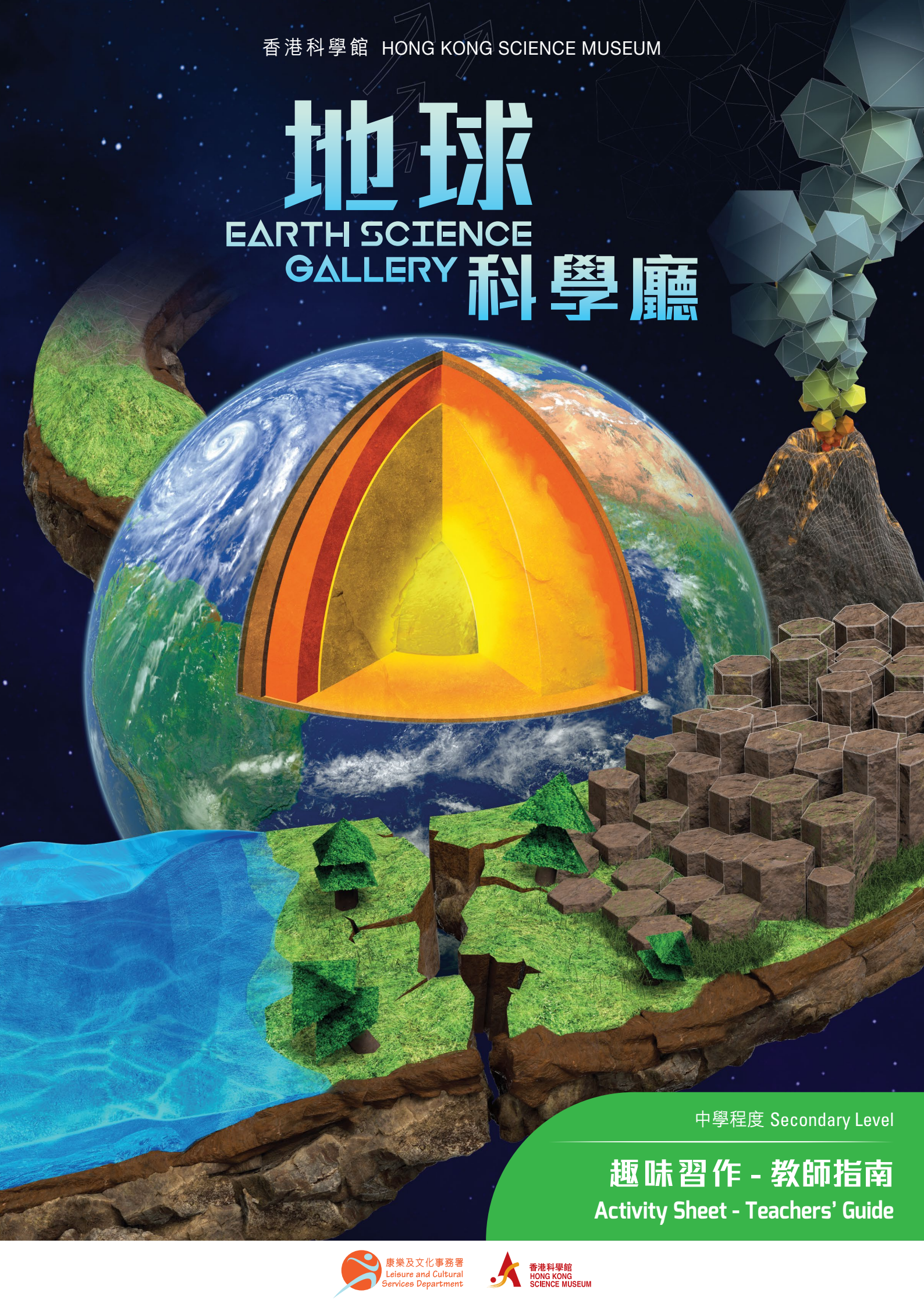


香港科學館 HONG KONG SCIENCE MUSEUM

# 地球

EARTH SCIENCE  
GALLERY 科學廳



中學程度 Secondary Level

趣味習作 - 教師指南  
Activity Sheet - Teachers' Guide

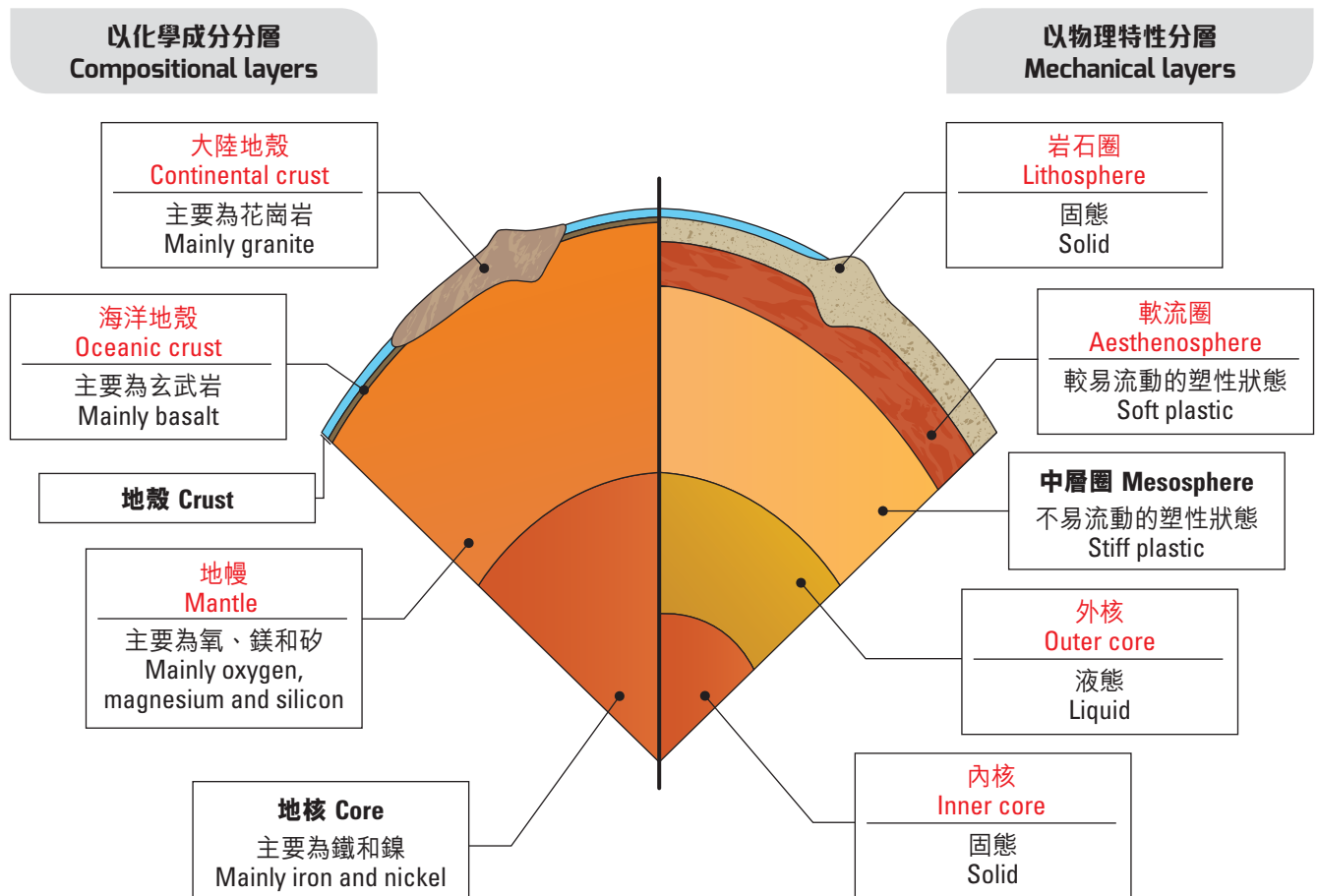
# 解構地球

## UNEARTH OUR PLANET

### 地球的分層結構 Layered Earth

我們在地球外圍的地殼生活。如果將地球好像西瓜般剖開，你知道地殼之下有着甚麼結構嗎？

We live on the outer surface of Earth which is called the crust. Imagine if you were to cut open Earth like a watermelon, what would you find beneath the crust?



### 迷路太空人 Lost in Space

一艘飛船正迷失在太空之中！你能幫助太空人輸入地球的宇宙地址，把他帶回地球嗎？

A spaceship is now lost in space! Can you help the astronaut to complete Earth's cosmic address and bring him back?

拉尼亞凱亞超星系團 室女座星系團 本星系群

銀河系 太陽系 (行星系統) 地球 (行星)

Earth (planet), Solar System (planetary system), Milky Way,

*The Local Group, Virgo Supercluster, Laniakea Supercluster*

