



UNIVERSITI SAINS MALAYSIA

REG 531

STRUCTURAL SYSTEM & DESIGN

# STONES & ROCKS

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# ROCKS & STONES

## ~DEFINITION

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### **ROCKS:**

- i) A lump or mass of hard consolidated mineral matter.
- ii) Material consisting of the aggregate of minerals like those making up the Earth's crust

### **STONES:**

- v) A lump or mass of hard consolidated mineral matter.
- vi) Building material consisting of a piece of rock hewn in a definite shape for a special purpose.

# ROCKS & STONES

## ~DEFINITION

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### **IN CONSTRUCTION:**

#### **Rock –**

An indefinite mixture of naturally occurring substances, mainly minerals. Its composition may vary in containment of minerals and organic substances, and are never exact.

#### **Stone –**

Small piece of rock; may or may not refer to ornamental material.

To ease the understanding of this topic, Rock=Stone.

# ROCKS & STONES





# ROCKS & STONES

## ~ORIGIN

In geology, rock is a naturally occurring solid aggregate of minerals and/or mineraloids.

The Earth's outer solid layer, the lithosphere, is made of rock. In general rocks are of three types, namely, **igneous**, **sedimentary**, and **metamorphic**.

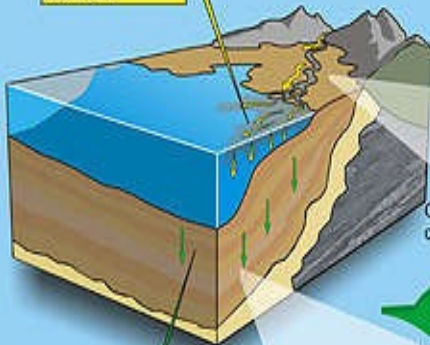
The scientific study of rocks is called petrology, and petrology is an essential component of geology.





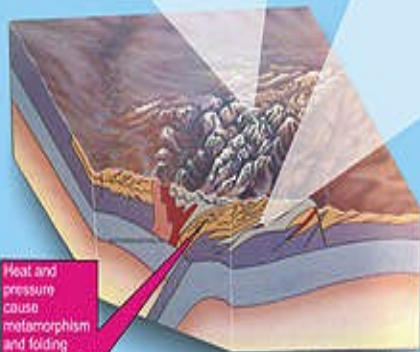
# IF ROCKS COULD TALK...

Interplay of weather, water, and gravity cause erosion, transportation, and deposition of sediments.



Weight of overlying sediment causes compaction and cementation forming sedimentary rocks.

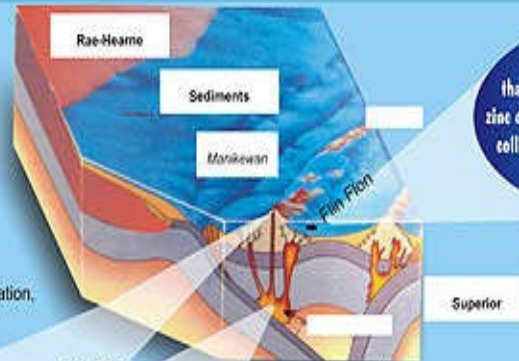
**DID YOU KNOW** that a huge mountain range formed in Saskatchewan 1.8 billion years ago as a result of the collision of several oceanic and continental plates?



Heat and pressure cause metamorphism and folding of rocks forming metamorphic rocks.

