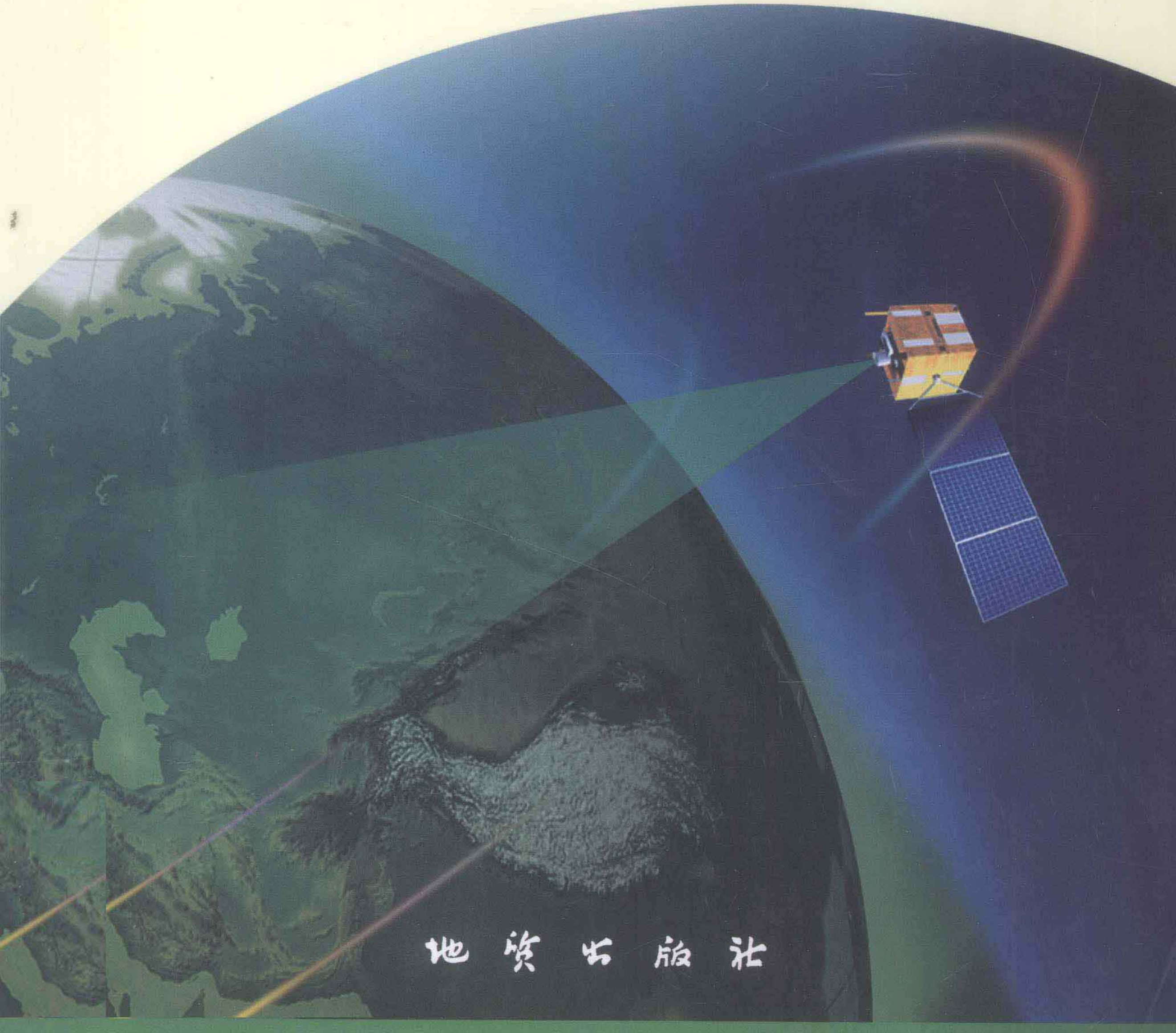
中国地质大学（北京）
勘查技术与工程国家特色专业系列教材

勘查工程专业英语

ENGLISH FOR PROSPECTING ENGINEERING

主编 马孝春 贾苍琴 郑秀华 张焕香



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内 容 提 要

本教材共有15个单元，内容涉及地质、现场勘察、土工测试、钻探工程、基础工程、注浆工程、边坡治理工程、石油钻井、非开挖工程等方面的英语阅读材料。文后附有详细的同类扩展词汇，语言规范、信息量大。