# 變動不息的地球

## THE RESTLESS EARTH

### 板塊構造 Plate Tectonics

地球最外層稱為岩石圈，由地殼和上地幔的最上層組成。岩石圈分裂為多塊板塊，根據你的地理常識，你能認出當中的七塊主要板塊的位置嗎？

The outermost surface of Earth is called the lithosphere, which is made up of the crust and the upper part of the upper mantle. The lithosphere is broken into pieces of tectonic plates. Based on your geological knowledge, can you identify the whereabouts of the seven major tectonic plates?

**A**

非洲板塊  
African Plate

**B**

南極洲板塊  
Antarctic Plate

**C**

歐亞板塊  
Eurasian Plate

**D**

北美洲板塊  
North American Plate

**E**

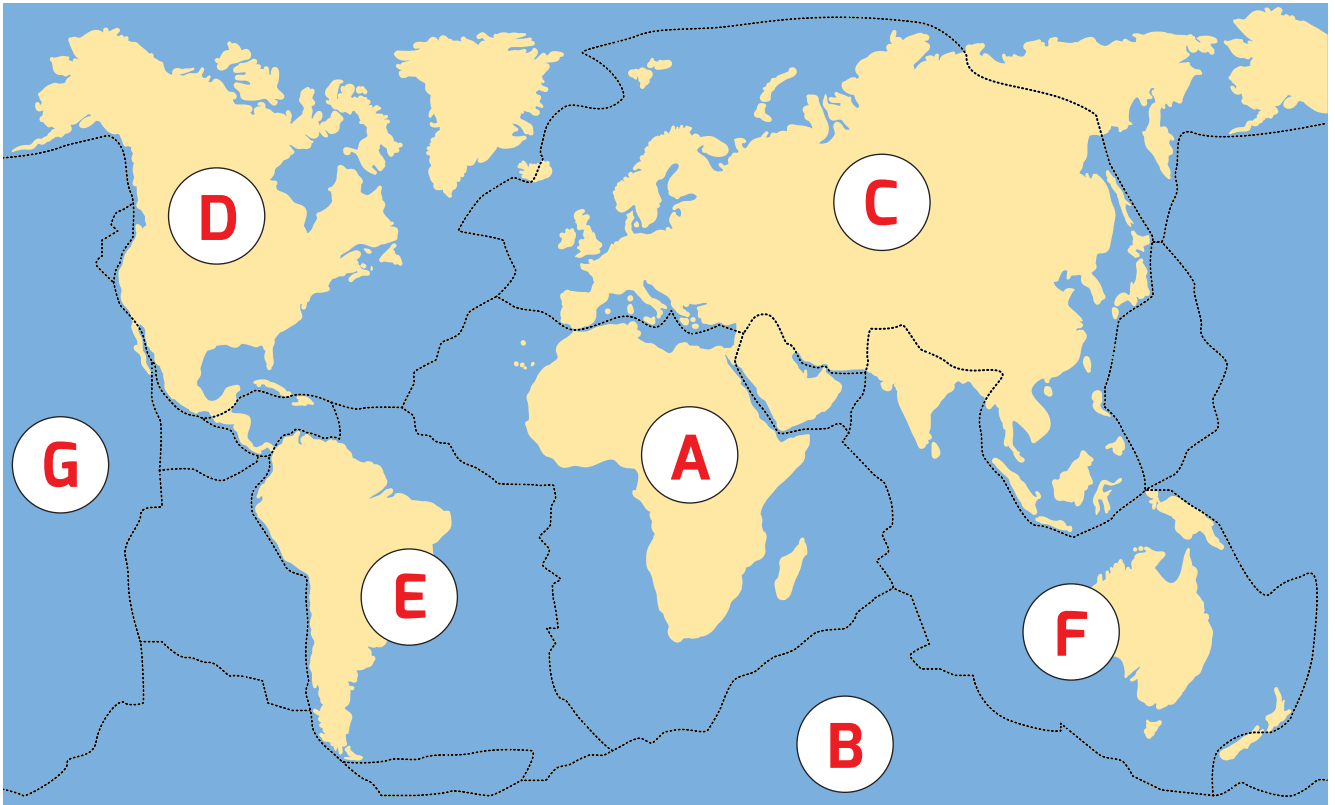
南美洲板塊  
South American Plate

**F**

印澳板塊  
Indo-Australian Plate

**G**

太平洋板塊  
Pacific Plate



## 移動中的大陸 Continents on the Move

各個大陸的位置一直在改變。約在三億年前，所有陸塊都是相連的。你能完成「大陸移動之旅」嗎？  
The positions of the continents are always changing. Around 300 million years ago, all landmasses were connected. Can you complete the journey of the continents?



