Indian Institute of Technology, Kanpur

Department of Earth Sciences

ESO213A: Fundamentals of Earth Sciences

# Lecture 13. Identification of Minerals

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## Aims of this lecture

- Physical properties of Minerals
- Identification methodology

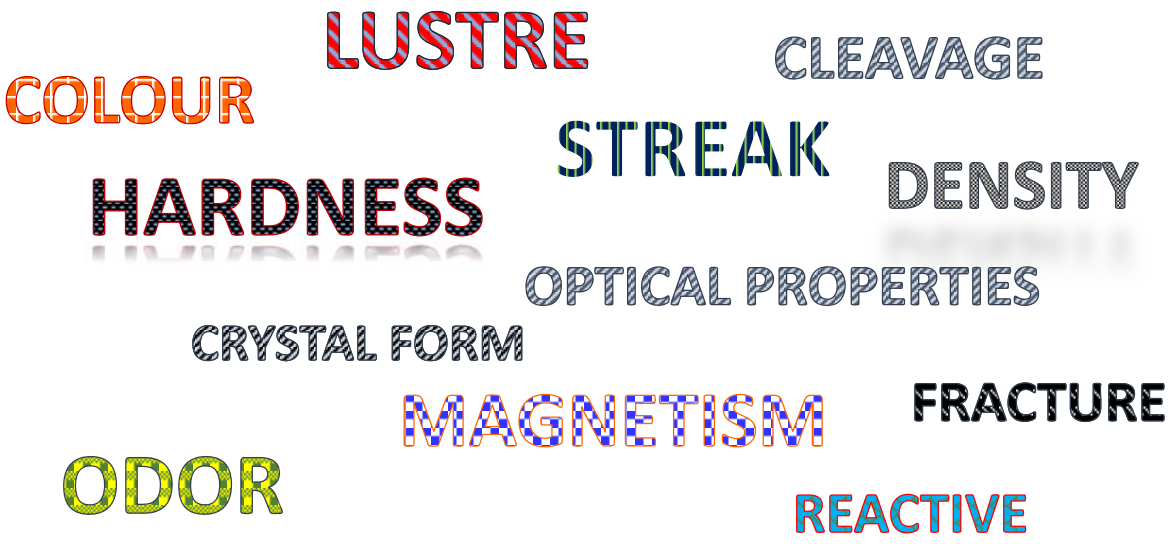
Reference:
Chapter 3, Grotzinger_Jordan's Book
Chapter 5, Marshak's Book

Most images used in this presentation are from different web sources and a few are own collection

## Minerals

- We learnt, there are more than 4000 minerals and they occur naturally.
- There are certain tools and techniques (qualitative, quantitative and relative), which help geologists to identify minerals easily and quickly.
- The quantitative identification techniques are mostly micro-scale and include power-XRD, EPMA, Optical Microscopy, Electron Microscopy (scanning and transmission) and many other spectroscopic tools.
- In the field, geologist rely on some basic physical properties of the minerals for identification. Of course, experience plays a major role. In other words, one has to see minerals, in reality.

## The Physical Properties



## COLOUR

Color is one of the most obvious properties of a mineral but it is often of limited diagnostic value, especially in minerals that are not opaque.

While many metallic and earthy minerals have distinctive colors, transucent or transparent minerals can vary widely in color.

Amethyst
(purple)

Smoky Quartz
(bworn-black)

Citrine Quartz
(yellowish)

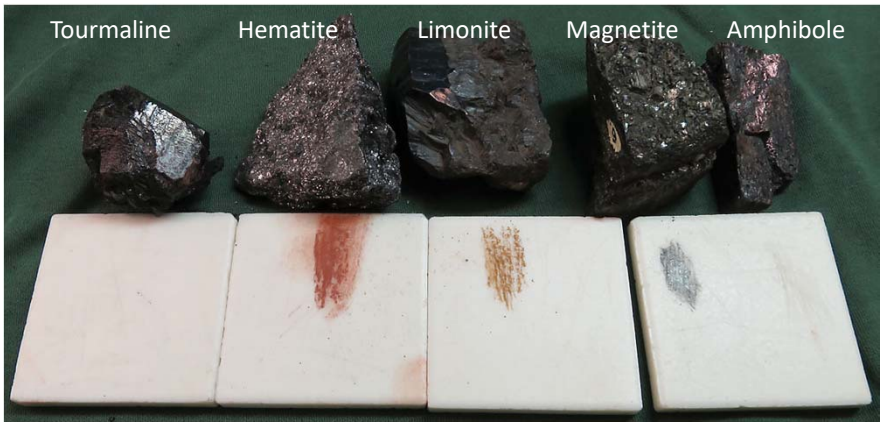
Rose Quartz
(pink-reddish)

Quartz Crystal
(colourless)

## COLOUR

## STREAK

The mineral-colour is seen when light reflects off the surface of the sample. The colour can be variable due to surface texture. A way to get around this problem is to grind a small amount of the sample to a powder and observe the colour of the powder. This colour is the mineral's **streak**. The mineral can be powdered by scraping the sample across a piece of unglazed porcelain called a **streak plate.**




