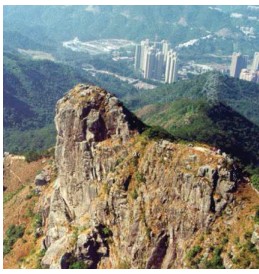
土木工程拓展署
土力工程處
Geotechnical Engineering Office
Civil Engineering and
Development Department

岩石與礦物導論
INTRODUCTION TO ROCKS AND MINERALS



岩石與礦物 1
ROCKS AND MINERALS

前言

教育局於2005年公布，三年新高中學制將於2009年9月在中四級實施。地理科是其中一個重點的選修科目。

新高中地理科課程是根據2005年教育局出版的一份文件和課程發展議會《高中課程指引》(2007)的建議而制訂。在此課程中，地理被視為一門學科讓學生可以從空間的角度了解自身所處的地球。

土木工程拓展署轄下的土力工程處應教育局的請求，在天然災害及地球科學兩個新高中地理科課程內容上製備了一份「教學支援教材套」。其中有關香港岩石及礦物的資料亦適用於部份化學科的課程。

「教學支援教材套」包括了14本小書冊、4張海報、3片光碟及其他一些補充資料。此教材套在香港的斜坡安全、山泥傾瀉、地質及地貌等課題上提供了合適及最新的資料並同時符合新高中地理科課程的水平。

土力工程處的「香港地質調查組」負責編寫有關香港地質及地貌方面的內容，而「斜坡安全部」則負責香港斜坡安全及山泥傾瀉的部份，「斜坡安全部」的同事亦負責整個項目的策劃與安排。我謹向各位參與這項工作的同事致謝。

我相信這教材套對各位負責新高中地理科目的老師在擬備教材時能提供合適的參考。此教材套亦給予有興趣於這些課題的廣大讀者一些有用的資料。

陳健碩
土木工程拓展署
土力工程處處長
2008年12月

Foreword

In 2005, the Education Bureau (EDB) announced that a three-year New Senior Secondary (NSS) curriculum would be implemented at Secondary 4 in September 2009. Geography is one of the elective subjects under the NSS curriculum.

The NSS curriculum has been developed on the basis of the recommendations made by an EDB document in 2005 and a Senior Secondary Curriculum Guide of 2007. Within the curriculum, geography is seen as a key educational discipline that provides students with a spatial understanding of the Earth on which we live and work.

At the request of the EDB, the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department have prepared support teaching materials for the NSS Geography curriculum under the topics of Natural Hazards and Earth Science. The materials written on rocks, minerals and ores in Hong Kong are also suitable for part of the Chemistry curriculum.

The "Teaching Support Materials Kit" consists of 14 booklets, 4 posters, 3 CDs and other supplementary information sheets. This teaching kit contains pertinent and up-to-date information on slope safety, landslides, geology and geomorphology in Hong Kong, written at a level that is suitable for the NSS Geography curriculum.

Hong Kong Geological Survey of GEO have compiled the teaching materials that describe the geology and geomorphology of Hong Kong. The Slope Safety Division of GEO have prepared the teaching materials on Hong Kong slope safety and landslides. Colleagues in the Slope Safety Division are also responsible for the overall planning and coordination of this project. Their contributions are gratefully acknowledged.

I am confident that, for years to come, secondary school geography teachers will find the kit invaluable for preparing their classroom teaching materials. The contents will also be of interest to the more general readers who may wish to learn more about these topics.

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December 2008

引言
Introduction

我們的地球是一個由大氣圈、水文圈、生物圈及岩石圈四個主要部份組成的動力體系。這四個部份在漫長的地球歷史中，持續互相影響。地質學為一門研究岩石圈的科學，並且包含岩石圈與其他三個部份相互作用的研究。

礦物和岩石是岩石圈的重要成分。雖然礦物種類超過三千種，但只有少數為常見組成岩石的礦物，例如石英、長石、雲母、角閃石、輝石、橄欖石及方解石**(岩石與礦物之一)**。岩石可視乎其形成的模式，劃分為火成、沉積及變質岩三大類**(岩石與礦物之一)**。過去地質年代期間，岩石逐漸從一種類變成另一類，這過程稱為岩石循環**(岩石與礦物之二)**。從仔細查驗岩石的岩理、成分及內部結構等特徵，可判斷該岩石的來源，這就是識別岩石的基礎**(岩石與礦物之二)**。在香港出現的岩石種類繁多，顯示區內複雜的地質情況**(岩石與礦物之三)**。

Our Earth is a dynamic system that comprises four main components: the atmosphere, the hydrosphere, the biosphere and the geosphere. These four components have been continuously interacting throughout the Earth's long history. Geology is the science that studies the geosphere, and encompasses the interactions between the geosphere and the other three components.