約在三億年前，地球上只有一片廣闊的超級大陸，稱為盤古大陸，它被一個稱為古大洋的海洋包圍着。

Around 300 million years ago, all landmasses existed as a single, gigantic supercontinent called Pangaea, which was surrounded by a single ocean called Panthalassa.



約在一億年後，板塊移動導致超級大陸開始分裂，形成兩個新大陸：勞亞古陸（北半部分）和岡瓦那古陸（南半部分）。

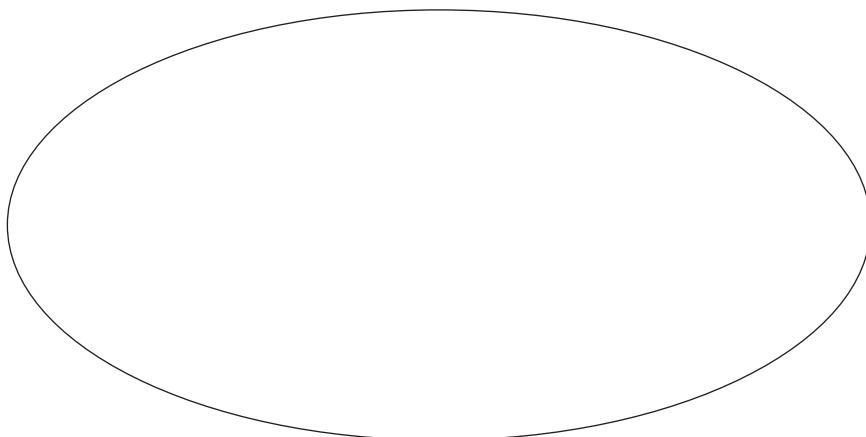
After about 100 million years, plate tectonics drove the supercontinent to split, forming two new continents: Laurasia (the northern half) and Gondwana (the southern half).



板塊運動至今仍然影響着各大洲的位置。現在的陸塊分為七大洲，依面積由大至小排列分別是：亞洲、非洲、北美洲、南美洲、南極洲、歐洲和澳洲。

Plate motion continues. Today the landmasses on Earth are separated into seven continents. In the order of size from largest to smallest, they are Asia, Africa, North America, South America, Antarctica, Europe and Australia.

陸塊在未來可能又會再次聚合，形成另一個超級大陸。試想像並在下方畫出這個超級大陸的形狀。  
All landmasses may reunite again to form a new supercontinent in the future. What would it look like?  
Draw your imaginary supercontinent in the space below.



# 板塊邊緣 Plate Boundaries

隨着板塊移動，板塊之間的相互作用產生了三種板塊邊緣：

As the tectonic plates move, the interaction between the plates creates three types of plate boundaries:

種類 Types	<p>聚合型板塊邊緣 Convergent plate boundary</p> 	<p>張裂型板塊邊緣 Divergent plate boundary</p> 	<p>錯動型板塊邊緣 Transform plate boundary</p> 
試試看 Try it with your hands	 	 	 
板塊移動方向 Direction of plate movement	<p>互相靠近 Towards one another</p>	<p>互相遠離 Apart from one another</p>	<p>互相擦過 Slide past one another</p>
相互作用的性質 Nature of the interaction	<p>破壞性 / 建設性 / 保守性 Destructive / Constructive / Conservative</p>	<p>破壞性 / 建設性 / 保守性 Destructive / Constructive / Conservative</p>	<p>破壞性 / 建設性 / 保守性 Destructive / Constructive / Conservative</p>
相關的構造地貌 Related tectonic landform	<p>溝槽 / 火山 (火山弧) Trenches / Volcanos (volcanic arcs)</p>	<p>山脊 (海洋中脊) / 裂谷 (Mid-ocean) Ridges / Rifts (Valley)</p>	<p>沒有重大影響 No major effect</p>

# 板塊運動造成的地質活動

## GEOLOGICAL PROCESSES DRIVEN BY PLATE TECTONICS

### 火山作用 Volcanism

火山爆發是指岩漿沿 地殼裂縫 湧出地表的過程。火山活動除了會在地球的熱點上發生外，亦會在聚合型板塊邊緣，因岩石出現局部 熔融 而引發，又或在張裂型板塊邊緣，因板塊 拉張 造成的地幔熔岩溢出而引發。你知道以下的火山是在甚麼情況下形成的嗎？

A volcano erupts when magma is forced through cracks in Earth's surface. Besides hotspots, volcanic activity can be caused by the partial melting of rocks and formation of magma found in convergent plate boundaries, or in the case of divergent plate boundaries the moving apart of the tectonic plates resulting in the magma rising from the mantle. Do you know the tectonic settings of the following volcanoes?