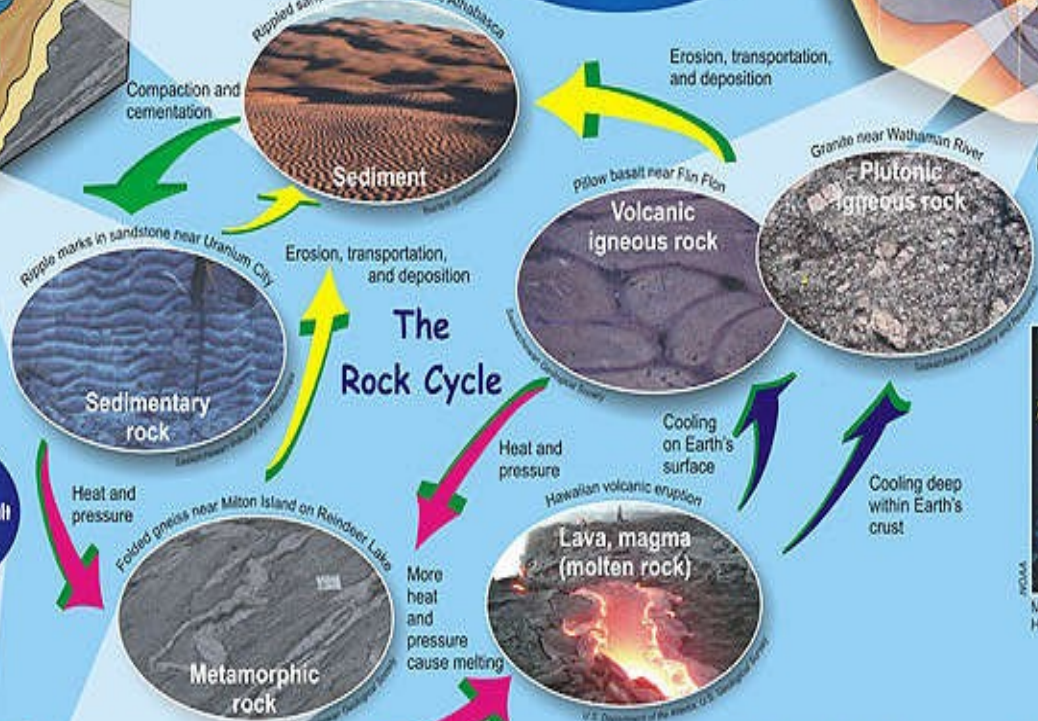
1830 TO 1800 MILLION YEARS AGO

**DID YOU KNOW** that the oldest known rocks in Saskatchewan are 3.1 billion years old and that 1.8 billion year old fossils record our oldest evidence of life?



**DID YOU KNOW** that the province's world-class copper-zinc deposits at Flin Flin formed during the collision of two ancient continents about 1.9 billion years ago?

1900 TO 1875 MILLION YEARS AGO



## The Rock Cycle

**Black smokers**  
Our understanding of the geological past is helped by studying processes taking place on Earth today. Black smokers, located along some plate boundaries in the ocean, are responsible for the formation of mineral deposits, and have been for billions.

**Iron**  
**Zinc**  
**Copper**  
**Gold**

Melville Bay deposit at Hanson Lake



1.9 billion years ago

The Precambrian shield forms Saskatchewan's bedrock formations. It resembles a jigsaw puzzle made up of five continental landmasses created 4.5 to 2.5 billion years ago (Archean Eon). Between these are zones of rocks that formed on or below the ocean floor about 2.5 to 0.5 billion years ago (Proterozoic Eon). This tectonic assembly, which included closure of the former Manikewan Ocean (to produce the now present Reindeer Zone), was complete by about 1.8 billion years ago, after which time the area we know as Saskatchewan remained a single and relatively stable land mass.

### PRESENT DAY NORTHERN SASKATCHEWAN: A JIGSAW PUZZLE OF CONTINENTAL PLATES



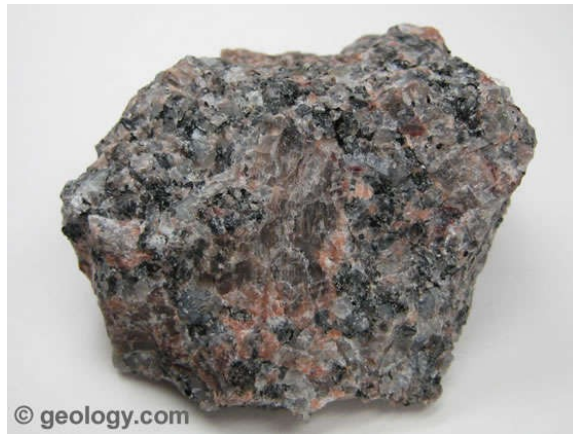


# ROCKS & STONES

## ~ORIGIN

**Igneous rock** is formed by magma (molten rock) being cooled and becoming solid. They may form with or without crystallization, either below the surface as intrusive (plutonic) rocks or on the surface as extrusive (volcanic) rocks.

