the mountains are minerals, such as coal, copper, gold, iron ore, lead, molybdenum, petroleum and natural gas, silver, and zinc. Important mining centers include Colorado; Atlantic City, Wyoming, Idaho, Montana, British Columbia. Major forest products industries, especially lumbering, are concentrated in the Northern and Canadian Rockies, and large numbers of sheep and cattle are raised in the Rockies of Colorado, Wyoming, and Montana. The chain has many centers for outdoor recreation and tourism.

SEAS AND OCEANS

Ocean and Oceanography

Great body of salt water comprising all the oceans and seas that cover nearly three-fourths of the surface of the earth, and the scientific study of the physical, chemical, and biological aspects of the so-called world ocean. The major goals of oceanography are to understand the geologic and geochemical processes involved in the evolution and alteration of the ocean and its basin, to evaluate the interaction of the ocean and the atmosphere so that greater knowledge of climatic variations can be attained, and to describe how the biological productivity in the sea is controlled.

Ocean Basin Structure

The world ocean covers 71 percent of the earth’s surface, or about 361 million sq km. Its average depth is 5,000 m, and its total volume is about 1,347,000,000 cu km. The three major subdivisions of the world ocean are the Atlantic Ocean, the Pacific Ocean, and the Indian Ocean, which are conventionally bounded by the continental masses. The two minor subdivisions of the world ocean are the Southern Ocean, bounded by the Antarctic Circumpolar Current to the north and Antarctica to the south, and the Arctic Ocean, almost landlocked except between Greenland and Europe. From the shorelines of the continents a submerged part of the continental mass, called the continental shelf, extends seaward an average distance of 75 km; it varies in width from nearly zero to 1,500 km. The shelf gives way abruptly at a depth of about 200 m to a steeper zone known as the continental slope, which descends about 3,500 m. The continental rise, a gradually sloping zone of sediment that is considered part of the ocean bottom, extends about 600 km from the base of the continental slope to the flat abyssal plains of the deep-ocean floor. In the central parts of the oceans are the midocean ridges, which are extensive mountain chains with inner troughs that are heavily intersected by cracks, called fracture zones. The ridges are sections of a continuous system that winds for 60,000 km through all the oceans. The Mid-Atlantic Ridge extends from the Norwegian Sea through the volcanic islands of Iceland and the Azores to the South Atlantic, where it is equidistant from the African and South American coasts. The ridge continues into the Indian Ocean, with a branch that reaches into the Gulf of Aden and the Red Sea, then passes between Australia and Antarctica and into the eastern South Pacific. The East Pacific Rise extends north to the Gulf of California; Easter Island and the Galápagos are volcanic islands that are part of this submarine mountain chain. The ridge system seems to merge into the continents in several areas, such as the Red Sea and the Gulf of California, and such areas are regions of great geologic activity, characterized by volcanoes, or earthquakes and faults.

The midocean ridges play a key role in plate tectonics (movements in the earth's crust), for it is from the inner troughs of these ridges that molten rock upwells from the earth's mantle and spreads laterally on both sides, adding new material to the earth's rigid crustal plates. The plates are moving apart, currently at the rate of 1 to 10 cm a year and are being forced against adjacent plates. From the Mid-Atlantic Ridge, the continents, which rest on the plates and which once were joined, have moved away from one another. In the Pacific Ocean, plates are also moving apart from the East Pacific Rise, but the bordering plates are overlapping them and forcing them under at the edges. At these places, along almost the entire rim of the Pacific, deep trenches are formed as crust is subducted and returned to the mantle. The Pacific trenches commonly reach depths of more than 7 km; the deepest known point, in the Mariana Trench east of the Philippines, lies 11 km beneath the surface. Trench areas, or subduction zones, are characterized by volcanic and seismic activity, indicative of the motions and stresses of the earth's crustal plates.

The structure and topography of the ocean floor are studied through the use of satellite mapping, which measures the level of the ocean surface to estimate the shape of the ocean floor; sonar, which measures the depth of the oceans; and seismic techniques, which measure the thickness of sediments of the ocean floor. Depth measurements are made by sonar from ships that travel slowly, so only a small fraction of the ocean's floor has been mapped from depth measurements. Even using the latest sonar techniques, it would take about 125 years to map the ocean floor with depth measurements.

THE ATLANTIC OCEAN
Introduction

The Atlantic Ocean is the second largest of the earth's five oceans and the most heavily traveled. Only the Pacific Ocean is larger, covering about twice the area of the Atlantic Ocean. The Atlantic is divided into two nominal sections: The part north of the equator is called the North Atlantic; the part south of the equator, the South Atlantic. The ocean's name is **derived from Atlas, one of the Titans of Greek mythology.**

Boundaries and size

The Atlantic Ocean is essentially an S-shaped north-south channel, extending from the Arctic Ocean in the north to the Antarctic continent in the south and situated between the eastern coast of the American continents and the western coasts of Europe and Africa. The total area of the Atlantic Ocean is 76.8 million sq km.

The boundary between the North Atlantic and the Arctic Ocean is arbitrarily designated as lying along a system of submarine ridges that extend between the land masses of Baffin Island, Greenland, and Scotland. More clearly defined is the boundary with the Mediterranean Sea at the Strait of Gibraltar and with the Caribbean Sea along the arc of the Antilles. The South Atlantic is arbitrarily separated from the Indian Ocean on the east by the 20° east meridian and from the Pacific on the west along the line of shallowest depth between Cape Horn and the Antarctic Peninsula.

Geological formation and structural features

The Atlantic began to form during the Jurassic period, about 150 million years ago, when a rift opened up in the supercontinent of Gondwanaland, resulting in the separation of South America and Africa. The separation continues today at the rate of several centimeters a year along the Mid-Atlantic Ridge. Part of the midoceanic ridge system that girdles the world, it is a submarine ridge extending north to south in a sinuous path midway between the continents. Roughly 1,500 km wide, the ridge has a more rugged topography than any mountain range on land, and is a frequent site of volcanic eruptions and earthquakes. The ridge ranges from 1 to 3 km above the ocean bottom.

THE BLACK SEA

The Black Sea is an inland sea, lying between southeastern Europe and Asia Minor. The Bosporus, the Sea of Marmora, and the Dardanelles connect it with the Aegean Sea. Romania, Bulgaria, and the European portion of Turkey bound it on the west. Ukraine, Russia, and Georgia border the northern and eastern shores; the entire southern shore is Turkish territory.

The Black Sea has a length of 1,200 km from east to west, a maximum width of 610 km, and an area of 461,000 sq km. The Crimean Peninsula projects into the Black Sea from the north, forming the shallow Sea of Azov on the east and the Karkinitskiy Gulf on the west. The former is almost entirely cut off from the Black Sea. The sea receives the drainage of a large part of central and eastern Europe through the Dnieper, Dniester, Southern Bug, and Danube rivers. It also receives waters from a considerable section of eastern European Russia, through the Don River (which flows into the Sea of Azov) and from the western Caucasus region through the Kuban (which also flows into the Sea of Azov), and a number of smaller rivers; and the Black Sea drains northern Asia Minor through the Çoruh (Chorokh), Yeşil Irmak, Kızılırmak, and Sakarya rivers. The floor of its single central basin lies 1,800 m below the surface; its greatest depth is 2,210 m. Severe storms occur frequently on the sea, particularly during the winter season. The prevailing winter winds are from the north.

THE CASPIAN SEA

The Caspian Sea is a saltwater lake in southeastern Europe and southwestern Asia, the largest inland body of water in the world. The Caspian Sea is bordered on the west by Azerbaijan and Russia, on the northeast and east by Kazakhstan, on the east by Turkmenistan, and on the south by Iran. It extends about 1210 km in a northern and southern direction and about 210 to 436 km in an eastern and western direction. It has an area of 371,000 sq km. The Caspian coastline is irregular, with large gulfs on the east, including Krasnovodsk Gulf and the very shallow Garabogazköl Gulf, which acts as an evaporation basin and is the site of a major chemical plant that extracts salts from the deposits.

The Caspian Sea has a mean depth of about 170 m and is deepest in the south. Its level varies from year to year but averages about 28 m below sea level. In the 1960s and 1970s the level fell substantially, partly because water was withdrawn from tributary rivers for irrigation and other purposes. In 1980 a dike was built across the mouth of Garabogazköl Gulf in northwestern Turkmenistan to reduce water loss, creating a lake that was expected to last for several years. Instead, the gulf dried up completely by 1983. In the meantime, the level of the Caspian Sea began rising again at a rate of about 14 to 20 cm annually.