夏威夷冒納羅亞火山  
Mauna Loa, Hawaii



熱點 Hotspot

冰島埃亞菲亞德拉火山  
Eyjafjallajökull volcano, Iceland



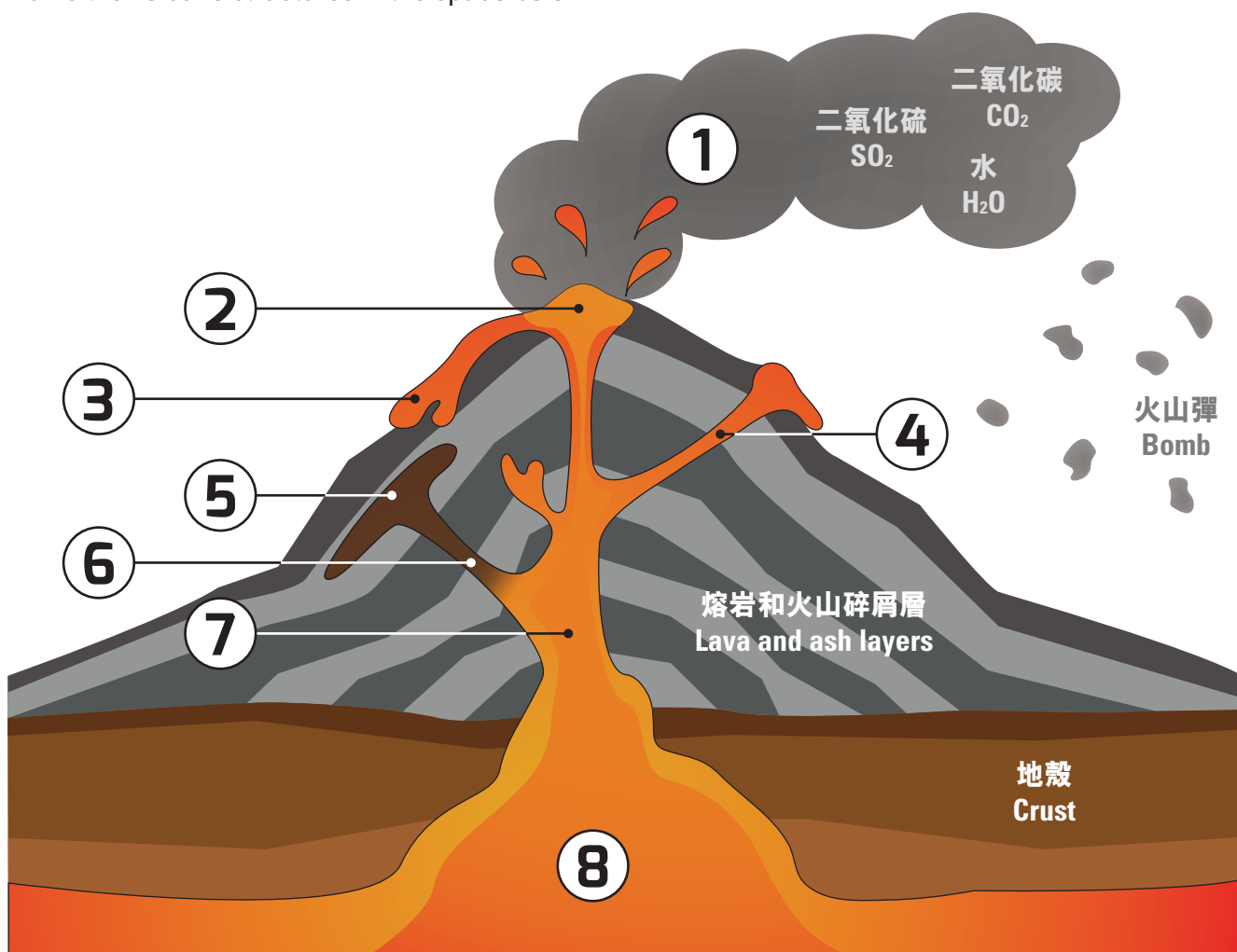
張裂型板塊邊緣 Divergent plate boundary

印尼喀拉喀托火山  
Krakatoa, Indonesia



聚合型板塊邊緣 Convergent plate boundary

你知道各火山結構的名稱嗎？  
Name the volcano structures in the space below.



1.                          火山灰雲  
Ash cloud
2.                          火山口  
Crater
3.                          熔岩 (流)  
Lava (Flow)
4.                          火山通道  
Vent
5.                          岩床  
Sill
6.                          岩牆  
Dyke
7.                          火山管  
Pipe / Conduit
8.                          岩漿 (庫)  
Magma (Chamber)

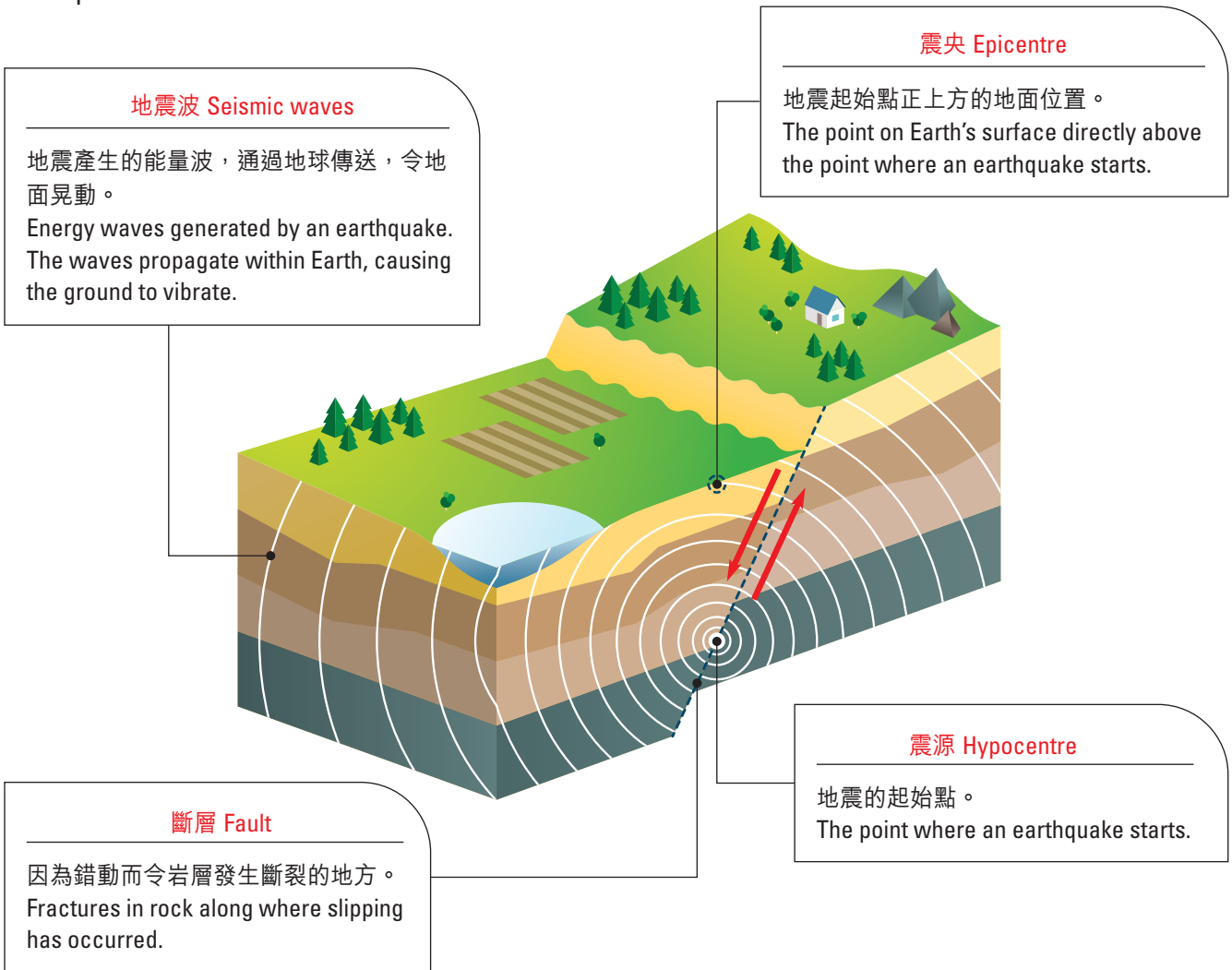
你能想出火山爆發會如何影響我們嗎？  
Can you think of how volcanic eruptions can affect us?

