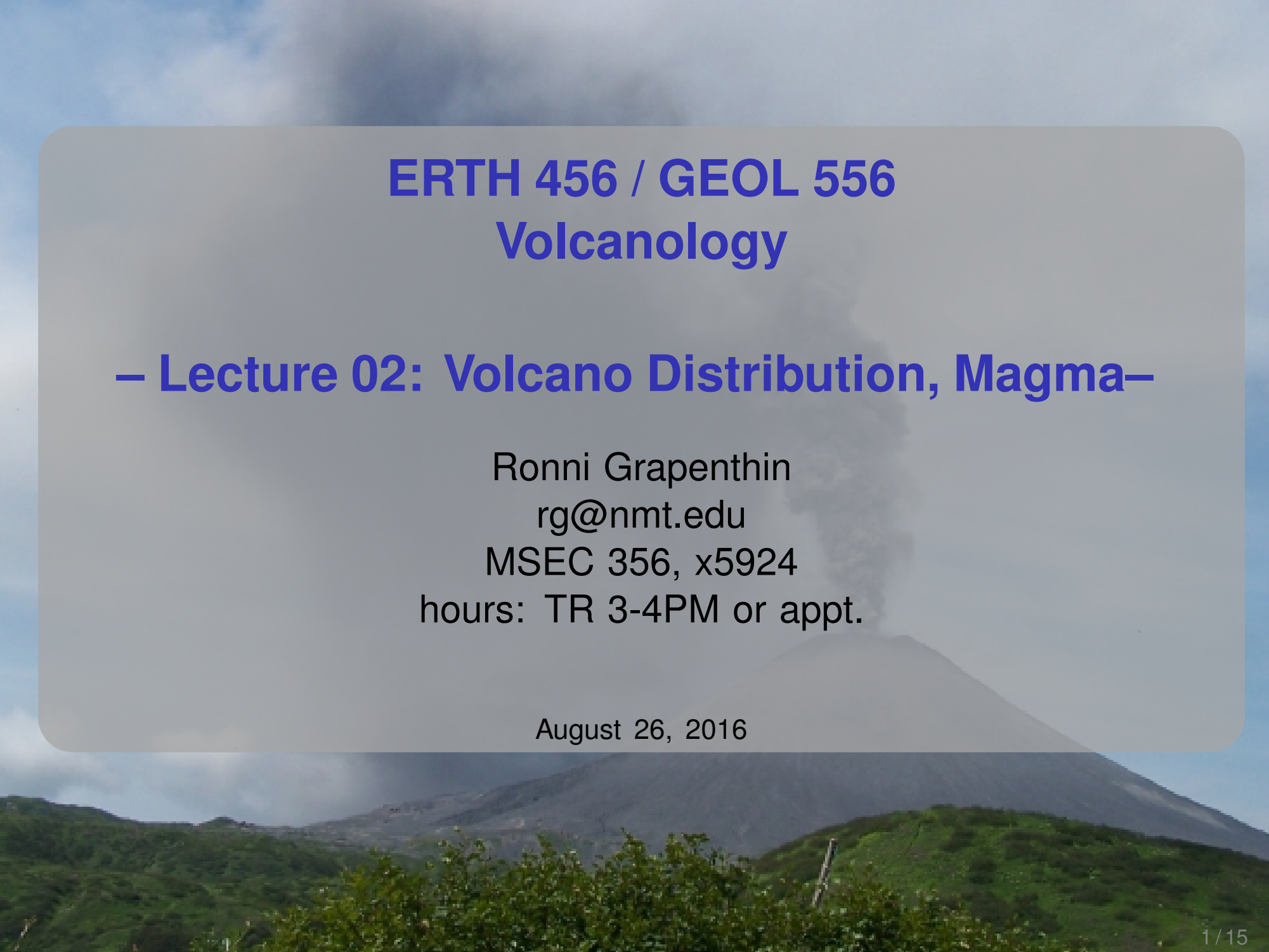

# ERTH 456 / GEOL 556
# Volcanology

## – Lecture 02: Volcano Distribution, Magma–

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hours: TR 3-4PM or appt.