Over 700 types of igneous rocks have been described, most of them formed beneath the surface of Earth's crust. These have diverse properties, depending on their composition and how they were formed. It is nonporous, hard, strong and durable.



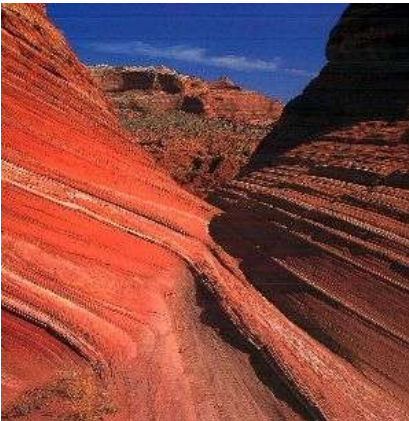
# ROCKS & STONES

## ~ORIGIN

**Sedimentary rock** is formed by deposition and consolidation of mineral and organic material and from precipitation of minerals from solution

Rock formed from sediments covers 75-80% of the Earth's land area, and includes common types such as **limestone**, **chalk**, **dolostone**, **sandstone**, **conglomerate**, some types of **breccia**, and **shale**.

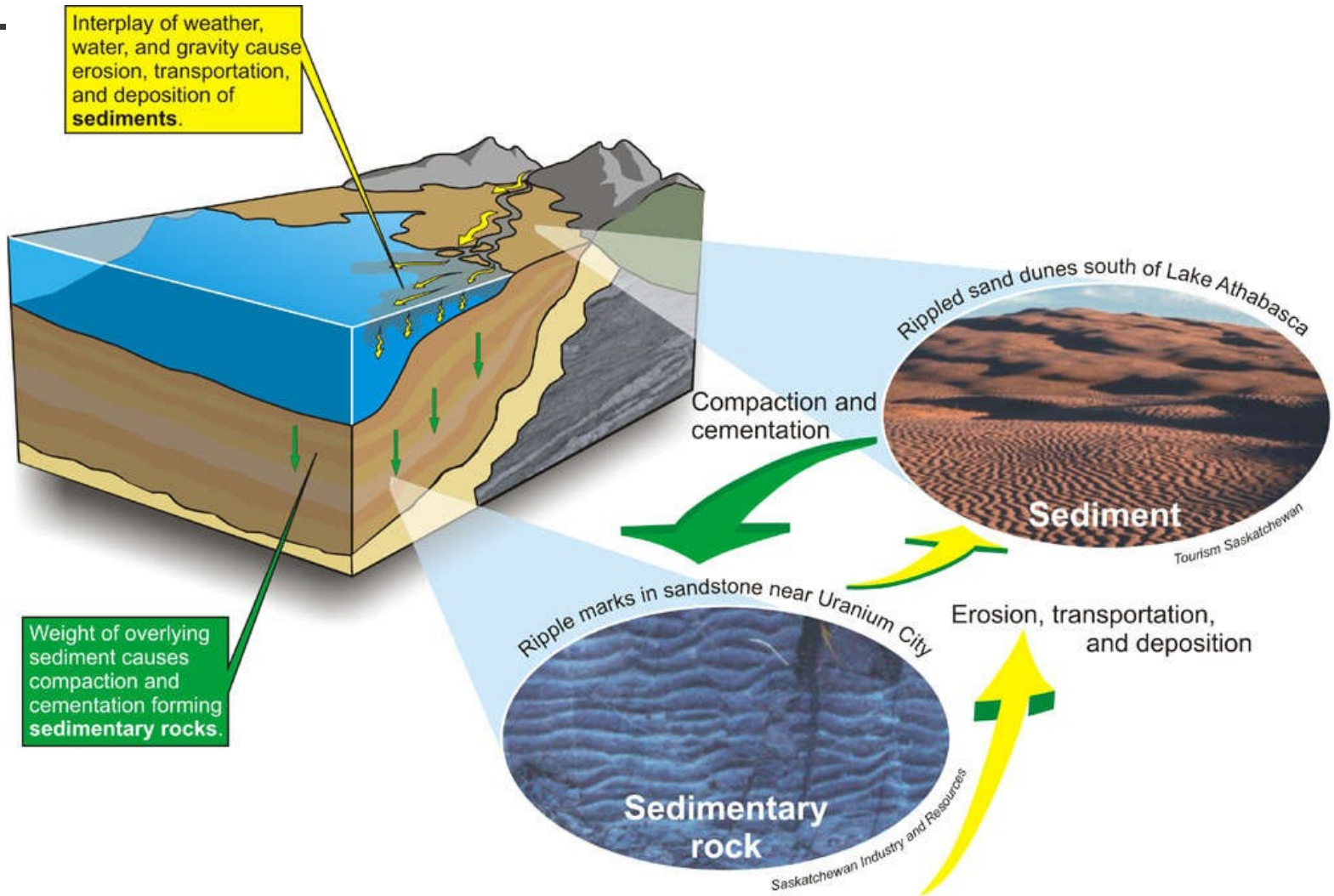
Sedimentary rocks are formed because of the overburden pressure as particles of sediment are deposited out of air, ice, wind, gravity, or water flows carrying the particles in suspension.





