

**LEARNING OUTCOMES:**

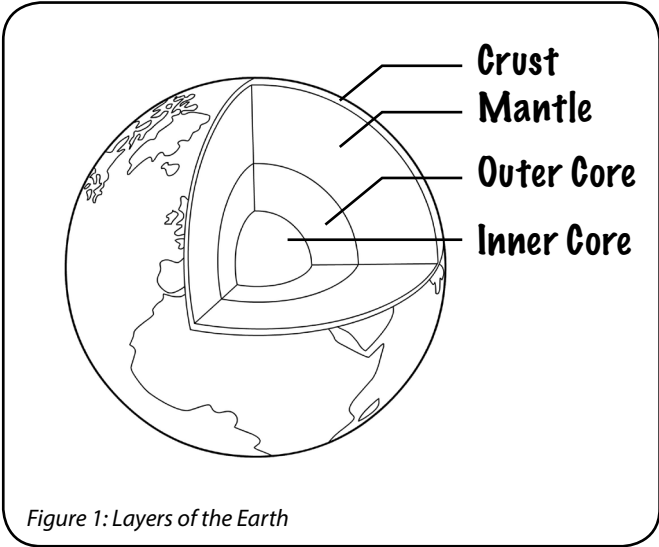
- Internal Structure of the Earth
- Classification of Rocks
- The Rock Cycle
- Intrusive Igneous Activity and associated features
- Overview of landforms associated with different rocks

**INTERNAL STRUCTURE OF THE EARTH**

The Earth is made up of four layers.

**The Crust**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



**Continental Crust**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**Continental Crust**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**The Mantle**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**The Core**

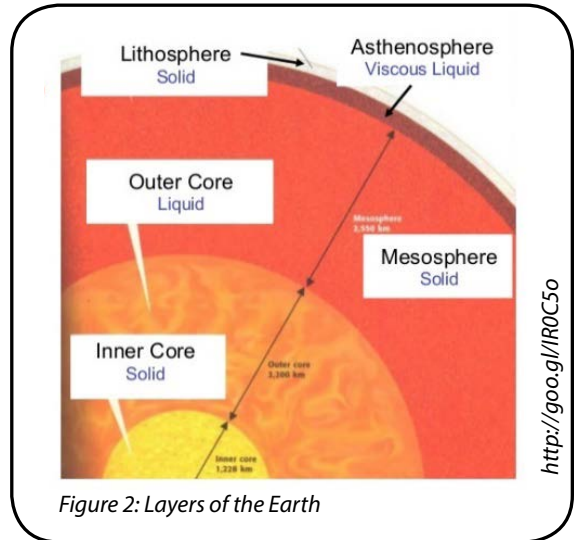
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

The layers can also be divided into different sections. Namely,

Lithosphere: \_\_\_\_\_

Asthenosphere: \_\_\_\_\_

Mesosphere: \_\_\_\_\_



**CLASSIFICATION OF ROCKS**

So, when molten material in the mantle (magma) reaches the surface of the Earth, or leaves the mantle and reaches the crust – it begins to cool and crystallise. This will form rocks.

Primarily, it forms igneous rocks which are eroded (worn down) over time or altered by heat and pressure. This can result in two other rock types forming: sedimentary and metamorphic.

**Igneous Rocks**

Igneous rocks are the base rocks from which all other rocks form and are therefore often called primary rocks. When molten material from the mantle cools and solidifies – igneous rocks form. If the magma cools on the surface of the Earth, the cooling process is quick and the crystals are small but if they cool within the crust – the cooling process is a lot longer and the crystals are much larger.

**Sedimentary Rocks**

ALL rocks are eroded. Agents of erosion (wind, water and ice) break down the rocks and transport the eroded rock sediments. Once these sediments are deposited somewhere; they accumulate and are compressed and over time form a new rock. Rocks that form in this way are called sedimentary rocks.

**Metamorphic Rocks**

Rocks that are affected by heat and pressure can often change their composition – we call these rocks metamorphic rocks.

**Crystals**

All minerals have a regular crystal structure. This structure is made up of many flat surfaces which are called faces. When these crystal faces join together, they form a crystal. The structure of a group of crystal faces form is called a *crystal system*. Although there are over 3 500 different minerals that have been identified, they all fall into one of seven crystal systems.

