The Origin of Magma

Magma Types and Volcanic Structures

Overview

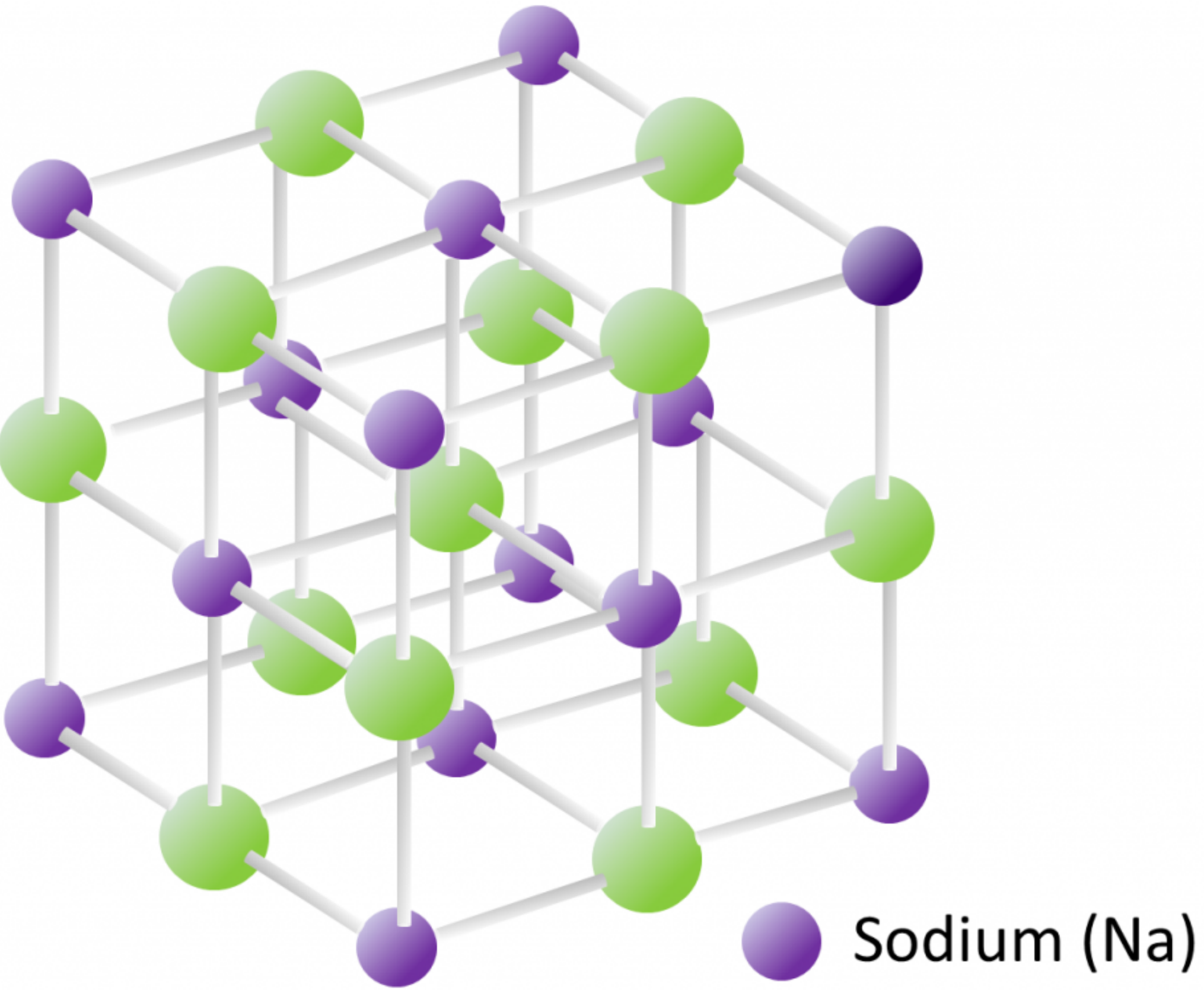
- Magma - Melted rock
- Found mostly within the Earth's outer core and NOT within the mantle
- Only limited areas around the globe possess surface magma which feeds volcanoes