# ROCKS & STONES

## ~ORIGIN-Sedimentary Rocks



# ROCKS & STONES

## ~ORIGIN

**Metamorphic** minerals are those that form only at the high temperatures and pressures associated with the process of metamorphism. These minerals, known as index minerals, include **sillimanite**, **kyanite**, **staurolite**, **andalusite**, and some **garnet**.

They may be formed simply by being deep beneath the Earth's surface, subjected to high temperatures and the great pressure of the rock layers above it.

Some examples of metamorphic rocks are **gneiss**, **slate**, **marble**, **schist**, and **quartzite**.



# ROCKS & STONES (Igneous Rock)

## ~APPLICATIONS



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**Stone Masonry:** Building stones obtained by quarrying from the rocky strata of earth and reducing it to the required shapes and sizes for construction.

**Granite :** Consists mainly of quartz, feldspar, mica, and other coloured minerals; colours include black, grey, red, pink, brown, buff, and green.

**Serpentine:** Main ingredient is serpentine; colour ranges from olive green to greenish black, is fine grained and dense.

**Basalt :** Colour ranges from grey to black; used mainly for paving stones and retaining walls.



# ROCKS & STONES (Igneous Rock)

## ~ APPLICATIONS

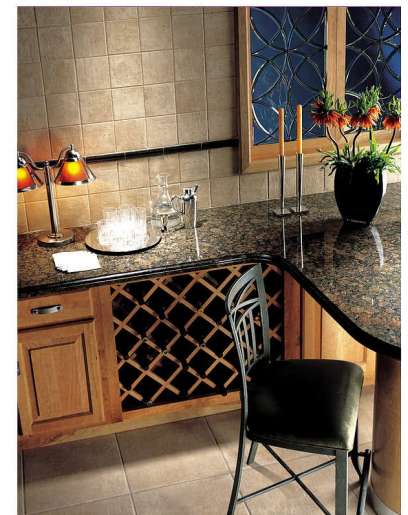
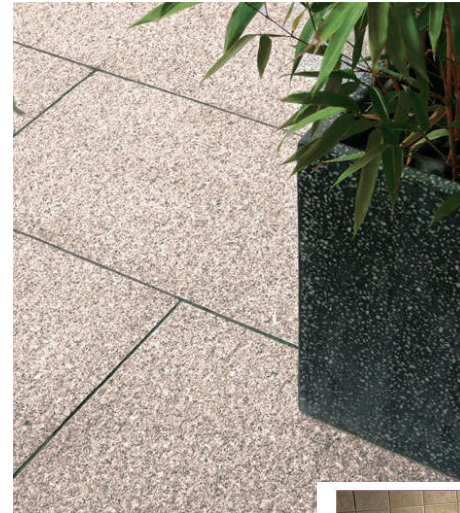
### Granite