August 26, 2016

# What is a volcano?

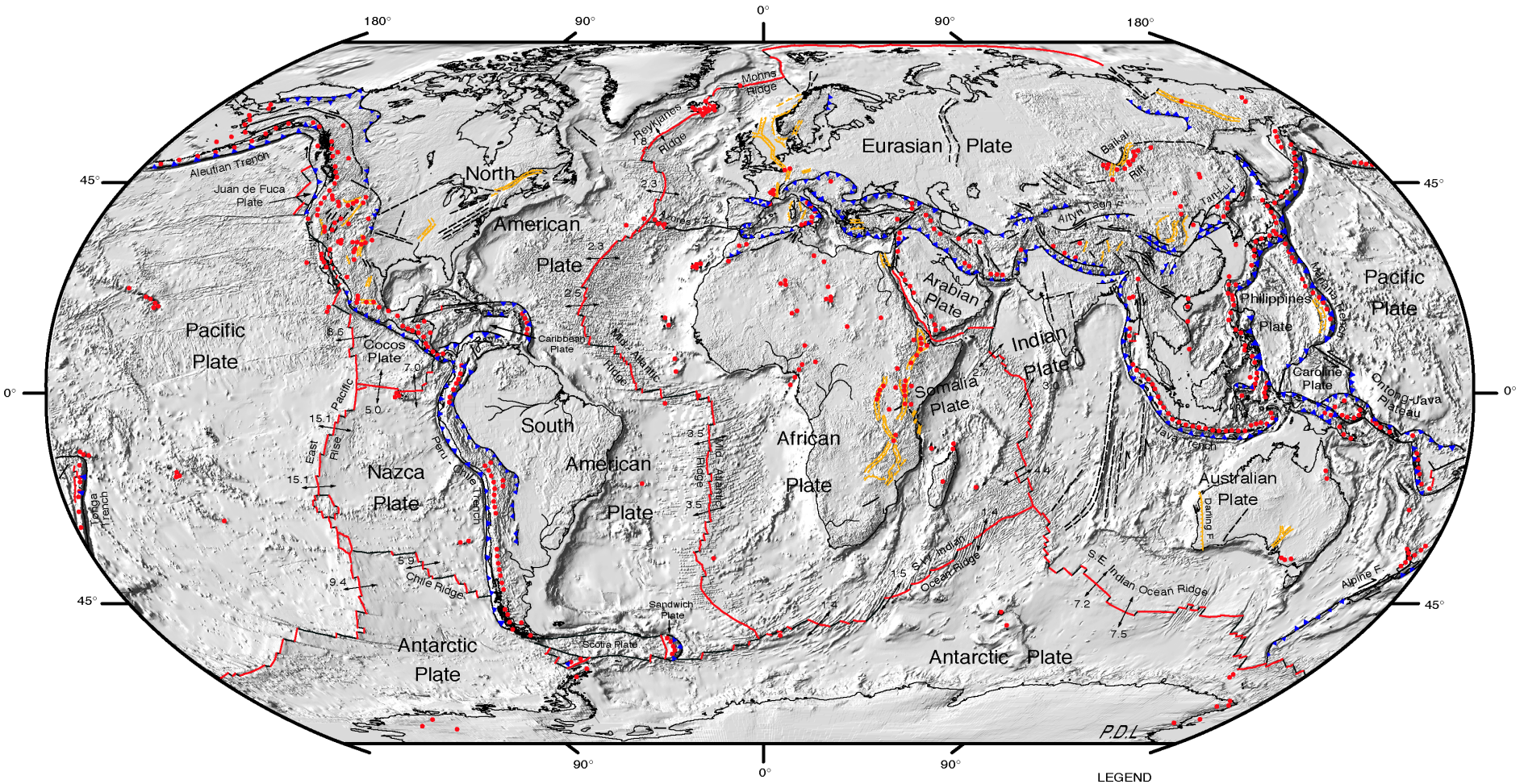
Where do we find volcanoes?

Where do we find volcanoes? . . . on Earth?

# Volcano Distribution

Google Earth

# Volcano Distribution




**DIGITAL TECTONIC ACTIVITY MAP OF THE EARTH**
Tectonism and Volcanism of the Last One Million Years

**DTAM - 1**

NASA/Goddard Space Flight Center
Greenbelt, Maryland 20771

Robinson Projection
October 2002

LEGEND

- Actively-spreading ridges and transform faults
- Total spreading rate, cm/year
- Major active fault or fault zone; dashed where nature, location, or activity uncertain
- Normal fault or rift; hachures on downthrown side
- Reverse fault (overthrust, subduction zones); generalized; barbs on upthrown side
- Volcanic centers active within the last one million years; generalized. Minor basaltic centers and seamounts omitted.

