Rocks & Minerals

(Adapted from: Geology and Geological Features: A Photographic Slide Collection compiled by B.F. Kean, 1993)

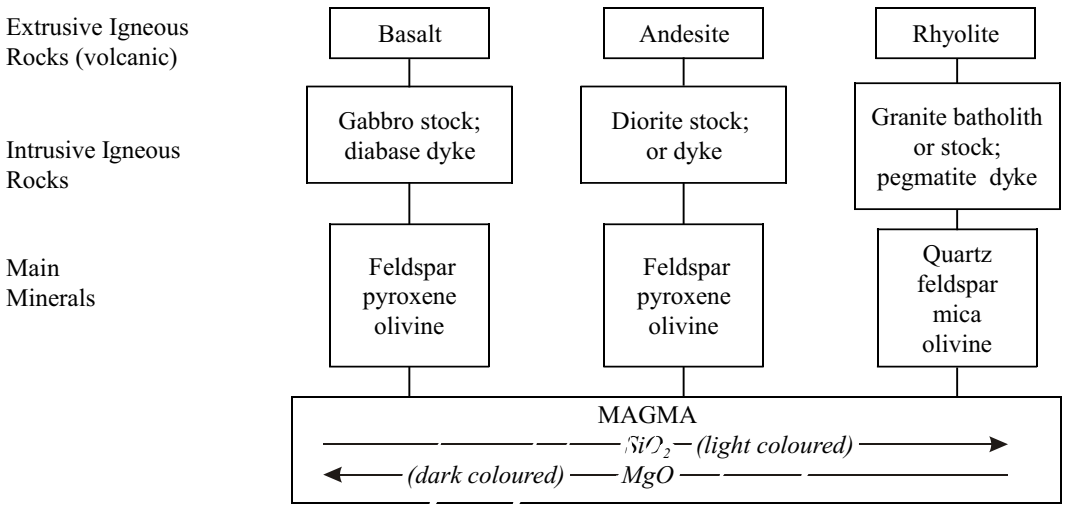
Minerals are naturally formed crystals that are composed of one or more chemical elements. They are distinguished from other natural solid materials by their crystalline structure. Some natural solid materials formed in rocks are not minerals because they lack a crystalline structure, i.e., they are amorphous, eg., obsidian or volcanic glass. Most minerals are formed by inorganic processes; however, a few are formed by organic processes (living organisms), eg., calcite in coral.

Single-element minerals include diamond (from carbon) and the native (i.e., elemental) metals gold, copper and silver. Other minerals, such as chalcopyrite, sphalerite and mica, are chemical compounds consisting of several elements.

Rocks are made up of minerals, the exception being glassy rocks (eg., some rhyolites). Most rocks are polymineralic (i.e., contain more than one mineral); however, a few are monomineralic, eg., limestone and marble.

Rock-forming processes, some rapid and others requiring millions of years, are as active today as in the geological past. **Rocks are divided into three main classes:**

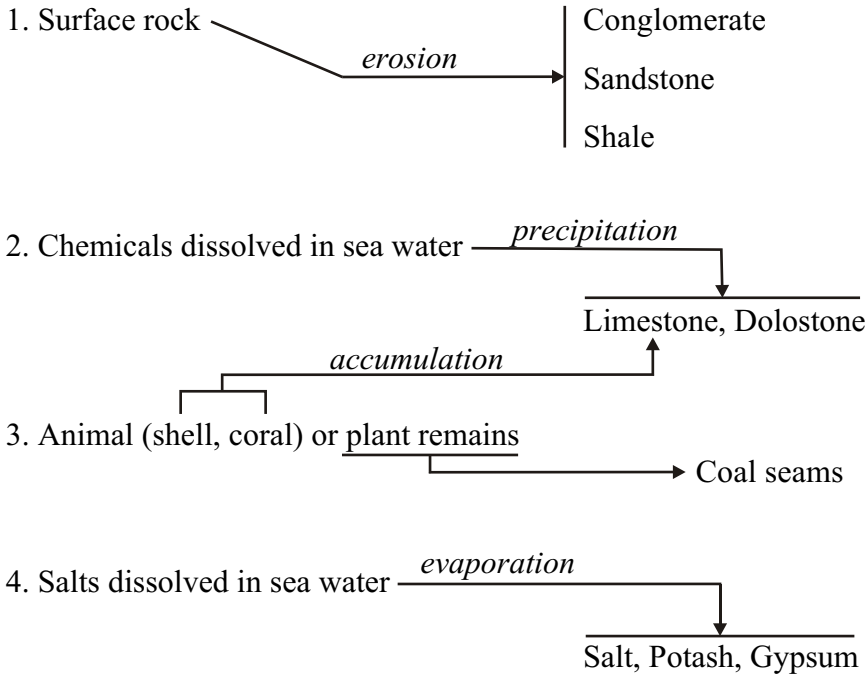
IGNEOUS ROCKS are formed as magma (molten rock) cools and solidifies. Magma is produced far below the Earth's surface by heat generated mainly from radioactive disintegration of uranium, thorium and potassium. The two main types of igneous rock are **extrusive** and **intrusive**. Extrusive rocks, or lava, form when magmas reach the surface of the Earth through volcanic fissures or vents. They cool rapidly and are fine-grained or glassy, eg., basalt and obsidian. Explosive eruptions produce rocks composed of rock dust or fragments (pyroclasts). Intrusive rocks form when magma cools slowly at depth, eg., granite, allowing the constituent minerals to grow much larger. These magmas intrude fissures and other zones of weakness in the Earth's crust, crystallize, and are eventually uplifted and exposed by erosion. Some magmas carry fragments of rocks and minerals from deep within the Earth, and this allows us to study samples from regions too deep to be reached by drilling. The table below shows the relationship between different igneous rocks and how they form.