Magma Influences

- Temperature and Pressure
- Mineral Composition

Temperature & Pressure

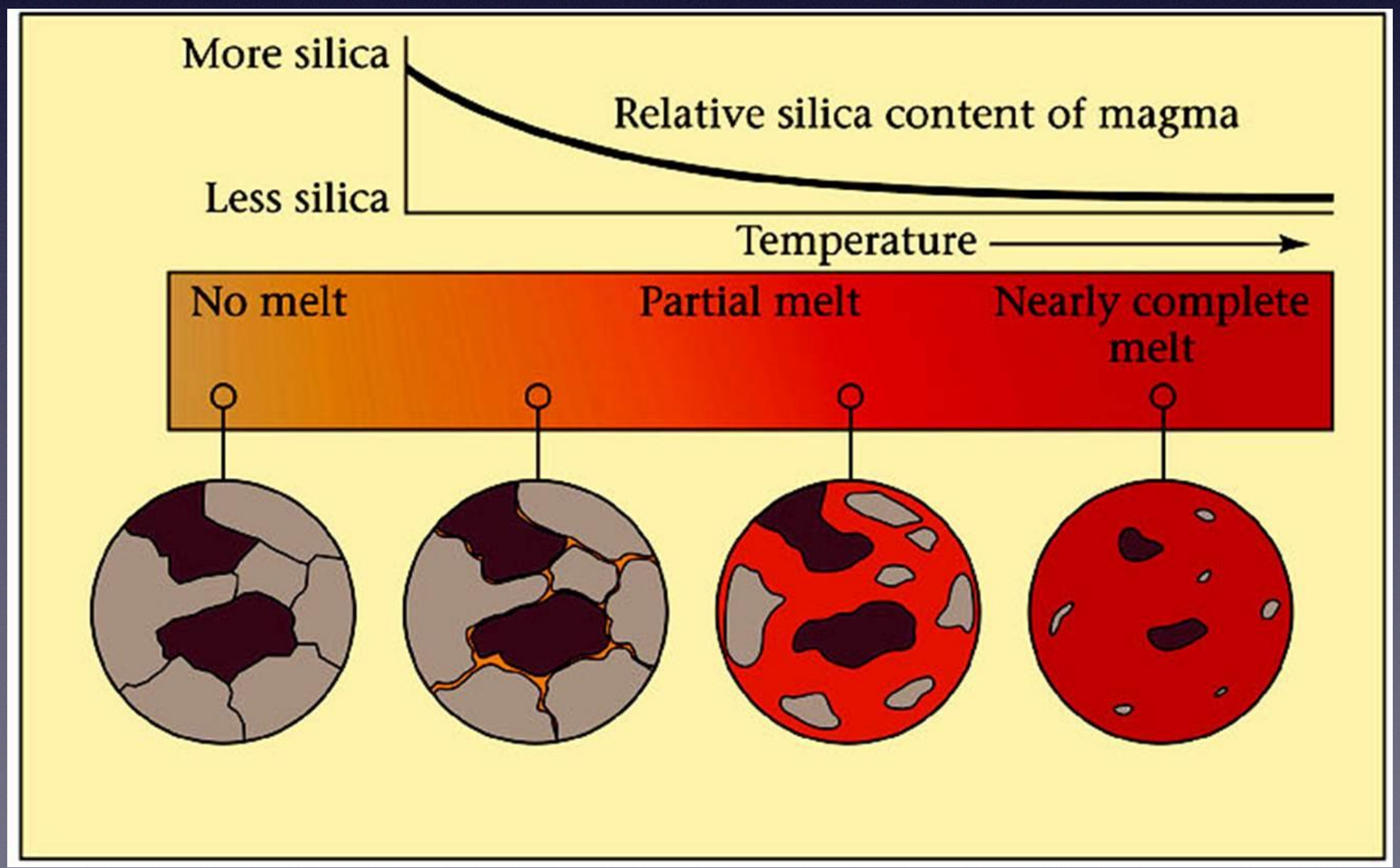
- The **melting point** of a rock refers to the exact point where the mineral crystals the make up a rock begin to liquify
- This is influenced by external heat and pressure applied to the rock



Halite (salt) NaCl

Temperature

- **Partial melting** occurs when a rock is made up of various minerals with varying degrees of melting points
- Heating of rocks is attributed to the depths and pressure they are found based on a **geothermal gradient**

