

EESC 4701: Igneous and Metamorphic Petrology  
**MINERAL TEXTURES AND ROCK ALTERATION**  
**LAB 4 HANDOUT**

**What is rock alteration?**

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Rock alteration occurs when the composition of a rock is changed by a chemical process. This occurs after the rock is formed, meaning it is a *secondary* process. *Secondary minerals* are formed from this process, mostly due to the breakdown and recrystallization of pre-existing minerals.

**Distinguishing characteristics of common secondary minerals**

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*Sericite* – Fine grained mica, high birefringence, colorless (or slightly yellow) ppl, texture that appears stippled and platy habit (like other micas)

*Carbonate (e.g., calcite)* – Very high relief, very high interference colors (try putting in the accessory plate, the color won't change appreciably), commonly twinned

*Chlorite* – Green in ppl, high birefringence, texture that appears stippled and platy habit (like other micas)

*Serpentine* – Generally greenish greenish-brown in ppl (can be colorless), weak pleochroism, no relief, fibrous habit, low birefringence, often associated with olivine

*Actinolite* – fibrous amphibole, usually pale-dark green in ppl, moderate pleochroism, moderate-high relief, high birefringence

*Zeolite* – colorless in ppl, no pleochroism, no relief, moderate birefringence, cleavage at 90°

**Crystal shapes**

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*Tabular*: a term used to describe grains with rectangular tablet shapes.

*Equant*: a term used to describe grains that have all of their boundaries of approximately equal length

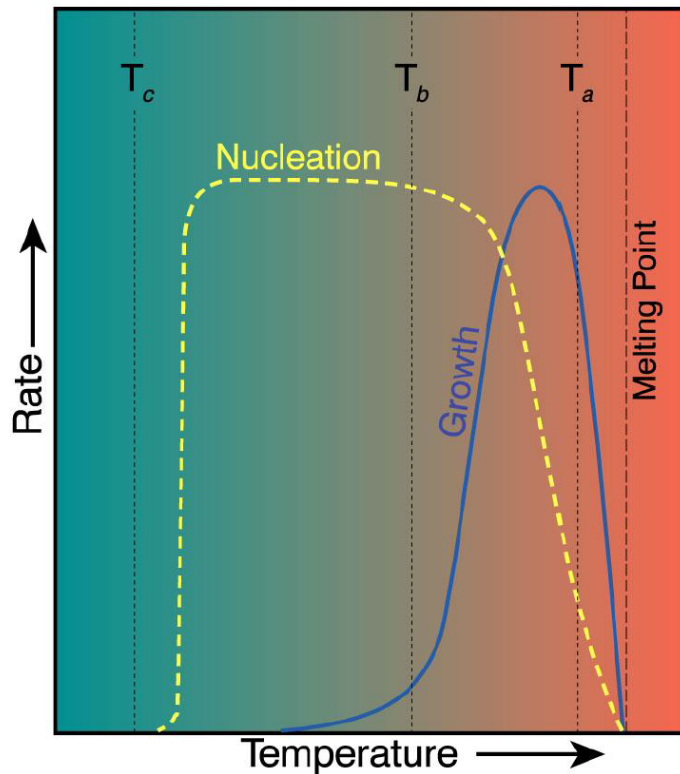
*Fibrous*: a term used to describe grains that occur as long fibers.

*Acicular*: a term used to describe grains that occur as long, slender crystals.

*Prismatic*: a term used to describe grains that show an abundance of prism faces.

## Crystal nucleation and growth

**Figure 3.1.** Idealized rates of crystal nucleation and growth as a function of temperature below the melting point. Slow cooling results in only minor undercooling ( $T_a$ ), so that rapid growth and slow nucleation produce fewer coarse-grained crystals. Rapid cooling permits more undercooling ( $T_b$ ), so that slower growth and rapid nucleation produce many fine-grained crystals. Very rapid cooling involves little if any nucleation or growth ( $T_c$ ) producing a glass.



## Crystal zonation

A texture developed in solid-solution minerals and characterized optically by changes in the colour or extinction angle of the mineral from the core to the rim. This optical zoning is a reflection of chemical zoning in the mineral. For example, a plagioclase can be zoned from a Ca-rich core to an Na-rich rim. Zoning results from the mineral's inability to maintain chemical equilibrium with a magma during rapid cooling; the zonation represents a frozen picture of the continuous reaction series for that mineral. Some common types of zoning: (a) Normal zoning is where the mineral is zoned from a high-temperature core composition to a low-temperature rim composition. (b) Reverse zoning is where a mineral is zoned from a low-temperature core composition to a high-temperature rim composition. (c) Oscillatory zoning is where the mineral chemistry continuously oscillates between high- and low-temperature compositions going from the core to the rim.

### Two types of zoning:

- *Patchy zoning*: This sometimes occurs in plagioclase crystals where irregularly shaped patches of the crystal show different compositions as evidenced by going extinct at angles different from other zones in the crystal.
- *Oscillatory zoning*: This sometimes occurs in plagioclase grains wherein concentric zones around the grain show thin zones of different composition as evidenced by extinction phenomena.