Minerals and rocks are essential components of the geosphere. Although there are over 3,000 species of minerals, only a few of them, such as quartz, feldspar, mica, amphibole, pyroxene, olivine and calcite, occur commonly as rock-forming minerals **(Rocks and Minerals 1)**. Rocks are classified into three main types, igneous, sedimentary and metamorphic, depending upon their mode of formation **(Rocks and Minerals 1)**. Over geological time, rocks are gradually transformed from one type to another in what is termed the Rock Cycle **(Rocks and Minerals 2)**. The origin of any particular rock can be determined by careful examination of its texture, composition, and internal structure, features that form the basis of rock identification and classification **(Rocks and Minerals 2)**. The large variety of rock types present in Hong Kong reflects the complexity of the geology of the region **(Rocks and Minerals 3)**.

內容
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礦物

礦物是什麼？

礦物是岩石的基本成分，屬天然形成的無機物質，它們由特定化學元素組成，原子規律地重複構成晶體結構。

矽酸鹽礦物是地球表面的岩石中，所含最豐富的成分，佔地殼物質超過90%。矽酸鹽礦物的基本成分是化合物四氧化矽(SiO_4)(圖1)。

其他常見的非矽酸鹽礦物，合共佔地殼成分不足10%，計有碳酸鹽、氧化物、硫化物、磷酸鹽和鹽。此外，還包括少量可能以單一化學元素存在的礦物，例如金、銀、銅、鉍、砷、鉛、碲及碳。

儘管自然界的天然化學元素多達92種，但當中僅有8種天然化學元素，常見於地殼內的岩石，而這8種元素合共已佔去地殼的98%以上。

以質量計，8種地殼最常見的元素是：

氧(O)	46.6%
矽 (Si)	27.7%
鋁(Al)	8.1%
鐵(Fe)	5.0%
鈣(Ca)	3.6%
鈉(Na)	2.8%
鉀(K)	2.6%
鎂(Mg)	2.1%

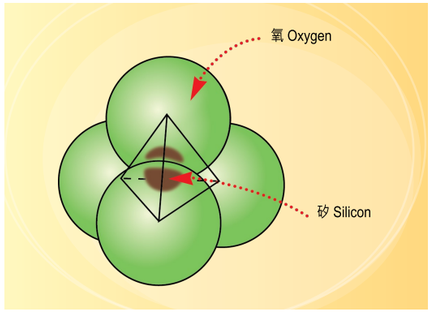

圖 1. 四氧化矽
Figure 1. Silicon tetroxide, SiO_4

礦物的分類及鑑定

礦物是以其化學成分分類。

礦物按照其物理性質，如堅硬度、光澤、顏色、解理、斷口及相對密度來識別。這些一般特性主要由礦物的原子結構(晶體結構)操控。

構成岩石的常見礦物

▶ **石英** (圖2)

- 石英，常稱矽，是地殼中最常見的礦物之一。
- 石英由化合物二氧化矽形成。
- 石英的晶體多呈六角及稜柱形狀。
- 純石英是無色的，但若含有雜質，則會呈現各種不同的顏色，如紫、粉紅或橙色。
- 石英是製造玻璃的原料。

Minerals

What are Minerals?

Minerals are the fundamental components of rocks. Minerals are naturally occurring inorganic substances with a specific chemical composition and an orderly repeating atomic structure that defines a crystal structure.

Silicate minerals are the most abundant components of rocks on the Earth's surface, making up over 90% by mass of the Earth's crust. The fundamental chemical building block of silicate minerals is the chemical compound silicon tetroxide, SiO_4 (Figure 1).

