

**MAGMA : ORIGIN AND COMPOSITION.**

Virtually all of the igneous rocks that we see on Earth are derived from magmas that formed from **partial melting** of rocks, either in the upper mantle or the crust. (Partial melting is what happens when only some parts of a rock melt; it takes place because rocks are not pure materials.)

The magma formation through melting of pre-existing rocks generally occurs in one of two ways:

- (1) by convection of rock upwards through the mantle until it melts, or
- (2) by melting rock at a subduction zone.

Mantle convection occurs because deep within the earth, radioactive decay raises the temperature of rock, making it expand. This expansion lowers the rock's density, causing it to rise, or convect. As the rock rises through the mantle, the surrounding pressure decreases and eventually the convecting rock melts as a result. Geologists call this **decompression melting**. The magma moves upward and erupts to form either an oceanic ridge, a hot spot or a volcano.

As the oceanic lithosphere descends into the mantle at a subduction zone, it will be taken to increasingly higher temperatures as it gets deeper. This will result in essentially a series of dehydration and decarbonation reactions, i.e. chemical reactions that transform hydrous and carbonate minerals into nonhydrous minerals and give up H<sub>2</sub>O and CO<sub>2</sub> as a fluid phase. Addition of this fluid phase, either to the subducted lithosphere or the mantle overlying the subducted lithosphere could lower the solidus and liquidus temperatures enough to cause partial melting and magma forms as a result. Such a melting mechanism is referred to as **flux melting**.

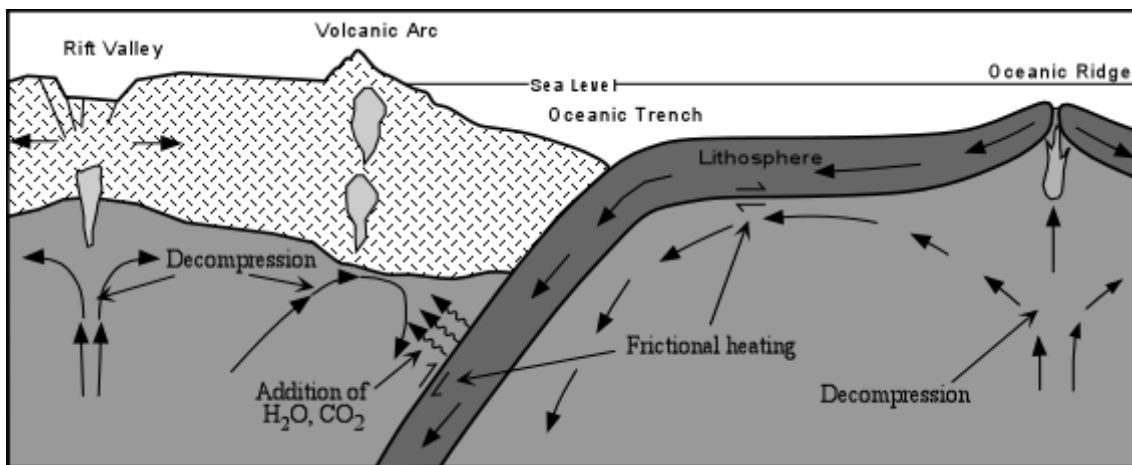


Figure showing the generation of magma by various processes.

# MAGMA

## (Its Composition and Constitution)

Magma is a natural rock fluid beneath the earth's crust, which may consolidate to form an igneous rock. When magma is erupted to the surface, it is known as lava, the consolidation of which gives rise to volcanic rocks.

**Composition and Constitution.** Magmas consist of mixtures of solids, fluids and dissolved gases. Essentially they are very hot silicate melts containing large quantities of water and varying amounts of highly reactive fluids and gases in solution. These reactive fluids include such things as hydrochloric acid and hydrofluoric acid. Magmas do not have a fixed composition. Although the compositions of different magmas undoubtedly vary, many are close to the following composition :

### (a) Chemical composition :

#### (i) In terms of oxide :

|                                |      |                                |      |
|--------------------------------|------|--------------------------------|------|
| SiO <sub>2</sub>               | 59%  | Al <sub>2</sub> O <sub>3</sub> | 15%  |
| Fe <sub>2</sub> O <sub>3</sub> | 3%   | FeO                            | 3.5% |
| CaO                            | 5%   | Na <sub>2</sub> O              | 3.8% |
| MgO                            | 3.5% | K <sub>2</sub> O               | 3%   |
| H <sub>2</sub> O               | 1%   | TiO <sub>2</sub>               | 1%   |
| P <sub>2</sub> O <sub>5</sub>  | 0.3% | MnO                            | 0.1% |
| CO <sub>2</sub>                | 0.1% |                                |      |

(ii) In terms of elements. Oxygen, Silicon, Aluminium, Iron, Calcium, Sodium, Potassium, Magnesium, Titanium, etc. They together constitute more than 99% of the fixed constituent of any magma.

Source-

A textbook of geology- G.B. Mahapatra