CE 2141
ENGINEERING GEOLOGY AND GEOMORPHOLOGY

Lecture 03 – Mineraloids and Type of Rock

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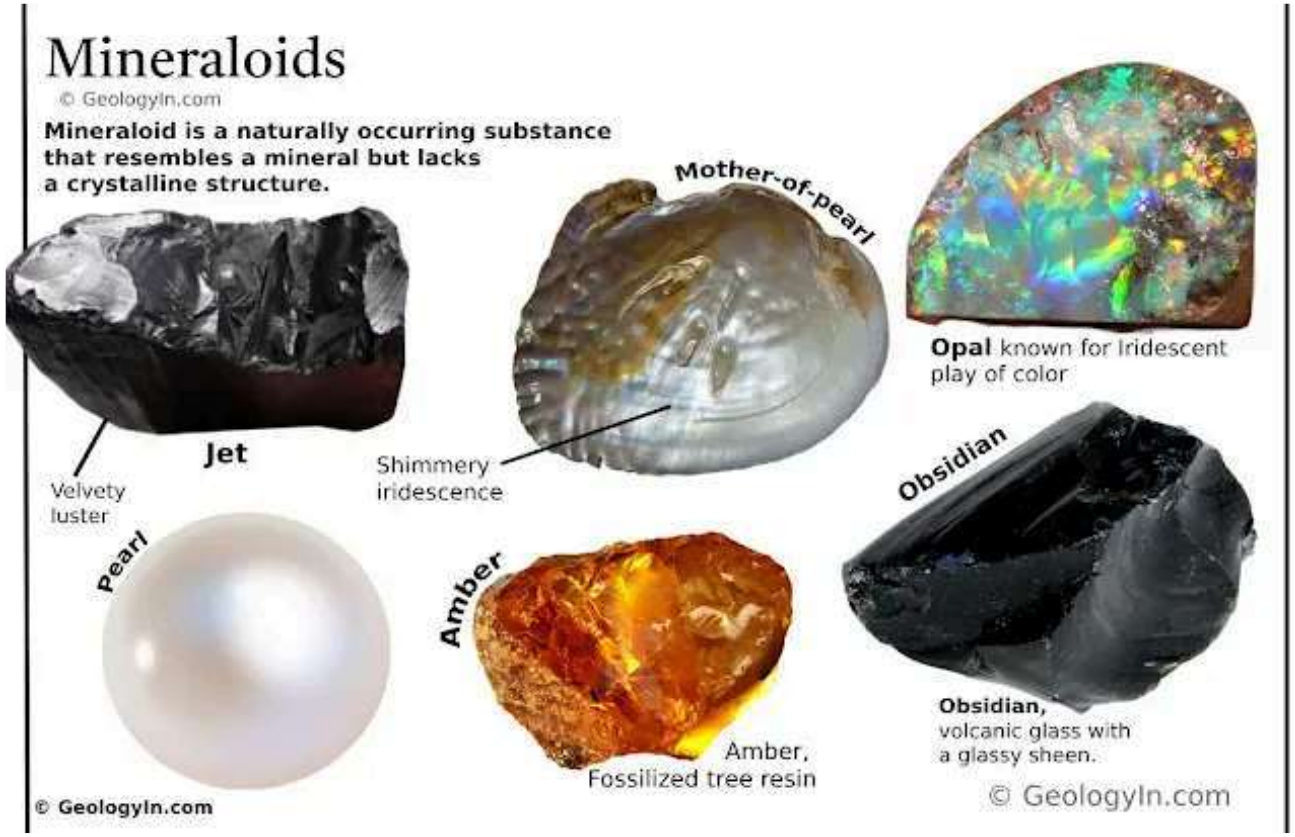
Lecture 03: Topics

- Mineraloids
- Difference Between Minerals and Mineraloids
- Some Useful Mineraloids
- Rock and their Properties
- Classification of Rocks
- Type of Igneous Rocks
- Formation of Plutonic Rocks

What are Mineraloids?

Mineraloid is a naturally occurring substance that resembles a mineral but lacks a crystalline structure.



The Differences Between Minerals and Mineraloids

Crystal Structure

- Mineral: Minerals have a crystalline structure. This means their atoms are arranged in a specific, ordered, and repeating pattern. This ordered structure allows them to form crystals with defined shapes and flat cleavage planes (preferred directions for breaking).
- Mineraloid: Mineraloids lack a crystalline structure. Their atoms are arranged in a more disorganized and random way. This amorphous structure prevents them from forming crystals and gives them a glassy or conchoidal fracture (uneven, curving breaks).