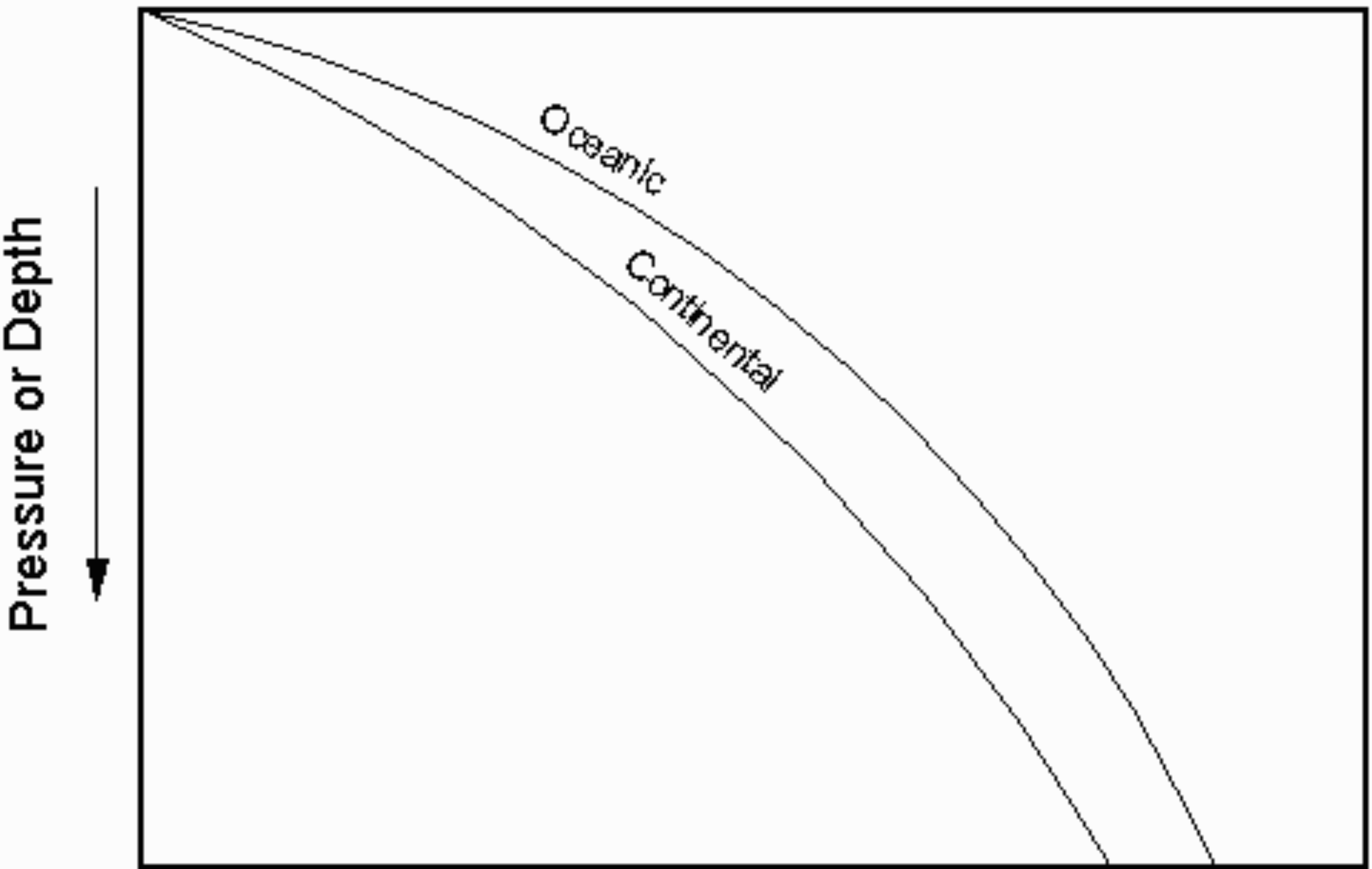


Temperature & Pressure

- Materials found within the body of the earth experience pressure exerted from the weight of air pressure on the surface **(Confining Pressure)**

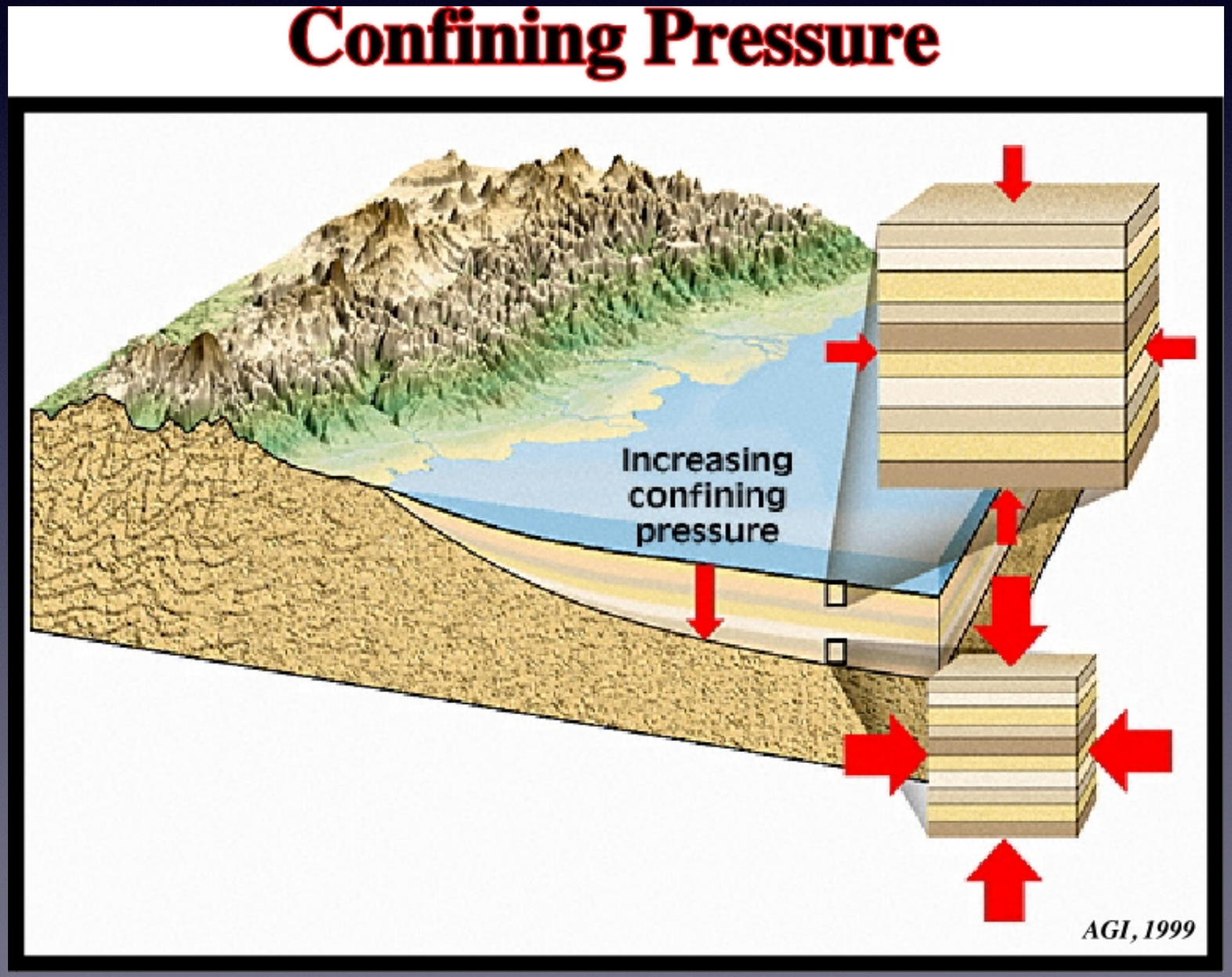
- The confining pressure presents the molecular bonds from breaking from solid to liquid

