Science and Society Ⅱ
Rock and Mineral

Contents

・Mineral is a naturally occurring substance with a characteristic chemical composition expressed by a chemical formula.

・Rock is an aggregate of mineral grains consisting of one or more mineral species.

・The polarizing microscope makes it possible to study the optical properties of minerals.

1.Minerals

Rocks and Minerals

Minerals are normally defied as solid crystalline substances, formed by natural and usually inorganic processes.

Rocks are natural aggregates of one or more minerals, and sometimes non crystalline substances, constituting masses that are geologically independent.

For example, the granite is composed of minerals such as quartz, feldspar and biotite.

Feldspar

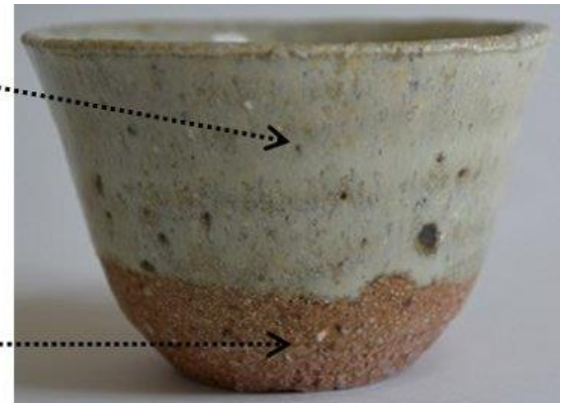
- A group of silicate minerals that make up about 60% of the outer 15 km of the earth's crust.
- They are silicates of aluminum with the potassium, sodium, and calcium, and rarely, barium.
- Feldspar is divided into Alkali feldspar and Plagioclase.

Feldspar: an important industrial mineral

・The mixture alkali feldspar (orthoclase), kaolin and quartz is easy to mold and fuses at a relatively low temperature to a light, glassy, white, translucent, slightly porous mass known as porcelain.

・Feldspar is one material for a glaze.

・When very pure, it is used to make special porcelains (high-tension electrical insulators, ceramic glazes and dental products) and opalescent glass.



Feldspar Mine in Aichi Pref.

2.Rock classification

Igneous rocks: They are the final product of the consolidation of a magma, hot molten mass of essentially silicate composition, rich in volatile elements and formed deep in the Earth by the fusion of preexisting solid masses.

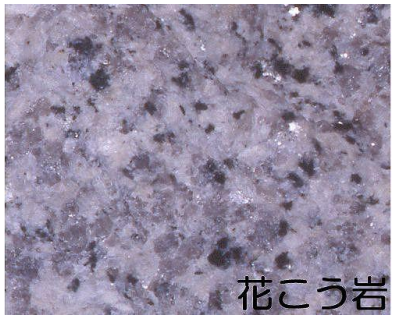
Sedimentary rocks: They, which cover two–thirds of the Earth's surface, are produced by the transformation of preexisting rocks by gravity, atmospheric agencies and living organisms.

Metamorphic rocks: They are products of the totality of the chemical and physical reactions and processes in the solid state by which a preexisting rock of any kind adapts to new conditions resulting in a new rock type.

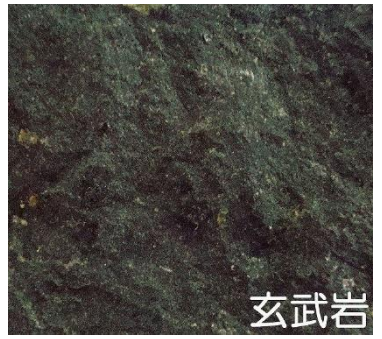
Classification of igneous rocks

	Ultramafic	Mafic	Intermediate	Felsic
SiO_2 wt %	40 ～ 45	45 ～ 52	52 ～ 63	63 ～75
Volcanic rock		Basalt	Andesite	Rholite
Plutonic rock	Peridotite	Gabbro	Diorite	Granite

Plutonic rocks are generally coarse-grained due to slow cooling of magma in deep place.



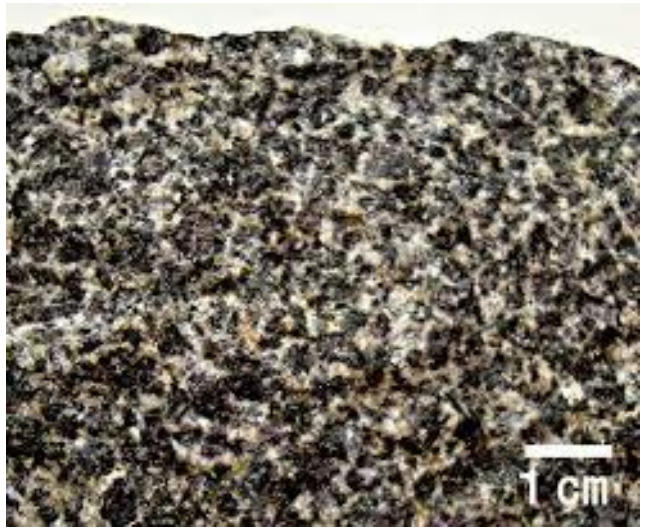
Volcanic rocks are generally fine-grained due to rapid cooling of magma on surface.