本书可作为勘查工程、土木工程、岩土工程、地质工程等专业的本专科生、研究生的专业配套教材，以及上述专业领域学生出国深造前应知必会的学习材料，也是从事涉外工程翻译人员的重要参考资料。

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前　言

中国地质大学（北京）勘查技术与工程专业办学历史悠久，已培养了大批优秀专业人才。在总结多年教学实践和教学改革经验的基础上，我们组织本校优秀师资编写了一套独具特色的勘查技术与工程专业核心课程系列教材，共13部。其中《勘查技术方法概论》、《钻探工程学》、《钻探与施工机械》、《钻井液工艺原理》、《钻井工程》、《煤层气勘探与开发》、《岩石断裂与损伤》、《勘查工程专业英语》及《工程地质实习指导书》共9部由地质出版社出版，其余4部由中国建筑工业出版社出版。本套教材的编写与出版得到了国家特色专业建设项目和北京市特色专业建设项目的资助。

具有阅读本专业外文文献的能力，是勘查技术与工程专业本科生和研究生的培养目标之一。通过多年的教学实践我们发现，即使是通过普通英语四、六级考试的学生，在研究生阶段进行专业英语文献检索、阅读或发表论文时，或者毕业后从事涉外工程，进行专业资料翻译与标书编写时，仍是困难重重，自信不足。究其原因，主要是没有掌握勘查技术与工程专业常用的中英文基本词汇及本专业英语文献的表述特点。

本教材以勘查技术与工程专业的教学内容为指导，编写了15个单元8个方面的阅读材料，内容涉及：

（1）地质方面的基本术语，如关于岩石、土、地下水方面的基本参数、分类、组成等方面的中英文表述方法；

（2）现场勘察、土工测试等关于各种勘查方法、勘探方法、现场测试方法、室内测试指标及用到的各种机具的表述方法；

（3）钻探工程中用到的钻机、钻具、钻进方法、钻进原理等方面的术语；

（4）基础工程中关于土力学、浅基础、深基础、地基处理等方面的术语及表述方法；

（5）注浆工程中涉及的注浆理论、注浆材料和注浆工艺方面的英语表述方法；

（6）边坡治理工程中涉及的边坡、地质灾害、地质灾害治理等术语；

（7）石油钻井中关于石油钻井设备、钻井方式、钻井液、固井与完井等方面的术语；

（8）非开挖工程中关于定向钻、顶管、微型隧道、管道修复与更换等方面的英语表述方法。课后附有相关专业的扩展词汇，语言规范、信息量大。

教材在有限的篇幅内尽量选取专业内容精炼、专业词汇集中、语言流畅的英文原文作范文，以便在短期内使学生能够达到较好的学习效果。从专业工程资料翻译和写作的角度讲，课后的词汇扩展与分类具有极大的实用性，可以有效地帮助从业人员迅速地提高翻译水平，完成工作任务。若在翻译过程中感觉专业词汇不足，可参考地质出版社出版的《非开挖工程英汉词典》，或与编者联系获取电子版，也可利用编者开发的“地质工程英汉辅助翻译软件”提高翻译速度与翻译质量。本课程计划学时为32学时，若学时较多或学生要求较高时，任课教师还可从相关的英语专业期刊中选取最新的文献进行补充。

本教材是在马孝春、郑秀华教授编写的《勘查工程专业英语》校内试用教材的基础上做了重大修改之后编写而成的。教材编写过程中得到了中国地质大学（北京）工程技术学院领导的大力支持及教研室主任王贵和教授的热忱帮助，同时还要感谢张姗磊、蒲燕萍、任鑫、李俊、刘恒林、简崇林、王姗姗等同学为完成书稿所做的工作。