The southern and southwestern shorelines of the Caspian Sea are bordered by the Elburz Mountains and the Caucasus Mountains. The sea has numerous tributaries, notably the Volga, Ural, and Zhem rivers, all of which flow into it from the north. Other tributaries include the Gorgan (Gurgan) and Atrek rivers, flowing from the east, and the Kura River, flowing from the west. The Caspian Sea has no outlet. However, it is linked to the Baltic Sea, the White Sea, and the Black Sea by an extensive network of inland waterways, chief of which is the Volga River.

Navigation is frequently dangerous because of violent southeastern storms. During the winter months the northern parts of the Caspian Sea are closed by ice. The chief ports are Krasnovodsk, Turkmenistan; Baku, Azerbaijan; and Makhachkala, Russia.

The Caspian Sea region contains significant reserves of oil and natural gas. The region is estimated to hold the third largest reserves after the Middle East and Russia. Bordering countries are actively exploring and tapping offshore reserves. Azerbaijan and Kazakhstan are the region's leading oil exporters. Baku, the capital of Azerbaijan, is the chief point of export for oil obtained from offshore fields. A new oil pipeline linking Baku with the Mediterranean seaport of Ceyhan, Turkey, opened in 2005, supplementing two other pipelines linking Baku to ports on the Black Sea.

Decades of environmental mismanagement have led to severe pollution problems in the Caspian region. Discharges from offshore oil and gas drilling and inflows from the highly polluted Volga River have contributed to the degradation of Caspian waters. The pollution poses a serious threat to animal life, including tortoises, porpoises, and seals. In addition, overfishing has depleted the sea's stocks of sturgeon (a source of caviar), salmon, perch, herring, and carp. In November 2003 representatives from all the bordering countries signed the United Nations-sponsored Convention for the Protection of the Marine Environment of the Caspian Sea, which provided a framework for alleviating environmental damage in the region. However, environmental laws and regulations remain weak.

THE BAIKAL

The Lake Baikal is a lake in southern Siberian Russia, the deepest lake in the world with a maximum depth of 1,637 m. It is estimated to contain approximately one-fifth of all the earth's fresh surface water. The lake has an area of 31,500 sq km and about 1,963 km of shoreline, making it the third largest lake in Asia, as well as the continent's largest freshwater lake in terms of surface area. The crescent-shaped lake is 636 km long and varies in width from about 14 to 80 km. The lake is fed by the Selenge, Barguzin, and Verkhnaya Angara rivers and by more than 300 mountain streams. The only outlet is the lower Angara, which flows west from the lake into the Yenisey River. The Baikal, Barguzin, and other mountain ranges surround the lake, rising on all shores except the southeastern Selenge delta. Lake Baikal has several islands, the largest of which is Olkhon. Nizhneangarsk and Listvyanka are ports on the lake. Baikal is known for the remarkable clarity of its waters and for the great diversity of its plant and animal life; the majority of species found in the lake are endemic. The sturgeon, salmon, and freshwater-seal fisheries of the lake are valuable, and large quantities of other fish are also caught. Petroleum wells and mineral and hot springs are found in the vicinity. The southern shores of the lake are inhabited by the Buryats, who are closely related to the Mongols of neighboring Mongolia.

THE MISSISSIPPI RIVER

The Mississippi is a river in the central United States, the largest and most important river in North America. The Mississippi has played a central role in the exploration and economic development of the continent, and it is a principal artery for bulk freight, carrying more than any other inland waterway in North America.

The Mississippi River system, comprising the Mississippi River and its tributaries, drains 2,979,000 sq km. It is the largest drainage system in area in North America and the third largest in the world. Its discharge, which averages 16,800 cu m per second, is the sixth largest in the world. The Mississippi River, from Lake Itasca in Minnesota to the Gulf of Mexico, is 3,770 km long. However, if the river system is measured from the headwaters of the Missouri River, the Mississippi's longest tributary, to the Gulf of Mexico, its length totals 5,970 km.

Description

During the most recent Ice Age, which ended about 10,000 years ago, glaciers deposited layers of sediment across what is now the upper Mississippi Valley. As the glaciers melted, large quantities of water cut channels through this debris. Today, the upper Mississippi and its tributaries all follow these channels. Farther to the south, the Ohio and Missouri rivers joined the meltwater. This great volume of water carved the great channel that now constitutes the lower Mississippi. Now the Mississippi River begins its course at Minnesota's Lake Itasca and flows south through the central United States to the Gulf of Mexico. The Mississippi forms the eastern border of most of Minnesota, Iowa, Missouri, and Arkansas and much of Louisiana; and the western border of most of Wisconsin, Illinois, Kentucky, Tennessee, and Mississippi. Along its course the river is joined by many tributaries.

At Lake Itasca, the Mississippi is 4 m wide and 0.5 m deep. The river is not navigable by commercial traffic north of Saint Paul, Minnesota, because of the Falls of Saint Anthony, a 20 m cascade located there. From Saint Paul to the junction of the Missouri River, the Mississippi is generally 300 to 600 m wide. In the approximately 320-km stretch between St. Louis and Cairo, large volumes of water and sediment from the Missouri River make the channel muddy and swift flowing.

THE MISSOURI RIVER

The Missouri is a river in central United States. The Missouri is formed by the confluence of the Jefferson, Gallatin, and Madison rivers at Three Forks in southwestern Montana. The longest river system in the United States, the Missouri is one of the primary tributaries of the Mississippi River. From its source, it flows 4,090 km and drains an area of about 1,370,000 sq km.

The Missouri initially flows north, skirting the main range of the Rocky Mountains. Then it passes through a 366-m gorge called the Gates of the Mountains, turns northeast and reaches Fort Benton, Montana, the head of navigation. From Fort Benton the river flows east and is joined by the Milk River at Frazer, Montana, and by the Yellowstone River at Buford, North Dakota. From this point the Missouri flows generally southeast through North Dakota and South Dakota to Sioux City, Iowa, where it turns south and becomes the boundary between Nebraska and Kansas on the west and Iowa and Missouri on the east. The Platte River is received near Omaha, Nebraska, and the Kansas River at Kansas City, Missouri. On receiving the Kansas, the Missouri turns east and flows across the state of Missouri. About 27 km north of St. Louis, the muddy Missouri enters the channel of the Mississippi. Other important cities on the river are Bismarck, North Dakota; Council Bluffs, Iowa; Saint Joseph, Missouri; and Atchison, Leavenworth, and Kansas City, Kansas.

The upper Missouri crosses mountainous terrain covered with dense coniferous forests. These forests support large animals, including bears, elk, and moose. Fish found in the cold upper river include the Montana grayling and the rainbow trout. One can see grasslands and forests of poplar, hickory, and other trees along the middle and lower river valleys, which provide a habitat for rabbits, foxes, beavers, and other animals. Fish in the warmer lower river include bass, several species of catfish, and carp.

What are Maps?

Definition: Map is a set of points, lines, and areas all defined both by position with reference to a coordinate system and by their non-spatial attributes.

Maps are the world reduced to points, lines, and areas, using a variety of visual resources: size, shape, value, texture or pattern, color, orientation, and shape. A thin line may mean something different from a thick one, and similarly, red lines from blue ones.

How do Maps represent reality?

A photograph shows all objects in its view; a map is an abstraction of reality. The cartographer selects only the information that is essential to fulfill the purpose of the map, and that is suitable for its scale. Maps use symbols such as points, lines, area patterns and colors to convey information.

How are Maps used?

1. To locate places on the surface of the earth,
2. To show patterns of distribution, and
3. To discover relationships between different phenomena by analyzing map information.

Every point on Earth has a specific location that is determined by an imaginary grid of lines denoting latitude and longitude. Parallels of latitude measure distances north and south of the line called the Equator. Meridians of longitude measure distances east and west of the line called the Prime Meridian. Geographers use latitude and longitude to pinpoint a place's absolute, or exact, location.

Coordinate systems

Numeric methods of representing locations on the earth's surface.

Latitude and Longitude

The most commonly used coordinate system today is latitude and longitude - angle measures, expressed in degrees, minutes, and seconds.

Equator and Prime Meridian

The Equator and the Prime Meridian are the reference lines used to measure latitude and longitude. The equator which lies halfway between the poles is a natural reference for latitude. A line through Greenwich, England, just outside London, is the Prime Meridian.

Latitude- Parallels that run east-west.
Longitude- Meridians that run north-south.

Latitude runs from 0° at the equator to 90°N or 90°S at the poles. These lines of latitude, called parallels, run in an east-west direction. Lines of longitude, called meridians, run in a north-south direction intersecting at both poles. Longitude runs from 0° at the prime meridian to 180° east or west, halfway around the globe.

