

## Phase Diagrams and Phase Chemistry

### Phase diagrams

- provide a graphical means of presenting the results of experimental studies of complex natural process
- such that at a given \_\_\_\_\_ (T) and \_\_\_\_\_ (P) for a specific \_\_\_\_\_ the \_\_\_\_\_ or \_\_\_\_\_ present can be determined at \_\_\_\_\_.

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## DEFINITIONS

### SYSTEM

- \_\_\_\_\_
- \_\_\_\_\_ versus \_\_\_\_\_ systems

### PHASE

- \_\_\_\_\_

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## PHASE

A phase is any part of a system that is:

- \_\_\_\_\_
- \_\_\_\_\_, and
- \_\_\_\_\_

There exists a \_\_\_\_\_ surface between different phases

Phases may exist in a \_\_\_\_\_, \_\_\_\_\_ or \_\_\_\_\_ state

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### Gas State

- Gases are completely \_\_\_\_\_ with each other, regardless of composition.
- There can only be \_\_\_\_\_ gas phase in a system at \_\_\_\_\_.



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### Liquid State

- Many liquids can be \_\_\_\_\_ in any proportion to form a \_\_\_\_\_ phase
- Liquids are \_\_\_\_\_ to \_\_\_\_\_ immiscible (do not mix).
- Such liquids remain as separate phases with a distinct boundary surface between them.



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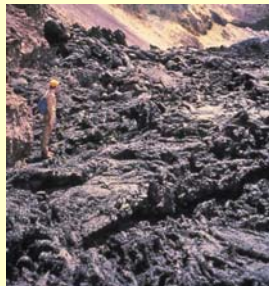
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### Solid State

- Some solids have very strict compositional limits
  - e.g. quartz -  $\text{SiO}_2$ .
- Others exhibit a wide range in composition
  - plagioclase Ab to An
- Due to \_\_\_\_\_ limits of many solid phases, there are commonly more than one solid phase in a system.



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### Phase (continued)

• **Example:**

• A lava flow at \_\_\_\_\_ containing a mixture of ol and pl in liquid, contains \_\_\_\_\_ phases - ol, pl and liquid.

• \_\_\_\_\_:

• any \_\_\_\_\_ phase which can coexist with a liquid, i.e. it formed directly from the liquid

• \_\_\_\_\_:

• formed after all the liquid has crystallized, i.e. \_\_\_\_\_ minerals

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### EQUILIBRIUM

• Condition of \_\_\_\_\_ energy for the system:

– such that the state of a \_\_\_\_\_ will not change with time

– provided T and P are kept \_\_\_\_\_

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### EQUILIBRIUM (continued)

In Experimental petrology there are three practical criteria to test for equilibrium:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

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## COMPONENT

- The smallest number of independent variable chemical constituents necessary to define any phase in a system.
- Components may be:
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_

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## ONE COMPONENT OR UNARY SYSTEMS

- Examples
  - Water -  $H_2O$
  - Silica -  $SiO_2$
  - Aluminosilicate -  $Al_2SiO_5$

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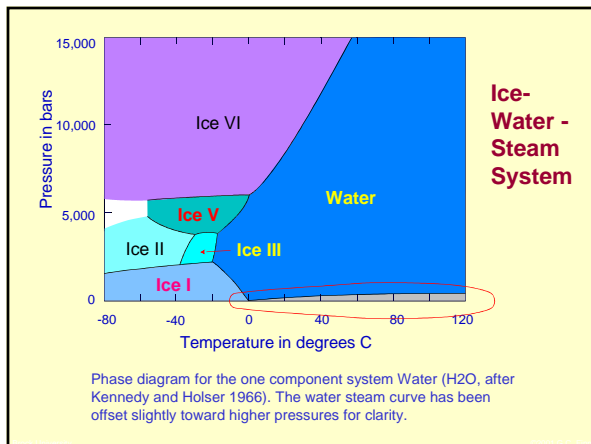
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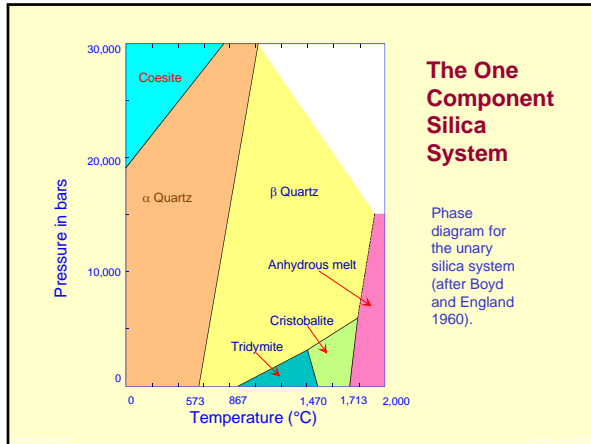
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# Phase Diagrams #1




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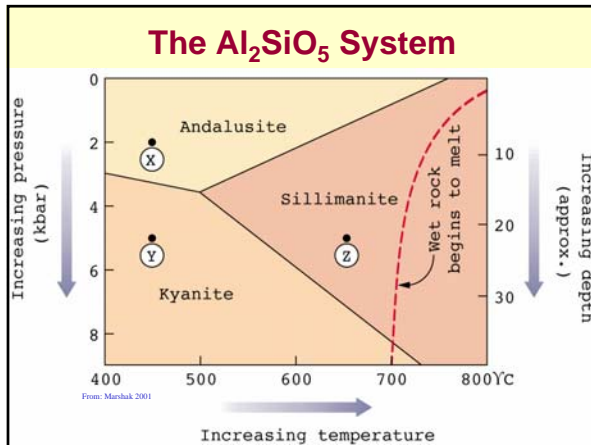
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**PHASE RULE**

- For a system at equilibrium, the Phase Rule relates:
  - $P =$  \_\_\_\_\_
  - $C =$  \_\_\_\_\_, and
  - $F =$  \_\_\_\_\_
- Where:
 
$$P + F = C + 2$$
- Degrees of Freedom
  - environmental conditions which can be independently varied without changing the number of phases in the system.
  - Conditions include T, P, chemical composition, pH, Eh, oxygen fugacity.

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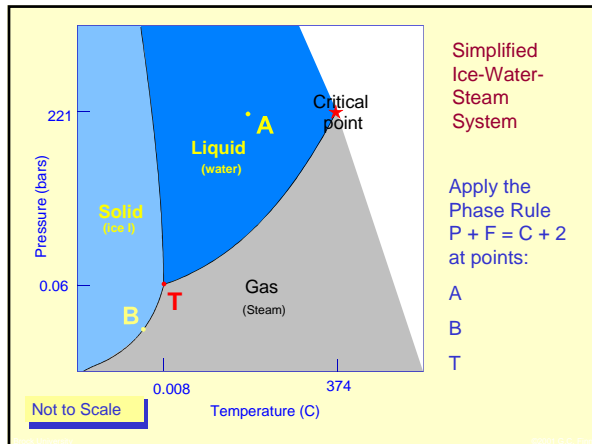
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# Phase Diagrams #1



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