在本教材编写过程中，我们节选了一些优秀的国外专业教材或期刊文章中的部分章节作为课文原文，参考了大量的国内外专业词典。在此向被引用的文献的作者表示衷心的感谢。

由于作者水平有限，时间仓促，书中的疏误之处恐难避免，恳请同行专家及广大读者批评指正，以利提高。

编　者

2010 年 7 月

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目　　录

Unit 1

Chemical and Physical Properties of Rocks

Before discussing the specific mechanical properties of rocks, it is necessary to define a rock and discuss some of its chemical and physical properties—particularly its structure, which may assist or resist the application of design criteria.

A rock, unlike a steel which can be refined to consistent internal state before use, is a naturally occurring material and must be used in its natural state. Certain simplifying assumptions are justified to assist design processes; others are not, and to a large extent the basis for all assumptions lies in the composition and structure of the rock.

1.1 Composition of Rocks

All rocks consist of an aggregate of mineral particles. The proportion of each mineral in the rock, together with the granular structure, the texture and the origin of the rock, serves as a basis for geological classification.

A mineral may be defined as an inorganic substance with consistent physical properties and a fixed chemical composition. With the exception of some carbon forms, sulphur and a few metals, all minerals are chemical compounds containing two or more elements in fixed proportions by weight. Some elements are present in many minerals, the commonest being oxygen and silicon, whilst others, including most of the precious and base metals, form an insignificant proportion of the rocks in the earth's crust.

The way in which the composition of the earth's crust is dominated by eight elements is shown in Table 1.1.

Table 1.1 Elements in the earth's crust

Element	Approximate proportion (%)	Element	Approximate proportion (%)
Oxygen (O)	46.7	Calcium (Ca)	3.6
Silicon (Si)	27.7	Sodium (Na)	2.8
Aluminium (Al)	8.1	Potassium (K)	2.6
Iron (Fe)	5.0	Magnesium (Mg)	2.1

These elements comprise approximately 98. 6% of the earth's crust and together with other elements form twelve common minerals which make up 99% of all rocks in the earth's crust. The remainder of the known rock-forming minerals, numbering over 1000, make up less than 1% of the earth's crust. It can be assumed, therefore, that most if not all rocks encountered in problems connected with mining or engineering work, will consist of two or more of these minerals, each of which has a particular set of physical properties which may affect the engineering properties of the rock as a whole. In general mineral particles in a rock will be so small that under normal circumstance they may have little individual effect on the rock properties.

Properties such as the preferred direction of cleavage and fracture, hardness and crystal structure used to define minerals can, however, under certain circumstances determine the reaction of a rock to outside forces, particularly where large amounts of a relatively soft mineral with marked fracture properties, such as a mica or calcite, or of a particular hard mineral, such as quartz, are present. Some mineral properties relevant to an analysis of the mechanical properties of rock are listed in Table 1. 2. The Mohs scale of hardness used in the table is based solely on the empirical property of one mineral to scratch another and rises from the softest, talc equivalent to 1, to the hardest diamond equivalent to 10. It is, as such, a useful scale for gauging the apparent toughness of a mineral. A more accurate and useful method of quoting hardness in terms of sclerometer units based on one of the pendulum sclerometer tests is sometimes used. The correlation between scratch hardness and sclerometer hardness is reasonably consistent.

Table 1. 2 Properties of common rock-forming minerals

Mineral	Hardness (Mohs)	Specific gravity	Fracture	Structure
Orthoclase	6	2. 6	Good cleavage at right angles	Monoclinic, commonly occurs as crystals
Plagioclase	6	2. 7	Cleavage nearly at right angles, very marked	Triclinic, showing distinct cleavage
Quartz	7	2. 65	No cleavage or fracture	Hexagonal
Muscovite Biotite	2. 5 3	2. 8 3	Perfect single cleavage into thin Easily separated plates	Monoclinic, exhibiting strong cleavage lamellae
Hornblende	5 - 6	3. 05	Good cleavage at 120 degrees	Hexagonal normally in elongated prisms
Augite	5 - 6	3. 05	Cleavage nearly at right angles	Monoclinic
Olivine	6 - 7	3. 5	No cleavage	No distinctive structure
Calcite	3	2. 7	Three perfect cleavages, rhomboids formed	Hexagonal
Dolomite	4	2. 8	Three perfect cleavages	Hexagonal
Kaolinite	1	2. 6	No cleavage	No distinctive structure
Hematite	6	5	No cleavage	Hexagonal