More on Degrees, Minutes, and Seconds

On the globe, one degree of latitude equals approximately 70 miles. One minute is just over a mile, and one second is around 100 feet. Length of a degree of longitude varies, from 69 miles at the equator to 0 at the poles. Because meridians converge at the poles, degrees of longitude tend to 0.

Longitude and Time

Since the earth rotates 360 degrees every 24 hours, or 15 degrees every hour, it's divided into 24 time zones- 15 degrees of longitude each. When it is noon at Greenwich, it is 10:00 A.M. 30 degrees W., 6:00 A.M. 90 degrees W., and midnight at 180 degrees on the opposite side of the earth.

Historical Note

The planet gave no clear direction on selecting the Prime Meridian, as it did with the equator lying half-way between the poles as the 0 degree of latitude. As late as 1881, there were 14 different prime meridians still being used on topographic survey maps alone. The International Meridian Conference of 1884 adopted the Prime Meridian line passing through the Greenwich Observatory near London, England. Take a trip down the Prime Meridian and explore the countries that lie on it.

The Physical Geography of Canada

Unit aim	To understand the complexity of the physical landscape of Canada, the major physical regions, the impact of glaciation on the Canadian landscape, soils and their land use potential.
Keywords	Nature regions, physical landscapes, lowlands, mountains, basins and trenches, geomorphology and morphogenetics, glacial deposits, soils, land use

Some of the world's oldest rocks (3.96 million years in age) have been found in the Canadian shield the generally low rugged ancient geological nucleus of northern North America that comprises almost one half of Canada. The eastern part of the Shield is high enough to be mountainous and rises to over 2000 m in Baffin Island, but the central part is depressed well below sea level, and forms the Hudson Bay, a large interior sea connected to the Atlantic Ocean by the Hudson Strait. To the west and south of the Shield are younger, flat, sedimentary strata of Paleozoic and more recent age, the Great Plains and the Great Lakes-St. Lawrence Lowland respectively. Along the junction of the Great Plains and the Shield a north to south sequence of extremely large lakes is arrayed, Great Bear, Great Slave, Athabasca, and Winnipeg lakes, all very apparent on the map of Canada. South of the Shield is the greatest group of lakes in the world, the Great lakes, Superior, Michigan, Huron, Erie, and Ontario. The largest, Lake Superior, is so deep that its bottom is well below sea level.

Three great mountain systems form the physical margins of Canada. The Canadian Cordillera on the Pacific coast, over 700 km wide, is composed of numerous ranges, plateaus and valleys. The most famous range, of course, is the Rocky Mountains. The Cordillera is a system of young high mountains, and Mount Robson in the Rockies of British Columbia is 3954 m high, and Mount Logan in the St. Elias range in Yukon is 5959 m, the highest peak in Canada. On the Atlantic coast, in the Atlantic provinces and southeastern Quebec, is the much older and lower

Appalachian mountain system, almost 600 km wide, and broken into many peninsulas, gulfs, embayments, and islands. Elevations in most of the ridges are well below 1000 m, although the highest ridge, which is in the Gasp peninsula of Quebec, rises to over 1200 m. In the extreme north of Canada is another old mountain system, the little-known Innuitian ranges, about 400 km wide, and reaching an elevation of 2616 m in Ellesmere Island. Off the North American land mass in the Atlantic Ocean is a broad continental shelf, important for centuries for its great fisheries. Gas is produced from these sedimentary strata, and oil is flowing from wells that are 310 km offshore, drilled where the Atlantic has a depth of about 80 m. The continental shelf in the Arctic Ocean also is known to hold oil and gas reserves, but at the present time they are much too distant from market to be exploited.

Almost all of Canada was covered by ice during the last ice age. High mountains in the west and north have all the classic glacial alpine features so well known in the European Alps. Ice fields still exist in the Canadian Cordillera; the Columbia Ice Field in the Rockies can easily be reached by highway, and is a very popular tourist attraction. In the far north, on Baffin, Ellesmere, and other islands, ice caps remain on the highest slopes.

All farming areas in Canada are on soils produced on parent materials derived from glacial deposits. During the last ice age, continental ice sheets had their main centers of accumulation on the Canadian Shield, with the ice lobes pushing north, west, east, and south. After glaciation, the Shield was left as a surface of rounded resistant rock knobs, a disarranged drainage pattern of countless lakes and rivers, marshlands, and some thin patches of glacial drift, often sands and gravels deposited by melt water, and clays gently dropped in proglacial lakes. On the plains to the west and south of the Shield, the less resistant Paleozoic sedimentary rocks of the lowlands provided much rock material for the advancing ice lobes to erode, and when the broken up materials were subsequently deposited by the ice, deep accumulations of glacial till were laid down in the form of ground moraines. After deglaciation, as the climate moderated and vegetation returned, fertile soils were slowly formed on these parent materials. Lacustrine deposits laid down in pre-glacial lakes today are clay plains used for farming in parts of the prairies and southern Ontario, and also are the basis of agriculture on islands of settlement in the midst of the Shield in Ontario and Quebec. In these northern clay belts, as they are known, the short growing season and frost hazards limit what can be grown because they are located at the climatic limits of commercial agriculture.

DESERTS

In geography, a **desert** is a landscape form or region that receives very little precipitation. Deserts are defined as areas that receive an average annual precipitation of less than 250 mm.

Desert features

Sand covers only about 20 percent of Earth's deserts. Most of the sand is in sand sheets and sand seas - vast regions of undulating dunes resembling ocean waves "frozen" in an instant of time. Because of a lack of moisture in the soil and low humidity in the atmosphere, most of the sunlight penetrates to the ground. Daytime temperatures can reach 55° C in the shade. At night the desert floor radiates heat back to the atmosphere, and the temperature can drop to near freezing. In general, there are six forms of deserts:

- Mountain and basin deserts
- Hamada deserts, which comprise of plateau landforms
- Regs, which consist of rock pavements
- Ergs, which are formed by sand seas
- Intermontane Basins
- Badlands, which are located at the margins of arid lands comprising of clay-rich soil

Nearly all desert surfaces are plains where eolian deflation - removal of fine-grained material by the wind - has exposed loose gravels consisting predominantly of pebbles but with occasional cobbles.

There are several different types of dunes. Barchan dunes are produced by strong winds blowing across a level surface and are crescent-shaped. Longitudinal dunes are dunes that are parallel to a strong wind that blows in one general direction. Transverse dunes run at a right angle to the constant wind direction. Star dunes are star-shaped and have several ridges that spread out around a point.

Deserts are caused by a combination of climate patterns and geological features.

Wind Systems

Most desert regions have been formed by movements of air masses over the planet. As the earth turns on its axis, it produces gigantic air swirls. Hot air rising over the equator flows northward and southward; the currents cool in the upper regions and descend as high-pressure areas in two subtropical zones. North and south of these zones are two more areas of ascending air and low pressure. Still farther north and south are the two polar regions of descending air. As air rises, it cools and loses its moisture. As it descends, it warms and picks up moisture, drying out the land.

The downward movements of warm air masses over the earth have produced two belts of deserts, one along the tropic of Cancer, in the northern hemisphere, and the other along the tropic of Capricorn, in the southern hemisphere. Among the northern deserts are the Gobi in China, the deserts of southwestern North America, the Sahara in North Africa, and the Arabian and Iranian deserts in the Middle East. Along the southern belt lie Patagonia in Argentina, the Kalahari Desert of southern Africa, and the Great Victoria and Great Sandy deserts of Australia.

Other desert areas result from the influence of ocean currents on landmasses. As cold waters move from the Arctic and Antarctic regions toward the equator and come into contact with the edges of continents, they are augmented by upwellings of cold water from the ocean depths. Air currents cool as they move across cold water; they carry fog and mist but little rain. Such currents flow across the coastal regions of southern California, Baja California, southwest Africa, and Chile; although often shrouded in mist, these coasts are deserts.

Land Formation

Mountain ranges influence the development of deserts by creating rain shadows. As moisture-laden winds flow upward over the windward slopes, they cool and lose their moisture in the form of rain and snow. Dry air descending over the leeward slopes evaporates moisture from the soil. The Great Basin, a desert of North America, results from the rain shadow produced by the Sierra Nevada.

Other desert areas in the interiors of some continents have formed because the prevailing winds are far removed from large bodies of water and have lost much of their moisture by the time they reach those regions. Such deserts are the Gobi and Turkistan of Eurasia.

Winds literally sandblast rocks into unusual shapes and also build up dunes. In sandy deserts such as the Sahara and parts of the North American desert, sand dunes are typical features. Wind-built mounds of sand can reach heights of more than 200 m in the Sahara, Arabian, and Iranian deserts. In deserts where prevailing winds are strong and sand is relatively scarce, as in the coastal deserts of Peru, dunes may take on regular crescent shapes that move continuously across the desert floor.