**The crystal systems are:**



**Cubic**

1. The Cubic System
  - Also called Isometric System.
  - Diamonds, galena, gold, silver, fluorite, garnet, halite and copper.



**Hexagonal**

2. The Hexagonal System
  - Emerald, benitoite, graphite, vanadinite.

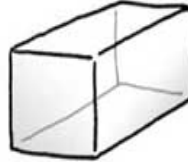
3. The Rhombohedral System

- This is a branch of the hexagonal system.
- Calcite, quartz, siderite and dolomite.



**Tetragonal**

4. The Tetragonal System
  - Rutile, scapolite, zircon



**Orthombic**

5. The Orthorhombic System
  - Aragonite, barite, celestite, goethite, marcasite



**Monoclinic**

6. The Monoclinic System
  - Gypsum, augite, biotite, hornblende



**Triclinic**

7. The Triclinic System
  - Plagioclase feldspar, ulexite, turquoise and albite.

**Rock Cycle**

As magma creates new rocks, so too do eroded rocks break down and return to the mantle along plate boundaries. All rocks undergo changes on the surface of the Earth and are eroded and compressed and heated and so on.

Rocks are made of magma which contains minerals and nutrients and as rocks are broken down and

changed – those nutrients and minerals are used by plants, animals and humans. It takes hundreds and thousands of years for these minerals to be recycled by the rock cycle.

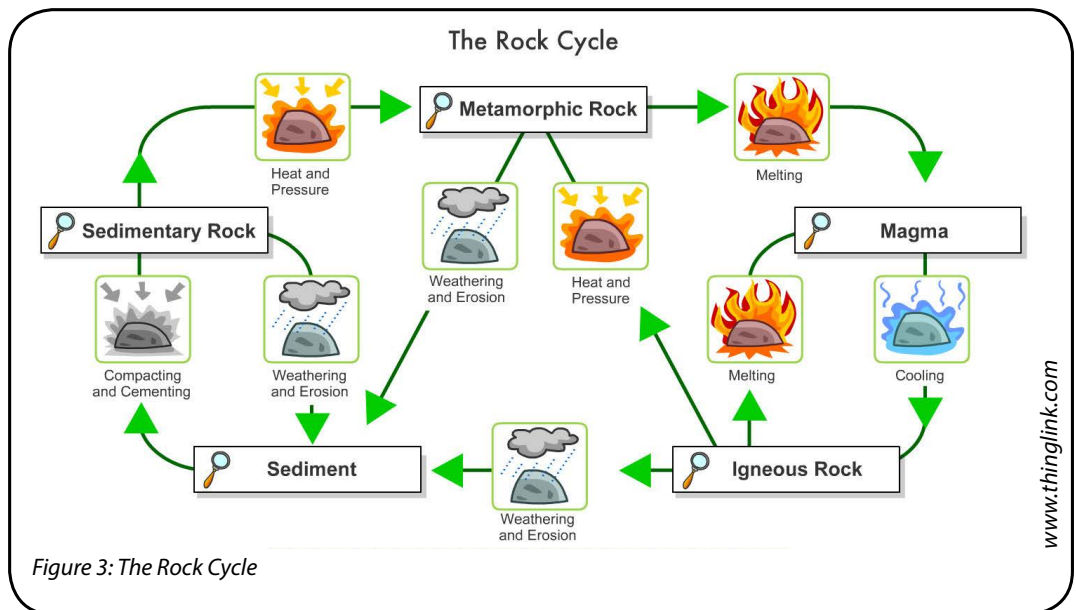


Figure 3: The Rock Cycle

**INTRUSIVE IGNEOUS ACTIVITY AND ASSOCIATED FEATURES**

Sometimes, magma will cool and harden in the Earth’s crust. As it does, it creates unique landforms called **igneous intrusions**. We classify these features according to the depth at which they form; their effect on the surrounding rocks, and their shape and size.