Hardness is sometimes used as a strength criterion in rocks, and as such it has certain facile usefulness. It can, however, be shown that hardness/toughness parameters are related primarily to dynamic strength rather than to static strength—a factor that can lead to serious discrepancies in some rocks. For instance a fibrous rock, such as gypsum or anhydrite, may have a relatively low hardness but a high bulk strength. Accurate strength criteria for rocks will be developed in a later unit, but it can immediately be seen that the anhydrous silicates, feldspar, quartz, hornblende, augite, olivine are considerably harder and hence stronger than any other common minerals except hematite. This is reflected to certain extent in the mechanical properties of a rock even where the rock contains only a limited amount of the mineral.

1.2 Geological Classification of Rocks

It is convenient to divide the rocks in the earth's crust into three different types based on their origin, namely igneous, sedimentary and metamorphic rocks. Igneous rocks are those formed by the solidification of molten magma, either at depth in the earth's crust or by extrusion, hence, their classification as plutonic, hypabyssal, or volcanic, depending on the depth and rate of their cooling and its effect on their texture or crystal size. Igneous rocks are also subdivided by their composition into acid, intermediate and basic rocks, depending on the amount of silica in their composition. A full classification is given in Table 1.3.

Table 1.3 Geological classification of igneous rocks

Texture	Acid rock (>66% silica)	Intermediate rock (52% –66% silica)		Basic rock (<52% silica)	
Plutonic (coarse)	Granite	Syenite	Diorite	Gabbro	
Hypabyssal	Micro-Granite	—	—	Dolerite	Peridotite
Volcanic (fine)	Rhyolite	Trachyte	Andesite	Basalt	Basalt
Major mineral	Quartz Orthoclase	Orthoclase Plagioclase	Plagioclase Hornblende	Augite Plagioclase	Augite Hornblende
Constituents	(Mica)	(Mica)	Orthoclase		Olivine

Sedimentary rocks, the second major type, are those rocks formed by the deposition (usually under water) of products largely formed by the destruction of pre-existing igneous rocks. They tend to be weaker than igneous rocks, largely because of the hydration of feldspars to form kaolinite and the introduction of organic minerals such as calcite. Sedimentary rocks can be subdivided into three main groups according to their method of formation, namely those mechanically formed, those formed from organic remains and those chemically deposited (Table 1.4). From an engineering point of view, the most important are arenaceous (sand) rocks, argillaceous (clay) rocks and calcareous (limestone) rocks. Typical arenaceous rocks consist of discrete fragments of mineral—usually quartz, held together by a matrix of calcite. Thus when a sandstone is broken, the fracture follows the weaker calcareous cement rather than cutting across the stronger grains. An argillaceous rock such as a clay or shale consists of minute particles held together weakly and comprising largely kaolinite. The calcareous rocks consist of organic remains or precipitates, mainly in the form of calcite and limestone.

Table 1. 4 Geological classification of sedimentary rocks

Method of formation	Classification	Rock	Description	Major mineral constituents
Mechanical	Rudaceous	Breccia, conglomerate	Large grains in clay matrix	Various
	Arenaceous	Sandstone	Medium round grains in calcite matrix	Quartz, calcite
		Gritstone	Medium angular grains in matrix	Quartz, calcite, various
		Breccia	Coarse angular grains in matrix	
	Argillaceous	Clay	Micro-fine grained plastic texture	Kaolinite, quartz, mica
		Shale, mudstone	Harder-laminated compacted clay	
Organic	Calcareous	Limestone	Fossiliferous, coarse or fine grained	Calcite
	Carbonaceous	Coal		
Chemical	Ferruginous	Ironstone	Impregnated limestone or clay	Calcite, iron, oxide
	Calcareous	Dolomite	Precipitated replaced limestone, fine grained	Dolomite, calcite

Metamorphic rocks may be either igneous or sedimentary rocks which have been altered physically and sometimes chemically by the application of intense heat or pressure at some time in their geological history. They are classified by their physical structure, i. e. massive or foliated structure (Table 1. 5).