## LUSTRE

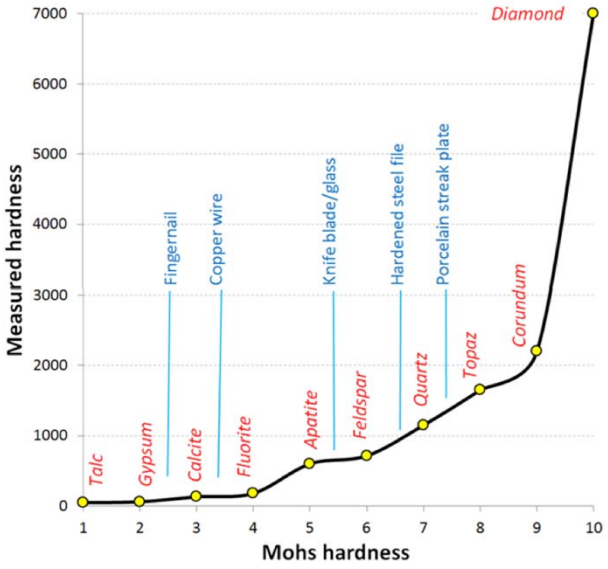
Lustre is the way light reflects off the surface of a mineral, and the degree to which it penetrates into the interior. The key distinction is between **metallic** and **non-metallic lustre**. If a non-metallic mineral has a shiny, reflective surface, it is said to have a **glassy** lustre. If the mineral surface is dull and non-reflective, it has an **earthy** lustre

Clockwise from the left: Metallic (galena); Metallic (pyrite); Vitreous (quartz); Waxy (chalcedony); Pearly (talc); and Earthy (goethite)

# HARDNESS

One of the most important diagnostic properties of a mineral is its hardness. In practical terms, hardness determines whether or not a mineral can be scratched by a particular material.

In 1812 German mineralogist Friedrich Mohs came up with a list of 10 minerals representing a wide range of hardness, and numbered them 1 through 10 in order of increasing hardness.




# CRYSTAL HABIT/SHAPE

When minerals form within rocks, there is a possibility that they will form in distinctive crystal shapes if they are not crowded out by other pre-existing minerals. Every mineral has one or more distinctive **crystal habits** determined by their atomic structure, although it is not that common in ordinary rocks for the shapes to be obvious.

**Fibrous** = fiber-like, similar to hair or cotton fibers. **Asbestos.**

**Acicular** = needle-shaped. **Natrolite; Kyanite**

**Prismatic** = prism-shaped. **Tourmaline**

**Blocky** = shaped like a block or brick. **Orthoclase**

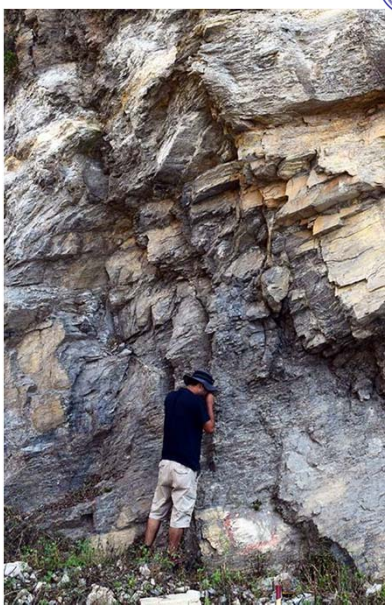
## CRYSTAL HABIT/SHAPE

**Equant** approximately equal size in all directions.

**Platy** = plate-shaped, flat. **Biotite, Muscovite.**

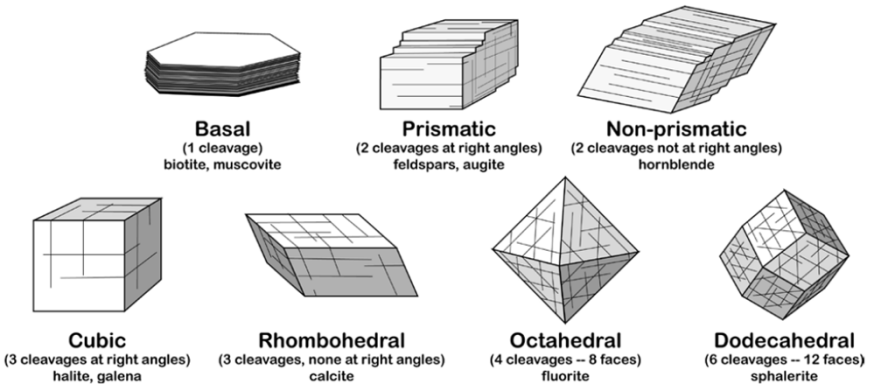
**Massive** = compact mass **Magnetite.**

