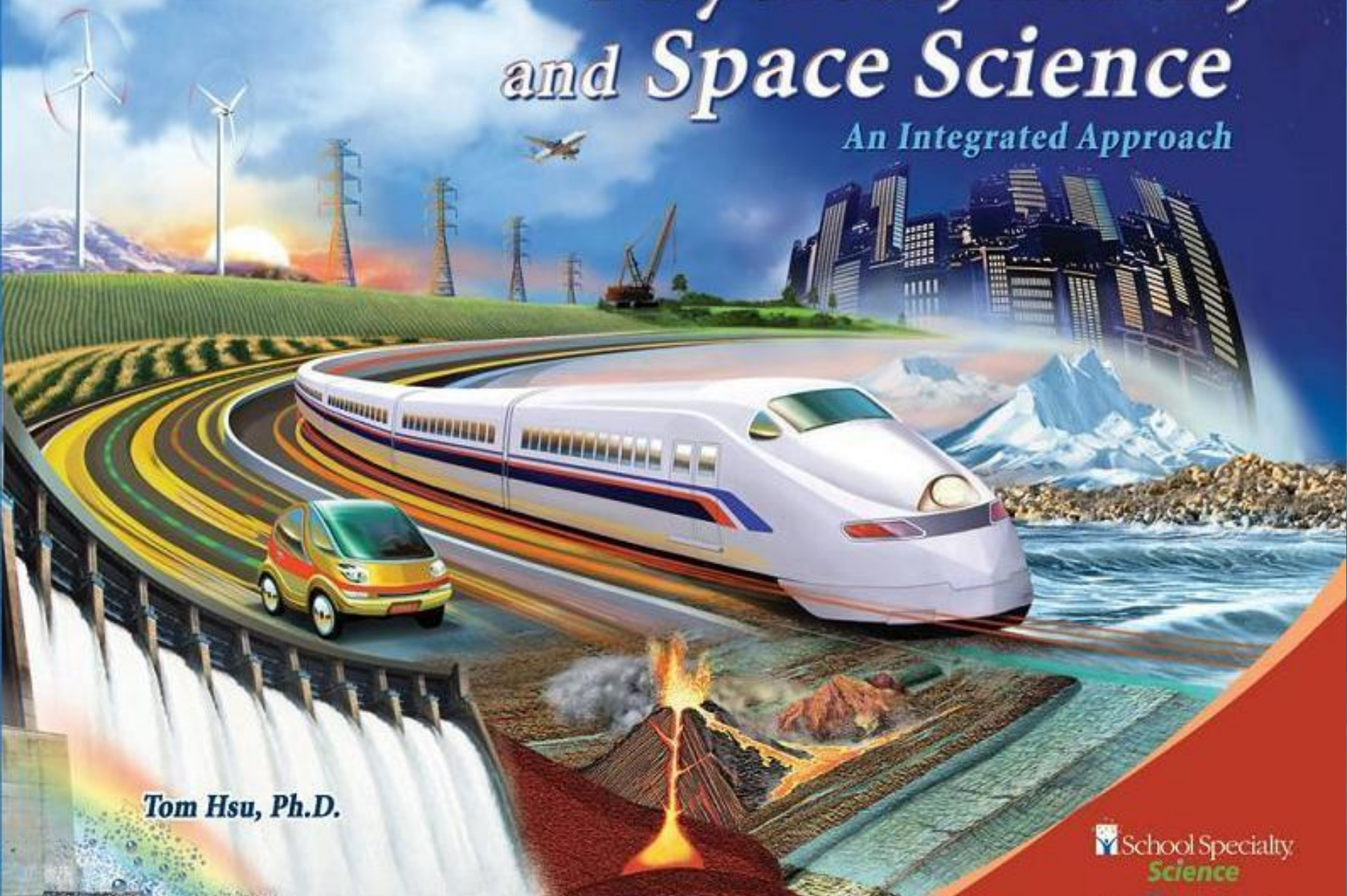


cpo science

# Physical, Earth, and Space Science

*An Integrated Approach*



**Tom Hsu, Ph.D.**

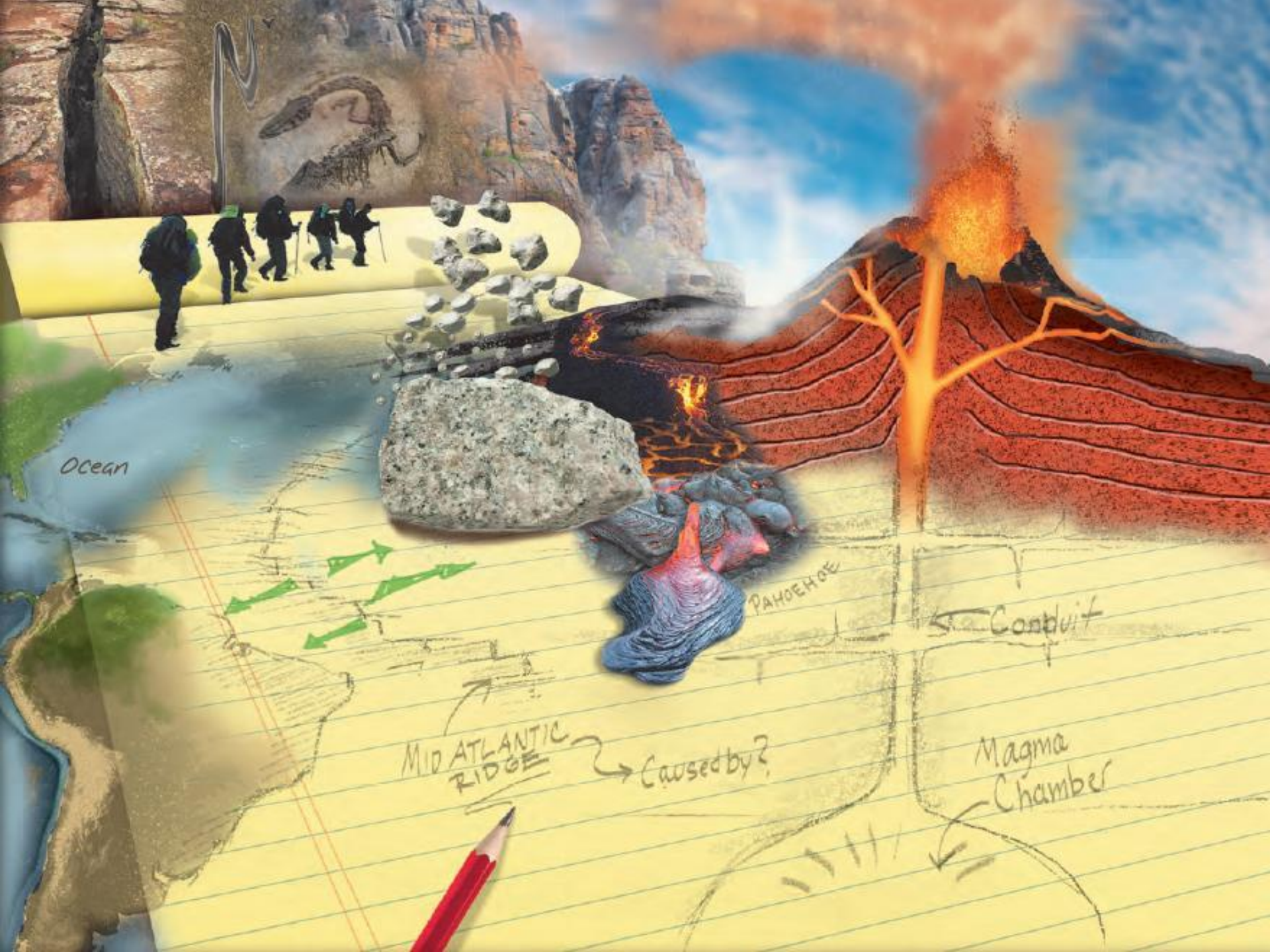
 School Specialty  
Science



## **UNIT SIX: Earth's Structure**

- **Chapter 18 Earth's History and Rocks**
- **Chapter 19 Changing Earth**
- **Chapter 20 Earthquakes and Volcanoes**





Ocean

РАНОЕНОЕ

Conduit

MID ATLANTIC RIDGE

Caused by?

Magma Chamber



# Chapter Twenty: Earthquakes and Volcanoes

- **20.1 Earthquakes**
- **20.2 Volcanoes**
- **20.3 Igneous Rocks**



## 20.3 Learning Goals

- **Explain how igneous rocks are formed.**
- **Distinguish intrusive and extrusive igneous rocks.**
- **Describe the relationship between crystallization in rocks and where the rocks are formed.**