The Differences Between Minerals and Mineraloids

Chemical Composition

- Mineral: Minerals have a definite chemical composition, although it can vary within a limited range. This means they are composed of specific elements in specific ratios.
- Mineraloid: Mineraloids can have a variable chemical composition. The proportions of elements can differ more significantly than what's allowed for minerals.

The Differences Between Minerals and Mineraloids

Formation

- Mineral: Minerals are typically formed through geological processes like cooling magma, evaporation of solutions, or metamorphism (transformation of rocks under high pressure and temperature).
- Mineraloid: Mineraloids can form through various processes, including rapid cooling of volcanic materials, decomposition of organic materials, or chemical weathering.

Useful Mineraloids

Limonite

- Limonite is a source of iron and can be used in steelmaking
- Limonite's yellow and brown hues make it a useful pigment. This pigment use is ancient, dating back to cave paintings and early art.
- It can be used as an aggregate in high-density concrete (HDC).

Useful Mineraloids

Obsidian

- Obsidian stone, a naturally occurring volcanic glass, has been utilized throughout history for a variety of purposes, including tools, weapons, ornaments, and even in spiritual practices.
- Obsidian blades, due to their extreme sharpness, have been experimented with and used as surgical scalpels in some cases.

Useful Mineraloids

Opals

- Opals are highly valued for their play-of-color, the shimmering rainbow effect, making them popular in jewelry.
- It can be used as an ingredient in ceramics.

Useful Mineraloids

Opals

Shows various colors when dry, but after soaking up water it is color less.

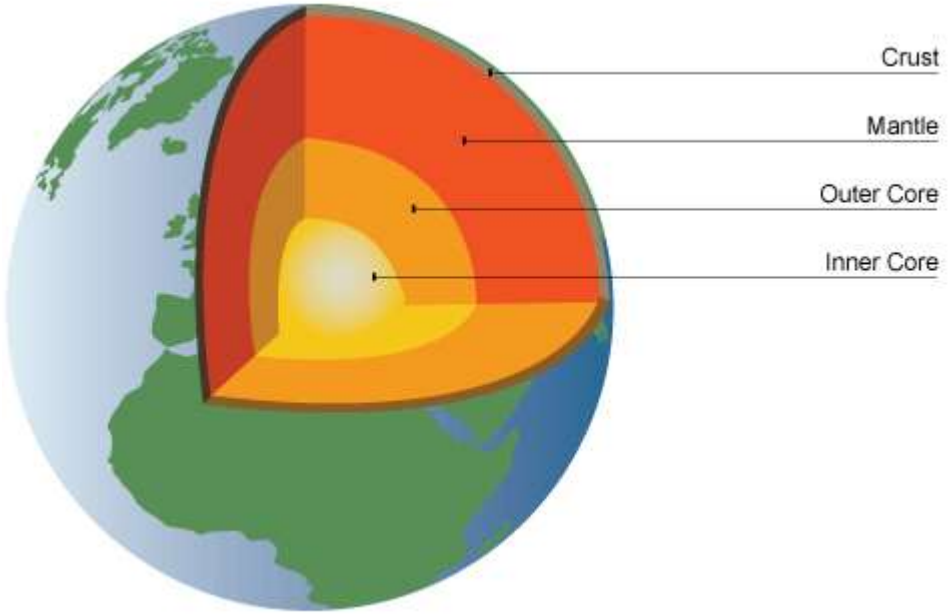
Useful Mineraloids

Coal

- Coal is a major fuel source for power plants, accounting for a significant portion of global electricity production.
- Coking coal, is a crucial ingredient in the production of steel.
- It is used as a fuel in the production of cement.
- Coal can be processed to produce a variety of chemicals, including dyes, solvents, and plastics.

Composition of Earth's Crust

Component	Approx. Volume	Main Types/Elements
Rocks	**~95%**	**Granite, basalt, gneiss, sandstone**
Soil	<1%	Sand, silt, clay + organic matter
Other Materials	~4%	Sediments, fossils, groundwater, gas



What is Rock?

Rock is a naturally occurring solid aggregate of one or more minerals.