火山爆發會造成空氣污染 / 熔岩流出 / 山泥傾瀉 / 酸雨 / 影響航空等。  
Volcanic eruptions can cause air pollution / discharge of lava / landslides / acid rain / affect aviation, etc.

## 地震 Earthquakes

板塊就像一塊巨大的拼圖互相緊鎖着。隨着板塊持續移動，相鄰板塊之間不停積聚壓力，直至岩石無法承受而斷裂，引發地震。

Tectonic plates interlock like a massive jigsaw. The non-stop plate movement causes pressure to build up between adjacent plates until eventually the rocks cannot withstand and break, resulting in earthquakes.



### 與展品互動 Interact with Exhibit

「環太平洋火山帶」是太平洋板塊與多塊板塊（包括印澳、北美洲和菲律賓板塊等）的交匯處，它是世界上地震和火山活動最頻密的地帶！

參觀展廳內的展品：**板塊地圖**。你能找到在太平洋周邊一個馬蹄形的地震、火山活躍帶嗎？

The "Ring of Fire" is the belt where the Pacific Plate meets many surrounding tectonic plates, such as the Indo-Australian, North American and Philippine Plates. It is the most seismically and volcanically active zone in the world!

Visit our exhibit: **Boundary Map**. Can you find a horseshoe-shaped seismically and volcanically active belt around the edges of the Pacific Ocean?



我們通常會以震級或烈度來形容一場地震。你知道它們的分別嗎？

An earthquake can usually be described by its magnitude or intensity. Do you know their differences?

	震級 Magnitude	烈度 Intensity
量度的對象 What it measures	<p>量度地震規模，一般與地震震源釋放出的 <u>能量</u> 有關。</p> <p>The size of an earthquake and is generally related to the amount of <u>energy</u> released at the source.</p>	<p>量度地震對一特定地方造成的搖晃或 <u>破壞程度</u>。</p> <p>The shaking and <u>damage</u> caused by the earthquake at a particular location.</p>
量度的方法 How it is measured	<p>震級是透過分析由標準儀器，如 <u>地震儀</u> 等所錄得的地震圖推算出來。</p> <p>Derived from the analysis of the ground vibrations recorded by standard instruments, e.g. a <u>seismograph</u>.</p>	<p>傳統上烈度以往是由人對地震的觀察，或根據震動及損毀報告所作出的主觀評估。現今則可根據地震站內儀器的數據估計出烈度。</p> <p>Traditionally, it is a subjective measure derived from human observations and reports of felt shaking and damage. Nowadays, instrumental data at each seismograph station can be used to calculate an estimated intensity.</p>
		
	 <p>▲ 地震儀記錄的地震圖 Seismogram recorded by seismograph</p>	 <p>▲ 令建築物出現部分倒塌的地震烈度約為 VII 至 VIII 度。 Considerable damage to buildings with partial collapse can result from Intensity VII to VIII.</p>
例子 Example	<p>矩震級 The Moment Magnitude Scale</p>	<p><u>修訂麥加利地震烈度</u> <u>The Modified Mercalli Scale</u></p>
與震源距離的關係 Relationship with the distance from the hypocentre	<p>無關 Unrelated</p>	<p>隨與震源的距離變化：通常越接近震源，烈度會越 <u>高</u>。</p> <p>Changes with the distance from the hypocentre - often the closer to the hypocentre, the <u>greater</u> the intensity.</p>

### 熱帶氣旋 Tropical Cyclones

6

個熱帶氣旋形成的基本因素：  
basic factors of tropical cyclone formation:

低壓區、合適的緯度、充足水汽、溫暖海面、  
偏弱垂直風切變、高空輻散

Low pressure area, suitable latitude,  
sufficient moisture, warm sea surface temperature, weak  
vertical wind shear, upper level divergence of ascending air

2

種熱帶氣旋旋轉方向：  
rotation directions of cyclones:

北半球 Northern hemisphere:  
逆時針旋轉 Anti-clockwise

南半球 Southern hemisphere:  
順時針旋轉 Clockwise

成因 Cause:  
科里奧利力 Coriolis force

2

處登陸地點帶來的不同天氣狀況  
landfall locations bring different  
weather conditions

為甚麼熱帶氣旋在香港以西登陸會帶來較惡劣  
的天氣？

Why do tropical cyclones making landfall to the west  
of Hong Kong often bring more severe weather?

熱帶氣旋在香港以西登陸時，本港普遍吹東南風。由於香港  
的南面為毫無遮擋的海洋，強烈的東南風會正面吹襲香港。  
在沿岸地區，強風會把海水推向岸邊，加上熱帶氣旋的低氣  
壓中心亦會將海水略為吸起，有可能會造成嚴重的風暴潮。

There are usually southeasterly winds if a tropical cyclone makes  
landfall to the west of Hong Kong. As Hong Kong faces the open sea  
to the south, strong southeasterly winds can hit Hong Kong directly.  
In coastal areas, strong winds also pile up the sea water over the  
coast which, when coupled with a slight bulge in the sea surface  
caused by the low pressure centre of the storm, may result in a  
serious storm surge.

