Understanding Reservoir Fluids & PVT Modeling

- ❑ Reservoir Fluid Behavior
- ❑ Why Predict Fluid Behavior ?
- ❑ Types of Fluid Models
- ❑ EOS Modeling: A Brief Review

◉ Reservoir Fluids: Types & Behavior

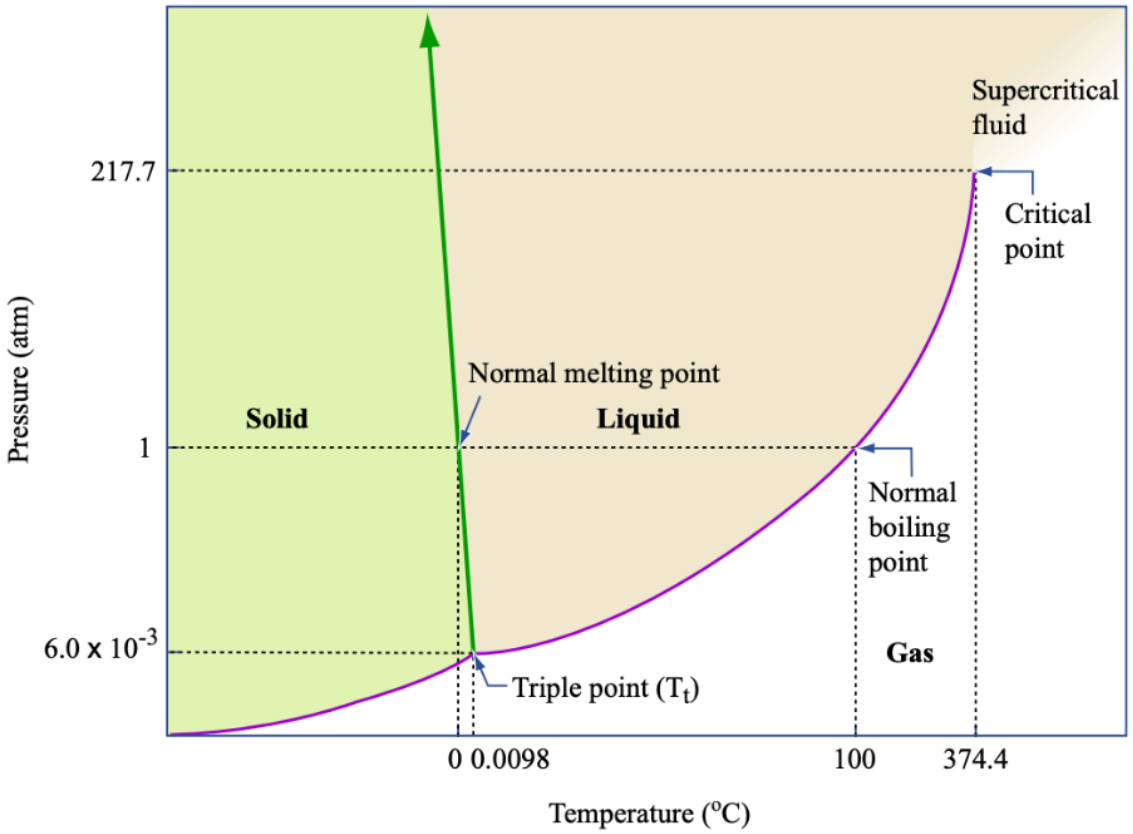
- Reservoir fluids are generally complex mixtures of hydrocarbons existing as “liquid-gas” systems under high pressures & temperatures.

- Seldom are two crude oil samples identical and seldom are two crude oils made up of the same proportions of the various compounds.