It forms the basic building material of the Earth's crust. Rocks are composed of minerals, but they can also contain other materials like organic matter or even pieces of other rocks.

Properties of Rock

1. Mineral Composition

- Types and proportions of minerals that make up the rock
- Determines hardness, durability, and chemical reactivity

Example: Granite contains quartz, feldspar, and hornblende

Properties of Rock

2. Texture

- Size, shape, and arrangement of minerals
- Can be coarse-grained (e.g., granite) or fine-grained (e.g., basalt)

3. Porosity

- The percentage of void spaces (pores) in a rock
- Affects water absorption and storage

Important in groundwater studies

Properties of Rock

4. Permeability

- Ability of a rock to transmit fluids
- Depends on connectivity of pores or cracks

5. Strength

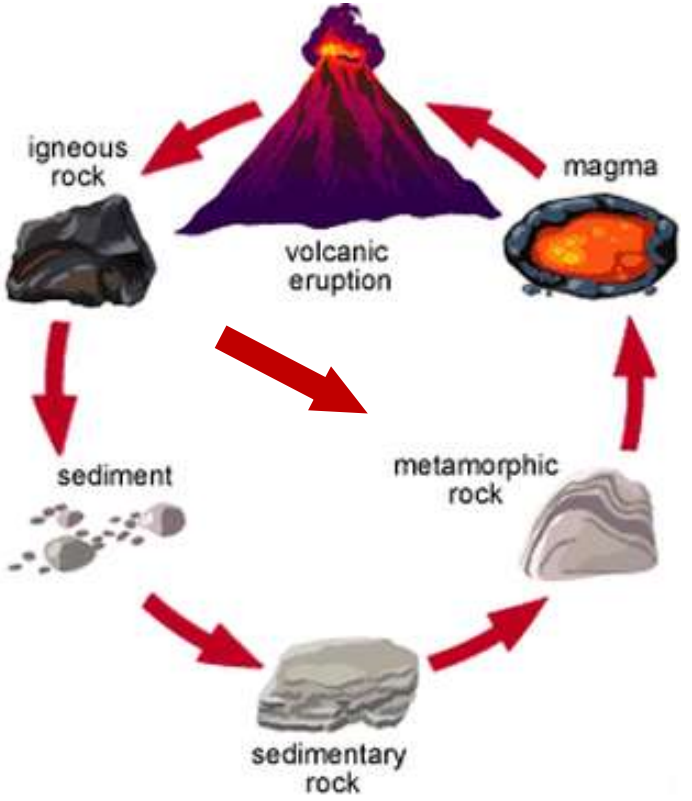
Resistance to stress or deformation:

- Compressive strength: resistance to being squashed
- Tensile strength: resistance to being pulled apart
- Shear strength: resistance to sliding along planes

Type of Rocks

Based on mode of origin rocks can be grouped in 3 classes

- ***Igneous rock***, have been formed from molten magma.
- ***Sedimentary rocks***, have been laid down mainly under water (aqueous) by mechanical, chemical, or organic agents.
- ***Metamorphic rocks***, have been transformed from original igneous or sedimentary rocks by external forces into rock having different properties.



Type of Igneous Rock

Igneous rocks have been formed at some depth below the surface where it is cooled and solidified under the influence of the surrounding rocks, or it may reach the surface and be poured out upon it, solidifying to form hard rock.

Based on the locality of formation Igneous Rock can be divided into following types:

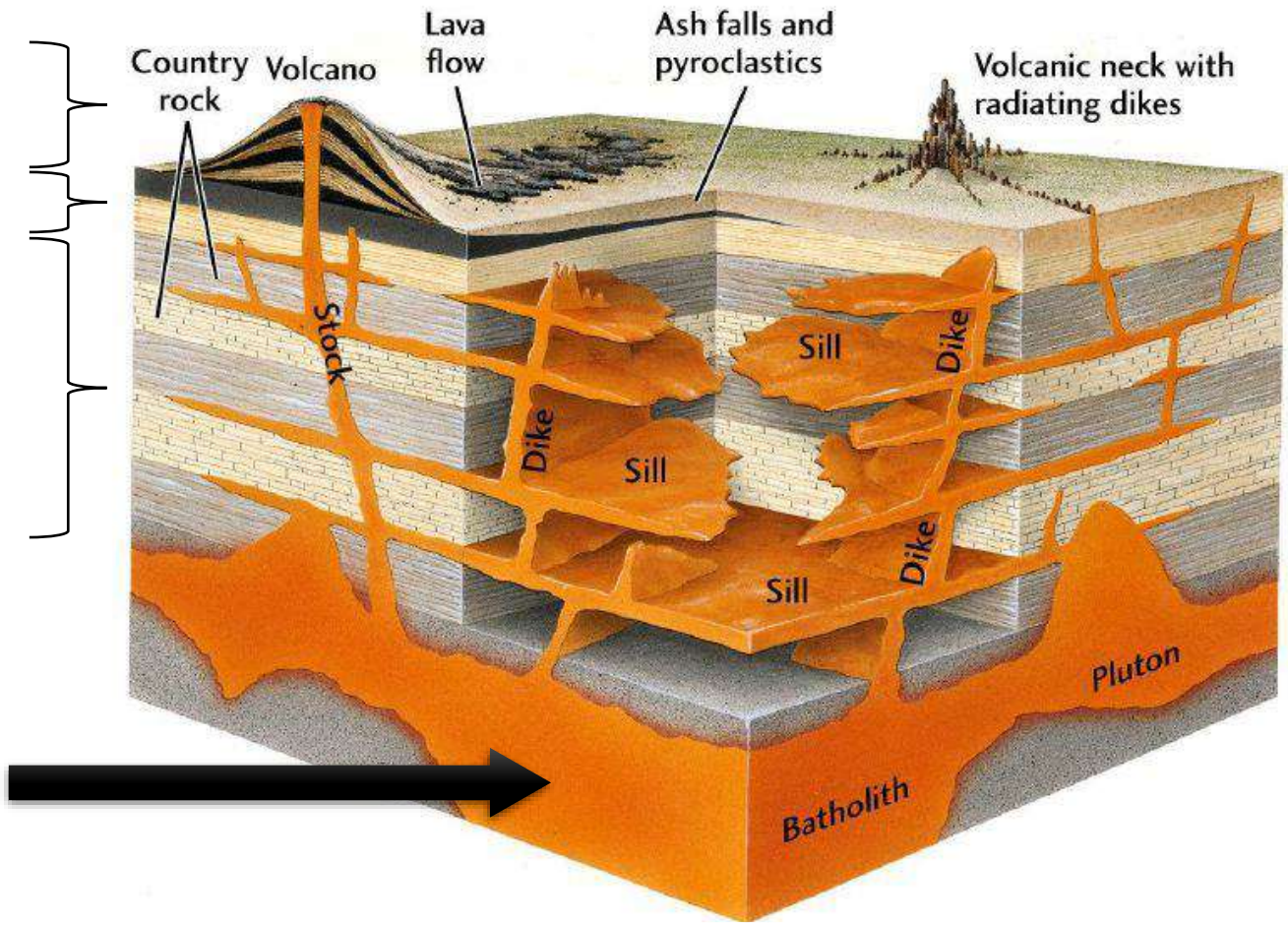
Type	Formation Depth	Cooling Rate	Example
Plutonic	Deep underground	Slow	*Granite, Gabbro*
Volcanic	Surface	Rapid	*Basalt, Obsidian*
Sub-volcanic	Shallow depth	Intermediate	*Porphyries*

Type of Igneous Rock

Volcanic Rock

Sub-volcanic Rock

Plutonic Rock



Molten magma

Formation of Plutonic Rock

The principal modes of occurrence of intrusive igneous rocks are as follows:

- Dikes
- Sheets/Sills
- Laccoliths
- Necks
- Stocks
- Batholiths

Formation of Plutonic Rock

Dikes –

- A dike results from the filling of a fissure in other rocks by molten material from below.
- It is the simplest form of intrusion, and has great length as compared with Thickness.