6

種熱帶氣旋的分類：  
categories of tropical cyclone:

類別 Classification	接近風暴中心的 10 分鐘最高平均風力 (公里/小時) Max. 10-min mean wind speed near the centre (km/h)
熱帶低氣壓 Tropical Depression	41-62
熱帶風暴 Tropical Storm	63-87
強烈熱帶風暴 Severe Tropical Storm	88-117
颱風 Typhoon	118-149
強颱風 Severe Typhoon	150-184
超強颱風 Super Typhoon	185 或以上 or above

熱帶氣旋為我們帶來甚麼影響？你又會作出甚麼防風措施？

What are the impacts of tropical cyclones? How would you prepare for a typhoon?

熱帶氣旋會帶來狂風暴雨，而它帶來的湧浪及風暴潮會引致沿海地區水浸。

防風措施：鎖緊門窗、切勿外出、遠離岸邊等。

Tropical cyclones can bring heavy rain and strong winds while the swell and storm surge brought by the cyclone can cause coastal flooding. Precautions: securely lock all windows and doors, do not go outside, stay away from the shoreline, etc.

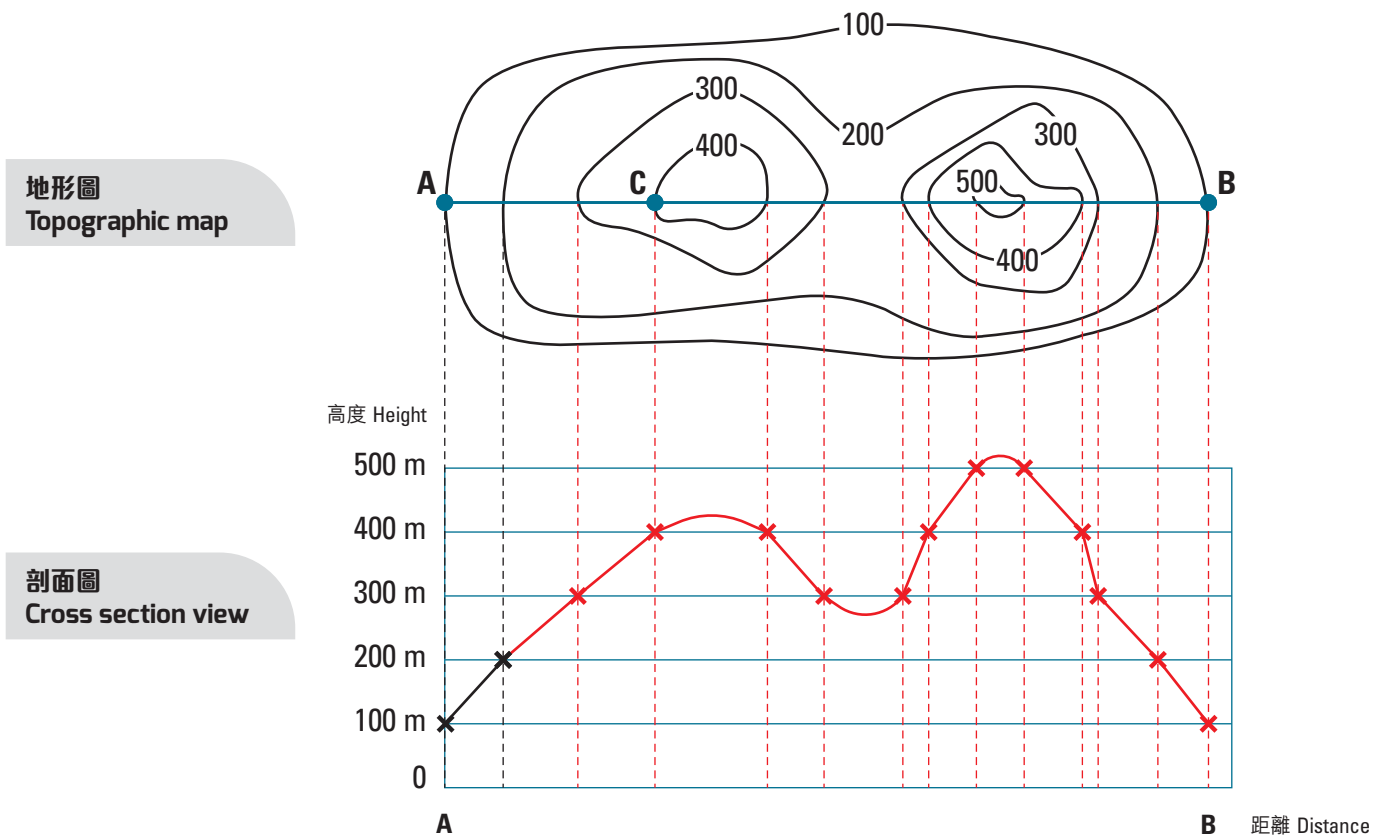
## 等高線與地貌 Contour Lines and Landforms

地形圖是一幅表示地形和地勢的地圖。在地形圖上，地表高度相同的各點會被連成一條閉合的曲線，稱為等高線。我們可以利用地形圖獲得地形剖面圖。試完成 A 點與 B 點之間的地形剖面圖：

1. 根據地形圖上等高線與線段 AB 相交的位置，在剖面圖上相對應的高度線上畫上「×」。
2. 將所有「×」連成一條曲線。

A topographic map is a map illustrating the shape and elevation of the land surface. On topographic maps, points at the same elevation are joined to form contour lines. From the map, we can obtain a cross-sectional view of the terrain. Try to complete the cross-sectional view diagram between points A and B:

1. Based on the intersections of the contour line and line AB in the topographic map, mark an "x" at the corresponding line of height in the cross-sectional view.
2. Connect all the "x" marks with a smooth curve.



以上地形圖的等高距是甚麼？  
What is the contour interval?