GOBI

Gobi is an extensive desert area of southern Mongolia and northern China. The largest desert in Asia, it is also known as Shamo, the Chinese word for “sand desert”. The Gobi, which is about 1,600 km in extent from east to west and about 1,000 km from north to south, has a total area of 1,300,000 sq km. It is bounded by the Da Hinggan Ling (Greater Khingan Range) on the east, the Altun Shan and Nan Shan mountains on the south, the Tian Shan mountains on the west, and the Altay and Hangayn Nuruu (Khangai) mountains and Yablonovyy Range on the north.

The Gobi is formed by a series of small basins within a larger basin rimmed by upland. The elevations of these basins range from 900 m above sea level in the east to 1,500 m in the west. The basins are divided by low, flat-topped ranges and isolated hills that are the result of faulting action. The floors of the basins are unusually flat and level, and are formed of a desert pavement of small gravel resting on granite. There are, however, large areas of sedimentary rocks and some lava bed areas. Much of the sand and fine material has been blown away, but tall sand dunes rise along the desert’s southern edge.

The Gobi receives only a little snow in winter and no more than 200 to 250 mm of rain along the northern and eastern edges, mainly in summer. Only the southeastern portion of the Gobi is completely waterless. Temperatures range from -40°C in winter to 32°C in summer. The remainder of the region, approximately three-quarters of the area, has a thin growth of grass, scrub, and thorn sufficient to feed the flocks of the nomadic herders who live there; water is available in wells and occasional shallow lakes. The borders of the Gobi to the north and northwest are fertile, and grassy steppes or prairies lie at the southeastern edge of the desert area. The desert is crossed from north to south by traditional trade routes and, alongside of them, a railroad from Ulaanbaatar, Mongolia (extending north to the main Trans-Siberian Railroad), to Jining on China’s main east-west line in the north.

Archaeological finds in the Gobi include remains of Eolithic, Upper Paleolithic, Neolithic, and Bronze Age civilizations. The first Europeans to traverse the Gobi were Venetian traveler Marco Polo and his father and uncle, who crossed the region about 1275. The next recorded crossing is that of the French Jesuit priest Jean François Gerbillon in the 1680s. In modern times a number of expeditions have explored the Gobi, including expeditions commanded by the Swedish explorer Sven Anders Hedin. In the 1920s the American Museum of Natural History sponsored a series of expeditions in the Gobi under the leadership of the American naturalist Roy Chapman Andrews. The expeditions discovered fossilized dinosaur eggs belonging to the previously unknown Oviraptor species.

THE SAHARA

The **Sahara** ("The Great Desert") is technically the world's second largest desert after Antarctica. At over 9,000,000 square kilometres, it covers most parts of northern Africa; an area stretching from the Red sea, including parts of the Mediterranean coasts, to the outskirts of the Atlantic ocean. It is almost as large as the United States, and is larger than Australia. Its name derives from an Arabic word meaning "desert":

The Sahara covers huge parts of Algeria, Burkina Faso, Chad, Egypt, Libya, Mali, Mauritania, Morocco, Niger, Senegal, Sudan and Tunisia.

The Sahara includes many landforms such as rivers (Nile River, Sénégal River), mountain ranges (Aïr Mountains, Ahaggar Mountains, Saharan Atlas, Tibesti Mountains), smaller deserts and ergs (Libyan Desert, Ténéré, Egyptian Sand Sea, Qattara Depression, Erg of Bilma, Erg Chebbi), lakes (Lake Chad) and oases (Bahariya, Ghardaïa, Timimoun).

Several ecoregions cover the Sahara.

The Sahara is the world's largest hot desert (Antarctica is a larger desert, but is cold) and is located in northern Africa. It stretches from the Red Sea to the highlands of Ethiopia. However, the Sahara includes regions different from an ecological perspective. The surface of the desert ranges from large areas of sand dunes (which are called erg), to stone plateaus (hamadas), gravel plains (reg), dry valleys (wadis), and salt flats. The northern and southern margins also receive more rainfall and have greater vegetation than central Sahara. The very scarce rain (less than 25 mm and even less than 5 mm per annum in the east) can fall in any season and in a very irregular way: some areas may receive no rain for years then suffer intense storms. Some areas include vast underground aquifers resulting in oases, while other regions severely lack water reserves. Some mountains also rise up in the desert and receive more rainfall and mostly present slightly cooler summer temperatures.

EARTHQUAKES

Earthquake is shaking of the Earth's surface caused by rapid movement of the Earth's rocky outer layer. Earthquakes occur when energy stored within the Earth, usually in the form of strain in rocks, suddenly releases. This energy is transmitted to the surface of the Earth by earthquake waves. The study of earthquakes and the waves they create is called seismology (from the Greek *seismos*, "to shake"). Scientists who study earthquakes are called seismologists.

The destruction an earthquake causes depends on its magnitude and duration, or the amount of shaking that occurs. A structure's design and the materials used in its construction also affect the amount of damage the structure incurs. Earthquakes vary from small, imperceptible shaking to large shocks felt over thousands of kilometers. Earthquakes can deform the ground, make buildings and other structures collapse, and create tsunamis (large sea waves). Lives may be lost in the resulting destruction.

Earthquakes, or seismic tremors, occur at a rate of several hundred per day around the world. A worldwide network of *seismographs* (machines that record movements of the Earth) detects about 1 million small earthquakes per year. Very large earthquakes, such as the 1964 Alaskan earthquake, which caused millions of dollars in damage, occur worldwide once every few years. Moderate earthquakes, such as the 1989 tremor in Loma Prieta, California, and the 1995 tremor in Kōbe, Japan, occur about 20 times a year. Moderate earthquakes also cause millions of dollars in damage and can harm many people.

In the last 500 years, earthquakes around the world, have killed several million people including over 240,000 in the 1976 T'ang-Shan, China, earthquake. Worldwide, earthquakes have also caused severe property and structural damage. Adequate precautions, such as education, emergency planning, and constructing stronger, more flexible, safely designed structures, can limit the loss of life and decrease the damage caused by earthquakes.

Anatomy of an Earthquake

Seismologists examine the parts of an earthquake, such as what happens to the Earth's surface during an earthquake, how the energy of an earthquake moves from inside the Earth to the surface, how this energy causes damage, and the slip of the fault that causes the earthquake. Faults are cracks in Earth's crust where rocks on either side of the crack have moved. By studying the different parts and actions of earthquakes, seismologists learn more about their effects and how to predict and prepare for their ground shaking in order to reduce damage.

Focus and Epicenter

The point within the Earth along the rupturing geological fault where an earthquake originates is called the focus, or hypocenter. The point on the Earth's surface directly above the focus is called the epicenter. Earthquake waves begin to radiate out from the focus and subsequently form along the fault rupture. If the focus is near the surface - between 0 and 70 km deep - shallow-focus earthquakes are produced. If it is intermediate or deep below the crust - between 70 and 700 km deep - a deep-focus earthquake will be produced. Shallow-focus earthquakes tend to be larger, and therefore more damaging, earthquakes. This is because they are closer to the surface where the rocks are stronger and build up more strain.

Seismologists know from observations that most earthquakes originate as shallow-focus earthquakes and most of them occur near plate boundaries - areas where the Earth's crustal plates move against each other. Other earthquakes, including deep-focus earthquakes, can originate in subduction zones, where one tectonic plate subducts, or moves under another plate.

Faults

Stress in the Earth's crust creates faults, resulting in earthquakes. The properties of an earthquake depend strongly on the type of fault slip, or movement along the fault, that causes the earthquake. Geologists categorize faults according to the direction of the fault slip. The surface between the two sides of a fault lies in a plane, and the direction of the plane is usually not vertical; rather it dips at an angle into the Earth. When the rock hanging over the dipping fault plane slips downward into the ground, the fault is called a normal fault. When the hanging wall slips upward in relation to the footwall, the fault is called a reverse fault. Both normal and reverse faults produce vertical displacements, or the upward movement of one side of the fault above the other side, that appear at the surface as fault scarps. Strike-slip faults are another type of fault that produce horizontal displacements, or the side by side sliding movement of the fault, such as seen along the San Andreas fault in California. Strike-slip faults are usually found along boundaries between two plates that are sliding past each other.

Waves

The sudden movement of rocks along a fault causes vibrations that transmit energy through the Earth in the form of waves. Waves that travel in the rocks below the surface of the Earth are called body waves, and there are two types of body waves: primary, or P, waves, and secondary, or S, waves. The S waves, also known as shearing waves, move the ground back and forth.