Table 1. 5 Geological classification of metamorphic rocks

Classification	Rock	Description	Major mineral constituents
Massive	Hornfels	Micro-fine grained	Quartz
	Quartzite	Fine grained	Quartz
	Marble	Fine to coarse grained	Calcite or dolomite
Foliated	Slate	Micro-fined grained, laminated	Kaolinite, mica
	Phyllite	Soft, laminated	Mica, kaolinite
	Schist	Altered hypabyssal rocks, coarse grained	Felspar, quartz, mica
	Gneiss	Altered granite	Hornblende

It has been estimated that the earth's crust is made up of about 95% igneous rocks, about 5% sedimentary rocks and an insignificant proportion of metamorphic rocks. This does not, however, give a completely true picture of the rocks likely to be encountered by engineers working in rock. The earth's crust may be assumed to be from 30 to 50 km in thickness and virtually all major works take place in the top a few kilometers which contain the major part of the sedimentary rocks. In addition, a high percentage of these sedimentary rocks will be argillaceous, and the majority of the remainder being arenaceous or calcareous.

This is in some ways unfortunate, igneous rocks are with few exceptions competent, massive and strong, while sedimentary rocks are weak and strongly foliated and jointed. Of the sedimentary rocks, the arenaceous and calcareous, under favorable conditions, approach nears to the ideal of the igneous rocks. The argillaceous rocks depart furthest from them.

Argillaceous rocks comprise mainly shale, normally closely bedded or laminated. The former are reasonably strong in a dry state, but weak when wet; the latter tend to have intermediate strength under most conditions, but are easily deformed under load. The problems encountered in mining, tunneling or foundation work in such rocks are immediately apparent.

New Words

aluminium /ˌæljəˈmɪnɪəm/ 铝
amphibole /ˈæmfɪbəʊl/ 角闪石
andesite /ˈændɪzaɪt/ 安山岩
anhydrite /ænˈhaɪdraɪt/ 硬石膏
arenaceous /ˌærɪˈneɪʃəs/ 砂质的
argillaceous /ˌɑːdʒɪˈleɪʃəs/ 泥质的
augite /ˈɔːdʒaɪt/ 斜辉石
basalt /ˈbæsɔːlt/ 玄武岩
biotite /ˈbaɪətaɪt/ 黑云母
breccia /ˈbretʃə/ 角砾岩
calcareous /kælˈkeərɪəs/ 石灰质的,含钙的
calcite /ˈkælsaɪt/ 方解石
calcium /ˈkælsɪəm/ 钙
carbonaceous /ˌkɑːbəˈneɪʃəs/ 碳的,含碳的
cleavage /ˈkliːvɪdʒ/ 解理,劈理
deposition /ˌdepəˈzɪʃn/ 沉积(作用)
destruction /diˈstrʌkʃn/ 破坏,破裂
diorite /ˈdaɪəraɪt/ 闪长岩
discrepancy /dɪsˈkrepənsɪ/ 不同,差异
discrete /dɪˈskriːt/ 分散的,单个的
dolerite /ˈdɒləraɪt/ 粗粒玄武岩
dolomite /ˈdɒləmaɪt/ 白云岩
elongate /ˈiːlɒŋgeɪt/ 拉长,伸长
facile /ˈfæsaɪl/ 容易的,轻便的
feldspar /ˈfeldspɑː/ 长石
ferruginous /fɪˈruːdʒɪnəs/ 铁的,含铁的
fibrous /ˈfaɪbrəs/ 纤维状的
foliate /ˈfəʊlɪeɪt/ 叶状的
fossiliferous /ˌfɒsɪˈlɪfərəs/ 含化石的
fragment /ˈfrægmənt/ 碎片
gabbro /ˈgæbrəʊ/ 辉长岩
gneiss /naɪs/ 片麻岩
gritstone /ˈgrɪtstəʊn/ 粗砂岩
gypsum /ˈdʒɪpsəm/ 石膏
hematite /ˈhemətaɪt/ 赤铁矿
hexagonal /hekˈsægnəl/ 六方的
hornblende /ˈhɔːnblend/ 普通角闪石
hornfels /ˈhɔːnfelz/ 角页岩
hydration /haɪˈdreɪʃn/ 水化作用
hypabyssal /ˌhɪpəˈbɪsl/ 浅成的
igneous /ˈɪgnɪəs/ 火成的
inorganic /ˌinɔːˈgænɪk/ 无机的
iron oxide /ˈaɪənˈɒksaɪd/ 铁的氧化物
ironstone /ˈaɪənstəʊn/ 菱铁矿
kaolinite /ˈkeɪəlɪnaɪt/ 高岭岩
lamellae /ləˈmelə/ 薄片
laminate /ˈlæmɪneɪt/ 碾压
limestone /ˈlaɪmˌstəʊn/ 石灰岩
magma /ˈmægmə/ 岩浆
magnesium /mægˈniːzɪəm/ 镁
marble /ˈmɑːbl/ 大理岩
massive /ˈmæsɪv/ 块状的
matrix /ˈmeɪtrɪks/ 基质
metamorphic /ˌmetəˈmɔːfɪk/ 变质的

