Generation and Ascent of Magma

Magmas originate in the crust and the upper mantle (asthenosphere). The source regions often coincide with the plate margins. Very few magmas are generated within the plates (hotspots like Hawaii). Most form at convergent and divergent margins.

The mechanisms for melting include:

1. Temperature rise which could occur due to radioactive decay.
2. Mechanical work during rock deformation (compressional squeezing) or frictional heating at the convergent margins. Shear flow of highly viscous mantle or lower crustal rocks may induce melting.
3. Decompression occurs mainly at divergent margins where diverging convection currents cause release of pressure. As the rock at this depth is already at an elevated temperature, the release of pressure induces melting.
4. Water and volatiles increase the entropy of the entropy of the system. Therefore water depresses the melting temperature of the system and helps melting.

Melts are produced due to partial fusion (partial melting/anatexis) at various levels in the crust and upper mantle.
Two possible types of melting of complex silicates have been advocated.

EQUILIBRIUM FUSION	**FRACTIONAL FUSION**
1. Occurs when the liquid continually reacts and equilibrates with the crystalline residue.	1. Occurs when the liquid which forms is immediately isolated from the system so that there is little or no reaction with the crystalline residue.
2. Also called as Batch melting.	2. Also called as Rayleigh fusion.
3. Liquids produced by the process of equilibrium form a continuous but relatively limited compositional melt.	3. It produces discrete melts spanning a greater compositional and temperature range.

Actual melting in the upper mantle is of an intermediate type between batch and fractional models.
Pressure also influences partial melt compositions. Partial melts of peridotite mantle yield basalt. As pressure increases (with depth) more olivine is dissolved in the melt and it becomes increasingly undersaturated in silica.
The concentration of water also influences melting. Low confining pressures and high water pressure favour silica rich melts. Anataxis of crustal rocks produce granitic melts often due to high water pressure in these rocks.

Ascent of Magma:
The fundamental driving force causing a crystal-liquid diaper (or body of melt) to rise upwards is the **buoyancy** of the less dense magma. Liquids occupy greater volume (and are therefore less dense) then the crystalline phases. The overlying higher density rocks are hydrostatically unstable and a buoyant force causes the melt to rise.
Processes that facilitate the magma to rise include **solution stoping** or **zone melting**. As the melts form and rise the overlying rocks are much cooler and also at lower confining pressures. While crystallization may take place in the lower part of the magma column, the overlying rocks may melt into the magma. Sometimes emplacement is accompanied by engulfment of blocks of country rock in the magma (stoping and assimilation). Old fractures and fault zones may also form pathways for magma intrusion and extrusion.