Earthquakes also contain surface waves that travel out from the epicenter along the surface of the Earth. Two types of these surface waves occur: Rayleigh waves, named after British physicist Lord Rayleigh, and Love waves, named after British geophysicist A. E. H. Love. Surface waves also cause damage to structures, as they shake the ground underneath the foundations of buildings and other structures.

Body waves, or P and S waves, radiate out from the rupturing fault starting at the focus of the earthquake. P waves are compression waves because the rocky material in their path moves back and forth in the same direction as the wave travels alternately compressing and expanding the rock. P waves are the fastest seismic waves; they travel in strong rock at about 6 to 7 km per second. P waves are followed by S waves, which shear, or twist, rather than compress the rock they travel through. S waves travel at about 3.5 km per second. S waves cause rocky material to move either side to side or up and down perpendicular to the direction the waves are traveling, thus shearing the rocks. Both P and S waves help seismologists to locate the focus and epicenter of an earthquake. As P and S waves move through the interior of the Earth, they are reflected and refracted, or bent, just as light waves are reflected and bent by glass. Seismologists examine this bending to determine where the earthquake originated.

On the surface of the Earth, Rayleigh waves cause rock particles to move forward, up, backward, and down in a path that contains the direction of the wave travel. This circular movement is somewhat like a piece of seaweed caught in an ocean wave, rolling in a circular path onto a beach. The second type of surface wave, the Love wave, causes rock to move horizontally, or side to side at right angles to the direction of the traveling wave, with no vertical displacements. Rayleigh and Love waves always travel slower than P waves and usually travel slower than S waves.

Causes

Most earthquakes are caused by the sudden slip along geologic faults. The faults slip because of movement of the Earth's tectonic plates. This concept is called the elastic rebound theory. The rocky tectonic plates move very slowly, floating on top of a weaker rocky layer. As the plates collide with each other or slide past each other, pressure builds up within the rocky crust. Earthquakes occur when pressure within the crust increases slowly over hundreds of years and finally exceeds the strength of the rocks. Earthquakes also occur when human activities, such as the filling of reservoirs, increase stress in the Earth's crust.

Elastic Rebound Theory

In 1911 American seismologist Harry Fielding Reid studied the effects of the April 1906 California earthquake. He proposed the elastic rebound theory to explain the generation of certain earthquakes that scientists now know occur in tectonic areas, usually near plate boundaries. This theory states that during an earthquake, the rocks under strain suddenly break, creating a fracture along a fault. When a fault slips, movement in the crustal rock causes vibrations. The slip changes the local strain out into the surrounding rock. The change in strain leads to *aftershocks* (smaller earthquakes that occur after the initial earthquake), which are produced by further slips of the main fault or adjacent faults in the strained region. The slip begins at the focus and travels along the plane of the fault, radiating waves out along the rupture surface. On each side of the fault, the rock shifts in opposite directions. The fault rupture travels in irregular steps along the fault; these sudden stops and starts of the moving rupture give rise to the vibrations that propagate as seismic waves. After the earthquake, strain begins to build again until it is greater than the forces holding the rocks together, then the fault snaps again and causes another earthquake.

Human Activities

Fault rupture is not the only cause of earthquakes; human activities can also be the direct or indirect cause of significant earthquakes. Injecting fluid into deep wells for waste disposal, filling reservoirs with water, and firing underground nuclear test blasts can, in limited circumstances, lead to earthquakes. These activities increase the strain within the rock near the location of the activity so that rock slips and slides along pre-existing faults more easily. While earthquakes caused by human activities may be harmful, they can also provide useful information. Prior to the Nuclear Test Ban treaty, scientists were able to analyze the travel and arrival times of P waves from known earthquakes caused by underground nuclear test blasts. Scientists used this information to study earthquake waves and determine the interior structure of the Earth.

Scientists have determined that as water level in a reservoir increases, water pressure in pores inside the rocks along local faults also increases. The increased pressure may cause the rocks to slip, generating earthquakes. Beginning in 1935, the first detailed evidence of reservoir-induced earthquakes came from the filling of Lake Mead behind Hoover Dam on the Nevada-Arizona state border. Earthquakes were rare in the area prior to construction of the dam, but seismographs registered at least 600 shallow-focus earthquakes between 1936 and 1946. Most reservoirs, however, do not cause earthquakes.

Distribution

Seismologists have been monitoring the frequency and locations of earthquakes for most of the 20th century. Seismologists generally classify naturally occurring earthquakes into one of two categories: interplate and intraplate. Interplate earthquakes are the most common; they occur primarily along plate boundaries. Intraplate earthquakes occur where the crust is fracturing within a plate. Both interplate and intraplate earthquakes may be caused by tectonic or volcanic forces.

Tectonic Earthquakes

Tectonic earthquakes are caused by the sudden release of energy stored within the rocks along a fault. The released energy is produced by the strain on the rocks due to movement within the Earth, called tectonic deformation. The effect is like the sudden breaking and snapping back of a stretched elastic band.

Volcanic Earthquakes

Volcanic earthquakes occur near active volcanoes but have the same fault slip mechanism as tectonic earthquakes. Volcanic earthquakes are caused by the upward movement of magma under the volcano, which strains the rock locally and leads to an earthquake. As the fluid magma rises to the surface of the volcano, it moves and fractures rock masses and causes continuous tremors that can last up to several hours or days. Volcanic earthquakes occur in areas that are associated with volcanic eruptions, such as in the Cascade Mountain Range of the Pacific Northwest, Japan, Iceland, and at isolated hot spots such as Hawaii.

Locations

Seismologists use global networks of seismographic stations to accurately map the focuses of earthquakes around the world. After studying the worldwide distribution of earthquakes, the pattern of earthquake types, and the movement of the Earth's rocky crust, scientists proposed that plate tectonics, or the shifting of the plates as they move over another weaker rocky layer, was the main underlying cause of earthquakes. The theory of plate tectonics arose from several previous geologic theories and discoveries. Scientists now use the plate tectonics theory to describe the movement of the Earth's plates and how this movement causes earthquakes. They also use the knowledge of plate tectonics to explain the locations of earthquakes, mountain formation, and deep ocean trenches, and to predict which areas will be damaged the most by earthquakes. It is clear that major earthquakes occur most frequently in areas with features that are found at plate boundaries: high mountain ranges and deep ocean trenches. Earthquakes within plates, or intraplate tremors, are rare compared with the thousands of earthquakes that occur at plate boundaries each year, but they can be very large and damaging.

Earthquakes that occur in the area surrounding the Pacific Ocean, at the edges of the Pacific plate, are responsible for an average of 80 percent of the energy released in earthquakes worldwide. Japan is shaken by more than 1,000 tremors greater than 3.5 in magnitude each year. The western coasts of North and South America are also very active earthquake zones, with several thousand small to moderate earthquakes each year.

Intraplate earthquakes are less frequent than plate boundary earthquakes, but they are still caused by the internal fracturing of rock masses. The New Madrid, Missouri, earthquakes of 1811 and 1812 were extreme examples of intraplate seismic events. Scientists estimate that the three main earthquakes of this series were about magnitude 8.0 and that there were at least 1,500 aftershocks.

Effects

Ground shaking leads to landslides and other soil movement. These are the main damage-causing events that occur during an earthquake. Primary effects that can accompany an earthquake include property damage, loss of lives, fire, and tsunami waves. Secondary effects, such as economic loss, disease, and lack of food and clean water, also occur after a large earthquake.

Ground Shaking and Landslides

Earthquake waves make the ground move, shaking buildings and causing poorly designed or weak structures to partially or totally collapse. The ground shaking weakens soils and foundation materials under structures and causes dramatic changes in fine-grained soils. During an earthquake, water-saturated sandy soil becomes like liquid mud, an effect called liquefaction. Liquefaction causes damage as the foundation soil beneath structures and buildings weakens. Shaking may also move large earth and rock masses, producing dangerous landslides, mudslides, and rock avalanches that may lead to loss of lives or further property damage.

Tsunami Waves and Flooding

Along the coasts, sea waves called tsunamis that accompany some large earthquakes centered under the ocean can cause more death and damage than ground shaking. Tsunamis are usually made up of several oceanic waves that travel out from the slipped fault and arrive one after the other on shore. They can strike without warning, often in places very distant from the epicenter of the earthquake. Tsunami waves are sometimes inaccurately referred to as tidal waves, but tidal forces do not cause them. Rather, tsunamis occur when a major fault under the ocean floor suddenly slips. The displaced rock pushes water above it like a giant paddle, producing powerful water waves at the ocean surface. The ocean waves spread out from the earthquake source and move across the ocean until they reach the coastline, where their height increases as they reach the continental shelf, the part of the Earth's crust that slopes, or rises, from the ocean floor up to the land. Tsunamis wash ashore with often disastrous effects such as severe flooding, loss of lives due to drowning, and damage to property.

