



STONE





General

- Natural Stone is one of the oldest construction material known. Various types and forms of natural stone can also be processed to produced other construction materials.

- As a part of the study of stones as a construction material, some understanding of the origin and occurrence of rocks is essential.

CLASSIFICATION OF ROCKS

Rocks can be divided into three major categories depending on their geological origin:

- Igneous: *formed by the cooling and crystallization of molten material within or at the surface of the earth;*
- Sedimentary: *formed from sediments derived from preexisting rocks, by precipitation from solution, or by the accumulation of organic materials;*
- Metamorphic: *resulting from the change of preexisting rocks into new rocks*

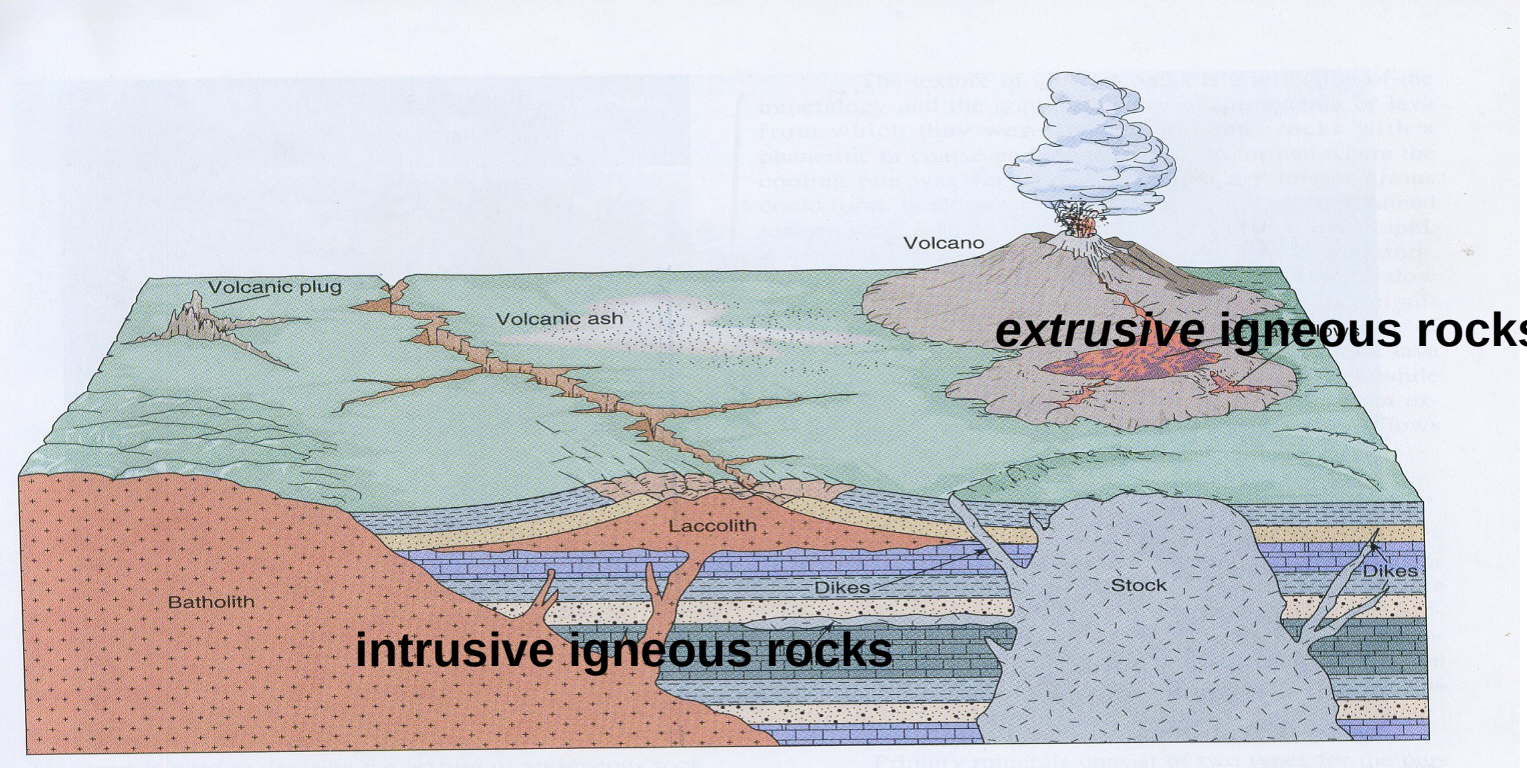
THE PROCESS OF ROCK FORMATION

The earth's crust is dynamic and is subject to a variety of processes that act upon all types of rocks. Given time and the effect of these processes, anyone of these rocks can be changed into another type.





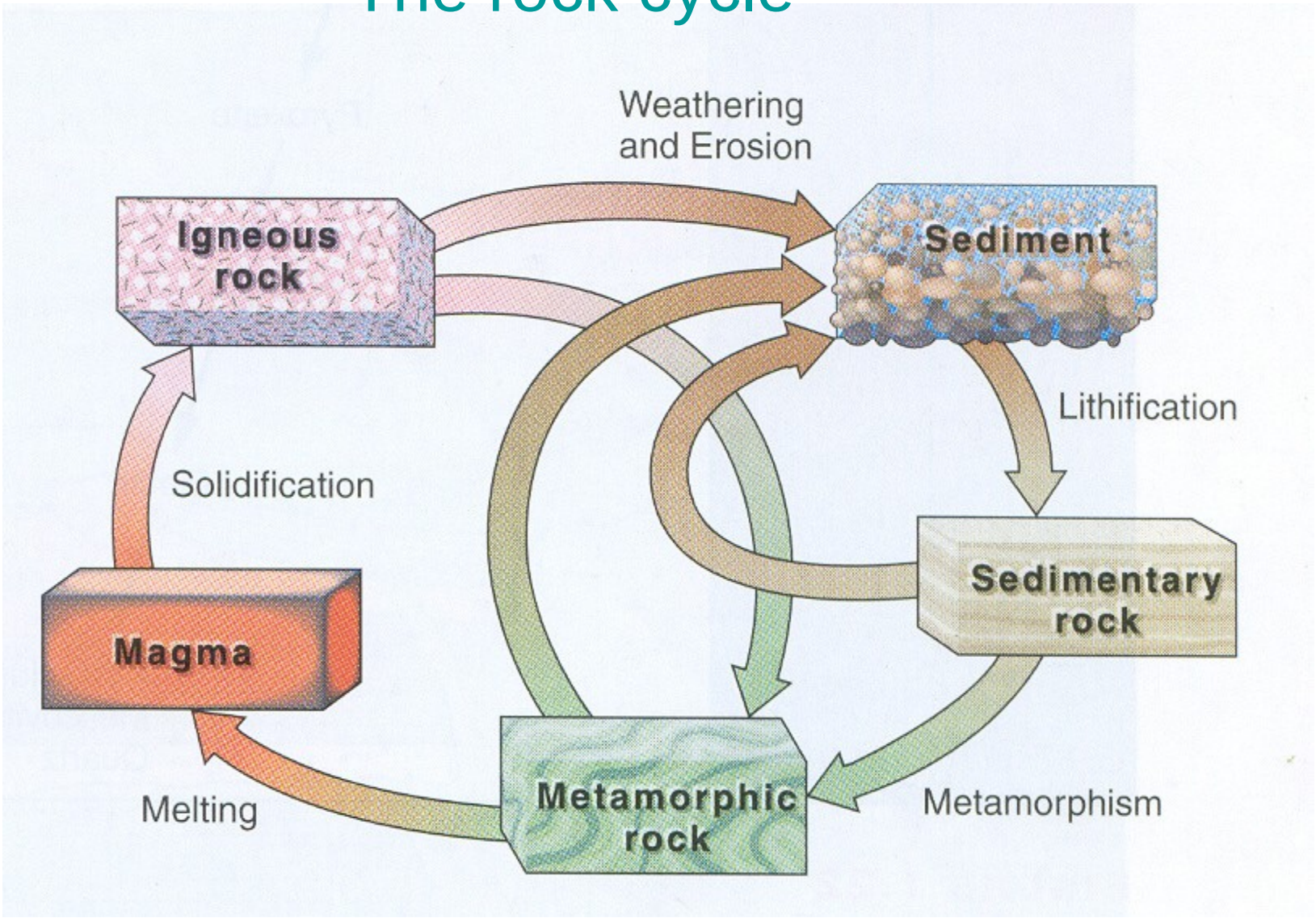
The temperature of the earth increases with depth at a rate of about 30° C per kilometer of depth.