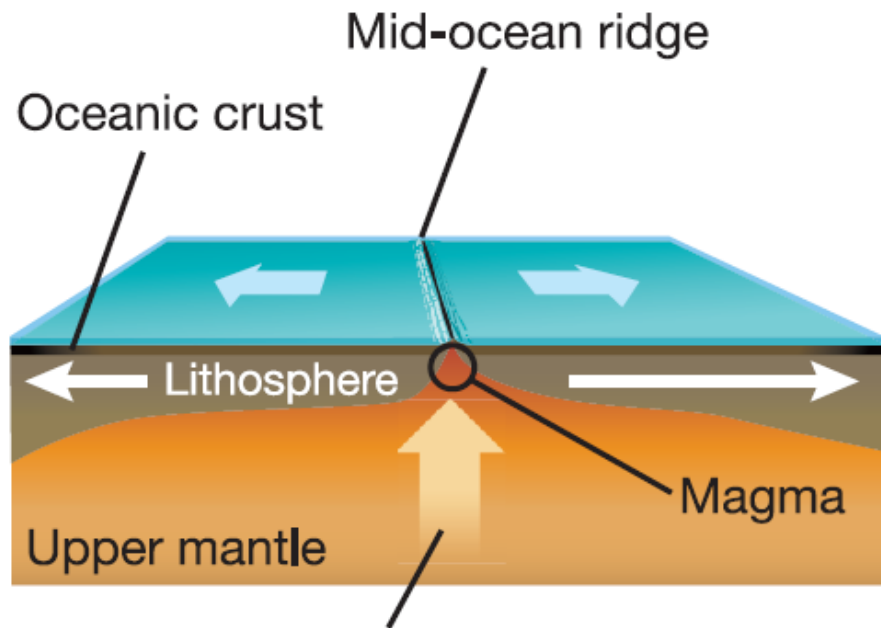


## 20.3 Igneous Rocks

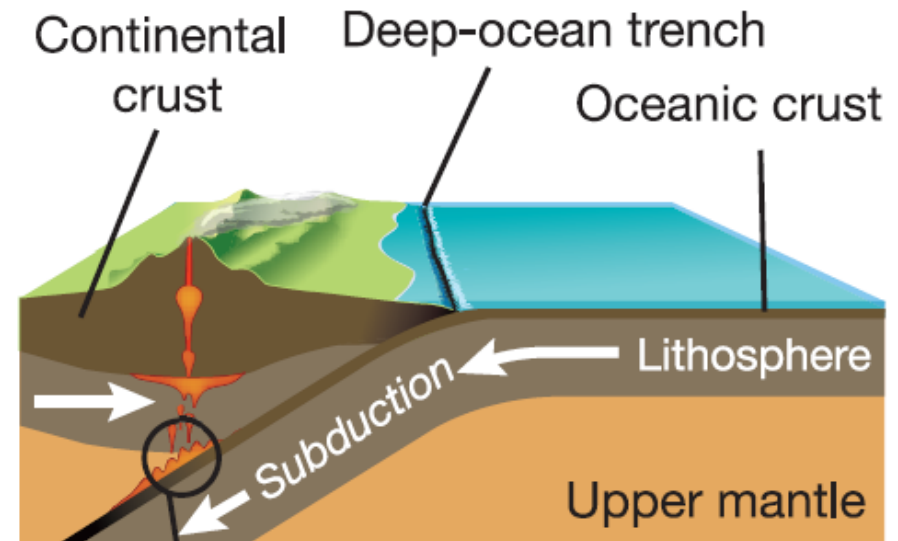
- **\* Igneous rocks begin to form when rock melts in Earth's mantle.**
- **A good way to describe hot, solid mantle rock is that it is like stiff putty that takes millions of years to move.**
- **\* Decreased pressure and the addition of water lower the melting temperature of mantle rock so that it melts.**



