The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

**COURSE: GMT 301**  
**IGNEOUS AND METAMORPHIC**  
**PETROLOGY**

**A) IGNEOUS PETROLOGY**

# STRUCTURE OF LECTURES

- MODULAR
- THERE WILL BE 5 MAIN MODULES
- A MODULE WILL BE COVERED A MAJOR CHAPTER
- EACH MODULE WILL CONSISTS OF LECTURES (1 TO 5)
- DESIGNED IN SUCH A WAY THAT INDIVIDUAL MODULES CAN BE CHECKED AND WILL BE ASKED FOR ASSIGNMENT

# STRUCTURE OF LECTURES (23+5)

Module	Descriptions	Lectures
1	Introduction of Igneous Petrology	1
2	Magma	6
3	Igneous Rocks	8
4	Chemical Petrology	5
5	Subduction Related Igneous Activities	3
6	Practical (GMP-311)	5

# Objective & Outcomes of the Course

- ✓ Could explain -how igneous rocks are formed and can be classified;
- ✓ Describe- the range of processes that lead to the formation of igneous rocks;
- ✓ Explain- how geochemical and isotope data are acquired and their uses in constraining the sources, evolution and crystallization of magmas;
- ✓ Interpret- igneous rock textures and mineral assemblages;
- ✓ Critically evaluate- the evidence for the petro-genesis of igneous rocks in a variety of plate tectonic settings.

# **Introduction to Igneous Petrology**

- ✓ Definitions
- ✓ Magma
- ✓ Rocks
- ✓ General Characteristics

# Igneous Petrology

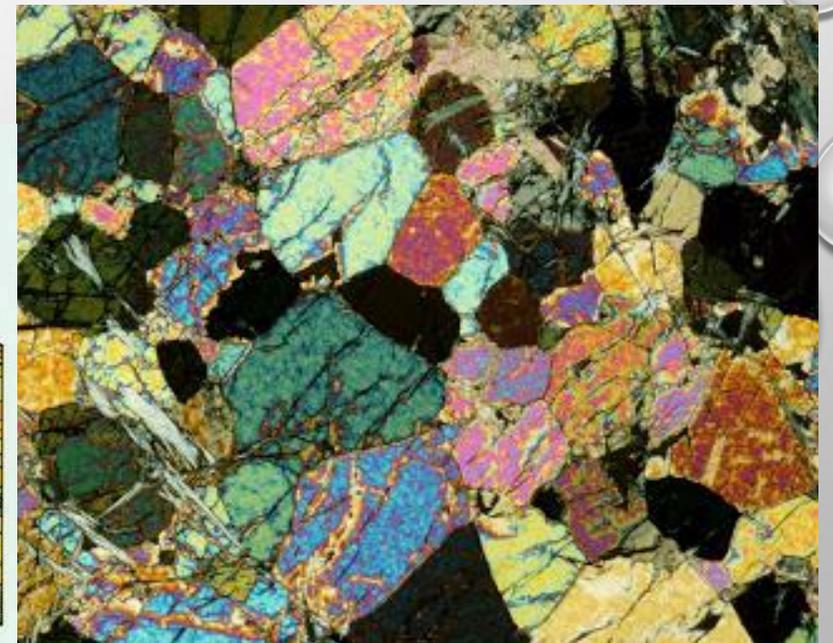
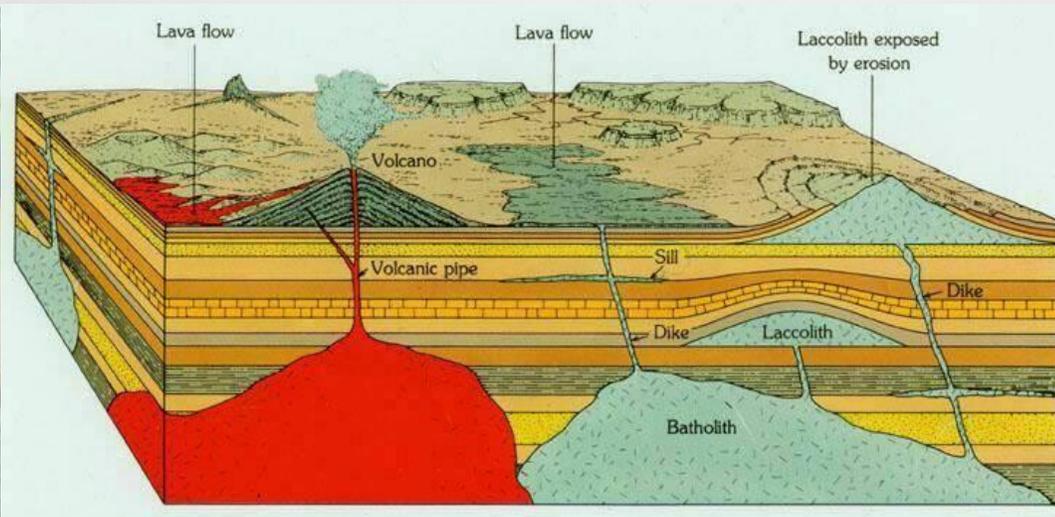
**Petrology:** The branch of geology dealing with the origin, occurrence, structure, and history of rocks.

**Petrography:** The branch of geology dealing with the description and systematic classification of rocks, especially by microscopic examination of thin sections.