The common non-silicate minerals, which constitute less than 10% of the Earth's crust, include carbonates, oxides, sulphides, phosphates and salts. A few elements may occur in pure form. These include gold, silver, copper, bismuth, arsenic, lead, tellurium and carbon.

Although 92 naturally occurring elements exist in nature, only eight of these are common in the rocks of the Earth's crust. Together, these eight elements make up more than 98% of the crust.

The eight most common elements in the Earth's crust (by mass) are:

Oxygen (O)	46.6%
Silicon (Si)	27.7%
Aluminium (Al)	8.1%
Iron (Fe)	5.0%
Calcium (Ca)	3.6%
Sodium (Na)	2.8%
Potassium (K)	2.6%
Magnesium (Mg)	2.1%

Classification and Identification

Minerals are classified according to their chemical composition.

The physical properties of minerals, such as their hardness, lustre, colour, cleavage, fracture and relative density, can be used to identify minerals. These general characteristics are controlled mainly by their atomic structure (crystal structure).

Common Rock-forming Minerals

▶ **Quartz** (Figure 2)

- Quartz, which is usually called silica, is one of the most common minerals in the Earth's crust.
- Quartz is made up of silicon dioxide (SiO_2).
- Quartz crystals are usually hexagonal and prismatic in shape.
- Pure quartz is colourless, although the presence of impurities may give a range of colours, such as violet, pink and orange.
- Quartz is the raw material for making glass.

圖2. 石英
Figure 2. Quartz

斜長石 (圖3)

- 斜長石是含有豐富鈉質或鈣質的長石。其化學成分組合範圍從鈉鋁矽酸鹽($NaAlSi_3O_8$)至鈣鋁矽酸鹽($CaAl_2Si_2O_8$)。
- 斜長石的晶體多呈短而粗的稜柱狀。
- 斜長石通常是白至灰白色，並顯出玻璃光澤。
- 斜長石是製造陶瓷的重要工業礦物原料。

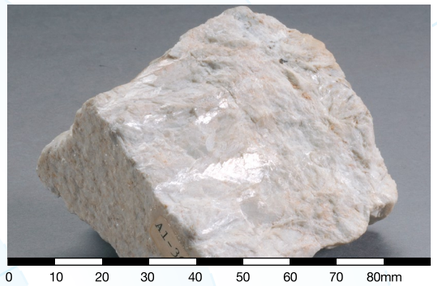

圖3. 斜長石
Figure 3. Plagioclase feldspar

鹼性長石 (圖4)

- 鹼性長石是長石礦物類中另一種礦石。
- 鹼性長石(鉀鈉鋁矽酸鹽$(K,Na)AlSi_3O_8$)含有豐富鹼金屬原素。
- 鹼性長石的晶體多呈短而粗的稜柱狀。
- 鹼性長石色澤以粉紅帶白色為主。
- 鹼性長石一般用作製造瓷器的原料。

註：長石是一組具有相若原子結構的礦物的統稱，其中以斜長石及鹼性長石較為重要。

圖4. 鹼性長石
Figure 4. Alkali feldspar

雲母

- 雲母屬矽酸鹽礦物。
- 雲母由鉀、鎂及鐵，以及鋁、矽和水份這些不同成分組成。
- 雲母的晶體多呈片狀，可沿其解理面分裂為平滑片面，仿如書本的薄頁。
- 雲母是侵入性火成岩中常見的礦物，亦見於沉積岩及變質岩。
- 黑雲母(圖5)色澤深、帶黑或啡色，而淺色或透明的雲母則稱為白雲母 (圖6)。

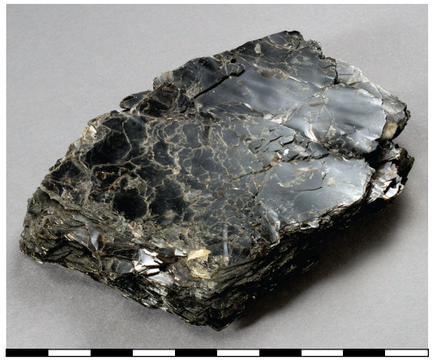

圖5. 黑雲母
Figure 5. Biotite

閃石類

- 閃石類礦物屬矽酸鹽礦物。
- 閃石類礦物含有鐵、鎂、鈣、鋁，以及矽、氧和水份。
- 閃石類礦物形成稜柱狀或針狀晶體。
- 閃石類礦物是多種火成岩及變質岩中的礦物成分。
- 角閃石(圖7)是岩石礦物中閃石類礦物的常見成員。

