

Metamorphism occurs as a result of increased temperature and/ or pressure on pre-existing rocks of all types (igneous, sedimentary and metamorphic).

It results in recrystallisation in the solid state (without melting) to form new minerals and textures. Sedimentary rocks are most easily affected by metamorphism as they contain minerals which are stable under low temperatures and pressures at or close to the Earth's surface.

It also leads to the loss of original sedimentary structures and fossils.

**Contact metamorphism** is caused by the action of heat alone and is associated with large-scale igneous intrusions (plutons). Recrystallisation begins at a temperature of 200 °C and ends when melting starts to occur above 700 °C. Also, crystal size increases with temperature. Contact metamorphic rocks show a random crystal orientation (non-foliated) as they have recrystallised under the absence of any directed pressure. The zone of recrystallised rock surrounding a major intrusion (pluton) is known as a metamorphic aureole.

## Contact metamorphic rocks:

**Metaquartzite** - formed by the recrystallisation of sandstones. As the quartz grains recrystallise, they become larger and form interlocking crystals with an equicrystalline texture. Any graded bedding, cross bedding or fossils will be destroyed. Metaquartzite is distinguished from marble as it will not react with dilute hydrochloric acid and will not be scratched by a steel pin.

**Marble** - formed by the recrystallisation of limestones. As calcite from fossils recrystallise, the crystals interlock with an equicrystalline texture. Any bedding planes or fossils will be destroyed. Marble is distinguished from metaquartzite as it will react with dilute hydrochloric acid (effervesce and gives off CO<sub>2</sub>) and will be scratched by a copper coin and steel pin.

**Regional metamorphism** is caused by the combined effect of increased temperature and pressure and is associated with large volumes of rock being buried at convergent plate boundaries. Recrystallisation begins at a depth of around 8 km and a temperature of 200 °C. Crystal size increases with temperature and depth of burial. Regional metamorphic rocks show a foliated texture as minerals have recrystallised under directed pressure. This causes the minerals (typically mica) to grow at right angles to the directed pressure and results in a banded appearance.

## Regional metamorphic rocks:

Slate is formed by the recrystallisation of shale at depths of 5-15 km and 200-300 °C. Microscopic clay minerals recrystallise to form coarser mica crystals which align parallel to each other to give a foliated texture known as slaty cleavage. Any original laminations or fossils will have been destroyed.

Schist is formed by the recrystallisation of shale at depths of 15-25 km and 400-500 °C. Microscopic clay minerals recrystallise to form coarser mica crystals which align parallel to each other to give a foliated texture coarser than that of slaty cleavage, known as schistosity. Quartz and garnet also occur at this higher grade of regional metamorphism. Any original laminations or fossils will have been destroyed.