

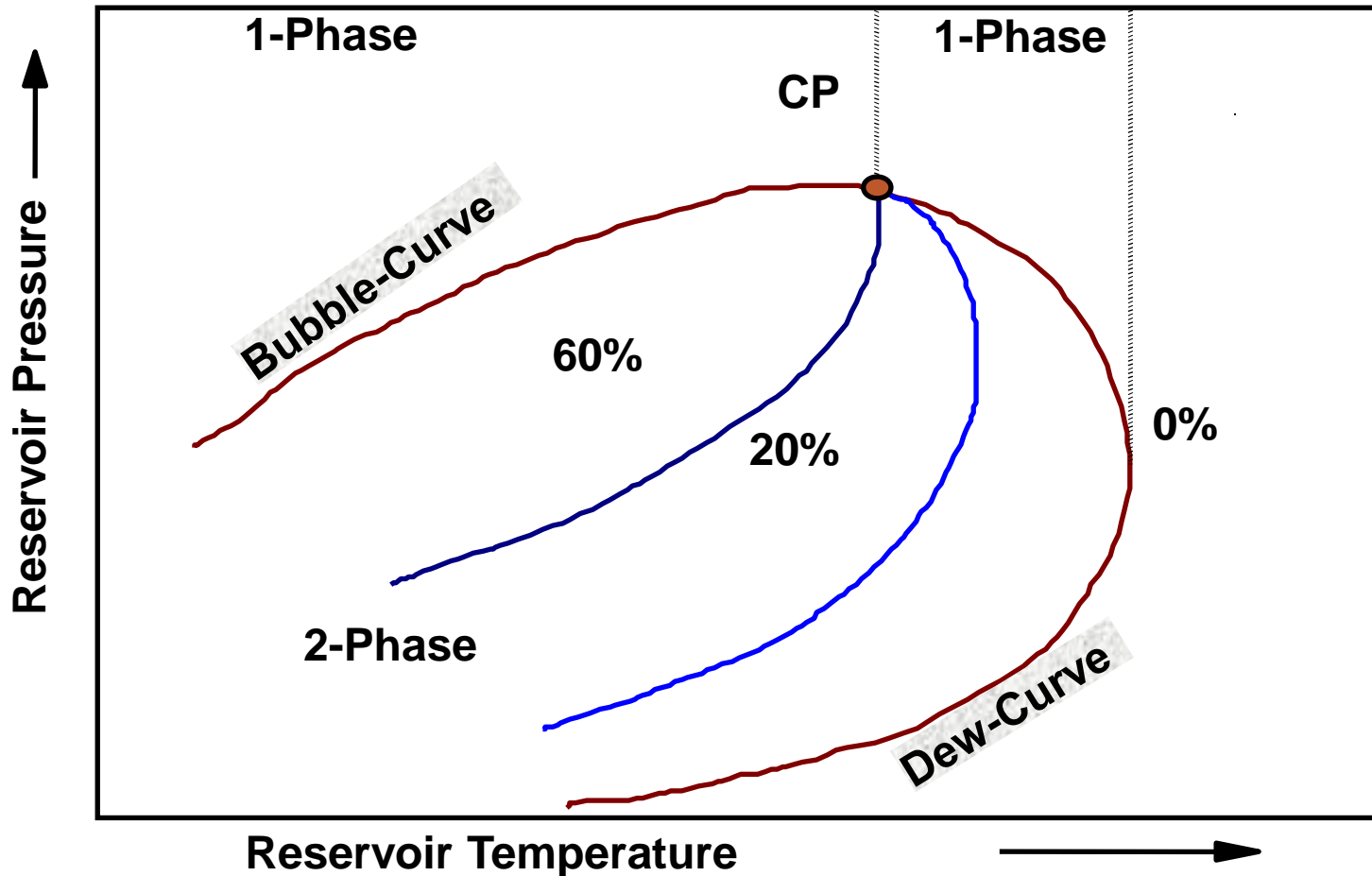
## Properties of Reservoir Fluids (PGE 362)