Geothermal Gradient

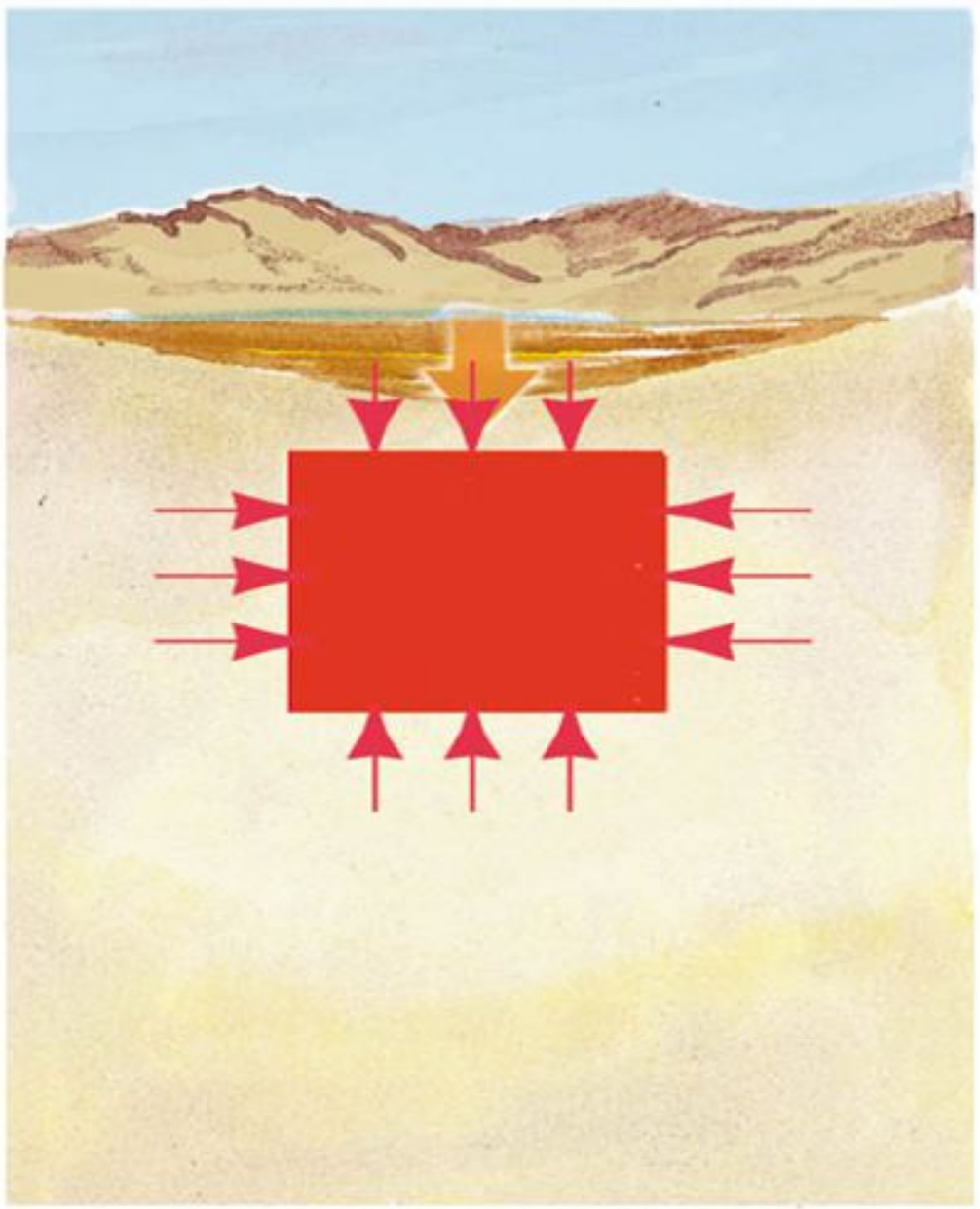


Pressure

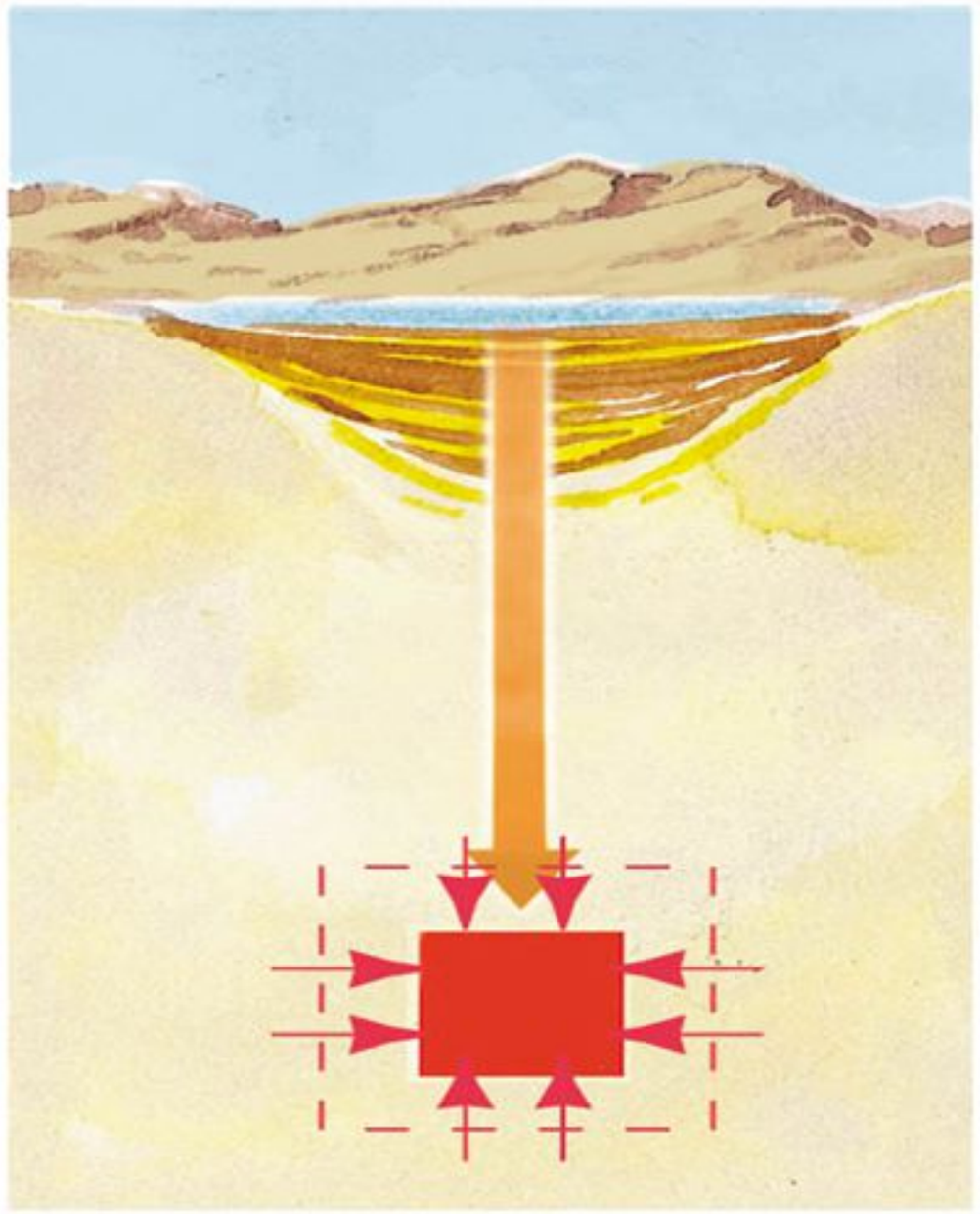
- The deeper towards the centre of the earth you move, the greater confining pressure