Plagioclase feldspar (Figure 3)

- Plagioclase feldspar is a sodium- or calcium-rich feldspar. The chemical composition ranges from sodium aluminium silicate, $NaAlSi_3O_8$ to calcium aluminium silicate, $CaAl_2Si_2O_8$.
- Plagioclase feldspar crystals usually occur as stubby prisms.
- Plagioclase feldspar is generally white to grey and has a vitreous lustre.
- Plagioclase feldspar is an important industrial mineral used in ceramics.

Alkali feldspar (Figure 4)

- Alkali feldspar is another member of the family of feldspar minerals.
- Alkali feldspars (potassium sodium aluminium silicate $(K,Na)AlSi_3O_8$) are rich in alkali metal ions.
- Alkali feldspar crystals usually occur as stubby prisms.
- Alkali feldspar is commonly pink to white.
- Alkali feldspar is used as raw material to make porcelain.

NOTE: Feldspar is a general name for a family of minerals with similar atomic structure. Two of the more important mineral members in the feldspar group are plagioclase feldspar and alkali feldspar.

Micas

- Micas are a family of silicate minerals.
- Micas are made up of varying amounts of potassium, magnesium, iron, as well as aluminium, silicon and water.
- Micas form flat, book-like crystals that split into individual sheets, separating into smooth flakes along the cleavage planes.
- They are common minerals in intrusive igneous rocks, and can also be found in sedimentary and metamorphic rocks.
- Biotite (Figure 5) is a dark, black or brown mica; muscovite (Figure 6) is a light-coloured or clear mica.

圖6. 白雲母
Figure 6. Muscovite

Amphiboles

- Amphiboles are a family of silicate minerals.
- Amphibole minerals generally contain iron, magnesium, calcium and aluminium as well as silicon, oxygen, and water.
- Amphiboles form prismatic or needle-like crystals.
- Amphibole is a component of many igneous and metamorphic rocks.
- Hornblende (Figure 7) is a common member of the amphibole group of rock-forming minerals.

圖7. 角閃石
Figure 7. Hornblende

輝石 (圖8)

- 輝石屬矽酸鹽礦物。
- 輝石礦物一般含有鎂、鐵、鈣、鋁，以及矽和氧。
- 輝石形成短小或柱狀的稜柱晶體。
- 輝石是多種火成岩及變質岩中的礦物成分。
- 輝石的晶體通常雕琢成寶石，珍貴的翡翠玉石(輝玉)正是輝石的一種。

圖8. 輝石
Figure 8. Pyroxene

橄欖石 (圖9)

- 橄欖石屬矽酸鹽礦物。
- 橄欖石($(Mg, Fe)_2SiO_4$) 含有鐵和鎂。
- 橄欖石是綠色、像玻璃質的礦物。
- 橄欖石是鐵鎂質岩石及超基性岩石中常見的礦物，但這類岩石並未在香港出現。
- 清澈及透明的橄欖石晶體多被切割成寶石。

圖9. 橄欖石
Figure 9. Olivine

方解石 (圖10)

- 方解石屬碳酸鹽礦物。
- 方解石由碳酸鈣($CaCO_3$)形成。
- 方解石通常是白色至透明無色，容易被刀刮花。
- 方解石是常見的沉積岩礦物，是石灰岩等鈣質沉積岩的重要成分。石灰岩經變質後會形成大理岩。

Pyroxene (Figure 8)

- Pyroxenes are a family of silicate minerals.
- Pyroxene minerals generally contain magnesium, iron, calcium and aluminium as well as silicon and oxygen.
- Pyroxenes form short or columnar prismatic crystals.
- Pyroxene is a component in many igneous and metamorphic rocks.
- Pyroxene crystals are commonly faceted as gemstones. For instance, precious jade (jadeite) is a pyroxene.

Olivine (Figure 9)

- Olivine is a silicate mineral.
- Olivine ($(Mg,Fe)_2SiO_4$) contains iron and magnesium.
- Olivine is a green, glassy mineral.
- Olivine is common in mafic and ultramafic rocks, but has not been found in Hong Kong.
- Clear and transparent olivine crystals are commonly faceted as gemstones.