Plutonic rocks (Kurashiki Museum)

- Granite (upper)
- Gabbro (lower)

Gabbro contains
Fe–Mg minerals
more than Granite.



Sedimentary rocks

Clastic sedimentary rocks are classified based on size of clastic materials.

・Coarse-grained：Conglomerate, Breccia（Larger than 2mm in grain size）, Upper

・Medium-grained：Sandstone (1/16～ 2mm in grain size), Middle

・Fine-grained：Mudstone (Less than 1/16mm in grain size), Lower

Chemical and biochemical sedimentary rocks are products of precipitation of inorganic salts or substances that living organisms need for their survival.

- Siliceous : Chert (originated from radiolarian)
- Calcareous : Limestone (originated from shell and coral)
- Carbonaceous : Coal (originated from matured forest–type plant material)

Reaction of hydrochloric acid and limestone

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

Metamorphic rocks

The classification of metamorphic rocks is based on genetic criteria, according to the process that led to the recrystallization of the parent rocks.

By thermal metamorphism

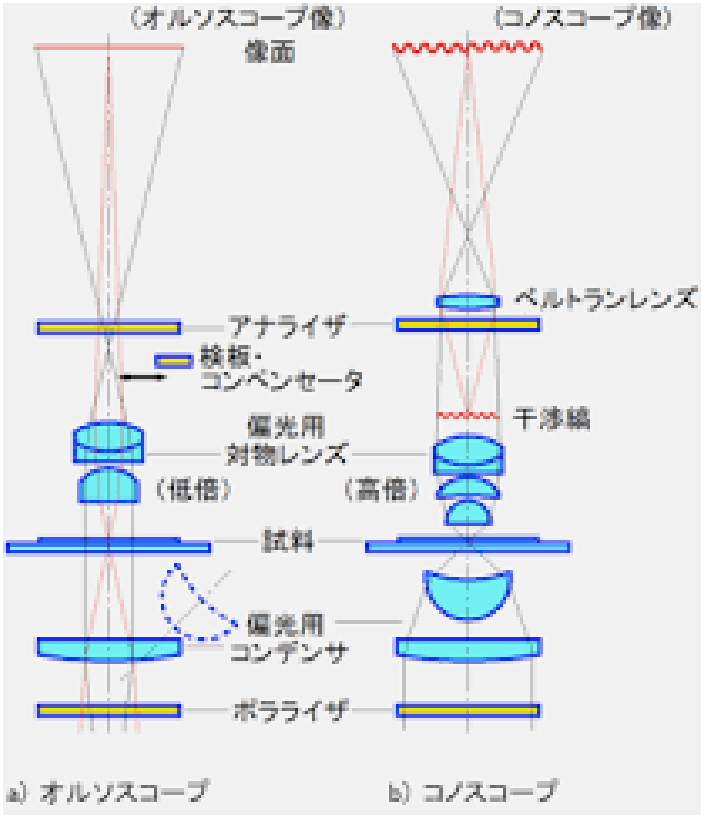
Hornfels, Marble (upper photo)

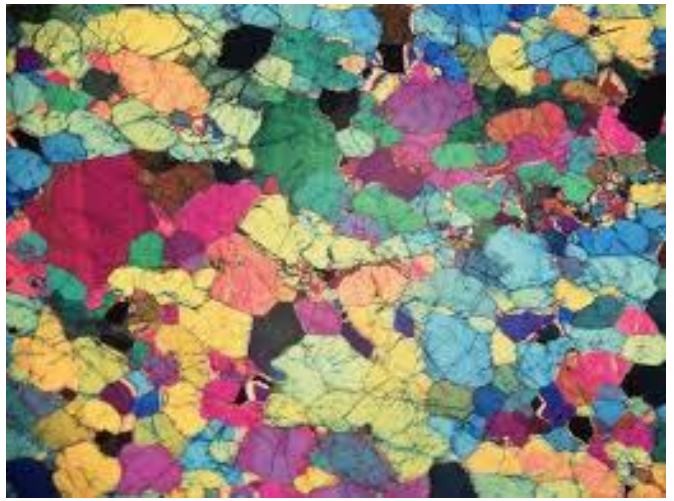
By regional metamorphism

Chlorite schist, Biotite gneiss (lower photo)

3.Polarizing microscope

This microscope makes it possible to study the optical properties of minerals. It is equipped with polarizers capable of producing polarized light.





Peridotite under the microscope. Olivine and pyroxene show red to yellow color.

Observation under the polarizing microscope

Digital microscope (Gifu University)

http://chigaku.ed.gifu-u.ac.jp/chigakuhp/html/kyo/chisitsu/dezital_henkoh/

See piemontite and biotite

They show pleochroism

Compare plagioclase and alkali feldspar

It is difficult to distinguish plagioclase and alkali feldspar in naked eyes. It becomes easier under the microscope by twinning lamellar of plagioclase.

Useful YouTube sites

・Quarry in England (3 min 35 sec)

https://www.youtube.com/watch?v=9YEJePoDlME

・How to identify a mineral (8min 39 sec)

https://www.youtube.com/watch?v=KB-2pO7pSK8