Formation of Plutonic Rock

Dikes

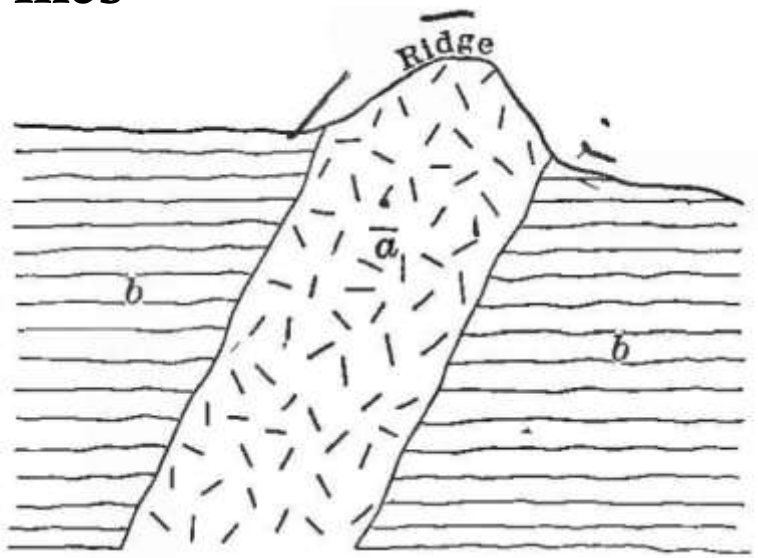


FIG. 47. — Section through dike more resistant to weathering than the inclosing rock, marking the position of a ridge. (*a*) dike; (*b*) inclosing rock.

Formation of Plutonic Rock

Dikes

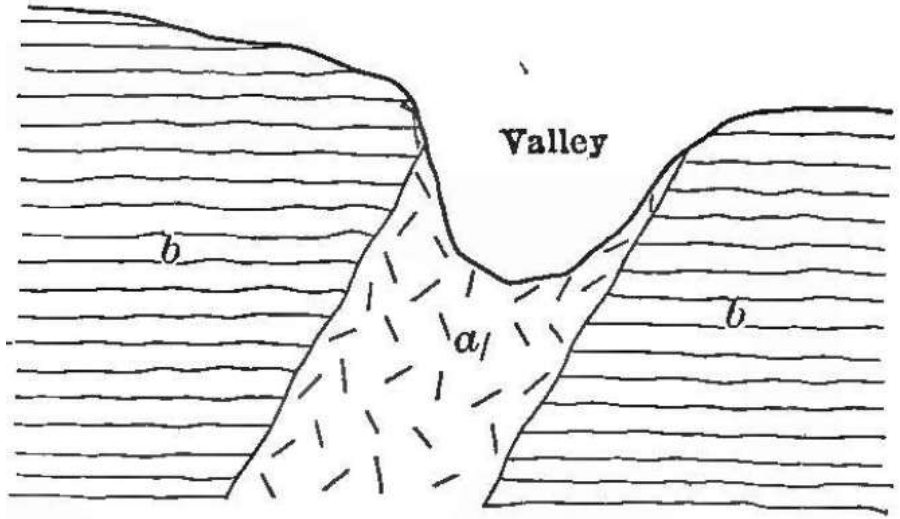
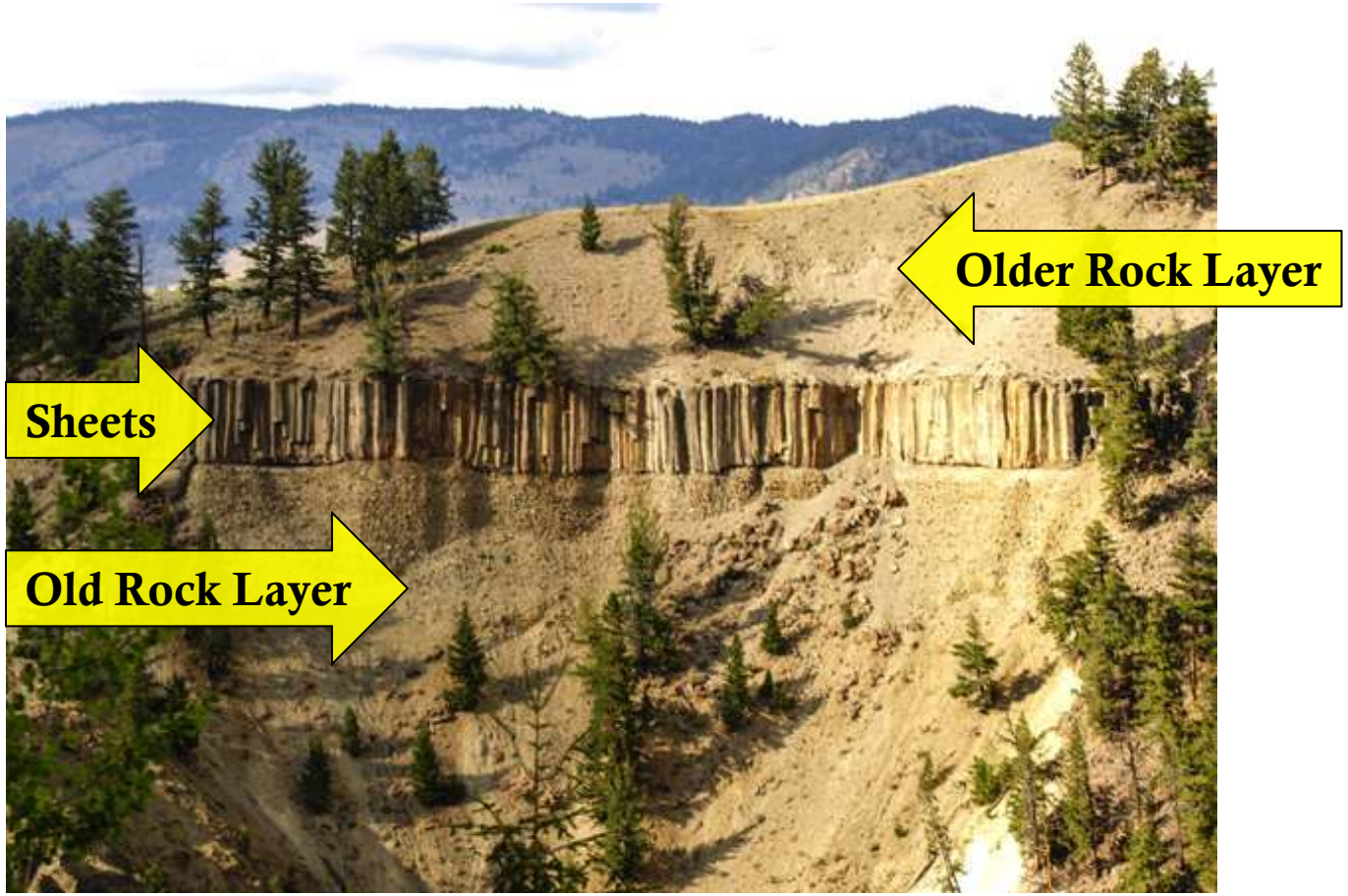