# Phase Behavior of Liquids

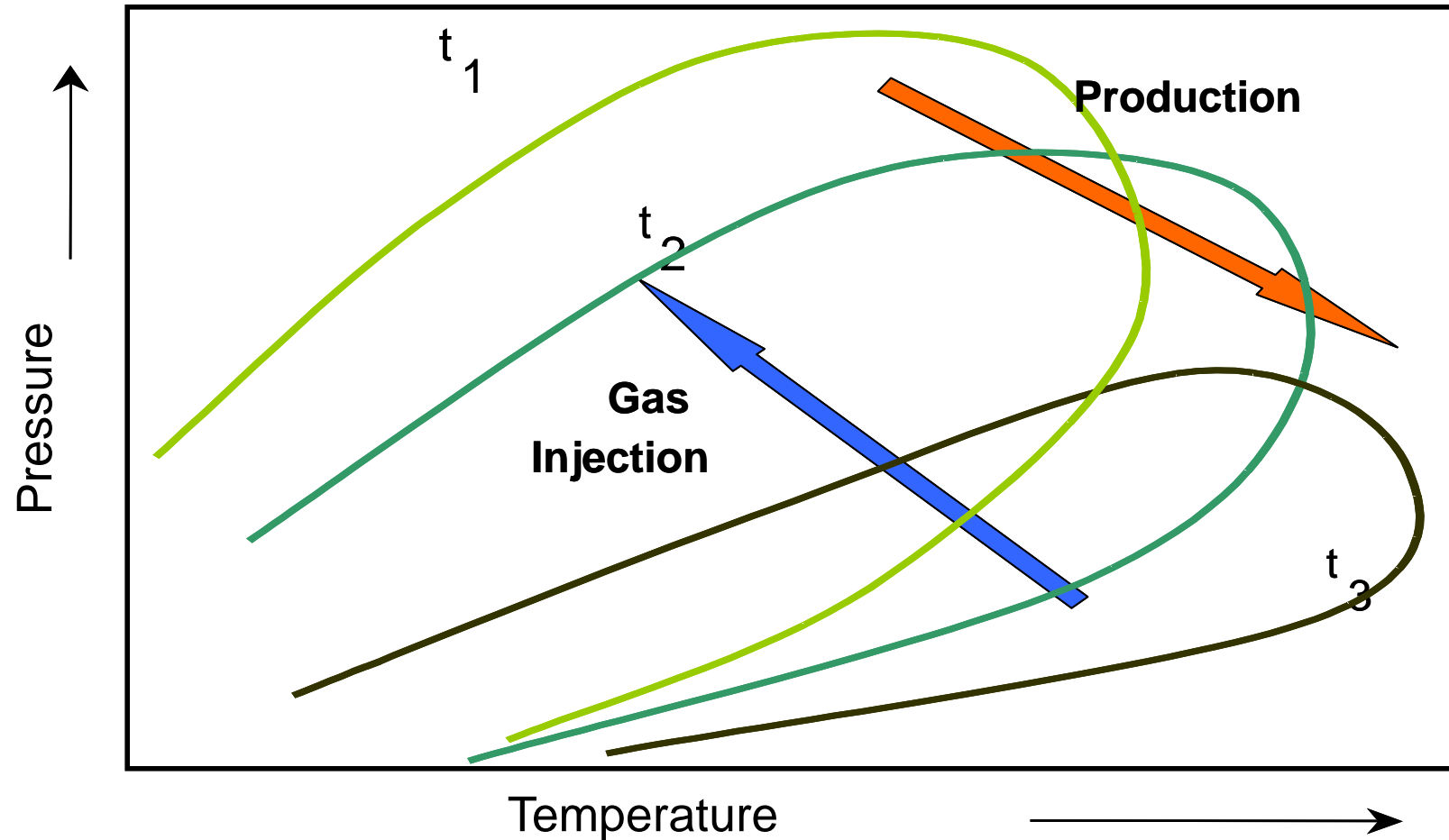
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# Pressure-Temperature Diagram for Multicomponent Systems



# Importance of Pressure-Temperature Diagram



# Terminologies

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- **Phase**

- A portion of the system which has homogeneous intensive properties and it is bounded by a physical surface.

- **Interface**

- Separates two or more phases. These phases are solid, liquid(s), and gas

- **Intensive Properties**

- Independent of system mass (i.e density)

- **Extensive Properties**

- Dependent of system mass (i.e volume)

# Terminologies

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- **System**
  - A body of matter with finite boundaries (physical or virtual)
- **Closed system**
  - Does not exchange matter with surroundings but may exchange energy (heat).
- **Open system**
  - Does exchange matter and energy with surroundings.
- **Homogenous system**
  - Intensive properties change continuously and uniformly (smoothly)
- **Heterogeneous system**
  - System made up of two or more phases in which the intensive properties change abruptly at phase-contact surfaces

