

Metamorphism and Metamorphic Rocks

In biology, we use "metamorphism" to talk about major change through time in individual organisms (as from caterpillars to butterflies). Rocks can likewise undergo

change to the extent that their nature and appearance are completely transformed. Thus the three fundamental kinds of rocks are igneous, sedimentary, and *metamorphic*.

A very schematic model of metamorphism

The process of metamorphism:

Change in mineralogy and texture of a rock because of increased temperature and pressure

"recrystallization"

(and perhaps because of chemical substances gained or lost to passing fluids).

The immediate products of metamorphism:

New minerals
Coarser crystals
Crystals with preferred orientation

Less hydrous minerals

For example, from analcime ($\text{NaAl}_2\text{Si}_2\text{O}_6 \cdot \text{H}_2\text{O}$) to albite ($\text{NaAlSi}_3\text{O}_8$)

More dense minerals

For example, from andalusite ($D=3.14$) to sillimanite ($D=3.24$)

Foliated (planar minerals parallel to each other, like the pages of a book)

Lineated (linear minerals parallel to each other, like pencils in a box)

Two general styles of metamorphism:

Regional metamorphism:

~300-700°C

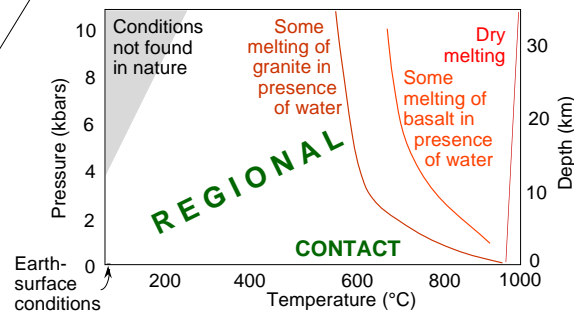
caused by high pressure and temperature with deep burial within the continents, and thus commonly covering entire *regions* when exposed by erosion.

Contact metamorphism:

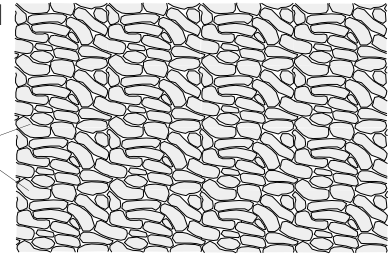
caused by high temperature near an igneous intrusion, and thus at the *contact* between the surrounding host rock and the intrusive rock.

Lack of significant and/or sustained pressure results in no preferred orientation of crystals.

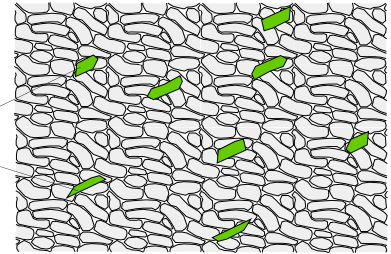
A batholith, pluton, dike, or sill



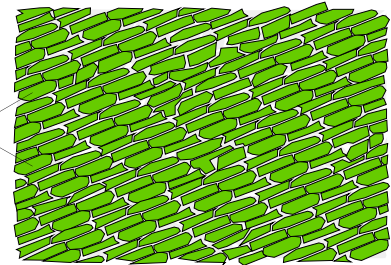
Shale
Clay minerals with little preferred orientation



Newly-formed minerals, perhaps micas (e.g., muscovite) after incipient metamorphism due to temperature and pressure

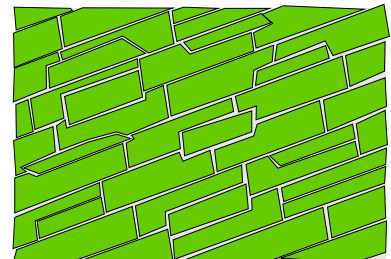


Slate
Small but foliated crystals



Phyllite

Larger, but still essentially microscopic, foliated metamorphic crystals



Schist

Foliated crystals visible to the naked eye