The rocks formed by solidification of magma within the mantle or crust are called **intrusive igneous rocks**,(e.g. granite and gabbro) and those that form at the surface from lavas are called ***extrusive* igneous rocks**(e.g. basalt and rhyolite).



The rock cycle



TEXTURES OF IGNEOUS ROCKS

a) Phaneritic or Coarse-Grained:

the constituent minerals are macroscopic in size.

b) Aphanitic or Fine-Grained:

composed of mineral crystals or grains that are microscopic in size

c) Porphyritic:

the macroscopic mineral crystals or grains are embedded in a matrix of microscopic crystals

e) Vesicular: This texture is characterized by the presence of vesicles- tubular, ovoid, or spherical cavities in the rock.

f) Glassy: This texture resembles that of glass



FIGURE 1.25 Pink granite.



FIGURE 1.26 White granite.



FIGURE 1.27 Pegmatite.

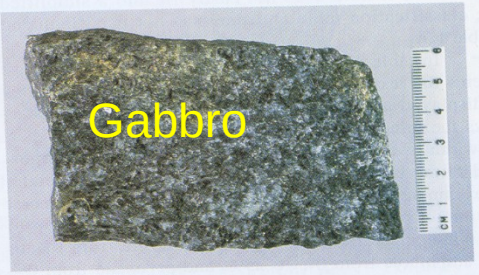


FIGURE 1.28 Gabbro.



FIGURE 1.29 Diorite.



FIGURE 1.30 Basalt.



FIGURE 1.31 Vesicular basalt.



FIGURE 1.32 Basalt porphyry.

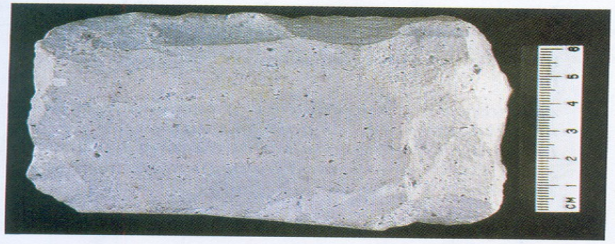


FIGURE 1.33 Rhyolite.

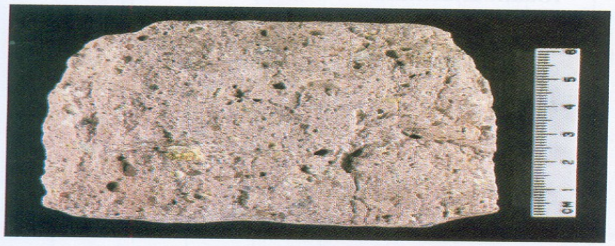


FIGURE 1.35 Rhyolite tuff.

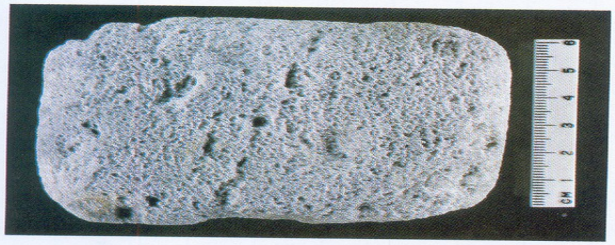


FIGURE 1.37 Pumice.