Predicting Earthquakes

Seismologists try to predict how likely it is that an earthquake will occur, with a specified time, place, and size. Earthquake prediction also includes calculating how a strong ground motion will affect a certain area if an earthquake does occur. Scientists can use the growing catalogue of recorded earthquakes to estimate when and where strong seismic motions may occur. They map past earthquakes to help determine expected rates of repetition. Seismologists can also measure movement along major faults using global positioning satellites (GPS) to track the relative movement of the rocky crust of a few centimeters each year along faults. This information may help predict earthquakes. Even with precise instrumental measurement of past earthquakes, however, conclusions about future tremors always involve uncertainty. This means that any useful earthquake prediction must estimate the likelihood of the earthquake occurring in a particular area in a specific time interval compared with its occurrence as a chance event.

The Earth's Interior

Seismologists also study earthquakes to learn more about the structure of the Earth's interior. Earthquakes provide a rare opportunity for scientists to observe how the Earth's interior responds when an earthquake wave passes through it. Measuring depths and geologic structures within the Earth using earthquake waves is more difficult for scientists than is measuring distances on the Earth's surface. However, seismologists have used earthquake waves to determine that there are four main regions that make up the interior of the Earth: the crust, the mantle, and the inner and outer core.

The intense study of earthquake waves began during the last decades of the 19th century, when people began placing seismographs at observatories around the world. By 1897 scientists had gathered enough seismograms from distant earthquakes to identify that P and S waves had traveled through the deep Earth. Seismologists studying these seismograms later in the late 19th and early 20th centuries discovered P wave and S wave shadow zones - areas on the opposite side of the Earth from the earthquake focus that P waves and S waves do not reach. These shadow zones showed that the waves were bouncing off some large geologic interior structures of the planet.

Extraterrestrial Quakes

Seismic events similar to earthquakes also occur on other planets and on their satellites. Scientific missions to Earth's moon and to Mars have provided some information related to extraterrestrial quakes. The current Galileo mission to Jupiter's moons may provide evidence of quakes on the moons of Jupiter.

Between 1969 and 1977, scientists conducted the Passive Seismic Experiment as part of the United States Apollo Program. Astronauts set up seismograph stations at five lunar sites. Each lunar seismograph detected between 600 and 3,000 moonquakes every year, a surprising result because the Moon has no tectonic plates, active volcanoes, or ocean trench systems. Most moonquakes had magnitudes less than about 2.0 on the Richter scale. Scientists used this information to determine the interior structure of the Moon and to examine the frequency of moonquakes.

Besides the Moon and the Earth, Mars is the only other planetary body on which seismographs have been placed. The Viking 1 and 2 spacecraft carried two seismographs to Mars in 1976. Unfortunately, the instrument on Viking 1 failed to return signals to Earth. The instrument on Viking 2 operated, but in one year, only one wave motion was detected. Scientists were unable to determine the interior structure of Mars with only this single event.

Richter Scale is the method of ranking the strength or size of an earthquake. The Richter scale, also known as the local magnitude scale, was devised in 1935 by the American seismologist Charles F. Richter to rank earthquakes occurring in California. Richter and his associates later modified it to apply to earthquakes anywhere in the world.

The Richter scale ranks earthquakes based on how much the ground shakes 100 km from the earthquake's epicenter, the site on the earth's surface directly above the earthquake's origin. An instrument called a seismograph measures the amount of ground movement. Seismographs can detect movements as small as about 0.00001 mm to movements as large as about 1 m. In order to deal with numbers in such a broad range, the Richter scale is a logarithmic scale - each increase of 1 on the Richter scale represents a tenfold increase in movement. Thus, an earthquake registering 7 on the scale is 10 times as strong as an earthquake registering 6, and the earth moves 10 times as far.

Earthquakes of magnitude 5 are considered moderate, while quakes of magnitude 6 are considered large, quakes of magnitude 7 are considered major, and quakes of magnitude 8 or larger are considered great. For example, the Los Angeles earthquake of 1994 was a magnitude 6.7 earthquake and the San Francisco earthquake of 1906 was a magnitude 7.9 earthquake. Although there is no upper limit to the Richter scale, earthquakes of magnitude 8 or greater are rare. Worldwide, they occur only about once a year. Scientists believe that the crust cannot store enough energy to release a magnitude 10 earthquake. There is also no lower limit on the Richter scale. An earthquake one-tenth the size of a magnitude 1 earthquake would be a magnitude 0 earthquake, and an earthquake one tenth that size would be a magnitude -1 earthquake. Earthquakes with negative Richter scale magnitudes occur every day, but are so small that they are difficult to detect.

The Richter scale is only one of several scales used to measure earthquakes. Currently, the scale most commonly used by seismologists to rank the effects of earthquakes is the Modified Mercalli Intensity Scale, or MM scale. The MM scale measures the effects of an earthquake at different sites and thus the same earthquake has different MM scale values at different sites. The MM scale is marked from I (for barely detectable) to XII (for almost complete destruction).

VOLCANOES

The Nature of Volcanoes

Volcanoes are mountains, but they are very different from other mountains; they are not formed by folding and crumpling or by uplift and erosion. Instead, volcanoes are built by the accumulation of their own eruptive products - lava, bombs (crusted over lava blobs), ashflows, and tephra (airborne ash and dust). A **volcano** is most commonly a conical hill or mountain built around a vent that connects with reservoirs of molten rock below the surface of the Earth. The term **volcano** also refers to the opening or vent through which the molten rock and associated gases are expelled.

Driven by buoyancy and gas pressure the molten rock, which is lighter than the surrounding solid rock, forces its way upward and my ultimately break through zones of weaknesses in the Earth's crust. If so, an eruption begins, and the molten rock may pour from the vent as nonexplosive lava flows, or it may shoot violently into the air as dense clouds of lava fragments. Larger fragments fall back around the vent, and accumulations of fallback fragments may move downslope as ash flows under the force of gravity. Some of the finer ejected materials may be carried by the wind only to fall to the ground many miles away. The finest ash particles may be injected miles into the atmosphere and carried many times around the world by stratospheric winds before settling out.

How do Volcanoes erupt

Deep within the Earth it is so hot that some rocks slowly melt and become a thick flowing substance called ***magma***. Because it is lighter than the solid rock around it, magma rises and collects in magma chambers. Eventually some of the magma pushes through vents and fissures in the Earth's surface. A volcanic eruption occurs! Magma that has erupted is called ***lava***.

Some volcanic eruptions are explosive and other are not. How explosive an eruption is depends on how runny or sticky the magma is. If magma is thin and runny, gases can escape easily from it. When this type of magma erupts, it flows out of the volcano. Lava flows rarely kill people because they move slowly enough for people to get out of their way. Lava flows, however, can cause considerable destruction to buildings in their path. If magma is thick and sticky, gases cannot escape easily. Pressure builds up until the gases escape violently and explode. In this type of eruption, the magma blasts into the air and breaks apart into pieces called ***tephra***. Tephra can range in size from tiny particles of ash to house-size boulders.

Explosive volcanic eruptions can be dangerous and deadly. They can blast out clouds of hot tephra from the side or top of a volcano. These fiery clouds race down mountainsides destroying almost everything in their path. Ash erupted into the sky falls back to Earth like powdery snow, but snow that won't melt. If thick enough, blankets of ash can suffocate plants, animals, and humans. When hot volcanic materials mix with water from streams or melted snow and ice, mudflows form. Mudflows have buried entire communities located near erupting volcanoes. Because there may be hundreds or thousands of years between volcanic eruptions, people may not be aware of a volcano's dangers. When Mount St. Helens in the State of Washington erupted in 1980, it had not erupted for 123 years. Most people thought Mount St. Helens was a beautiful, peaceful mountain and not a dangerous volcano.

What Types of Volcanoes Are There?

Calderas

The largest and most explosive volcanic eruptions eject tens to hundreds of cubic kilometers of magma onto the Earth's surface. When such a large volume of magma is removed from beneath a volcano, the ground subsides or collapses into the emptied space, to form a huge depression called a **caldera**. Some calderas are more than 25 kilometers in diameter and several kilometers deep

Cinder Cones

Cinder cones are the simplest type of volcano. They are built from particles and blobs of congealed lava ejected from a single vent. As the gas-charged lava is blown violently into the air, it breaks into small fragments that solidify and fall as cinders around the vent to form a circular or oval cone. Most cinder cones have a bowl-shaped crater at the summit and rarely rise more than a thousand feet or so above their surroundings. Cinder cones are numerous in western North America as well as throughout other volcanic terrains of the world.