Non-porous, hard, strong, durable

Colour Range

Surface Textures

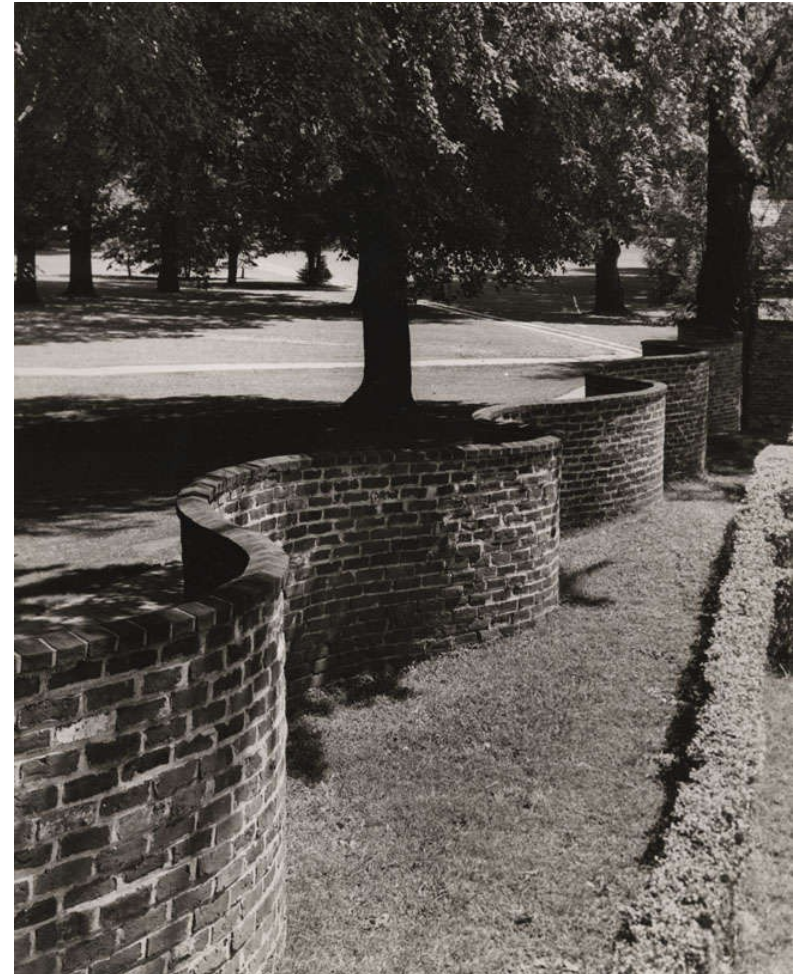
Primary Uses



# ROCKS & STONES (Igneous Rock)

## ~ APPLICATIONS

### Serpentine





# ROCKS & STONES (Igneous Rock)

## ~ APPLICATIONS

Basalt





# ROCKS & STONES (Sedimentary Rock)

## ~ APPLICATIONS



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**Sedimentary** : Sediments deposited by the action of water or wind gets consolidated to a rock.

**Sandstone** : Sedimentary rock composed of sand sized grains made of silica, iron oxide and clay - Colours include grey, brown, light brown, buff, russet, red, copper, and purple.

**Shale**: Derived from clays and silts; weak along planes and is in thin laminations - High in limestone and colour varies from black to red, yellow, and blue.

**Limestone**: Sedimentary rock composed of calcite and dolomite - Three types: oolitic, dolomitic and crystalline - Has high compressive strength - Used for building stones and for paneling.

# ROCKS & STONES (Sedimentary Rock)

## ~ APPLICATIONS

### Sandstone

Porous, relatively weak  
Colour Range  
Surface Textures



# ROCKS & STONES (Sedimentary Rock)

## ~ APPLICATIONS

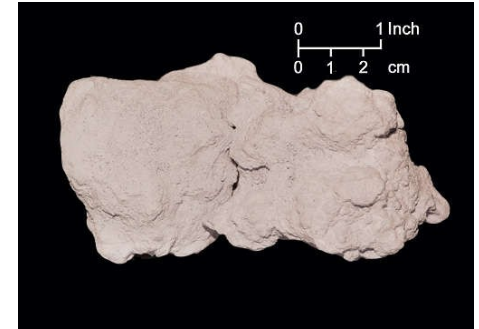
### Shale





# ROCKS & STONES (Sedimentary Rock)

## ~ APPLICATIONS



Limestone



# ROCKS & STONES (Metamorphic Rock)

## ~ PROPERTIES

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**Metamorphic:** Igneous or sedimentary rock transformed by heat and pressure into another rock.

**Marble:** Recrystallized limestone, colour varies from white through grey and black, red, violet, pink, yellow, and green - Presence of oxides of iron, silica, graphite, carbonaceous matter, and mica produce these colour variations.