Calcite (Figure 10)

- Calcite is a carbonate mineral.
- Calcite is made up of calcium carbonate ($CaCO_3$).
- Calcite is generally white to clear, and is easily scratched with knife.
- Calcite is a common sedimentary mineral that is the major component of calcareous sedimentary rocks such as limestone. Metamorphism of limestone produces marble.

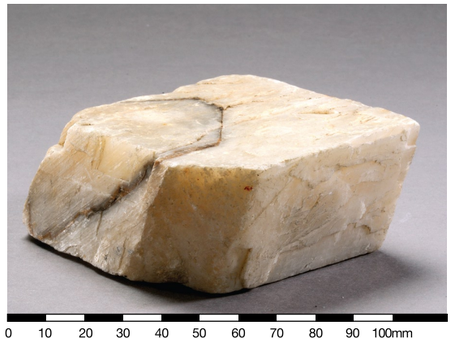

圖10. 方解石
Figure 10. Calcite

岩石

岩石是什麼？

岩石是礦物、岩石碎塊或有機物質的天然集成體。岩石的成分、外貌、形狀，以及岩石內顆粒和晶體的排列(即其岩理)皆顯示其形成過程。根據岩石的形成模式，岩石可分成三種類別：火成岩、沉積岩及變質岩。

火成岩

熾熱的岩漿冷卻凝固後形成火成岩。岩漿來自地球深處，鄰近活躍的板塊邊緣或熱點，並向地球表面上升。火成岩根據岩漿在不同地點凝固而劃分為兩大類：侵入岩及噴出岩。

有關板塊邊緣及熱點，見板塊運動之一。

- **侵入岩，或稱深成岩**，是當岩漿上升期間被困於地球深處，導致冷卻過程非常緩慢，往往歷時數千或百萬年才得以完全凝固。緩慢的冷卻過程給予個別礦物足夠時間凝固，結成體積相對較大的晶體。侵入性火成岩一般擁有較粗粒的岩理及互鎖的礦物。花崗岩(圖11)是香港境內常見的侵入性火成岩。

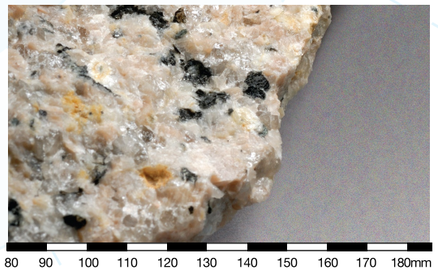

圖11. 花崗岩 — 為侵入性火成岩的例子。
Figure 11. Granite - an example of intrusive igneous rock.

- **噴出岩，或稱火山岩**，是當岩漿向上湧出噴發，並在地面或非常接近地球表面冷卻而形成。噴出的岩漿暴露於溫度較低的大氣層，其冷卻及凝固速度相對較快，因而形成岩理較幼的噴出性火成岩。熔岩及凝灰岩(圖12)是兩種常見的火山岩。

圖12. 凝灰岩 — 為噴出性火成岩的例子。
Figure 12. Tuff - an example of extrusive igneous rock.

沉積岩

沉積岩是由已存在的岩石被侵蝕後剝落的碎屑或死去的植物或生物的骨骼碎塊結成。沉積岩通常集中於地球表面的不同環境，一般呈現明顯的層次或層理。沉積岩可細分為三組，包括碎屑沉積岩、生物沉積岩及化學沉積岩。

- **碎屑沉積岩**由已存在的岩石碎片(岩石碎屑)組成。晶體及碎片從已存在的岩石中經過長期的風化而剝落，並搬運到另一地方沉積。沉積物被埋藏、壓縮及膠結，形成碎屑沉積岩。

  碎屑沉積岩以其岩石碎屑的顆粒大小、形狀而命名(表1)。例如粉砂岩(圖13)是由粉砂大小的顆粒集結而成，而砂岩則由沙粒組成。

Rocks

What are Rocks?

Rocks are naturally occurring aggregates of minerals, rock fragments or organic matter. The composition of a rock, as well as the appearance, shape, and arrangement of the grains or crystals within the rock (*i.e.* its texture), are the characteristics that reveal its process of formation. Based on their mode of formation, rocks are classified into three main types: igneous, sedimentary and metamorphic.