CONFINING PRESSURE



Before compression



After compression

(a) Confining pressure

Confining Pressure

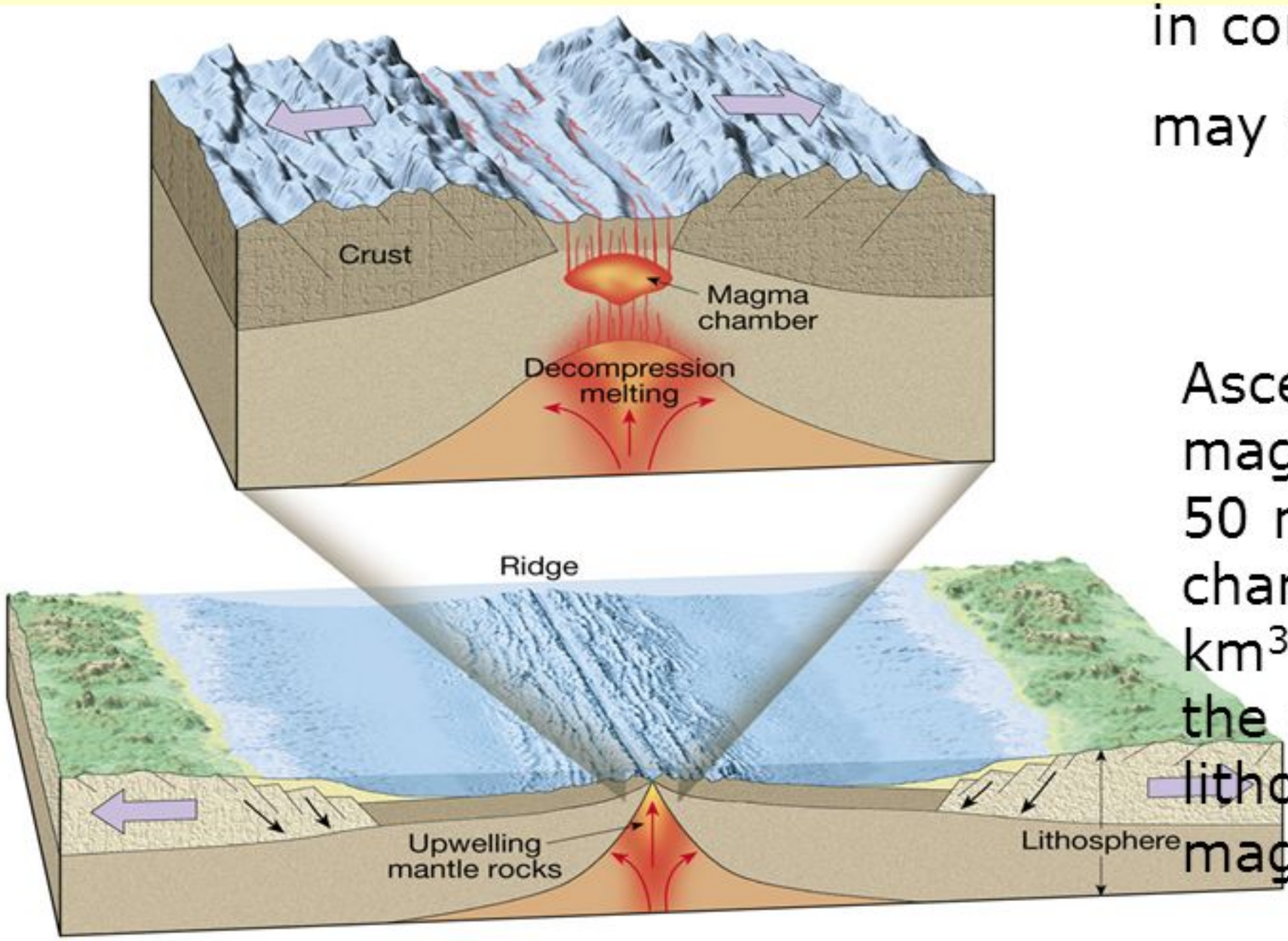
- Since molecules are “locked” in by confining pressure, normal rock melting points are not observed deep underground

- If a rock exposed to a temperature close to its normal melting point is released from its confining pressure, then it will melt