**Quartzite:** It is a variety of and stone composed of mainly granular quartz cemented by silica, colour varies from brown, buff, tan, ivory, red through grey.

**Schist:** Made of silica with smaller amounts of iron oxide and magnesium oxide. Colour varies from blue, green, brown, gold, white, grey, and red.

**Slate:** Consists mainly of clays and shales - Major ingredients are silicon dioxide, iron oxide, potassium oxide, magnesium oxide, and sometimes titanium, calcium and sulfur - Slate found in parallel layers, which enables it to be cut into thin sheets.



# ROCKS & STONES (Metamorphic Rock)

## ~ APPLICATIONS

Marble

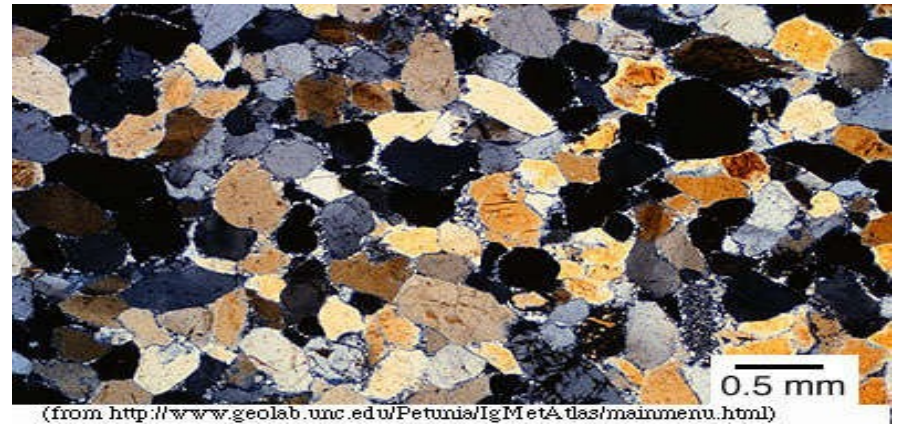




# ROCKS & STONES (Metamorphic Rock)

## ~ APPLICATIONS

Quartzite



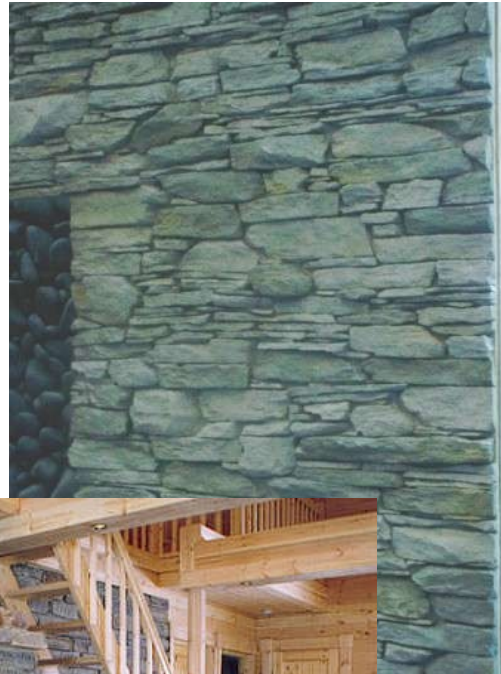
(from <http://www.geolab.unc.edu/Petunia/IgMetAtlas/mainmenu.html>)



# ROCKS & STONES (Metamorphic Rock)

## ~ APPLICATIONS

Schist





# ROCKS & STONES (Metamorphic Rock)

## ~ APPLICATIONS

Slate







# ROCKS & STONES (Crushed Stones)

## ~PROPERTIES

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**Construction aggregate**, or simply "*aggregate*", is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates.

Aggregates are a component of composite materials such as **concrete** and **asphalt concrete**; the aggregate serves as reinforcement to add strength to the overall composite material.

Aggregates are used as a stable foundation or road/rail base with predictable, uniform properties (e.g. to help prevent differential settling under the road or building), or as a low-cost extender that binds with more expensive cement or asphalt to form concrete.

# ROCKS & STONES (Crushed Stones)

## ~USAGE IN CONSTRUCTION

Aggregate





# ROCKS & STONES (Crushed Stones)

## ~ APPLICATIONS



# ROCKS & STONES

## ~CONCLUSION