mica /ˈmaɪkə/ 云母
mineral /ˈmɪnərəl/ 矿物
molten /ˈməʊltən/ 熔融的
monoclinic /ˌmɒnəˈklɪnɪk/ 单斜的
mudstone /ˈmʌdstəʊn/ 泥岩
muscovite /ˈmʌskəvaɪt/ 白云母
olivine /ˈɒlɪviːn/ 橄榄石
orthoclase /ˈɔːθəkleɪz/ 正长石
oxygen /ˈɒksɪdʒən/ 氧
pendulum /ˈpendjʊləm/ 钟摆
peridotite /ˌperɪˈdəʊtaɪt/ 橄榄岩
phyllite /ˈfɪlaɪt/ 千枚岩
plagioclase /ˈpleɪdʒɪəkleɪs/ 斜长石
plutonic /pluːˈtɒnɪk/ 深成的
potassium /pəˈtæsɪəm/ 钾
precipitate /prɪˈsɪpɪteɪt/ 使沉淀
prism /ˈprɪzəm/ 棱柱
pyroxene /paɪˈrɒksiːn/ 辉石
quartz /kwɔːts/ 石英
rhomboid /ˈrɒmbɔɪd/ 偏菱形
rhyolite /ˈraɪəlaɪt/ 流纹岩
rudaceous /ˈruːdeɪʃəs/ 砾状的
schist /ʃɪst/ 片岩
scratch /skrætʃ/ 刻画
sedimentary /ˌsedɪˈmentərɪ/ 沉积的
silica /ˈsɪlɪkə/ 硅石
silicate /ˈsɪlɪkeɪt/ 硅酸盐
silicon /ˈsɪlɪkən/ 硅
siltstone /sɪltstəʊn/ 粉砂岩
slate /sleɪt/ 板岩
sodium /ˈsəʊdɪəm/ 钠
sulphur /ˈsʌlfə/ 硫
syenite /ˈsaɪənaɪt/ 正长岩
talc /tælk/ 滑石
texture /ˈtekstʃə/ 结构
toughness /ˈtʌfnɪs/ 韧性,韧度
trachyte /ˈtreɪkaɪt/ 粗面岩
triclinic /traɪˈklɪnɪk/ 三斜的
volcanic /vɒlˈkænɪk/ 火山的