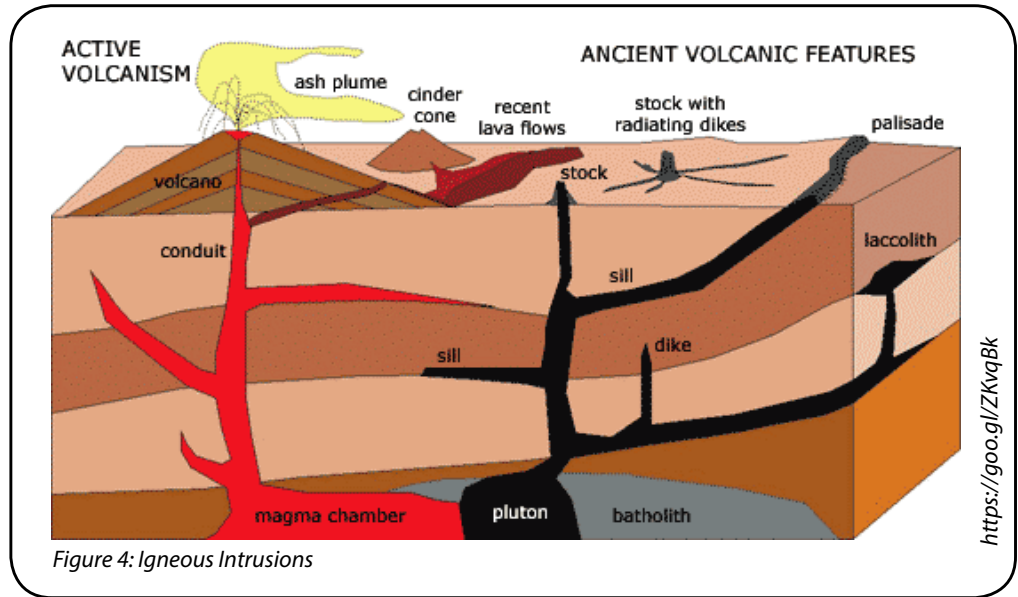


Figure 4: Igneous Intrusions

**ACTIVITY 1**

For each of the igneous intrusions below; write a description of the intrusion and draw a sketch diagram of what the intrusion would look like.

Intrusion	Description of formation and identifying features	Sketch Diagram
<b>Batholith</b>		
<b>Laccolith</b>		
<b>Lopolith</b>		
<b>Dyke</b>		
<b>Sill</b>		
<b>Monolith</b>		
<b>Pipe</b>		

**SOME DEFINITIONS:**

<b>Strata</b>	
<b>Magma</b>	
<b>Lava</b>	
<b>Weathering</b>	
<b>Erosion</b>	

**OVERVIEW OF LANDFORMS ASSOCIATED WITH DIFFERENT ROCKS**

**Landforms and Igneous Rocks**

These landforms can be divided into extrusive and intrusive formations. Extrusive are those that are formed from volcanoes and lava flows, whereas intrusive igneous rock are ones that formed beneath the Earth's surface and have been exposed through weathering and erosion.