# Forming Igneous Rocks



**Mantle rock melts as it rises.**



**Lithosphere is heated and melts as it goes deeper into the mantle and as water is added.**



## **20.3 How are igneous rocks formed?**

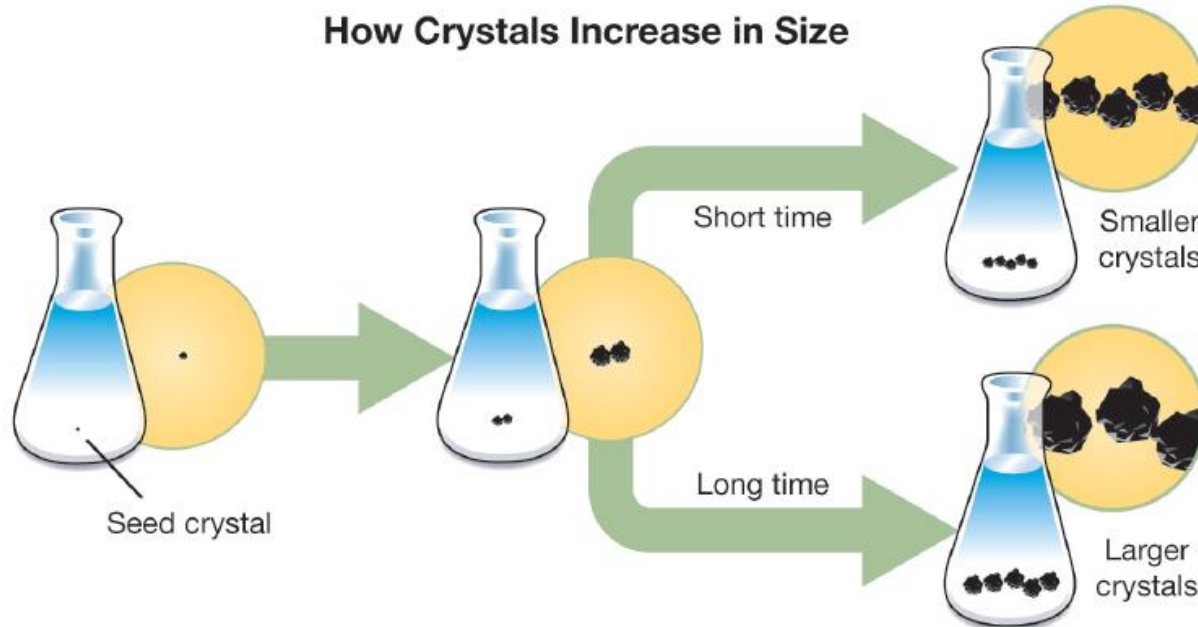
- **The wide variety of igneous rocks result from changes that take place after magma forms.**
- **\* As melted rock cools, minerals in magma or lava form crystals that can be large, small, or microscopic depending on the rate at which cooling takes place.**





## 20.3 Crystals in igneous rocks

- \* Minerals in magma or lava form crystals as the melted rock cools.
- \* **Crystallization** is the process by which crystals form and grow in size.





## 20.3 Crystals in igneous rocks



Obsidian

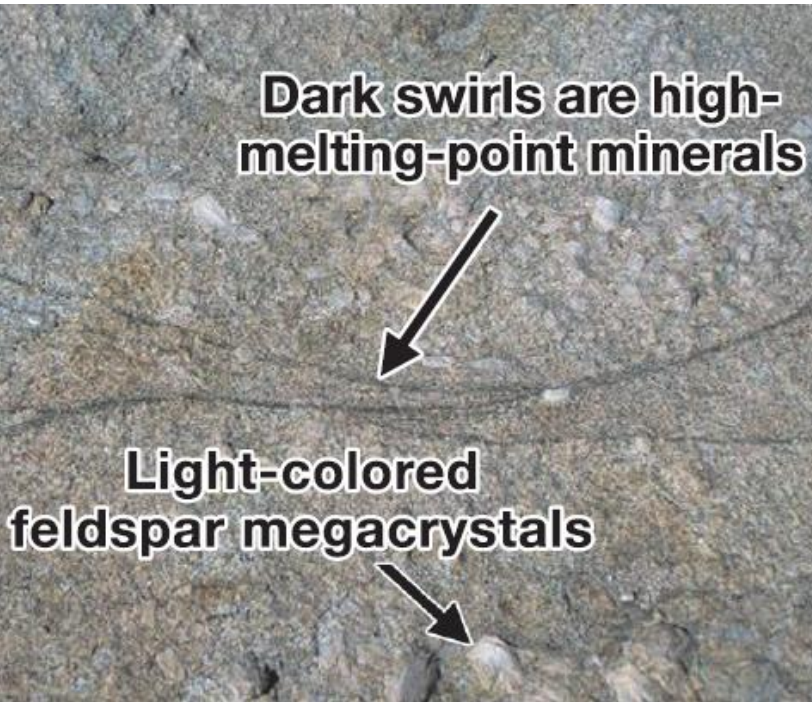
- \* Often called volcanic glass, *obsidian* is an igneous rock that lacks crystals.

**Which Oregon volcano produced the Big Obsidian Flow?**





## 20.3 Interpreting igneous rocks



- \* The general color of igneous rocks is a measure of the kinds of minerals present.