100 m

如果 A 點與 C 點之間的距離為 5 公里，請計算出 AC 的坡度。  
If the distance between point A and point C is 5 km, calculate the slope of AC.

$$(400 - 100) / 5000 = 0.06$$

## 香港地質知多少 HK Geo-quiz

1. 香港最古老的岩石在 \_\_\_\_\_ 形成，這些岩石主要出現在赤門海峽北岸和馬鞍山。  
The oldest rocks in Hong Kong were formed in the \_\_\_\_\_ and can be found on the northern shore of the Tolo Channel and at Ma On Shan.

A. 寒武紀 Cambrian period

B. 泥盆紀 Devonian period

C. 石炭紀 Carboniferous period

2. 連串的火山活動發生在侏羅紀中期和白堊紀早期，跨越約 2500 萬年。\_\_\_\_\_ 的超級火山爆發標示香港地區中生代火山活動的終結。

A series of volcanic activity occurred during the Middle Jurassic and Early Cretaceous periods, a timespan of about 25 million years. The \_\_\_\_\_ supereruption marked the end of Mesozoic volcanism in the Hong Kong region.

A. 糧船灣 High Island

B. 淺水灣 Repulse Bay

C. 大嶼山 Lantau Island

3. \_\_\_\_\_ 組是香港最年輕的岩層。  
The \_\_\_\_\_ formation is the youngest rock formation in Hong Kong.

A. 赤洲 Port Island

B. 八仙嶺 Pat Sin Leng

C. 平洲 Ping Chau



### 香港的六角柱石群 Hexagonal Rock Columns in Hong Kong

香港擁有豐富的地質結構和岩石種類。於一億四千萬年前爆發的糧船灣超級火山更形成了舉世知名的六角柱石柱群。石柱群在西貢萬宜水庫東壩、果洲群島和西貢東部均可看到，它們組成了香港地質公園的核心部分。

Hong Kong has a rich diversity of geological structures and rock types. The eruption of the High Island Supervolcano 140 million years ago gave rise to the world-class hexagonal rock columns we see today. These columns can be seen at the High Island East Dam, on the Ninepin Islands, and across much of east Sai Kung. They are the centrepiece of Hong Kong Geopark.

4. 香港有數種常見的岩石，試把岩石與它們的特徵配對。  
 Several kinds of rocks are common in Hong Kong. Try to match them with their characteristics.

## 岩石類型 Rock type

## 特徵 Feature



花崗質岩石  
Granitic rocks



沉積岩  
Sedimentary rocks



火山岩  
Volcanic rocks

- ◇ 約佔本港岩石 50 %  
Making up about 50% of rocks in Hong Kong
- ◇ 屬噴出性火成岩  
Belonging to extrusive rocks
- ◇ 晶體顆粒較小，岩理較幼細  
With small crystals and fine-grain texture
- ◇ 抗蝕能力相對高，形成高山，例如大東山  
Relatively resistant to erosion, forming high mountains such as Tai Tung Shan

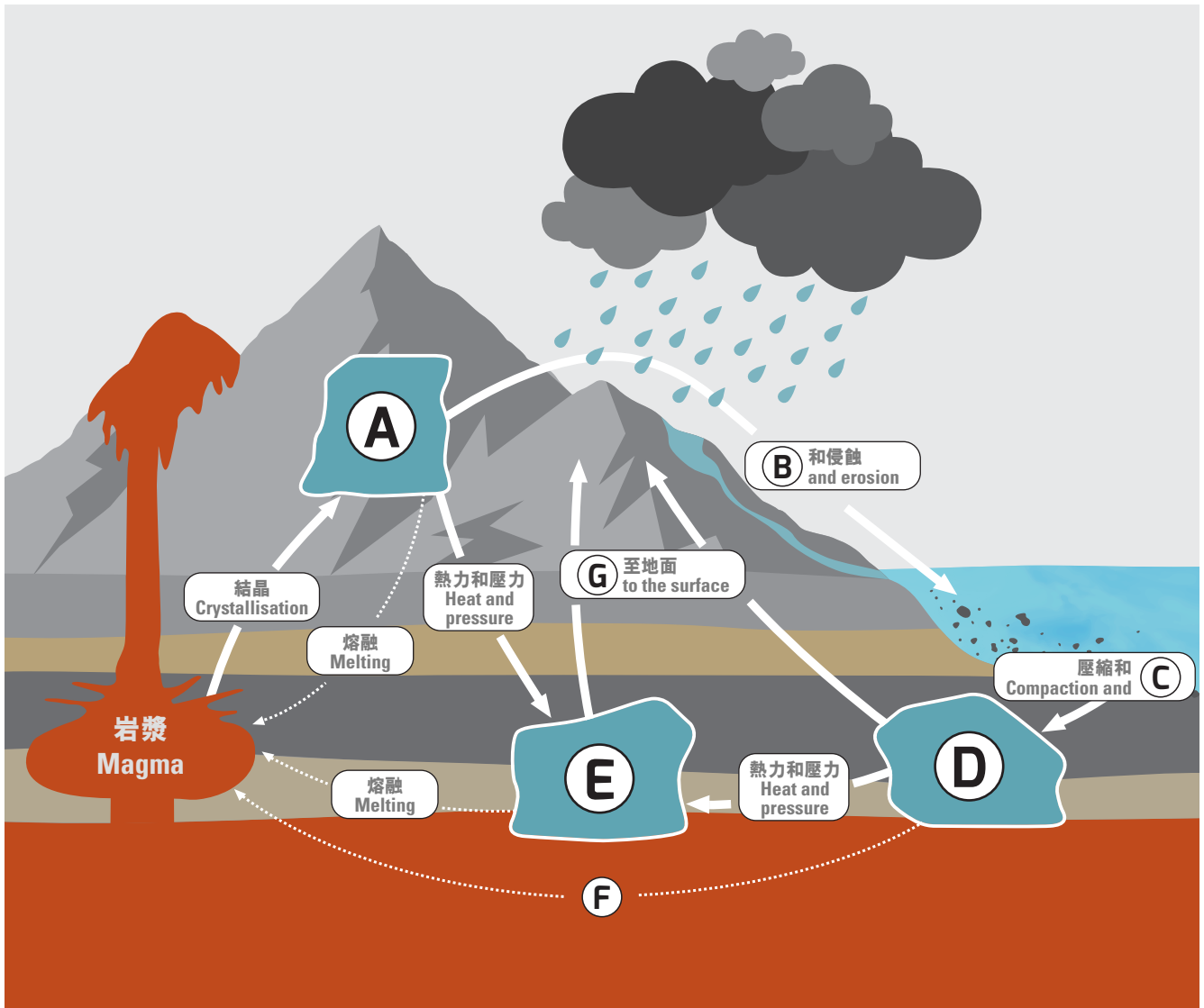
- ◇ 約佔本港岩石 35 %  
Making up about 35% of rocks in Hong Kong
- ◇ 屬侵入性火成岩  
Belonging to intrusive rocks
- ◇ 顆粒晶體較大，岩理較粗糙  
With large crystals and coarse-grain texture
- ◇ 易受風化和侵蝕，形成較矮的山丘，例如獅子山  
Vulnerable to weathering and erosion, forming relatively low hills like Lion Rock