# Terminologies

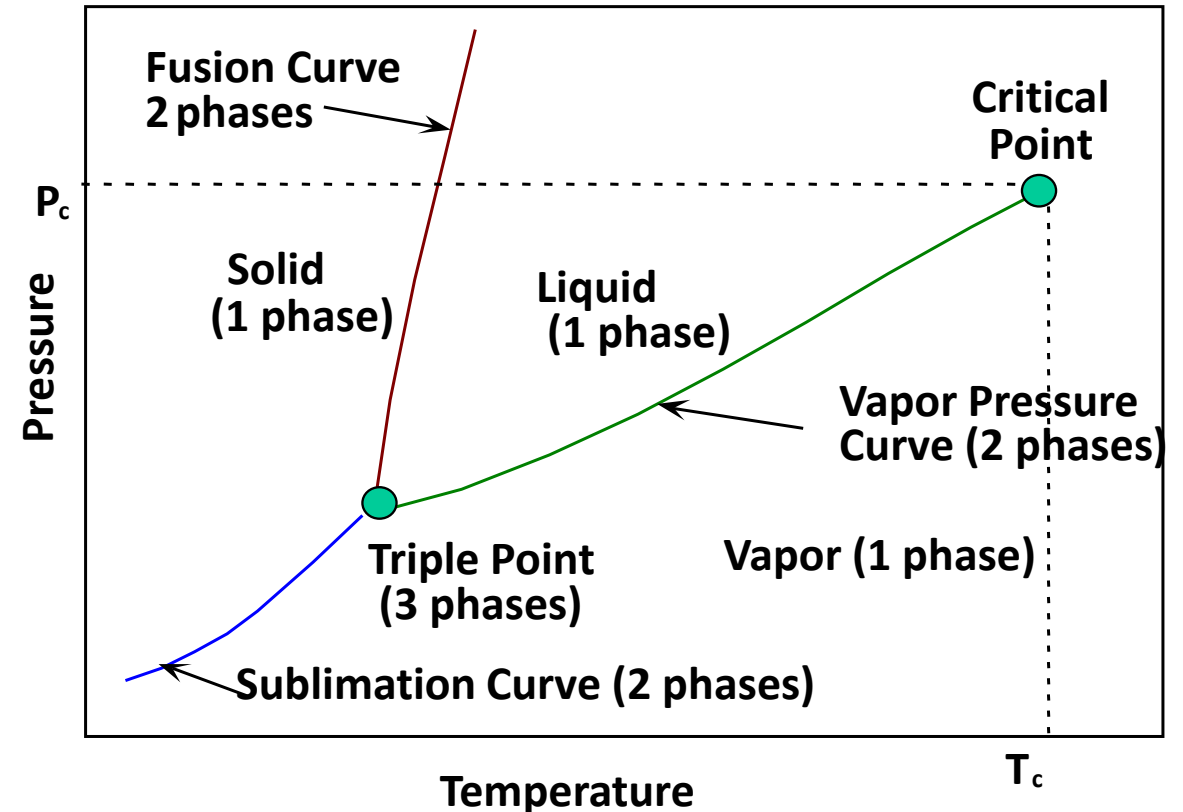
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- **Properties**
- Characteristics of a system (phase) that may be evaluated quantitatively. These are,
  - Phase density (liquid, gas, solid)
  - Compressibility
  - Surface tension
  - Viscosity
  - Heat capacity
  - Thermal conductivity

# Phase Diagram

- **Types of phase diagrams for a single component (pure substance)**

- Pressure-Temperature (PT)
- Pressure-Volume (PV) or ( $P\rho$ )
- Temperature-Volume (TV) or ( $T\rho$ )



# Phase Diagram

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- **Interesting videos**

- Phase Diagrams and the States of Matter

- <http://www.youtube.com/watch?v=gbUTffUsXOM>

- Triple Point

- <http://www.youtube.com/watch?v=BLRqpJN9zeA>

- What is Supercritical fluid

- <http://www.youtube.com/watch?v=QHcqyFm0i9M#aid=P8sRLIeLU1Q>



# Pressure-Volume-Temperature

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- **Temperature-Volume (TV)**

- At constant pressure the volume of a liquid at any temperature can be estimated using the formula:
  - $V = V_o(1 + \alpha(T - T_o))$
  - $V_o$ : initial volume at  $T_o$
  - $\alpha$ : average coefficient of thermal expansion (different for different liquids)
- At constant pressure the volume of a liquid at any temperature can be estimated using the formula:
  - $V = V_o(1 - C(P - P_o))$
  - $C$ : average coefficient of compression (different for different liquids)