关于岩石的分类词汇扩展

（1）地球（Earth）

地球 earth
大气圈 atmosphere /ˈætməsfɪə/
水圈 hydrosphere /ˈhaɪdrəsfɪə/
生物圈 biosphere /ˈbaɪəsfɪə/
地壳 the earth's crust, lithosphere /ˈlɪθəsfɪə/
地幔 earth mantle
地核 centrosphere /ˈsentrəsfɪə/
莫霍面 Moho /ˈməʊhəʊ/
软流圈 asthenosphere /æsˈθenəsfɪə/
岩石圈 lithosphere /ˈlɪθəsfɪə/
板块 plate

（2）地貌（Geomorphology）

地形 topography /təˈpɒgrəfɪ/
地貌 geomorphology /ˌdʒiːəʊmɔːˈfɒlədʒɪ/
地貌单元 landform unit
喀斯特地貌 karst land feature
河谷阶地 valley terrace /ˈterəs/
河流阶地 fluvial terrace
洪积扇 diluvial fan
冲沟 gully /ˈgʌlɪ/
冲积扇 alluvial fan

（3）地质结构（Geologic structure）

背斜 anticline
向斜 syncline
层理 bedding
产状 attitude /ˈætɪtjuːd/
断层 fault
断裂 fracture
节理 joint
倾角 dip angle

倾向 dip

走向 strike

褶皱 fold

整合 conformity

不整合 unconformity

假整合 disconformity

(4) 不利地质现象(Adverse geologic phenomena)

凹陷 sag

螯合作用 chelation /kiːˈleɪʃn/

坳陷区 down warping /wɔːpɪŋ/ region

崩塌 collapse

剥离 strip

沉陷 subsidence /ˈsʌbsɪdəns/

冲洗 flush

冲刷 washing

溶洞 cave

溶蚀 corrode /kəˈrəʊd/

地震 earthquake

断层 fault

断裂 rupture /ˈrʌptʃə/, fracture

断裂带 faulted zone

构造裂缝 structural fracture

泥流 mudflow

石流 rock glacier

泥石流 debris flow

(5) 地质年代 (Geologic chronicle)

新生代 Cenozoic /ˌsiːnəˈzəʊɪk/

中生代 Mesozoic /ˈmesəʊˈzəʊɪk/

古生代 Palaeozoic /ˌpælɪəˈzəʊɪk/

元古代 Proterozoic /ˌprəʊtərəˈzəʊɪk/

太古代 Archaeozoic /ˌɑːkɪəˈzəʊɪk/

第四纪 Quaternary /kwəˈtɜːnərɪ/

新近纪 Neogene /ˈniːədʒiːn/

古近纪 Paleogene /ˈpælɪədʒiːn/

白垩纪 Cretaceous /krɪˈteɪʃəs/

侏罗纪 Jurassic /dʒʊˈræsɪk/

三叠纪 Triassic /traɪˈæsɪk/

石炭纪 Carboniferous /ˌkɑːbəˈnɪfərəs/

二叠纪 Permian /ˈpɜːmɪən/

泥盆纪 Devonian /dɪˈvəʊnɪən/

志留纪 Silurian /saɪˈljʊərɪən/

奥陶纪 Ordovician /ˌɔːdəˈvɪʃɪən/

寒武纪 Cambrian /ˈkæmbrɪən /

(6) 矿物的物理性质(Physical properties of minerals)

形状 shape

颜色 color

条痕 streak

光泽 luster /ˈlʌstə/

解理 cleavage

断口 fracture

硬度 hardness

透明度 transparence

比重 specific gravity

密度 density

磁性 magnetic property

熔点 fusion point

(7) 矿物的十级硬度(Mineral hardness)

滑石 talc

石膏 gypsum

方解石 calcite

萤石 fluorite /ˈflʊəraɪt/

磷灰石 phosphorite /ˈfɒsfəraɪt/

正长石 orthoclase

石英 quartz

黄玉 topaz /ˈtəʊpæz/

刚玉 corundum /kəˈrʌndəm/

金刚石 diamond

(8) 岩体(Rock mass)

层面 bedding plane

层理 bedding, stratification