Igneous Rocks

Igneous rocks form when hot, molten rock (magma) cools and solidifies. The magma originates deep within the Earth near active plate boundaries or hot spots, then rises toward the surface. Igneous rocks are sub-divided into either, intrusive or extrusive rocks, depending upon where in the earth the magma solidifies.

Refer to Plate Tectonics 1 for more information on plate boundaries and hot spots.

- **Intrusive, or plutonic, igneous rocks** are formed when rising magma is trapped deep within the Earth, where it cools very slowly over many thousands or millions of years until it finally solidifies. Slow cooling allows the individual mineral grains sufficient time to grow and form relatively large crystals. Intrusive rocks have a coarse-grained texture with interlocking minerals. Granite (Figure 11) is a commonly occurring intrusive rock in Hong Kong.

- **Extrusive, or volcanic, igneous rocks** are produced when magma is erupted at, or very near, the Earth's surface. The erupted magma cools and solidifies relatively quickly when it is exposed to the cooler temperatures of the atmosphere. Lava and tuff (Figure 12) are two common volcanic rocks.

Sedimentary Rocks

Sedimentary rocks are formed from the eroded fragments of pre-existing rocks, or from the skeletal fragments of once-living plants or organisms. They accumulate in various environments on the Earth's surface. Sedimentary rocks commonly have distinctive layering or bedding. Sedimentary rocks are sub-divided into three groups, including clastic, biological and chemical.

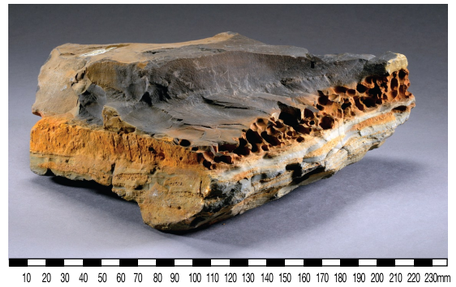

圖13. 粉砂岩 — 為碎屑沉積岩的例子。
Figure 13. Siltstone - an example of clastic sedimentary rock.

顆粒大小(毫米) Grain Size (mm)	沉積物 Sediment	沉積岩 Sedimentary Rock
> 200	巨礫 Boulder	礫岩/角礫岩 Conglomerate / Breccia
200 - 60	中礫 Cobble	
60 - 2	細礫 Gravel	
2 - 0.06	沙 Sand	砂岩 Sandstone
0.06 - 0.002	粉砂 Silt	粉砂岩/泥岩 Siltstone / Mudstone
< 0.002	黏土 Clay	

表1. 碎屑沉積物及沉積岩的分類。
Table 1. Classification of clastic sediment and sedimentary rock.

- **Clastic sedimentary rocks** are made up of fragments (clasts) of pre-existing rocks. Crystals or fragments of the pre-existing rocks are loosened by weathering, and subsequently transported to a site where they are deposited. Clastic sedimentary rock is formed when the sediment is buried, then compacted and cemented.

- **生物沉積岩**是當大量植物或生物死亡，其殘骸被分解、壓縮、膠結及堆積，形成的沉積岩。沉積物含豐富碳質的植物便可能形成煤；若沉積物中含大量動物貝殼，則可能形成石灰岩(圖14)或燧石。

圖14. 大理岩為石灰岩變質後的產物，石灰岩為生物沉積岩的例子，而大理岩則為無葉理變質岩的例子。
Figure 14. Marble is the metamorphic product of limestone. Limestone is an example of biological sedimentary rock, whereas marble is an example of non-foliated metamorphic rock.