FIG. 48. — Section through dike less resistant to weathering than the inclosing rock, marking the position of a valley. (*a*) dike; (*b*) wallrock.

Formation of Plutonic Rock

Sheets/Sills –

- The solidified bodies of molten material intruded between the horizontal layers of sedimentary and metamorphic rocks.
- They are characterized by relatively great lateral extent as compared with their thickness.



Formation of Plutonic Rock

Laccoliths –

- It is a dome-shaped mass of igneous rock intruded between strata.
- It may be considered as a special case of an intrusive sheet in which the supply of molten material from below exceeds the rate of lateral spreading and cause convex upper.

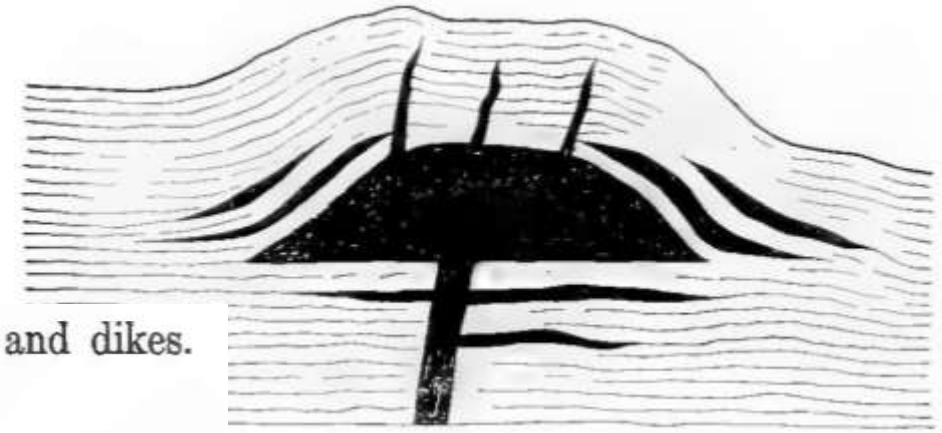


FIG. 52. — Section through laccolith showing associated sheets and dikes. Compare outline of laccolith with that of Fig. 53.