- **Decompression melting**

Decompression melting

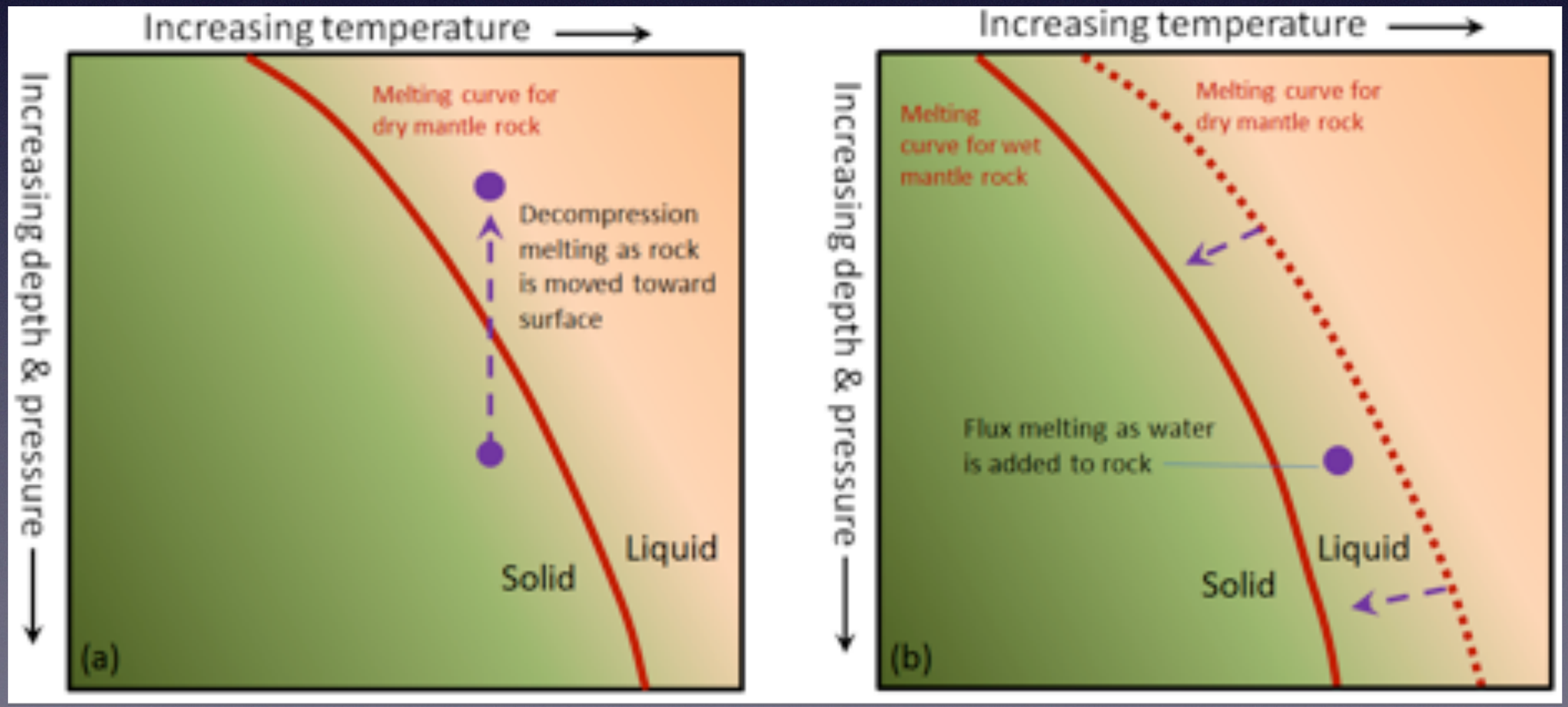
Hot mantle rock ascends and moves into zones of lower pressure. This drop in confining pressure may trigger melting.



Ascend rates of magma are 0.3 to 50 m/yr. Magma chambers (several km^3 big) form in the cavities of the lithosphere as magma rises.