FIGURE 1.39 Obsidian.



FIGURE 1.34 Rhyolite porphyry.

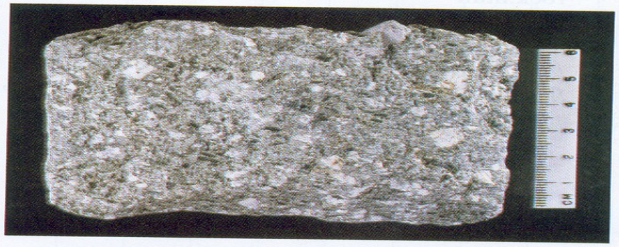


FIGURE 1.36 Andesite porphyry.



FIGURE 1.38 Scoria.

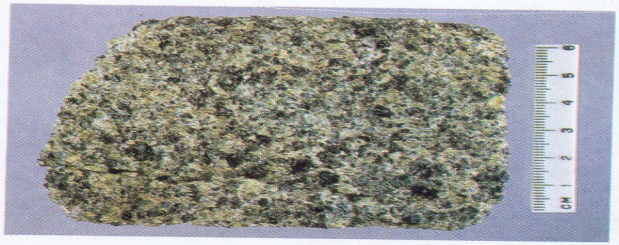


FIGURE 1.40 Peridotite.

SEDIMENTARY ROCKS

- Sedimentary rocks are derived from preexisting materials through the work of mechanical or chemical agencies under conditions normal at the surface of the earth, or they may be composed of accumulations of organic debris.
- Rock weathering on land produces rock and mineral fragments that are transported by gravity (falling) or by wind, water, or ice and deposited elsewhere on the earth's surface as *sediments.*

SEDIMENTARY ROCKS

- The process or processes by which soft sediment is transformed into rock is called **lithification**.
- Sedimentary rocks display various degrees of lithification.

METAMORPHIC ROCKS

- Once formed, all rocks are subject to processes of change that occur at the surface of the earth or within the crust of the earth.

- Metamorphic rocks are formed at varying depths within the crust when preexisting rocks are changed physically or chemically under conditions of high temperature, high pressure, or both. The process of **metamorphism**, literally a "change in form," takes place deep beneath the earth's surface and acts on all rocks-igneous, sedimentary, and metamorphic.

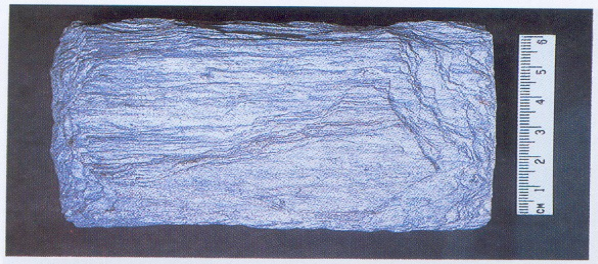


FIGURE 1.54 Phyllite.



FIGURE 1.55 Garnetiferous schist.



FIGURE 1.56 Gneiss.

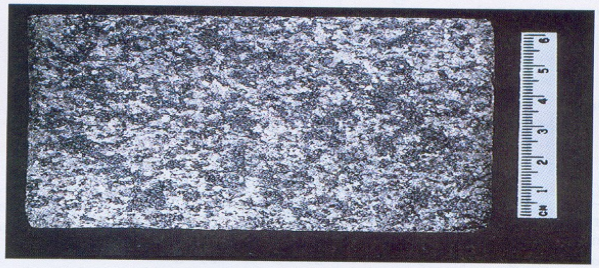


FIGURE 1.57 Granulite.



FIGURE 1.58 Quartzite.



FIGURE 1.59 Pink marble.



FIGURE 1.60 Metaconglomerate.



FIGURE 1.61 Anthracite coal.