Composite Volcanoes and Stratovolcanoes

Some of the Earth's grandest mountains are composite volcanoes - sometimes called **stratovolcanoes**. They are typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs and may rise as much as 8,000 feet above their bases. Some of the most conspicuous and beautiful mountains in the world are composite volcanoes, including Mount Fuji in Japan, Mount Cotopaxi in Ecuador, Mount Shasta in California, Mount Hood in Oregon, Mount St. Helens and Mount Rainier in Washington. Most composite volcanoes have a crater at the summit which contains a central vent or a clustered group of vents. Lavas either flow through breaks in the crater wall or issue from fissures on the flanks of the cone. Lava, solidified within the fissures, forms dikes that act as ribs which greatly strengthen the cone. The essential feature of a composite volcano is a conduit system through which magma from a reservoir deep in the Earth's crust rises to the surface. The volcano is built up by the accumulation of material erupted through the conduit and increases in size as lava, cinders, ash, etc., are added to its slopes.

Composite volcanoes tend to erupt explosively and pose considerable danger to nearby life and property.

"Continental" Volcanoes

In the typical "continental" environment, volcanoes are located in unstable, mountainous belts that have thick roots of granite or granite like rock. Magmas, generated near the base of the mountain root, rise slowly or intermittently along fractures in the crust. During passage through the granite layer, magmas are commonly modified or changed in composition and erupt on the surface to form volcanoes constructed of nonbasaltic rocks.

"Island-Arc" Volcanoes

In a typical "island-arc" environment, volcanoes lie along the crest of an arcuate, crustal ridge bounded on its convex side by a deep oceanic trench. The granite or granitelike layer of the continental crust extends beneath the ridge to the vicinity of the trench. Basaltic magmas, generated in the mantle beneath the ridge, rise along fractures through the granitic layer. These magmas commonly will be modified or changed in composition during passage through the granitic layer and erupt on the surface to form volcanoes built largely of nonbasaltic rocks.

Lava Plateaus

In some shield-volcano eruptions, basaltic lava pours out quietly from long fissures instead of central vents and floods the surrounding countryside with lava flow upon lava flow, forming broad plateaus. **Lava plateaus** of this type can be seen in Iceland, southeastern Washington, eastern Oregon, and southern Idaho.

Lava Domes

Lava (usually dacite or rhyolite) that is too sticky to flow far from its vent forms steep-sided mounds called **lava domes**.

Maars and Tuff Cones

Also called **"tuff cones"**, **maars** are shallow, flat-floored craters that scientists interpret have formed above diatremes as a result of a violent expansion of magmatic gas or steam; deep erosion of a maar presumably would expose a diatreme. Maars range in size from 200 to 6,500 feet across and from 30 to 650 feet deep, and most are commonly filled with water to form natural lakes. Most maars have low rims composed of a mixture of loose fragments of volcanic rocks and rocks torn from the walls of the diatreme.

"Oceanic" Volcanoes

In a typical "oceanic" environment, volcanoes are alined along the crest of a broad ridge that marks an active fracture system in the oceanic crust. Basaltic magmas, generated in the upper mantle beneath the ridge, rise along fractures through the basaltic layer. Because the granitic crustal layer is absent, the magmas are not appreciably modified or changed in composition and they erupt on the surface to form basaltic volcanoes.

Shield Volcanoes

Shield volcanoes are built almost entirely of fluid lava flows. Flow after flow pours out in all directions from a central summit vent, or group of vents, building a broad, gently sloping cone of flat, domical shape, with a profile much like that a warrior's shield. They are built up slowly by the accretion of thousands of flows of highly fluid basaltic (from basalt, a hard, dense dark volcanic rock) lava that spread widely over great distances, and then cool as thin, gently dipping sheets. Lavas also commonly erupt from vents along fractures (rift zones) that develop on the flanks of the cone. Some of the largest volcanoes in the world are shield volcanoes. In northern California and Oregon, many shield volcanoes have diameters of 3 or 4 miles and heights of 1,500 to 2,000 feet. The Hawaiian Islands are composed of linear chains of these volcanoes including Kilauea and Mauna Loa on the island of Hawaii - two of the world's most active volcanoes. The floor of the ocean is more than 15,000 feet deep at the bases of the islands. As Mauna Loa, the largest of the shield volcanoes (and also the world's largest active volcano), projects 13,677 feet above sea level, its top is over 28,000 feet above the deep ocean floor.

Submarine Volcanoes, Ridges, and Vents

Submarine volcanoes and **volcanic vents** are common features on certain zones of the ocean floor. Some are active at the present time and, in shallow water, disclose their presence by blasting steam and rock-debris high above the surface of the sea. Many others lie at such great depths that the tremendous weight of the water above them results in high, confining pressure and prevents the formation and explosive release of steam and gases. Even very large, deepwater eruptions may not disturb the ocean surface.

Tuyas

A volcano that erupted under a glacier.

Volcanic Fields; Lava Fields; Mafic Volcanoes; Monogenetic Volcanoes

Mafic volcanoes typically erupt for brief time intervals (weeks to perhaps centuries), but some can grow almost as large as composite volcanoes. Subsequent eruptions in the region typically issue from new vents and, over tens to hundreds of thousands of years, build broad fields of many volcanoes. Prominent mafic volcanoes in the Three Sisters region include North Sister, Mount Bachelor, Belknap Crater, Black Butte, and Mount Washington. Hundreds more mafic volcanoes form the High Cascades of central Oregon between the neighboring composite volcanoes of Mount Jefferson, 60 kilometers (40 miles) north of Three Sisters, Newberry volcano, a similar distance southeast, and Crater Lake, 120 kilometers (75 miles) south.

Composite volcanoes erupt episodically over tens to hundreds of thousand of years and can display a wide range of eruption styles. **Monogenetic volcanoes** typically erupt for only brief time intervals - weeks to perhaps centuries - and generally display a narrower range in eruptive behavior. Most monogenetic volcanoes are basaltic in composition but... a few are of andesite and dacite composition - that is, with a relatively higher silica content.

Monogenetic volcanic fields are collections of cinder cones, and/or Maar vents and associated lava flows and pyroclastic deposits. Sometimes a stratovolcano is at the center of the field.

PHYSICAL GEOGRAPHY

Physical geography (also know as geosystems or physiography) is one of the two major subfields of geography. Physical geography focuses on understanding the processes and patterns in the natural environment, as opposed to the built environment, which is the domain of Human geography. Within the body of physical geography the Earth is often split either into several spheres or into different environments, with the main spheres being the Atmosphere, Biosphere, Cryosphere, Geosphere, Hydrosphere, Lithosphere and Pedosphere. Within physical geography there are various fields of study, mainly but not exclusively focusing on the spheres of the earth. Research in physical geography is often interdisciplinary and uses the systems approach.

Fields of physical geography

- **Geomorphology** is the science concerned with understanding the surface of the Earth and the processes by which it is shaped, both at the present as well as in the past. Geomorphology as a field has several sub-fields that deal with the specific landforms of various environments e.g. desert geomorphology and fluvial geomorphology, however, these sub-fields are united by the core processes which cause them; mainly tectonic or climatic processes. Geomorphology seeks to understand landform history and dynamics, and predict future changes through a combination of field observation, physical experiment, and numerical modeling (Geomorphometry). Early studies in geomorphology are the foundation for pedology, one of two main branches of soil science.

- **Hydrology** is predominantly concerned with the amounts and quality of water moving and accumulating on the land surface and in the soils and rocks near the surface and is typified by the hydrological cycle. Thus the field includes water in rivers, lakes, aquifers and to an extent glaciers, in which the field examines the process and dynamics involved in these bodies of water. Hydrology originated from engineering and has thus developed a largely quantitative method in its research; however, it does have an earth science side that embraces the systems approach. Similar to most fields of physical geography it has sub-fields that examine the specific bodies of water or their interaction with other spheres e.g. limnology and ecohydrology.

- **Glaciology** is the study of glaciers and ice sheets, or more commonly the cryosphere or ice and phenomena that involve ice. Glaciology groups the latter (ice sheets) as continental glaciers and the former (glaciers) as alpine glaciers. Although, research in the areas are similar with research undertaken into both the dynamics of ice sheets and glaciers the latter tends to be concerned with the interaction of ice sheets with the present climate and the latter with the impact of glaciers on the landscape. Glaciology also has a vast array of sub-fields examining the factors and processes involved in ice sheets and glaciers e.g. snow hydrology and glacial geology.