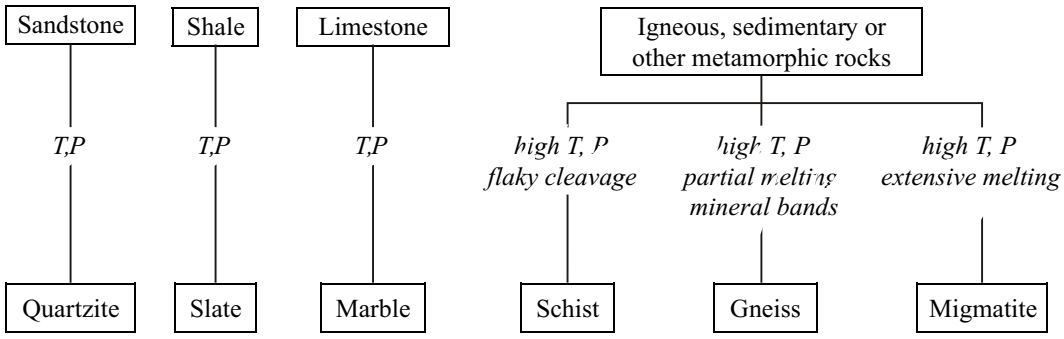
SEDIMENTARY ROCKS are formed by the accumulation and cementing of loose sediment (eg., sandstone), the deposition of chemical compounds held in solution in water (eg., limestone), or by the accumulation of animal or plant debris (eg., coal).

Wind, river and ocean currents are the main methods of transport. This transported material settles to form distinct layers, which are compressed by overlying layers and cemented to form solid rock. Rock layers can be distinguished from each other by differences in grain size, colour and composition.

Sedimentary rocks may have a coarse-grained, gravel-like appearance or be extremely fine grained, and may be hard or soft. The principal varieties are sandstone, limestone and shale. Many sedimentary rocks contain fossils and some, such as coral reefs, are composed entirely of such organic remains. The table below illustrates how sedimentary rocks form.

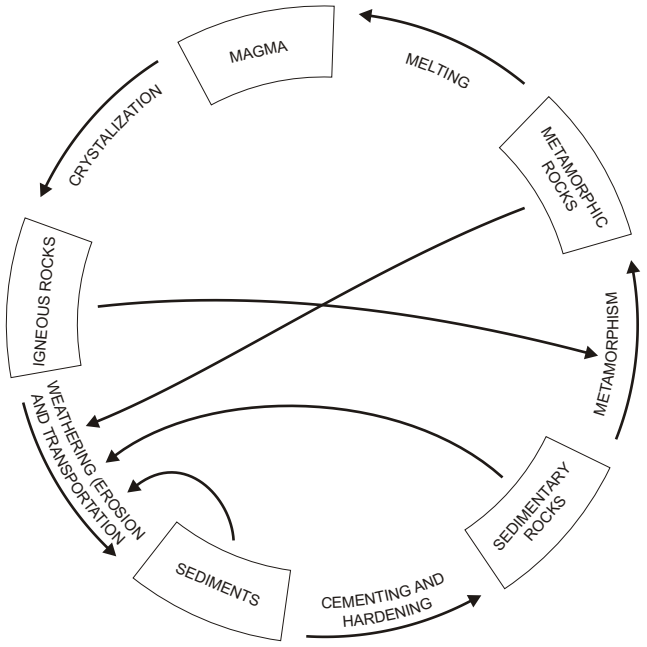


METAMORPHIC ROCKS are formed when rocks of any class are subjected to heat and pressure at depth. This causes new minerals to form and other minerals to recrystallize. During the process, material from the rock may be added or lost. Marked changes in temperature (T) and pressure (P) occur, which may produce completely new types of rocks. In addition to the formation of new minerals, existing minerals may be realigned into parallel bands and new textures may be formed. At sufficiently high temperatures, the rock may undergo partial melting to form magma, which may then become the source of an igneous rock. Metamorphic rocks include, gneiss, schist, slate, quartzite and marble, and the table below shows how they form.