- **化學沉積岩**由液體沉澱化合物形成。當水沿岩石隙流動時，石頭內部份礦物溶於水中，並被水流帶走。其後當水份蒸發或水中含礦物過多，最終礦物會沉積或從溶液中沉澱而形成化學岩石。岩鹽正是化學沉積岩的例子。

變質岩

當已存在的岩石遇上高溫、高壓、含豐富礦物成分熱溶液，或混合以上情況，皆可形成變質岩。原本的岩石可以是火成岩、沉積岩或已有的變質岩。在變質岩中，部份甚至全部原有的礦物會被新的礦物取代，而原有的岩理則可能受到與變質作用同時出現的變形(如剪切及褶皺)而被遮蓋。變質岩普遍於地球深處或板塊邊緣形成。

- **有葉理的變質岩**呈片狀或頁狀結構。葉理是當岩石中片狀或稜柱狀的礦物，受極高壓壓縮以致構成定向排列而形成。葉理構造可反映岩石受壓的方向。板岩、片岩(圖15)及片麻岩全是有葉理的變質岩石。

- **無葉理的變質岩**具均勻結構。此類岩石可於侵入性火成岩周圍，在接觸變質作用下形成。當遇到岩石侵入，已存在的岩石受到極度高溫的變質作用，但岩石中的礦物並無受到壓力擠壓，因此其結構有所改變卻沒有構成葉理。石英岩及大理岩(圖14)便是無葉理的變質岩石。

The naming of clastic sedimentary rocks is based on grain size and shape of the clasts (Table 1). For example, siltstone (Figure 13) is an aggregate of silt-sized grains, whereas sandstone is composed of sand-sized grains.

- **Biological sedimentary rocks** form when large quantities of living plants or organisms die and accumulate. Their remains are broken down, compressed and cemented to form rock. Accumulations of carbon-rich plant material may form coal. Deposits composed mainly of animal shells may form limestone (Figure 14) or chert.

- **Chemical sedimentary rocks** are formed by chemical precipitation from solutions. This process begins when water passes through rock dissolving some of the minerals and carrying them away from their source. Eventually the minerals are deposited, or precipitated, when the water evaporates or when the water becomes over-saturated with minerals. Rock salts are examples of chemical sedimentary rocks.

Metamorphic Rocks

Metamorphic rocks are formed when a pre-existing rock is subject to high temperature, high pressure, hot and mineral-rich fluid, or a combination of these conditions. The original rocks could be igneous, sedimentary, or earlier metamorphic rocks. In the case of metamorphic rocks, some or all of the original minerals are replaced by new minerals, and the original textures are commonly masked due to the deformation (such as shearing and folding) that may accompany metamorphism. Metamorphic rocks are generally formed deep within the Earth, or where tectonic plates meet.

- **Foliated metamorphic rocks** exhibit a platy or sheet-like structure. Foliation develops when platy or prismatic minerals within the rock are compressed and aligned under extreme pressure. The foliation pattern reflects the direction in which pressure was applied. Slate, schist (Figure 15), and gneiss are examples of foliated metamorphic rocks.

圖15. 片岩一為有葉理變質岩的例子。
Figure 15. Schist - an example of foliated metamorphic rock.

- **Non-foliated metamorphic rocks** display a massive structure. Non-foliated metamorphic rocks can be formed by contact metamorphism that occurs around intrusive igneous rocks. The pre-existing rocks that come into contact with the intruding igneous rocks are essentially baked by the heat. In this case, the mineral structures of the pre-existing rocks are changed without being subjected to intense pressure. Quartzite and marble (Figure 14) are examples of non-foliated metamorphic rocks.

表土沉積

表土沉積是什麼？

岩石經過風化後，被分解成鬆散的岩石碎屑及礦物顆粒，並經侵蝕過程轉移至另一地點。這些沉積物可能由水力、風力或地心吸力推動，最終堆積至不同的沉積環境。表土沉積是指未被整固在地表上的沉積物。

有關地球表面的地質活動，見地質與地景之一。

表土沉積的分類

表土沉積物一般按其沉積環境分為三大類：陸上(土地)、海岸及海洋沉積環境(表2)。沉積環境受各不同因素相互影響，包括該地點的板塊構造環境、地理位置、沉積物輸送媒體、可影響沉積物的生物、以及氣候系統等。沉積環境可能隨著時間，因海平面變化或河道變更等因素，而作出相應改變。

陸上(土地)沉積環境的例子包括： Examples of terrestrial (land) sedimentary environments are:	海岸沉積環境例子包括： Examples of shoreline sedimentary environments are:	海洋沉積環境例子包括： Examples of marine sedimentary environments are:
湖泊 Lake	三角洲 Delta	深海 Deep sea
河流 River	沙灘 Beach	大陸邊緣 Continental margin
沙漠 Desert	潮汐灘地 Tidal flat	大陸棚 Continental shelf
冰川 Glacier		珊瑚礁 Coral reef

表2. 各類沉積環境的例子。
Table 2. Example of various types of depositional environments.

