What is Igneous Rock?

Earth’s crust is 4/5 igneous rock.

Every igneous rock begins its life as molten magma deep in the mantle. As magma migrates toward the surface, some of it chills and hardens underground into granite and other types of igneous rocks.

Magma that reaches the surface erupts in either flowing or explosive volcanoes, generating lava, geysers, and hot springs.

Igneous rock crystallizes in Earth’s magma locations

- **Intrusive** igneous rock crystallizes within Earth’s crust.
- **Extrusive** igneous rock crystallizes upon Earth’s crust.

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**http://www.soest.hawaii.edu/coasts/lecture/gg101/index.html**
Igneous Rocks

• Igneous Rocks are named on the basis of their texture and composition.

Composition of a rock is the assemblage of minerals it contains.

Texture of a rock is the size and arrangement of the minerals it contains.

As magma crystallizes a network of interlocking minerals develops.

The composition and texture of the resulting rock is determined by these minerals.

Texture

Phaneritic texture - with large minerals (Granite)

Large crystals had a long time to crystallize. Therefore, this is an intrusive rock.

Aphanitic texture - mineral grains too small to see with the unaided eye (Basalt)

Small crystals had a short time to crystallize. Therefore, this is an extrusive rock.
Texture

Glassy texture - without obvious minerals (Obsidian)

No crystals. This is an extrusive rock.

Vesicular texture – many pits from gas escape (Basalt)

Extrusive rock.

Texture

Porphyry texture – with 2 distinct grain sizes, large and small (Andesite Porphyry)

What is the cooling history?

Composition

Igneous color (gray scale) is used to estimate chemical composition

Felsic Intermediate Mafic

Low Fe/Mg content.................................................High Fe/Mg content
High Si/O content.........................................................Low Si/O content
Remember, partial melting produces magma that is enriched in Silicon and Oxygen and depleted in Iron and Magnesium.

Composition

How do igneous rocks form in a cooling magma chamber? Remember partial melting?

Silica (felsic) compounds melt first – therefore in a cooling magma chamber they must crystallize last.

Iron-rich (mafic) compounds melt last – therefore in a cooling magma chamber they must crystallize first.

Felsic – Si/O/Na  Mafic – Fe/Mg/Ca

Melting

Crystallizing

Therefore a cooling magma chamber will become enriched in Si/O as it crystallizes.
How do igneous rocks form?

Bowen's Reaction Series

Types of Rocks formed

Hot

Olivine
Pyroxene
Amphibole
Biottite
Felsic
Orthoclase feldspar
Muscovite
Quartz

Ultramafic
Mafic
Intermediate
Felsic

Ca - plagioclase
Plagioclase feldspar
Na - plagioclase

Basalt
Gabbro
Andesite
Diorite
Rhyolite
Granite

Cold

Where do the Igneous Rocks form?

Intrusive
Granite
Diorite
Gabbro
Rhyolite
Andesite
Basalt

Extrusive
Mafic
Composition

Felsic
Intermediate
Mafic

Texture

plutonic
volcanic

The Igneous Minerals

Intrusive
Granite
Diorite
Gabbro
Rhyolite
Andesite
Basalt

Extrusive
Felsic
Intermediate
Mafic