*NASA*

What is magma and where does it come from?

What is magma and where does it come from?

*Answer to “Where does it come from?” left for next lecture.*

# What is magma?

Mixture of:

- melt (liquid rock)
- crystals (solids)
- volatiles (gases)

# Melt

- silicate molecules + other elements
- no free molecules, but polymerized
  - repeated linking of same molecule groups
  - due to strong linking of atoms in $SiO_2$ molecule
- no clear cut freezing point

# Factors on Melting Temperature

- **composition**: basaltic -> rhylotic compositon, temperature drops
  - Basalt (45-52 wt% $SiO_2$): 1000-1250$^\circ C$
  - Andesite (52-62 wt% $SiO_2$): 950-1200$^\circ C$
  - Dacite (62-70 wt% $SiO_2$) : 800-1100$^\circ C$
  - Rhyolite ($>$ 70 wt% $SiO_2$) : 700-900$^\circ C$

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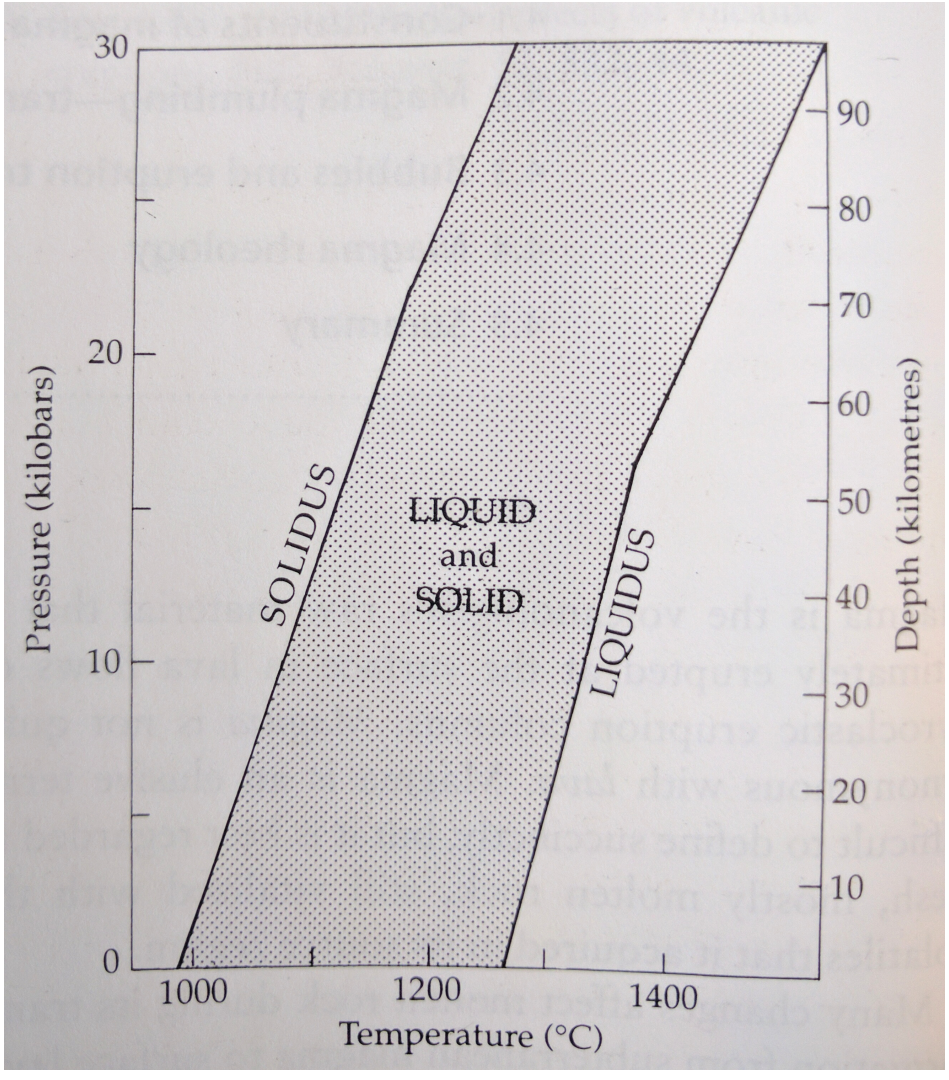
- **volatile content**: 'wet' silicate (lots of volatiles) melts at lower temperatures