- **Biogeography** is the science, which deals with geographic patterns of species distribution and the processes that result in these patterns. Biogeography emerged as a field of study as a result of the work of Alfred Russel Wallace, although the field prior to the late twentieth century had largely been viewed as historic in its outlook and descriptive in its approach. The main stimulus for the field since its founding has been that of evolution, plate tectonics and the theory of island biogeography. The field can largely be divided into five sub-fields: island biogeography, paleobiogeography, phylogeography, zoogeography and phytogeography

- **Climatology** is the study of the climate, scientifically defined as weather conditions averaged over a long period of time. As opposed to meteorology, which studies atmospheric processes over a shorter duration, which are then examined by climatologist to find trends and frequencies in weather patterns/phenomena. Climatology, examines both the nature of micro (local) and macro (global) climates and the natural and anthropogenic influences on them. The field is also sub-divided largely into the climates of various regions and the study of specific phenomena or time periods e.g. tropical cyclone rainfall climatology and paleoclimatology.

- **Pedology** is the study of soils in its natural environment. It is one of two main branches of soil science, the other being edaphology. Pedology mainly deals with pedogenesis, soil morphology, and soil classification. In physical geography pedology is largely studied due to the numerous interactions between climate (water, air, temperature), soil life (micro-organisms, plants, animals), the mineral materials within soils (biogeochemical cycles) and its position and effects on the landscape such as laterization.

- **Coastal geography** is the study of the dynamic interface between the ocean and the land, incorporating both the physical geography (i.e coastal geomorphology, geology and oceanography) and the human geography of the coast. It involves an understanding of coastal weathering processes, particularly wave action, sediment movement and weathering, and also the ways in which humans interact with the coast. Coastal geography although predominantly geomorphological in its research is not just concerned with coastal landforms, but also the causes and influences of sea level change.

- **Oceanography** is the branch of physical geography that studies the Earth's oceans and seas. It covers a wide range of topics, including marine organisms and ecosystem dynamics (biological oceanography); ocean currents, waves, and geophysical fluid dynamics (physical oceanography); plate tectonics and the geology of the sea floor (geological oceanography); and fluxes of various chemical substances and physical properties within the ocean and across its boundaries (chemical oceanography). These diverse topics reflect multiple disciplines that oceanographers blend to further knowledge of the World Ocean and understanding of processes within it.

- **Quaternary science** is an inter-disciplinary field of study focusing on the Quaternary period, which encompasses the last 2.6 million years. The field studies the last ice age and the recent interstadial the Holocene and uses proxy evidence to reconstruct the past environments during this period to infer the climatic and environmental changes that have occurred.

- **Palaeogeography** is the study of the distribution of the continents through geologic time through examining the preserved material in the stratigraphic record. Palaeogeography is a cross-discipline, almost all the evidence for the positions of the continents comes from geology in the form of fossils or geophysics the use of this data has resulted in evidence for continental drift, plate tectonics and supercontinents this in turn has supported palaeogeographic theories such as the Wilson cycle.

- **Landscape ecology** is a sub-discipline of ecology and geography that address how spatial variation in the landscape affects ecological processes such as the distribution and flow of energy, materials and individuals in the environment. The field was largely founded by the German geographer Carl Troll Landscape ecology typically deals with problems in an applied and holistic context. The main difference between biogeography and landscape ecology is that the latter is concerned with how flows or energy and material are changed and their impacts on the landscape whereas the former is concerned with the spatial patterns of species and chemical cycles.

- **Geomatics** is the filed of gathering, storing, processing, and delivering of geographic information, or spatially referenced information. Geomatrics includes geodesy (scientific discipline that deals with the measurement and representation of the earth, its gravitational field, and other geodynamic phenomena, such as crustal motion, oceanic tides, and polar motion) and G.I.S. (a system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the earth) and remote sensing (the short or large-scale acquisition of information of an object or phenomenon, by the use of either recording or real-time sensing device(s) that is not in physical or intimate contact with the object).

- **Environmental geography** is a branch of geography that describes the spatial aspects of interactions between humans and the natural world. The branch bridges the divide between human and physical geography and thus requires an understanding of the dynamics of geology, meteorology, hydrology, biogeography, and geomorphology, as well as the ways in which human societies conceptualize the environment. Although the branch was previously more visible in research than at present with theories such as environmental determinism linking society with the environment. It has largely become the domain of the study of environmental management or anthropogenic influences on the environment and vice a versa.

DICTIONARY

abyssal plain – абиссальная равнина; магматическая равнина
alteration – деформация; изменение пород по сложению и составу; метаморфическое вытеснение
arc – дуга
archipelago – архипелаг
arcuate – аркообразный, согнутый, дуговидный
aquifer – водоносный слой, водоносный горизонт
avalanche – лавина; обвал
axis – вал, ось

badlands – бесплодные земли
barrier reef – барьерный риф
basin – водоем; бассейн; водосбор; синклиналь
boundary – граница; предел

cape – мыс
clay – глина
circumpolar – приполярный, околополюсный
cobble – булыжник; крупная галька
congealed lava – застывшая лава
coniferous forest – хвойный лес
confluence – слияние (рек)
convex – выпуклый
core – ядро; центр
craggy – скалистый
crest – вершина; гребень
crescent – полумесяц
crystalline – кристаллический; кристаллической структуры
current – поток

debris – обломки пород; наносная порода, покрывающая месторождение; пустая порода
degree – градус
depth – глубина
desert – пустыня
diatreme – диатрема (вулканическая трубка или жерло вулкана)
dike – дайка; дамба
to discharge – сливать; впадать
drain – водосток
to drown – тонуть

Earth's crust – земная кора
earthquake – землетрясение
embayment – бухта
eolian deflation – ветровая эрозия
erg – эрг
to erode – эродировать; разрушать; выветривать; размывать

eruption – выброс, извержение
to evaporate – выпаривать; упаривать; обезвоживать

fall – водопад
fault – разлом
fertile – плодородный
fissure – трещина, расщелина; излом
fluvial – речной
flux – течение
fog – туман
fossil – ископаемое

glacier – ледник
gravel – гравий, галька
gravity – гравитация
gorge – ущелье

Hamada desert – пустыня Хамада
hemisphere – полушарие
humidity – влажность

island – остров
islet – островок; обособленная зона

jagged peak – острая вершина
Jurassic period – юрский период

lacustrine – озерный
landlocked – почти полностью окруженный сушей; закрытый
larch – лиственница
laterization – латеритизация
latitude – широта
lava blobs – шарики лавы
leeward – подветренная сторона
liquefaction – сжижение, ожижение; разжижение
longitude – долгота

maar – маар
mafic – мафический, темный (о породе)
magma chamber – магматическая камера
magnitude – амплитуда
mangrove swamp – мангровое болото
mantle – мантия
marsh – болото

meandering stream – меандрический поток
mist – туман
moisture – влага
molten – расплавленный
moraine – морана, ледниковое отложение
mound – холм, курган
mountain range – горная гряда
mountainous belt – горный пояс
mouth – устье
mudflow – сель

outlet – сток

pastureland – пастбище
pebble – галька
peninsula – полуостров
plate – плита, земной пласт
pole – полюс
prairie – прерия
precipitation – осадки

ravine – ущелье; лощина, овраг, ложбина
reg – рег
rift – трещина; расселина; разлом; щель; разрыв; прорез, просвет, разрез
rupture – трещина (на поверхности земли); ущелье, овраг, расселина

sand sheet – песчаная равнина
seabed – морское дно
seaward – направленный, ведущий к морю
scrub – невысокий кустарник, низкая поросль; низкорослая, чахлая растительность; местность, покрытая такой растительностью
sediment – осадочная порода, отложение
seismic tremor – сейсмический толчок
shelf – риф, отмель, шельф, бедрок
shoreline – береговая линия
shrub – кустарник
sinuous path – волнообразный путь
slope – склон
soil – почва
sonar – сонар; гидролокация
spatial – пространственный
spur – отрог, уступ
to steep – вымачивать
steppe – степь
strait – пролив
stream – поток
subduction zone – зона пододвигания (одной тектонической плиты под другую)

submarine – подводный
summit – вершина
swirl – водоворот, воронка

tephra – тефра
terrain – местность, район
tidal forces – приливные силы
trench – впадина, канава, ров
tributary – приток
tropic of Cancer – тропик Рака (Северный тропик)
tropic of Capricorn – тропик Козерога (Южный тропик)
trough – мульда, синклиналь
tuff cone – конус из туфа

undulate – волнообразный
uplift – взброс
upwelling – апвеллинг (подъём воды из глубины в верхние слои океана)

vent – кратер вулкана

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