- ◇ 約佔本港岩石 15 %  
Making up about 15% of rocks in Hong Kong
- ◇ 由古老岩層風化侵蝕而形成的碎塊沉積而成  
Formed by the deposition of weathered and eroded ancient rock fragments
- ◇ 常見於新界東北部，例如東平洲  
Found in the northeastern New Territories, for example, Tung Ping Chau

## 岩石循環 Rock Cycle

經過長年累月，火成岩、變質岩和沉積岩會受地質活動影響而變成另一種岩石。請完成以下岩石循環圖。

Igneous rocks, metamorphic rocks and sedimentary rocks are transformed from one type into another through geological processes. Please complete the rock cycle diagram below.



- A. 火成岩  
Igneous rocks
- B. 風化  
Weathering
- C. 膠結  
Cementation
- D. 沉積岩  
Sedimentary rocks
- E. 變質岩  
Metamorphic rocks
- F. 熔融  
Melting
- G. 抬升  
Uplift

## 岩石偵探 Rock Detective

觀察以下岩石，並根據岩石辨別流程圖確認出它們的種類。

Study the rocks carefully and try to find out their identity based on the Rock Identification Chart below.



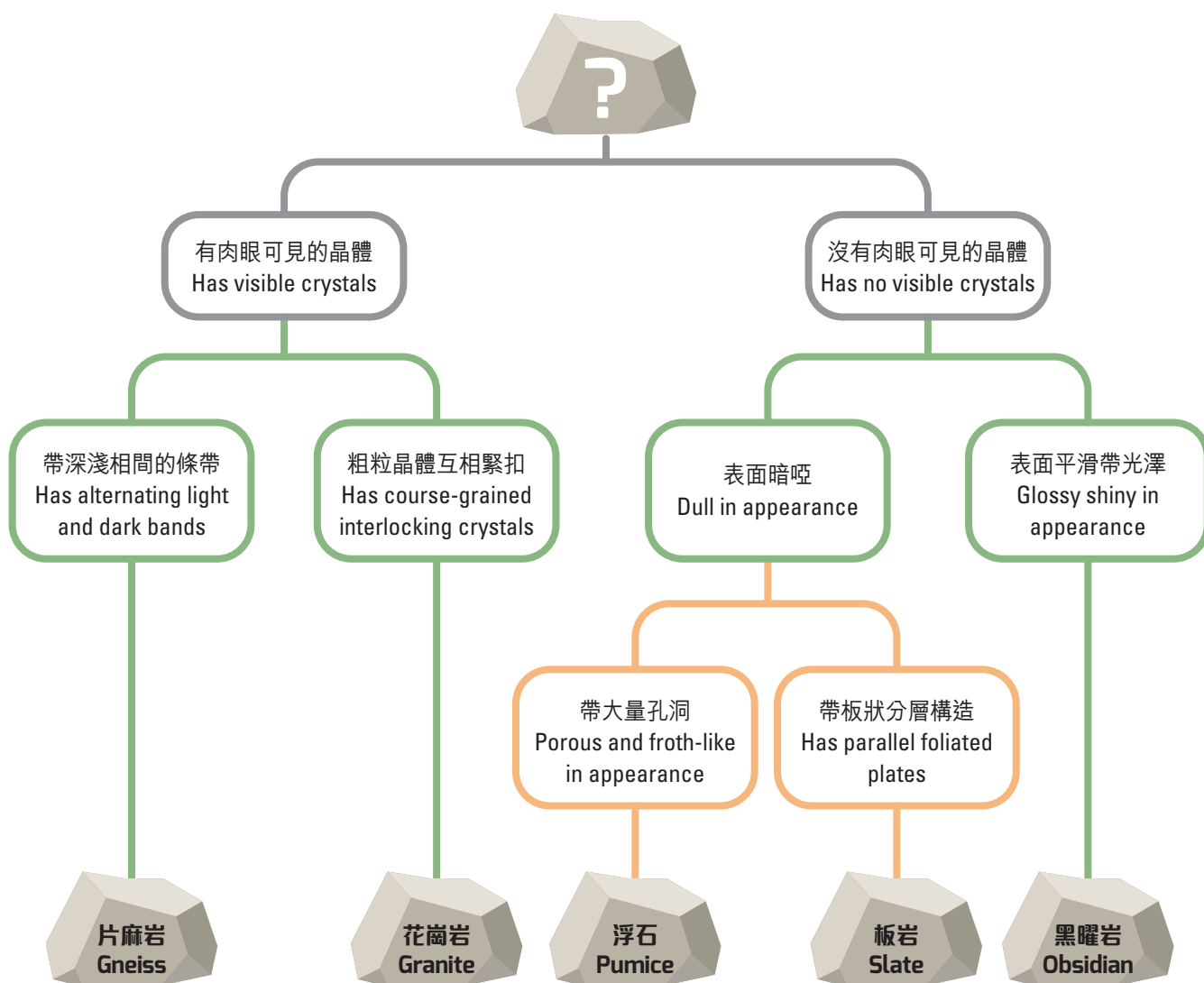
片麻岩  
Gneiss



浮石  
Pumice



板岩  
Slate



岩石辨別流程圖  
Rock Identification Chart

# 人類與自然的關係

## HUMAN-NATURE RELATIONSHIP

人類的急速發展是否對地球造成不可逆轉的破壞？參觀完地球科學廳後，寫下你對人與自然關係的感想。

Is the rapid development of humanity causing irreversible damage to Earth? Write down your reflections on the relationship between man and nature after visiting the gallery.