# Partial Melting: Liquidus - Solidus




*Francis & Oppenheimer*

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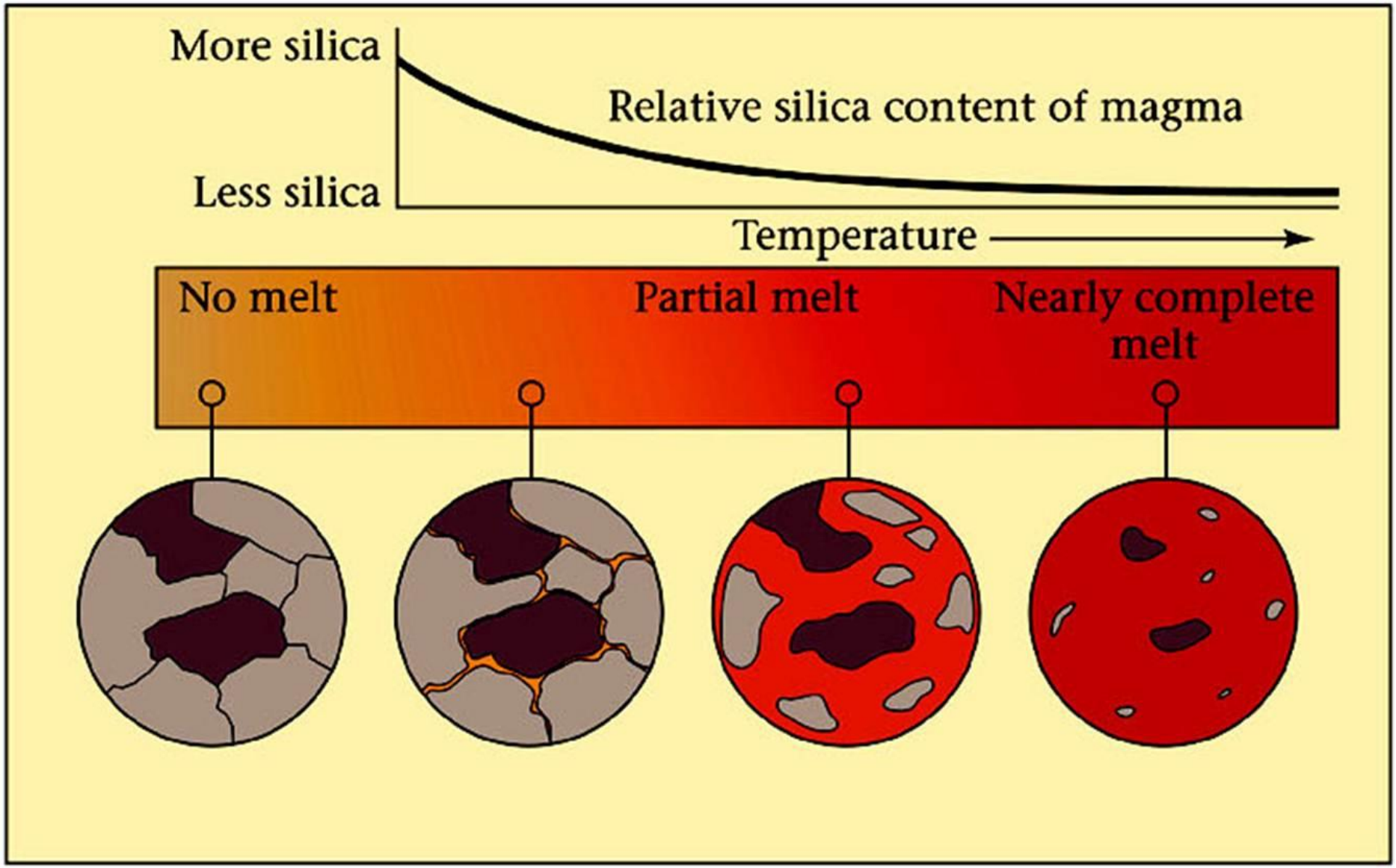
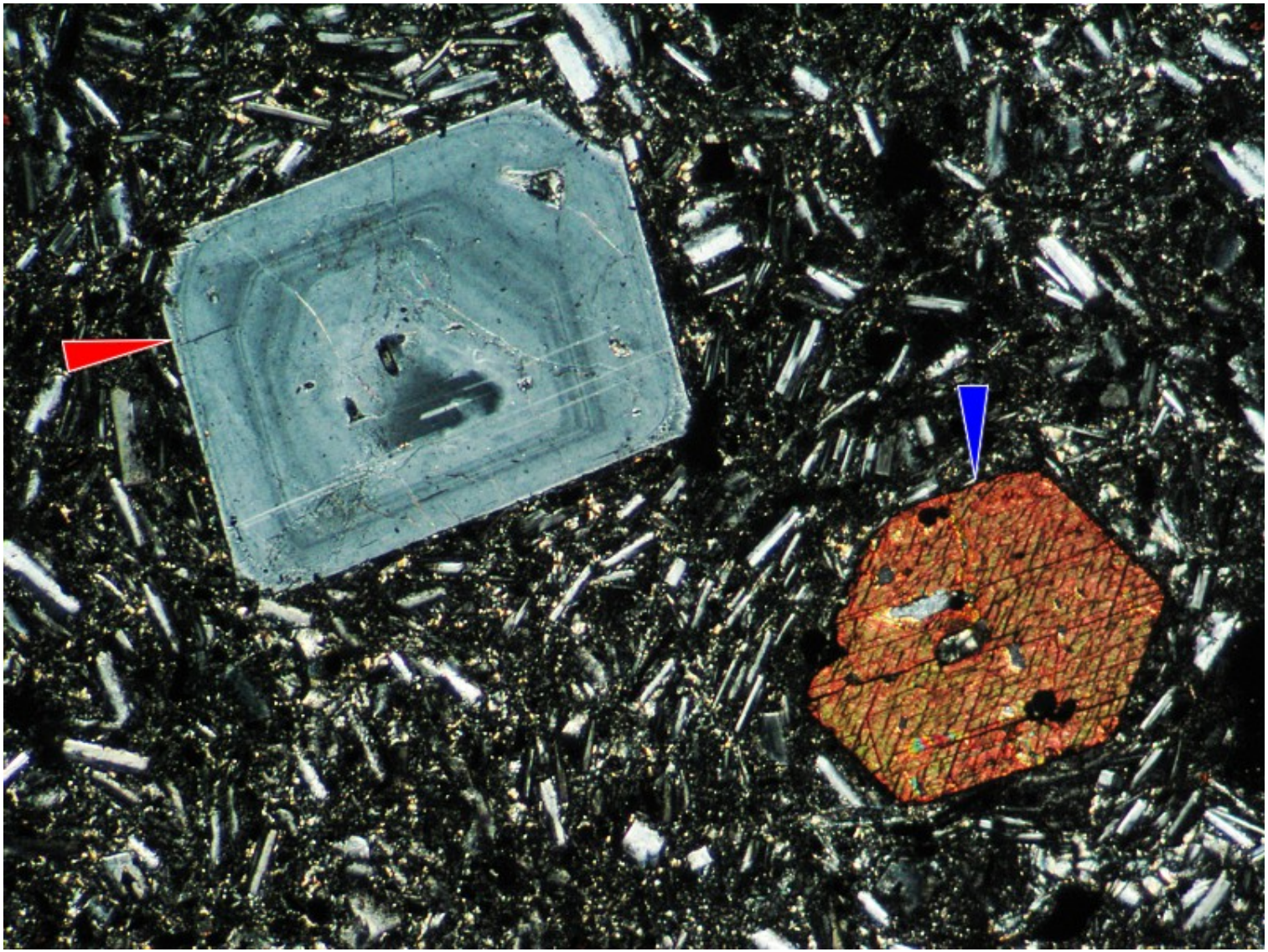