## 20.3 Interpreting igneous rocks

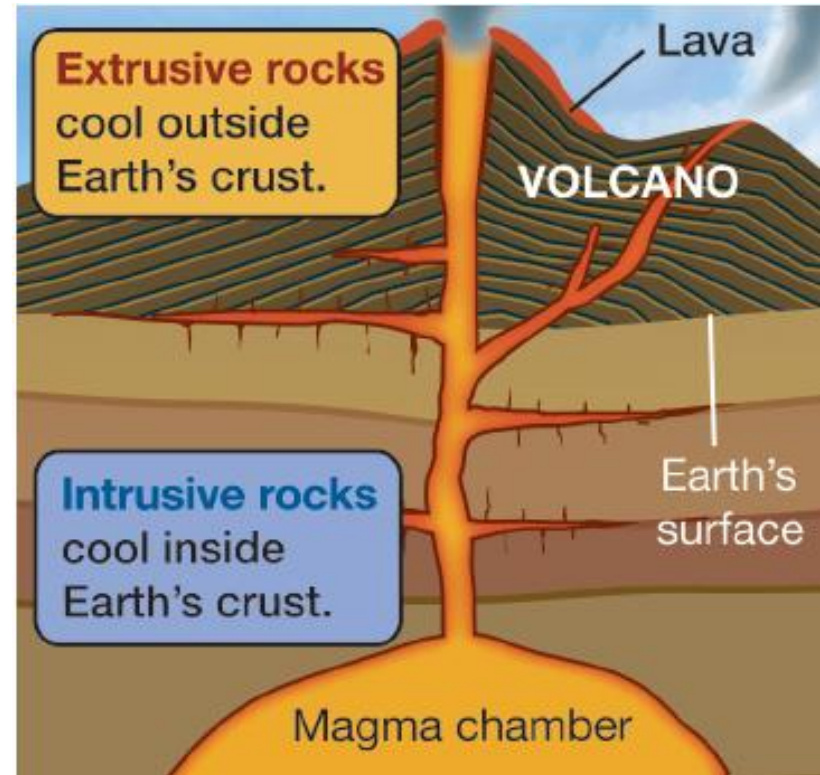
- \* Depending on the rate of cooling, the crystals might be invisible, small, or large.
- \* Pegmatite cooled slowly and formed large, visible crystals.

Pegmatite



## 20.3 Comparing igneous rocks

- An igneous rock that forms above Earth's surface is called an **extrusive rock**.
- An igneous rock that forms within Earth's crust is called an **intrusive rock**.



Which rocks are more likely to have large crystals?



## 20.3 Comparing igneous rocks

- Can you classify other igneous rocks such as rhyolite or andecite?

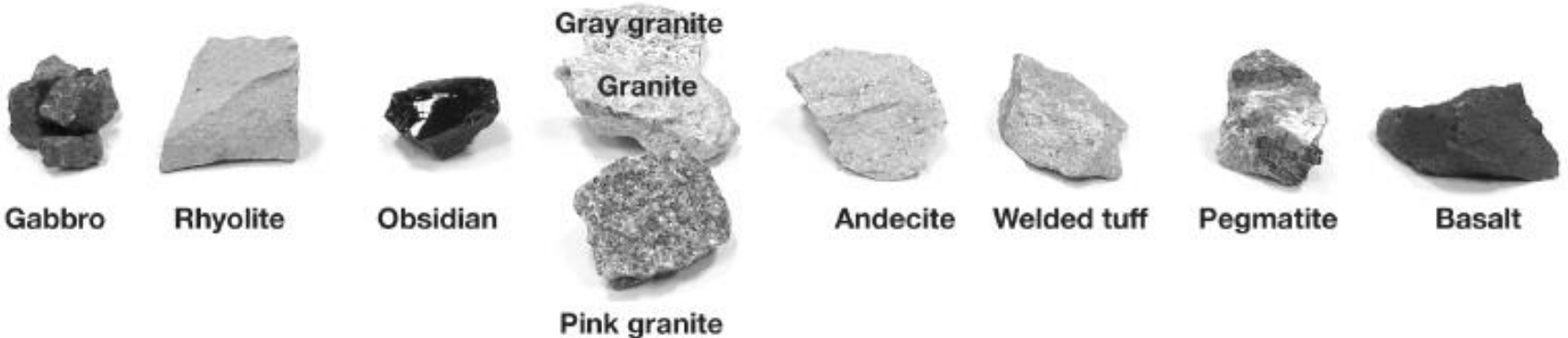
	No Visible Crystals	Visible Crystals
Low Silica	Basalt 	Gabbro 
High Silica	Obsidian 	Granite 



## Investigation 20C

# Igneous Rocks

- **Key Question:**
  - *How are igneous rocks classified?*





## 2004 Indian Ocean:

### Earthquake and Tsunami



Photos - courtesy of NASA

December 26, 2004

- **The Indian Ocean tsunami may be one of the deadliest natural disasters in modern history. Officials believe over 275,000 people died. Scientists used data from around the world to revise the earthquake to a 9.3 magnitude.**