Igneous Rocks

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Magma Composition

- Rock beneath the Earth's surface is sometimes heated to high enough temperatures that it melts into magma.
- Different magmas have different composition and contain whatever elements were in the rock or rocks that melted.
- The main elements are the same as the elements found in the crust.
- The remaining 1.5% is made up of many other elements that are present in tiny quantities.

Study Tip

Partial melting and fractional crystallization can be thought of as opposite ways of separating minerals. One uses heating, the other uses cooling.

Elements in Earth's Crust and Magma

Element	Symbol	Percent
Oxygen	O	46.67%
Silicon	Si	27.7%
Aluminum	Al	8.1%
Iron	Fe	5.0%
Calcium	Ca	3.6%
Sodium	Na	2.8%
Potassium	K	2.6%
Magnesium	Mg	2.1%
	Total	**98.5%**

Elements in Earth's Crust and Magma

The different geologic settings that produce varying conditions under which rocks melt will be discussed in Concept Plate Tectonics.

- **Temperature:** Increases with depth (melting more likely at greater depths).
- **Pressure:** Pressure increases with depth, but increased pressure raises the melting temperature, (melting less likely at higher pressures).
- **Water:** As water increases, the melting point decreases.
- **Rock Composition:** Temperature must be high enough to melt at least some minerals in the rock.

Melting and Crystallization

- Minerals that melt at the lowest temperatures melt first.
- If liquid separates solids in partial melting or fractional crystallization, then chemical composition of the liquid and solid will be different.

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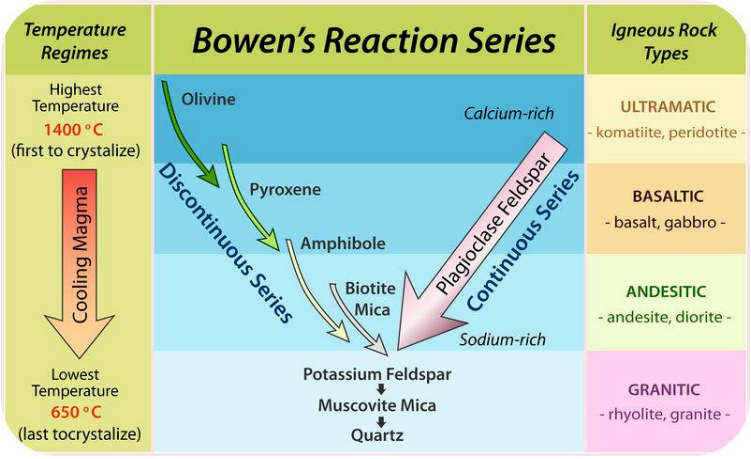
- When that liquid crystallizes, the resulting igneous rock will have a different composition from the parent rock.

- **Partial Melting:** Temperature high enough to melt only some of the minerals in the rock (ones that melt at lower temperatures).
- **Fractional Crystallization:** Crystallization of different minerals as magma cools.
- **Bowen's Reaction Series:** Tells temperatures at which minerals melt or crystallize.
  - Explains how atoms join together to form minerals, and leads to an understanding of how different igneous rocks form.
  - Bowen's Reaction Series also explains why some minerals are always found together and some are never found together.



Concept Check

- What needs to happen in order for a rock to melt or crystallize?
- What is Bowen's Reaction Series and how does it help us?

Supplemental Learning

Plate Tectonics: The different geologic settings that produce varying conditions under which rocks melt will be discussed in Concept Plate Tectonics.

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