**Earthy** = fine-grained with a dull, dirt-like appearance. **limonite.**

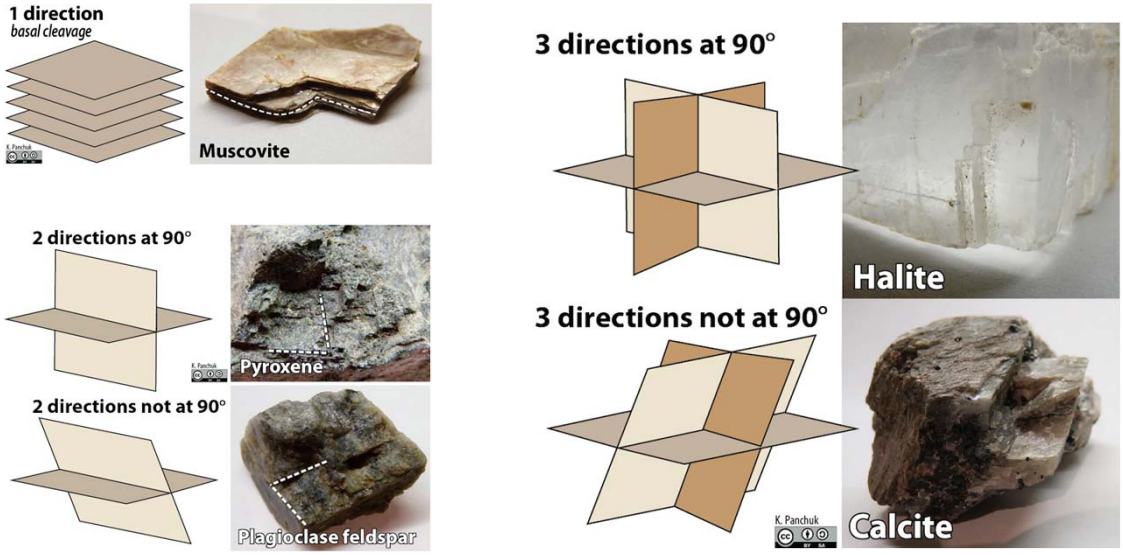


## Mineral CLEAVAGES & FRACTURES

Cleavage and fracture describe how a mineral breaks. These are the most important diagnostic features of many minerals, and often the most difficult to understand and identify. **Cleavage** is what we see when a mineral breaks along a plane or planes, while **fracture** is an irregular break. Some minerals tend to cleave along planes at various fixed orientations. Some, do not cleave at all, only fracture. Minerals that have cleavage can also fracture along surfaces that are not parallel to their cleavage planes.



## Mineral CLEAVAGES & FRACTURES




## Mineral CLEAVAGES & FRACTURES

Fracture surfaces can cut a mineral grain in any direction. Fractures are generally rough or irregular, rather than flat, and thus appear duller than cleavage surfaces. Some minerals fracture in a way that helps to identify them. For example, quartz has no cleavage but, like glass, it breaks along numerous small, smooth, curved surfaces called conchoidal fractures

## Density

**Density** is a measure of the mass of a mineral per unit volume, and it is a useful diagnostic tool in some cases.

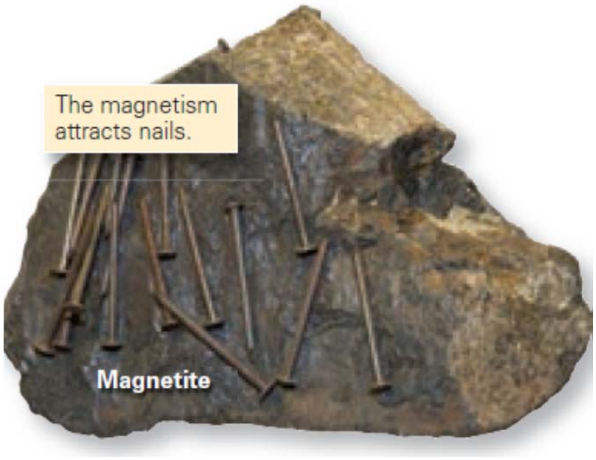
Most common minerals, such as quartz, feldspar, calcite, amphibole, and mica, are of average density (2.6 to 3.0 g/cm$^3$), and it would be difficult to tell them apart on the basis of their density. On the other hand, many of the metallic minerals, such as pyrite, hematite, and magnetite, have densities over 5 g/cm$^3$. If you picked up a sample of one of these minerals, it would feel much heavier compared to a similarly sized sample of a mineral with average density.

A limitation of using density as a diagnostic tool is that one cannot assess it in minerals that are a small part of a rock with other minerals in it. But, one can measure precisely the density in the laboratory.

## Magnetism

Some minerals are attracted to a hand magnet. To test a mineral for magnetism, just put the magnet and mineral together and see if they are attracted.

Magnetite is the only common mineral that is always strongly magnetic.



## Reaction with Acid

Some minerals, especially carbonate minerals, react visibly with acid. (Usually, a dilute hydrochloric acid [HCl] is used.)

When a drop of dilute hydrochloric acid is placed on calcite, it readily bubbles or effervesces, releasing carbon dioxide.


## Taste, Odor, Feel

Some minerals have a distinctive taste (halite is salt, and tastes like it).

some a distinctive odor (the powder of some sulfide minerals, such as sphalerite, a zinc sulfide, smells like rotten eggs).

Soaking clay minerals with water gives an earthy-smell.

Some with a distinctive feel (talc feels slippery).

## Next Lecture

Introduction to Rocks