REQUIREMENTS OF BUILDING STONE

- Despite the abundance of rock, relatively few stones satisfy the requirements as building stones.
- The important requirements are:

  (1) strength,
  (2) hardness,
  (3) workability,
  (4) durability,
  (5) color and grain,
  (6) porosity and texture,
  (7) ease of quarrying, and
  (8) accessibility.

REQUIREMENTS OF BUILDING STONE

- Hardness is vitally important only where the stone is to be used in floors, steps, walks, etc.
- hardness does have a bearing on workability. It varies all the way from soft sandstone, which can be easily scratched, to some stones harder than steel.

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REQUIREMENTS OF BUILDING STONE

- ***Workability*** is important since the ease of producing the required sizes and shapes has a direct bearing on the cost.
- ***Durability*** is the ability of the stone to withstand the effects of rain, spray, wind, dust, frost action, heat, and fire

REQUIREMENTS OF BUILDING STONE

- ***Color*** is very important from the standpoint of aesthetics and location but is also partially a matter of taste and fashion. The grain or surface appearance of stone affects its desirability for decorative purposes.

- ***Porosity*** has a direct bearing on the ability of the stone to withstand frost action.

REQUIREMENTS OF BUILDING STONE

- ***Texture*** the fineness of grain, affects workability and therefore cost. Fine-textured rock splits and dresses more readily than coarse rock. For many ornamental purposes, also, the texture is important.
- **The ease of quarrying** is a prime consideration in judging the suitability of stone for building. The bedding and joint planes must be such that the stone can be produced in sizable, sound blocks.
- **Accessibility** also affects cost. Transportation over long distances is expensive but in some cases becomes a necessity.

QUARRYING AND FINISHING OF STONE

- **Quarrying** is the process of removing stone from its natural bed. The method of quarrying will depend to some extent on the nature of the stone.

Dimension Stone Production

Processing stages applied in production:

- Drilling of closely spaced boreholes in rock for subsequent separation of large lumps of stone from the massif.
- Breaking of these lumps into standard products or similar-size stones.
- Treatment of stone surface ,dressing ,grinding and polishing.
- Loading and hauling of stone.



Quarry Stone Production

Process stage applied in production:

- Stripping and clearing of overburden
- Drilling of boreholes in rock charging with explosives
- Blasting operations
- Drilling of boreholes in oversize stone, cleaning of boreholes, blasting operations
- Loading of stone onto transport vehicles and hauling to a construction.

Crushed Stone Production

Process stage applied in production:

- Stripping and clearing of overburden
- Drilling of boreholes in rock and charging with explosives
- Blasting operations
- Drilling of boreholes in oversize stone, blasting operations
- Loading of stone onto transport vehicles and hauling to a crusher plant
- Screening of crushed stone in size fractions
- Storage of crushed stone size fractions (Loading and hauling of crushed stone and artificial sand to a construction site in size fraction)

GENERAL TYPES OF STONE USED IN ETHIOPIA

- Stone which does, in general, satisfy the foregoing requirements and which is commonly used for construction in Ethiopia include: basalt, trachyte, granite, limestone, marble, sandstone, ignimbrite, pumice, and scoria.
- Basalt and trachyte are very common in Ethiopia and are mostly used for stone masonry work and as boulders or crushed stone for road construction and crushed aggregate for concrete making.

GENERAL TYPES OF STONE USED IN ETHIOPIA

- Granite is generally hard, strong, durable, and capable of taking a high polish. Granite has a wide variety of use in building, including flooring, interior and exterior facing, stair trades and skirting.

- Owing to its beautiful colors and durability marble is used as wall cladding material, floor finishing and window sill.

GENERAL TYPES OF STONE USED IN ETHIOPIA

- Sandstone, and ignimbrite are widely used for decorative purpose. Ambo sand stone is a typical example in this aspect.

- Pumice and scoria are found in large quantities in the rift valley .they are widely used in the manufacture of light weight concrete block. Owing to its light weight concrete made of pumice is used for forming slopes on flat concrete roofs. Pumice is also used for production of Portland pozzolana cement.