*Internet*

# Crystals

- fractional crystallization: magmas commonly begin crystallizing before erupting
- often abundant phenocrysts (millimeters across), crystallize out at highest temperatures
- basalt: olivine & pyroxene
- phenocrysts may have complex histories:
  - plagioclase feldspar: compositional zoning (change in calcic to sodic)
  - e.g., normal zoning if more calcic in center to more sodic at edges
  - variations can be used to track evolution of conditions in magma chamber / ascend

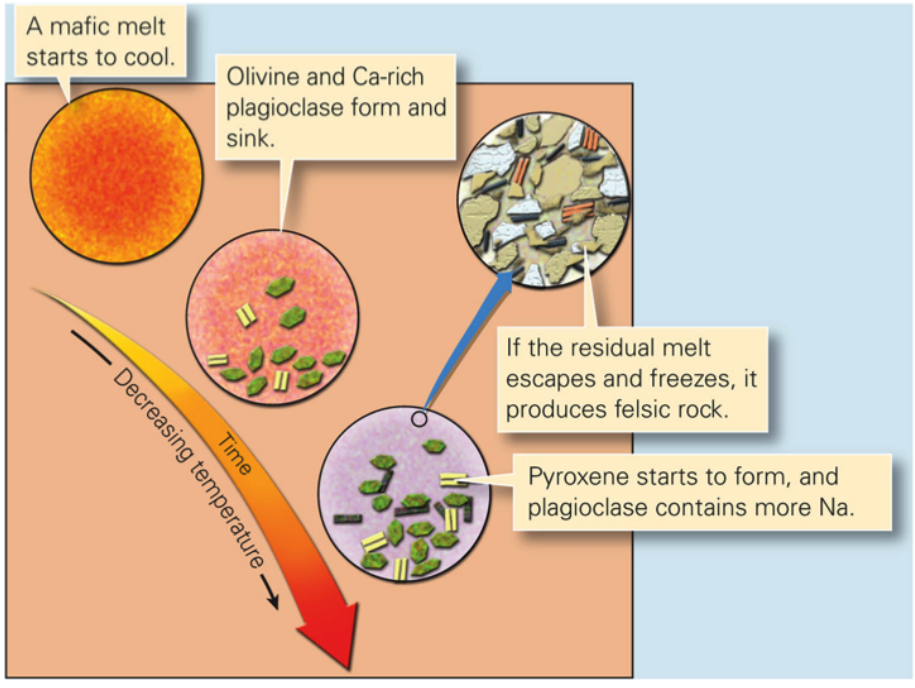
# Zoned Feldspar

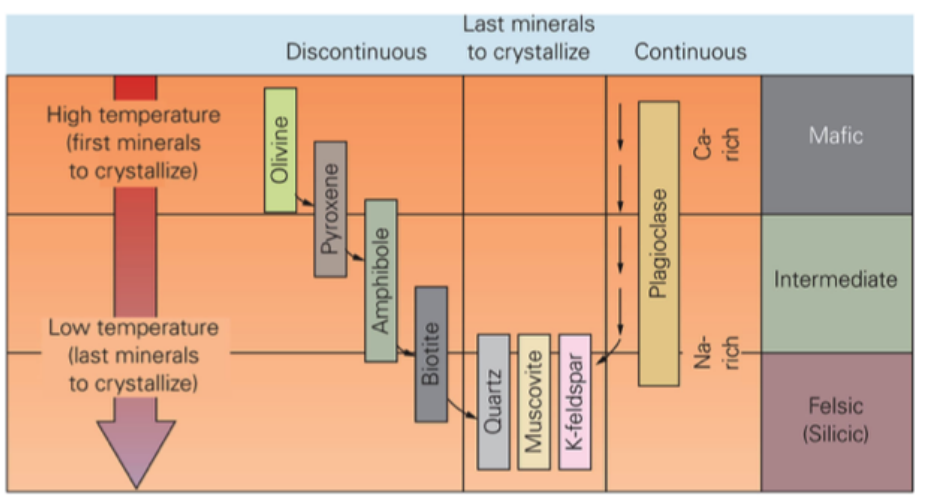


Alkali Feldspar oscillatory zoning (red); hornblende phenocryst (blue) *Imperial College Rock Library*

# Fractional Crystallization

- magma cools (e.g.: rises to cooler environment )
- not all parts of melt solidify simultaneously




*Internet*

# Volatiles

- *"hmmm . . . the fragrance"*
- vigorous degassing of volcanoes common in absence of eruptive activity (good!)
- Sulfur dioxide $SO_2$ most well recognized;
- water (steam), $H_2O$, & carbon dioxide $CO_2$ more abundant
- MORB $<$ 0.5 wt% water
- arc basalt / rhyolite 5 wt% water or more
- volcanic gas samples are a mix of elements from mantle, sea water, crust, atmosphere