Formation of Plutonic Rock

Laccolithic Dome

Formation of Plutonic Rock

Necks –

- These are roughly cylindrical masses of igneous rock having probably great but unknown depth, which fill the vents or conduits of volcanoes.

Formation of Plutonic Rock

Necks

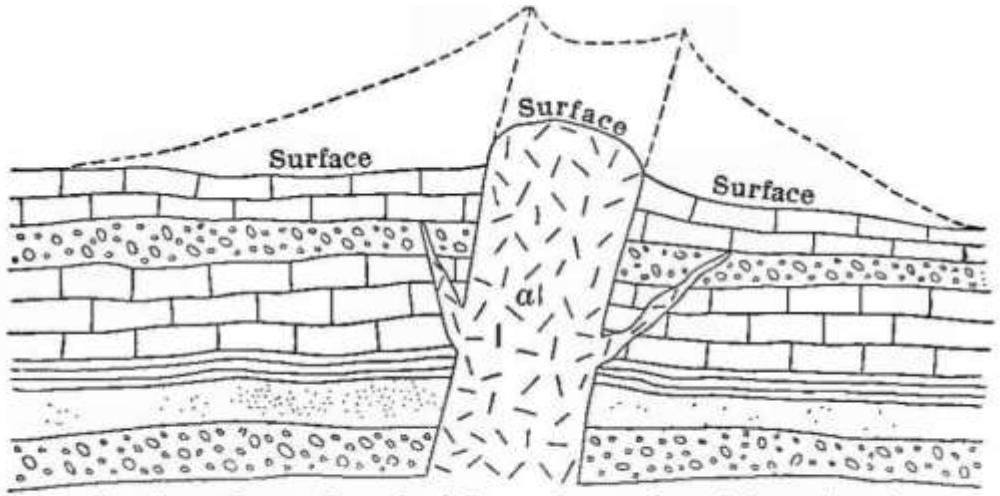


FIG. 54. — Section through volcanic neck or plug (*a*), volcanic cone shown by dotted lines, removed by erosion.

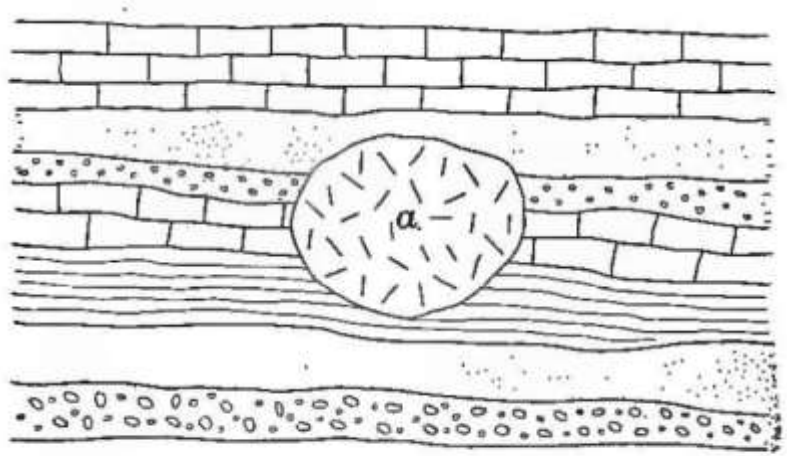


FIG. 55. — Plan of volcanic neck or plug (*a*).

Formation of Plutonic Rock

Stocks –

- These are irregular, rounded masses of igneous rock intruded and solidified at some depth beneath the surface, and now exposed from stripping by erosion of the thickness of overlying rocks.