**Tors** – are the weathered tops of igneous intrusions.

**Lava flows** – form when thin lava flows from vents in the Earth's surface and cover large areas of land.

**Caldera** – collapsed volcanoes, these often contain lakes.

**Domes and monoliths** – large igneous intrusions are exposed by the erosion of the less resistant rocks around them.

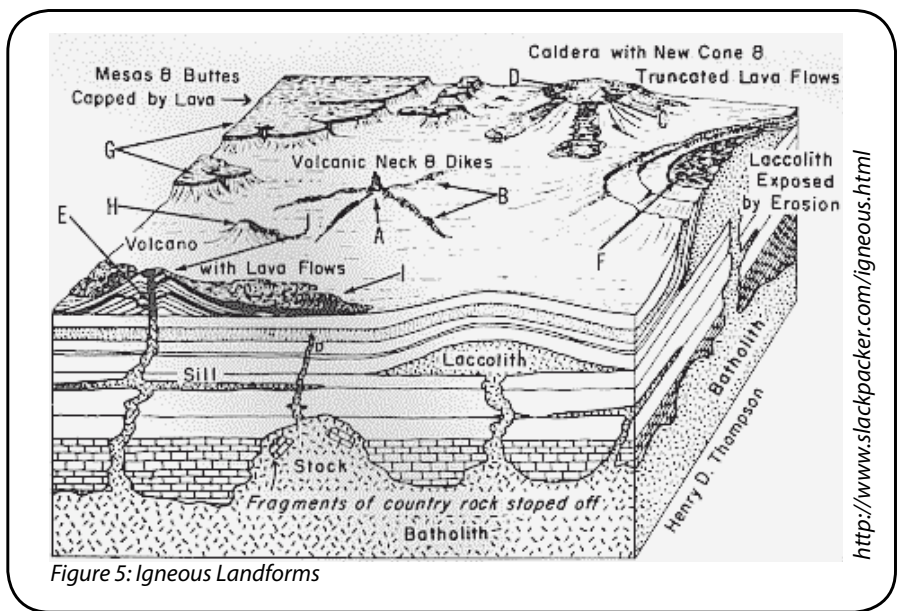
**Volcanic neck** – this stands out as a column of rock above the land. It is made of magma that has cooled and solidified inside the cone of the volcano. The rest of the volcano has since weathered and eroded.

**Economic Uses**

Many types of igneous rocks are used as building stone, facing stone, and decorative material, such as that used for tabletops, cutting boards, and carved figures.

Pumice is used as an abrasive material in hand soaps, emery boards, etc.

Gneiss, Schist and Gabbro are very hard and widely used as crushed stone for concrete aggregate, road surfaces and railroad ballast. Igneous rocks may also contain many important ores such tin or valuable minerals such as diamonds.



<http://www.slackpacker.com/igneous.html>

## LANDFORMS AND SEDIMENTARY ROCKS

Sedimentary rocks are usually formed from sediments that were deposited under water. Sometimes these sediments are horizontal and sometimes they are inclined (folding, faulting and the movement of the continents)

### Horizontal Landforms

- Strata of equal resistance
  - Hilly landscapes
  - Rocky hills with coarse grained soils
  - Basaltic plateaus
- Strata of unequal resistance
  - Canyon landscapes
  - Karoo landscape

### Inclined landforms

- A cuesta – dip slope 10 – 25 °
- Homoclinal ridge – dip slope 25 – 45 °
- Hogback – dip slope 45 °+

Some of the world's largest mountains are made from sedimentary rocks that have been uplifted and folded in mountain ranges by the Earth's movements.



Figure 6: A canyon landscape – Horizontal

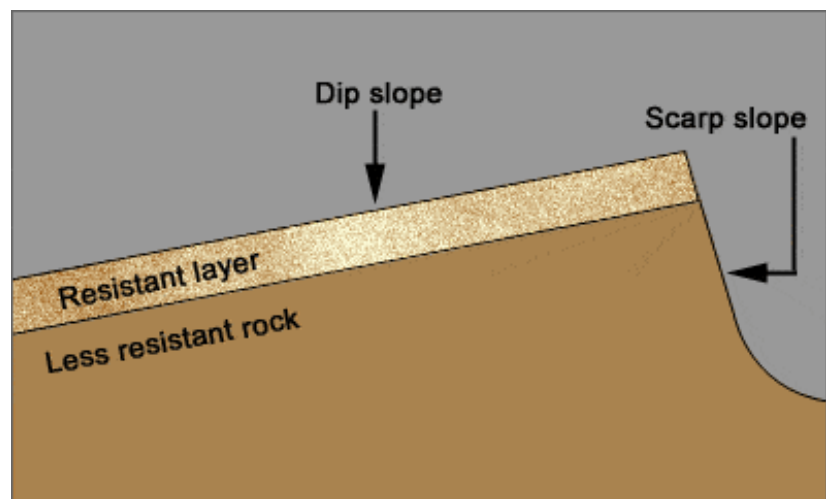


Figure 7: Diagram of inclined strata. Take note of the dip and scarp slopes

## LANDFORMS AND METAMORPHIC ROCKS

Metamorphic rocks are often harder than the rocks they were created from. Quartzite is metamorphosed sandstone is much more resistant to erosion than igneous rocks. These produce features that stand out in different landscapes.

Examples are waterfalls and quartzite ridges.



Figure 8: A quartz ridge in Kuala Lumpur

<http://goo.gl/HHXnfX>