Petrography is a subfield of Petrology. In this course, most of the lecture material falls under the field of Petrology, while some of the laboratory material falls in the field of Petrography.

**Igneous Petrology:** - Igneous petrology is the study of igneous rocks-those are formed from magma. As a branch of geology, igneous petrology is closely related to volcanology, tectonophysics, and petrology in general. The modern study of igneous rocks utilizes a number of techniques, some of them developed in the fields of chemistry, physics, or other earth sciences.

Petrography, crystallography, and isotopic studies are common methods used in igneous petrology.



# Introduction of Igneous Rocks

An **igneous rock** is any crystalline or glassy rock that forms from cooling of a magma.

A **magma** consists mostly of liquid rock matter, but may contain crystals of various minerals, and may contain a gas phase that may be dissolved in the liquid or may be present as a separate gas phase.

Magma can cool to form an igneous rock either on the surface of the Earth - in which case it produces a **volcanic** or **extrusive igneous** rock, or beneath the surface of the Earth, - in which case it produces a **plutonic** or **intrusive igneous** rock.



# Quick Review

- ✓ Igneous rocks form from cooled and solidified magma or lava.
- ✓ When magma cools slowly inside Earth, we get intrusive (plutonic) igneous rocks with large crystals.
- ✓ When lava cools quickly at or near Earth surface, we get extrusive (volcanic) igneous rocks with small or no crystals. These may be vesicular, meaning there are trapped gas bubbles.

**Igneous Rocks-** Igneous rocks are formed from the solidification of molten rock material.

- Some form below earth's surface (Intrusive Igneous rocks)
- Some form on or above earth's surface (Extrusive Igneous rocks)

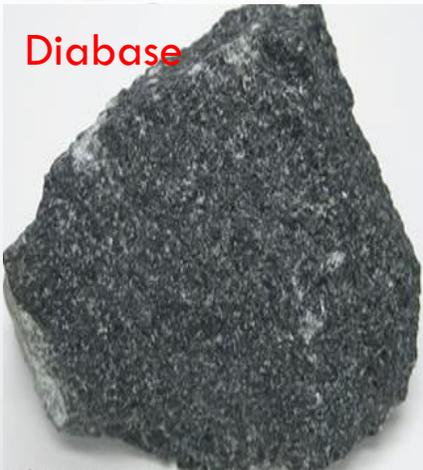
**Intrusive igneous rocks:** These are crystallized below earth's surface, and the slow cooling that occurs there allows large crystals to form. Example-

**Diabase, Diorite, Gabbro, Granite, Pegmatite, Peridotite etc.**

**Extrusive igneous rocks:** These are erupt onto the surface, where they cool quickly to form small crystal....some cool so quickly that they form an amorphous or glass. Example-

**Andesite, Basalt, Dacite, Obsidian, Pumice, Rhyolite, Scoria, Tuff etc.**

Diabase



Diorite



Gabbro



Granite



Pegmatite



Peridotite



Andesite



Basalt



Dacite



Obsidian



Pumice



Scoria



<b>Intrusive</b>	<b>Extrusive</b>
Rocks INSIDE the Earth	Rocks OUTSIDE the Earth
Plutonic	Volcanic
Formed from magma	Formed from lava
Usually dark	Usually light colored
Usually dense	Usually low density (light)
<u>Mafic</u> : <u>m</u> agnesium & <u>I</u> ron	<u>Felsic</u> : <u>f</u> eldspar (aluminum)
Cools slowly	Cools quickly
Large grains	Small or no grains (fine or glassy)

<b>Weight % of SiO<sub>2</sub></b>	<b>Plutonic rock type</b>	<b>Volcanic rock equivalent</b>
45-53	Gabbro	Basalt
53-63	Diorite	Andesite
63-68	Granodiorite	Dacite
68-75	Granite	Rhyolite

# Rocks

A **rock** is any naturally occurring solid mass or aggregate of minerals or mineraloid matter. It is categorized by the minerals included, its chemical composition and the way in which it is formed. Rocks form the earth's outer solid layer, the crust, and most of its interior, except for the liquid outer core and pockets of magma in the asthenosphere.

Rocks are usually grouped into three main groups: igneous, sedimentary and metamorphic rock.

Igneous rocks are formed when magma cools in the earth's crust, or lava cools on the ground surface or the seabed.

# Characteristics of Igneous Rocks

- 1) The igneous form of rocks does not include any fossil deposits.

If there are any chances of fossil deep inside the crust, it erupts out of the earth's surface and gets destroyed due to the sheer heat these rocks produce.

- 2) Most igneous forms include more than one mineral deposit.
- 3) They can be either glassy or coarse.
- 4) These usually do not react with acids.
- 5) The mineral existences are available in the form of patches with different sizes.

# Minerals . . . building blocks of **Rocks**

Classified based on how they form

## **Igneous Rock**

Form from the cooling and solidification of lava or magma

### **Intrusive**

Magma cools slowly  
Large crystals form

### **Extrusive**

Lava cools quickly  
Small or no crystals form  
May be vesicular  
Contains air bubbles



# *Spar Hawk*

Mint Green Teal Maine Tourmaline

RIVER OF GEMS POCKET

July 7, 2013

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Cross Jewelers