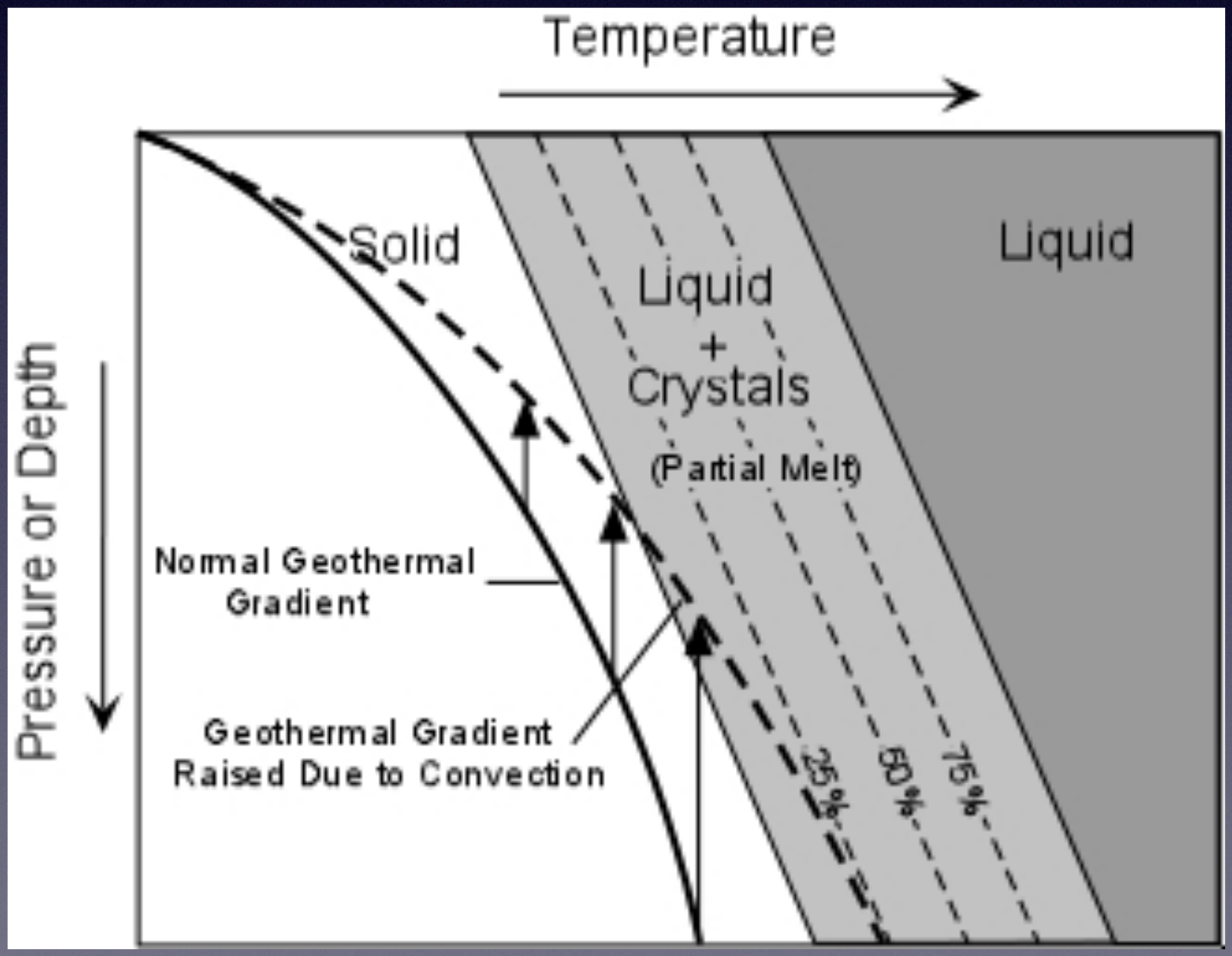
Pressure - Temperature Diagrams

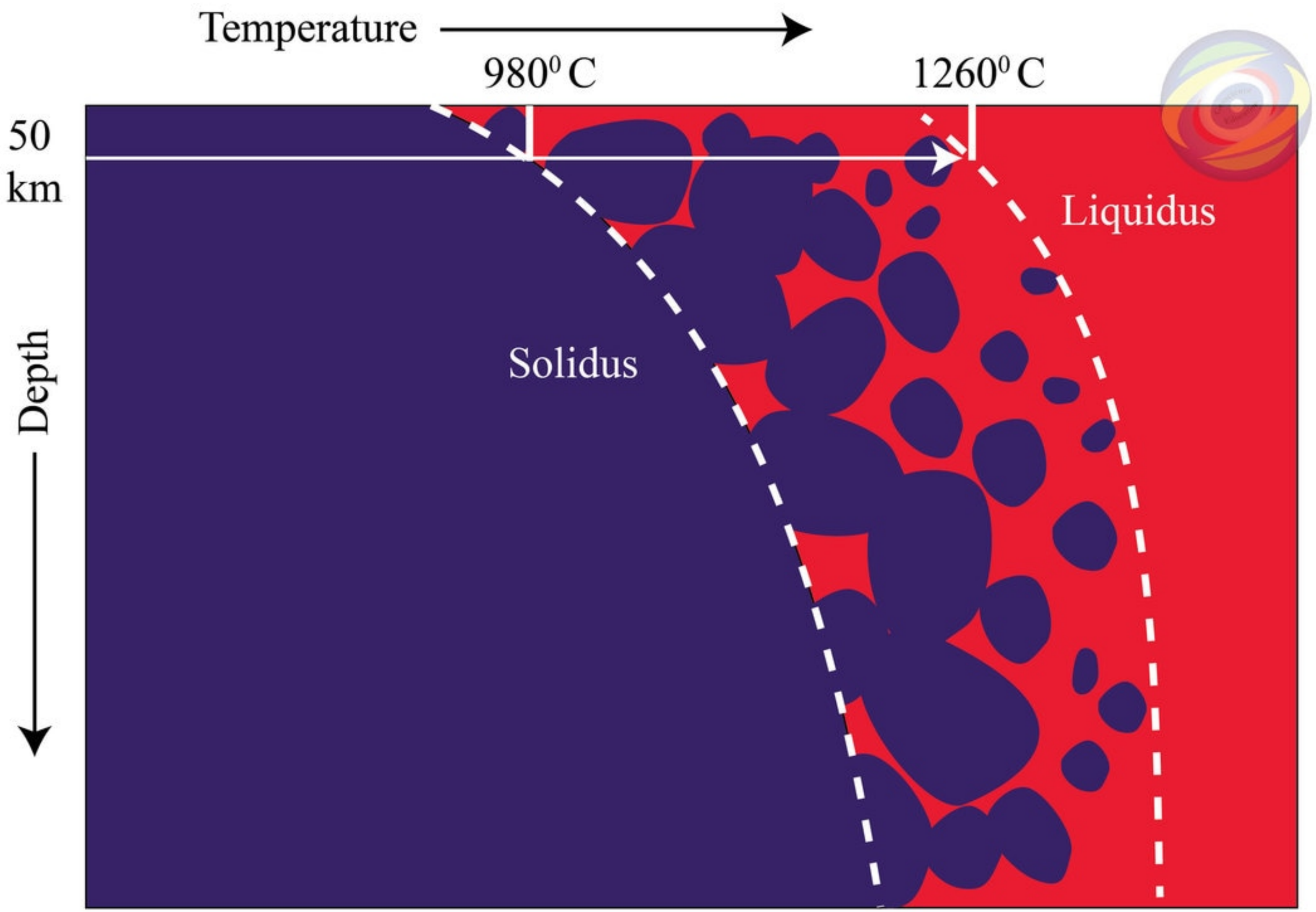
- Rock samples are heated and pressurized in lab settings in order to construct P-T diagrams



P-T Diagrams

- Designed to show the effect on rocks made of several different minerals




Temperature
980⁰ C
1260⁰ C
50
km
Depth
Solidus
Liquidus

Felsic Magma

Mafic Magma