Formation of Plutonic Rock

Stocks

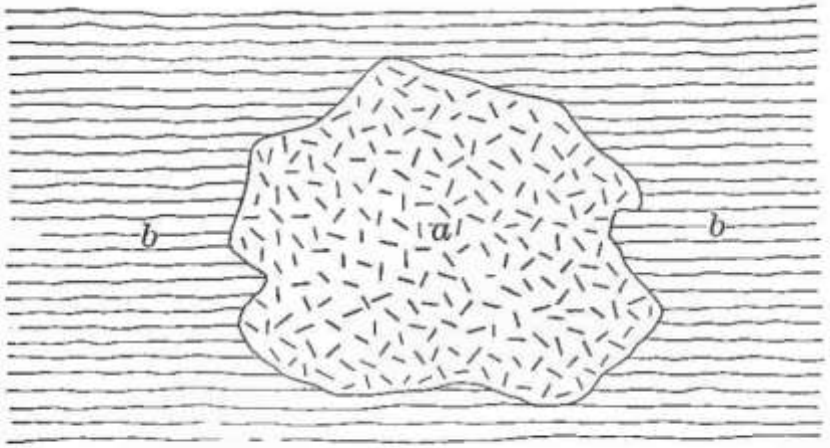


FIG. 57. — Plan of stock or boss. (*a*) granite; (*b*) inclosing rock.

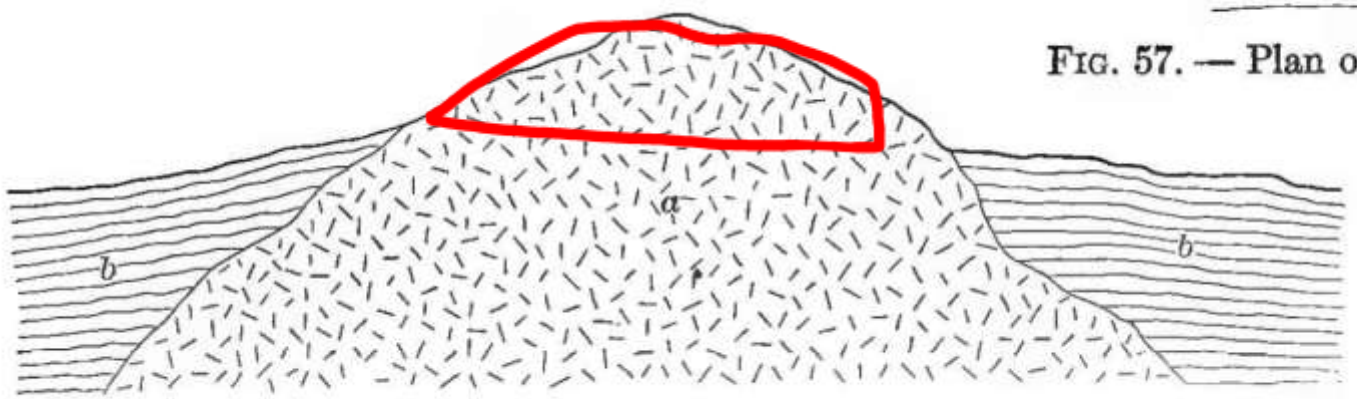


FIG. 56. — Section through stock or boss. (*a*) granite boss; (*b*) inclosing rock.

Formation of Plutonic Rock

Batholiths –

- These are huge masses of plutonic rock hundreds of miles in extent which are now exposed at the surface by erosion (Fig. 58).
- They are like stocks, but differ from them mainly in their much larger size,

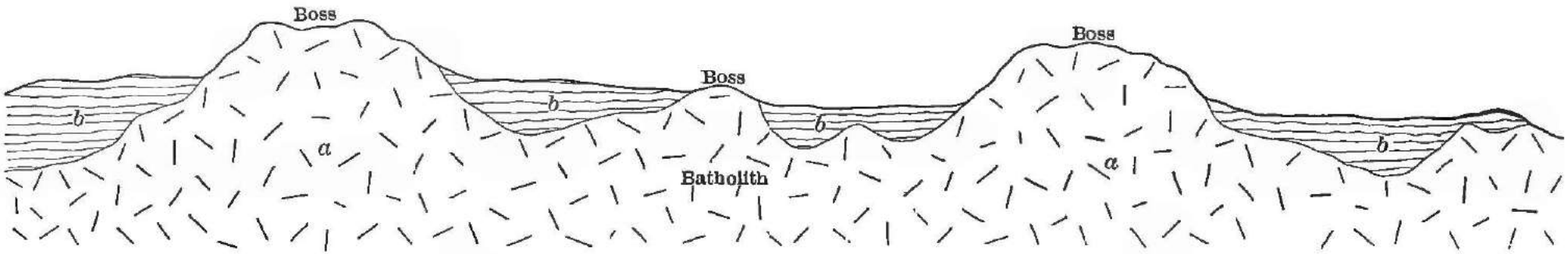


Fig. 58. — Section through a batholith. (*a*) granite; (*b*) schist.