

**Geology Sildes
For Petroluem & Civil Eng.**





IGNEOUS ROCKS

Nature of Magma

- **Magma:** A body of molten rock found at depth, including any dissolved gases and crystals. It is the ancestral to all igneous rocks. Magma often collects in a **magma chamber**.
- Magma is under high pressure and sometimes emerges through volcanic vents in the form of flowing **lava** (molten rock as it exists above the Earth's surface) and **pyroclastic ejecta**.

Nature of Magma

- Completely or partly molten material.
- Consist of three components:
 - 1) a **liquid component** (melt, mobile Earth's common elements; silica (SiO_2), Al , K , Ca , Na , Fe and Mg),
 - 2) a **solid component** (silicate minerals that have already crystallized from the melt) and,
 - 3) a **gaseous phase** (volatiles, water vapor (H_2O), carbon dioxide (CO_2) and sulfur oxide (SO_2)).

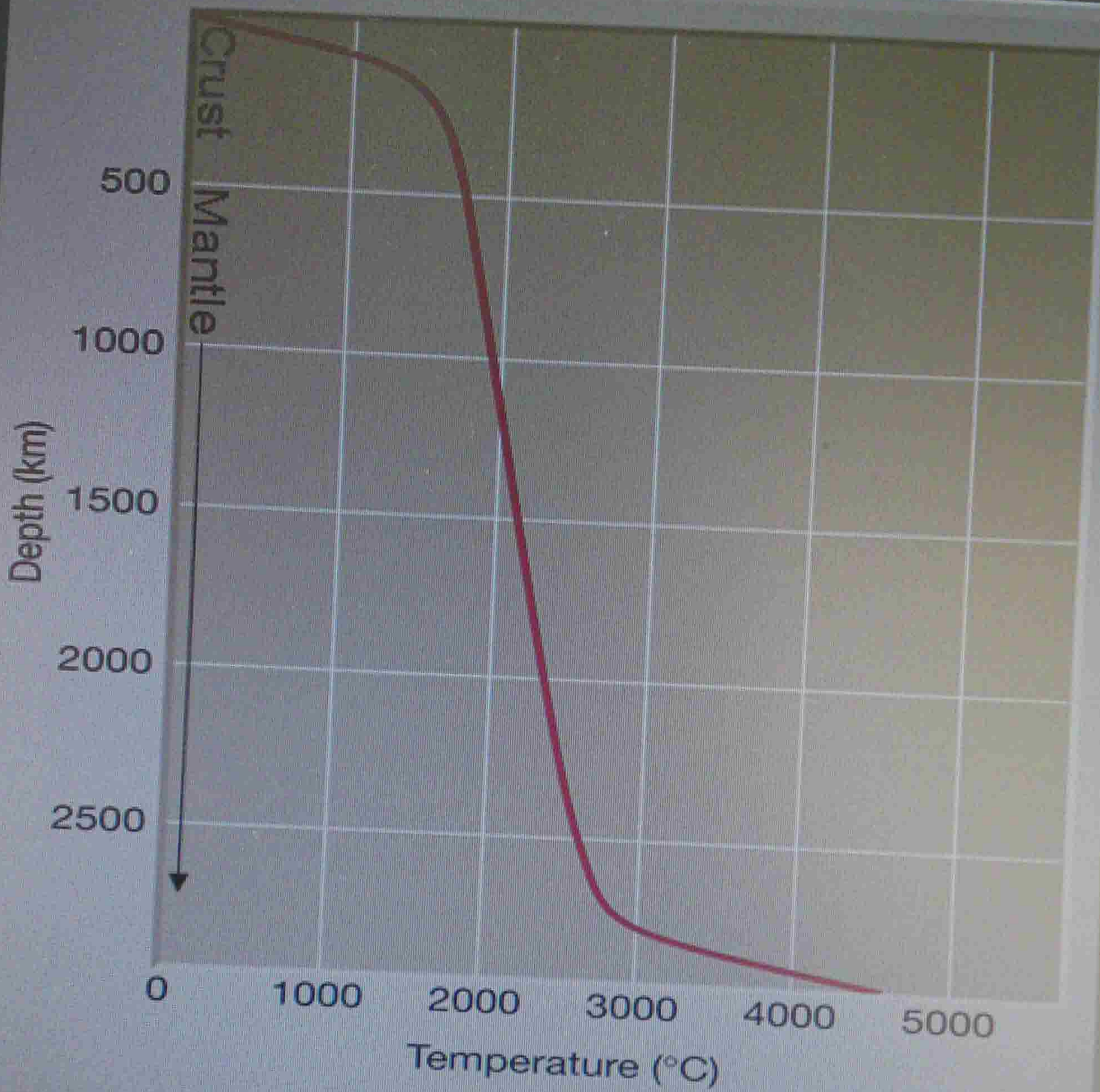
Origin of Magma

- Still under debate.
- Magma originates as solid rock, located in the crust and upper mantle.
- Produced from partial melting of rocks in the crust and upper mantle.

1. Role of Heat

Temperature increases within Earth's upper crust (called the geothermal gradient) average between 20°C to 30°C per kilometer.

Depth (km)



Estimated temperatures in the crust and the mantle

Origin of Magma

1. Role of Heat

At depth of 100km, temperature ranges from 1200°C and 1400°C.

Rocks in the lower crust and upper mantle are near their melting points.

Any additional heat (from rocks descending into the mantle or rising heat from the mantle) may induce melting.

Origin of Magma

2. Role of Pressure

With depth, temperature and pressure increase.

An increase in confining pressure cause an increase in a rock's melting temperature or conversely, reducing pressure lowers the melting temperature.

When confining pressure drops, **decompression melting** occurs.

Origin of Magma

3. Role of Volatiles

Volatiles (primarily water) cause rocks to melt at lower temperatures. Further, the effect of volatiles is magnified by increased pressure.

Thus, “wet” rocks buried at depth has lower melting temperatures compared to “dry” rock of the same composition under same confining pressure.

This is particularly important where oceanic lithosphere descends into the mantle.

Origin of Magma