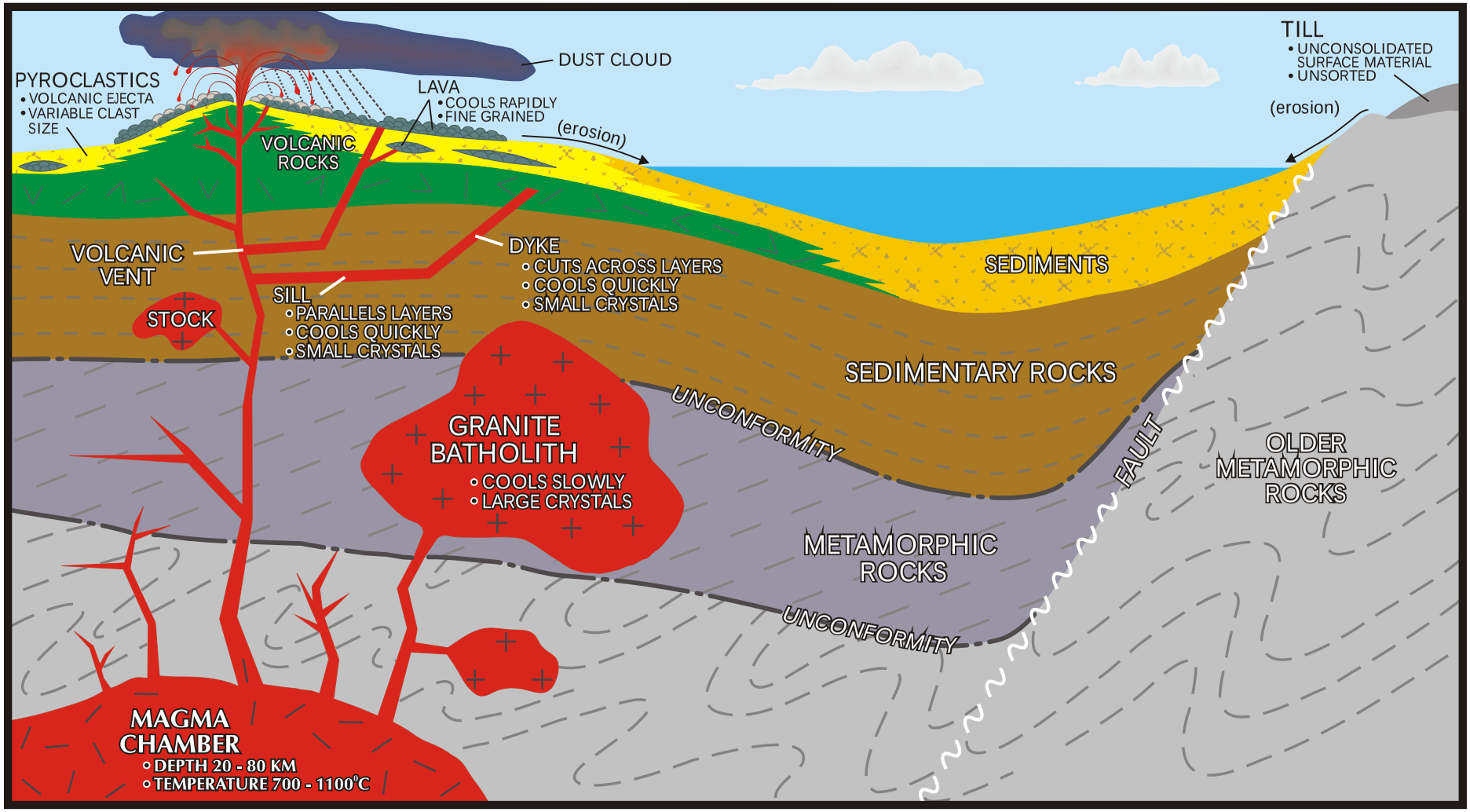


The Geological Cycle

Sooner or later most rocks are exposed to the processes of erosion. The resulting products accumulate to form sedimentary rocks. These may be buried to great depths and converted by heat and pressure into metamorphic rocks. At still greater depths, they may be melted to form magma, which if crystallized forms igneous rocks; if uplifted and exposed, these renew the cycle. The cycle may, however, be interrupted and follow any of the paths shown in the diagram below.



Click here for a “Schematic cross-section depicting geological concepts and processes”.


PYROCLASTICS
• VOLCANIC EJECTA
• VARIABLE CLAST SIZE
DUST CLOUD
LAVA
• COOLS RAPIDLY
• FINE GRAINED
VOLCANIC ROCKS
(erosion)
TILL
• UNCONSOLIDATED SURFACE MATERIAL
• UNSORTED
(erosion)
VOLCANIC VENT
DYKE
• CUTS ACROSS LAYERS
• COOLS QUICKLY
• SMALL CRYSTALS
SEDIMENTS
SILL
• PARALLELS LAYERS
• COOLS QUICKLY
• SMALL CRYSTALS
STOCK
SEDIMENTARY ROCKS
UNCONFORMITY
GRANITE BATHOLITH
• COOLS SLOWLY
• LARGE CRYSTALS
FAULT
OLDER METAMORPHIC ROCKS
METAMORPHIC ROCKS
UNCONFORMITY
MAGMA CHAMBER
• DEPTH 20 - 80 KM
• TEMPERATURE 700 - 1100°C