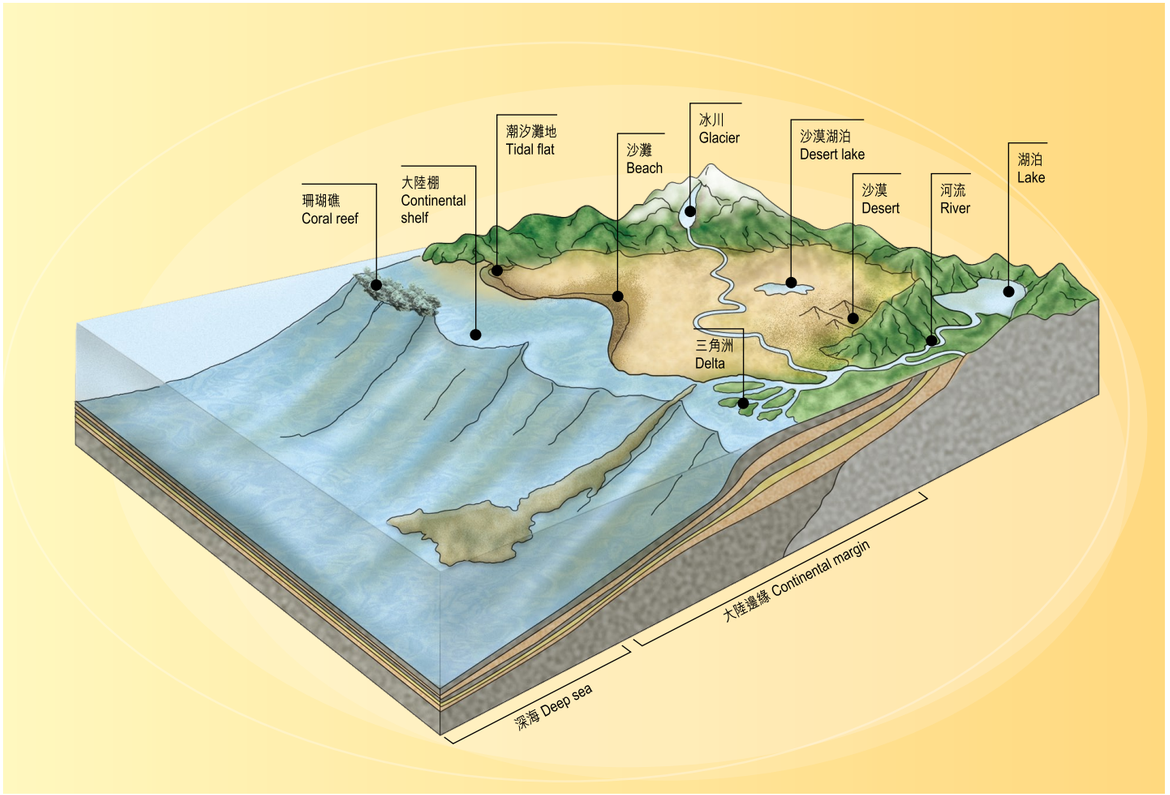

圖16. 沉積環境。
Figure 16. Depositional sedimentary environments.

Superficial Deposits

What are Superficial Deposits?

When rocks are weathered, they break down into loose rock and mineral grains, which are then carried away by erosion processes. These sediments are transported by water, wind, or gravity, and are eventually deposited in various sedimentary environments. Superficial deposits are unconsolidated accumulations of sediments on the landscape.

Refer to Geology and Landscape 1 for more information on Earth surface processes.

Classification of Superficial Deposits

Superficial deposits are generally classified into three broad categories according to environments of deposition: terrestrial (land), shoreline and marine environments (Table 2). A sedimentary environment results from the interaction of various factors, including the plate tectonic setting, geographical location of the site, transporting agents, organisms that may modify the sediments, and the climatic system. The sedimentary environment of a site may change over time in response to factors such as shifting river channels and relative sea level changes.

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