Sarah Lambart - 2016

LECTURE 2: 1001 RECIPES TO CREATE A IGNEOUS ROCK



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3 ingredients!

LECTURE 2: 1001 RECIPES TO CREATE A IGNEOUS ROCK

MART

• Earth: layered structure

differentiation



Chemical layering vs. Mechanical layering

δ 🗷



 Earth's formation and magma ocean: 1st igneous process





Arc volcanism (subduction) Intraplate Mid-ocean ridge volcanism plate3 plate2 plate1

Recap lecture 1

How do you melt rocks?









Carbonaceous Chondrites

Fe, Mg, Si and O: account for 93% of the mass of Earth

3 ingredients to create a igneous rock

Melting

Crystallization

Mixing/ assimilation



Magma chamber ⇒ Magma differentiation



Close system ⇔ equilibrium crystallization

Open system ⇔ fractional crystallization ± assimilation ± reinjection (mixing) Ingredient #1: Partial melting

⇒ incongruent melting: liquid and solid don't have the same composition
 ⇒ residue

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- Range of primary magmas (and residues):
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- Batch vs. Fractional melting

- Incongruent crystallization: $\beta \neq$ olivine
- In magma chamber

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- Equilibrium vs. Fractional crystallization

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Figure 6.10 in Winter

- Incongruent crystallization: $\beta \neq$ olivine
- In magma chamber
- Equilibrium vs. Fractional crystallization

Gravity settling



- Incongruent crystallization: $\beta \neq$ olivine
- In magma chamber
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This afternoon!

Bowen's Reaction Series



- Assimilation & crustal contamination
- Assimilation + fractional crystallization = AFC



Briquet & Lancelot, 1979

• Magma mixing: extremely common!



Credit: Etienne Médard



Magma mixing: extremely common!



Credit: Jean Plaine

Credit: Ben James Andrews



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• Evidence for magma mixing



Oscillatory zoning *https://wwwf.imperial.ac.uk/*

• Evidence for magma mixing



oxide-oxide variation diagrams:

- mixtures lie along a straight line
- proportional distances are the same on all diagrams

NEXT TIME

How do we predict what happens when we melt a rock or crystallize a magma? With THERMODYNAMICS!

> **TO READ:** Chapter 5 Chapter 3 (help for Lab 3)