Fluid Types

- Dry Gases
- Wet Gases
- Gas Condensate
- Volatile Oils
- Black Oils

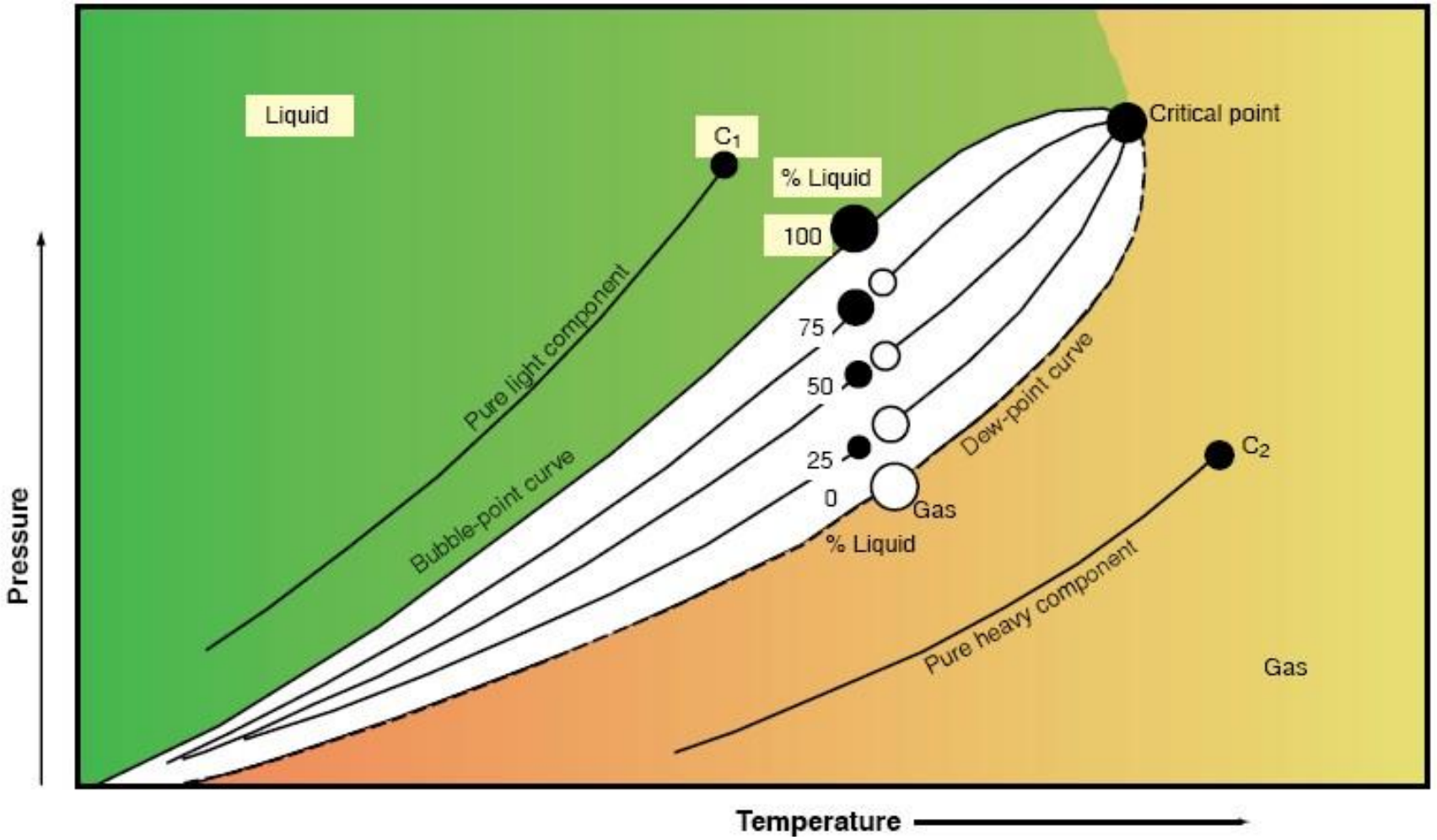
Phase Diagram
Pure Substance (P-T)



- For a single component system, phase behavior is primarily defined by two lines: vapor pressure curve and melting point curve
- Critical point: represents the conditions above which liquid and gas phases cannot be distinguished
- Triple point: condition at which all three phases can exist under equilibrium conditions

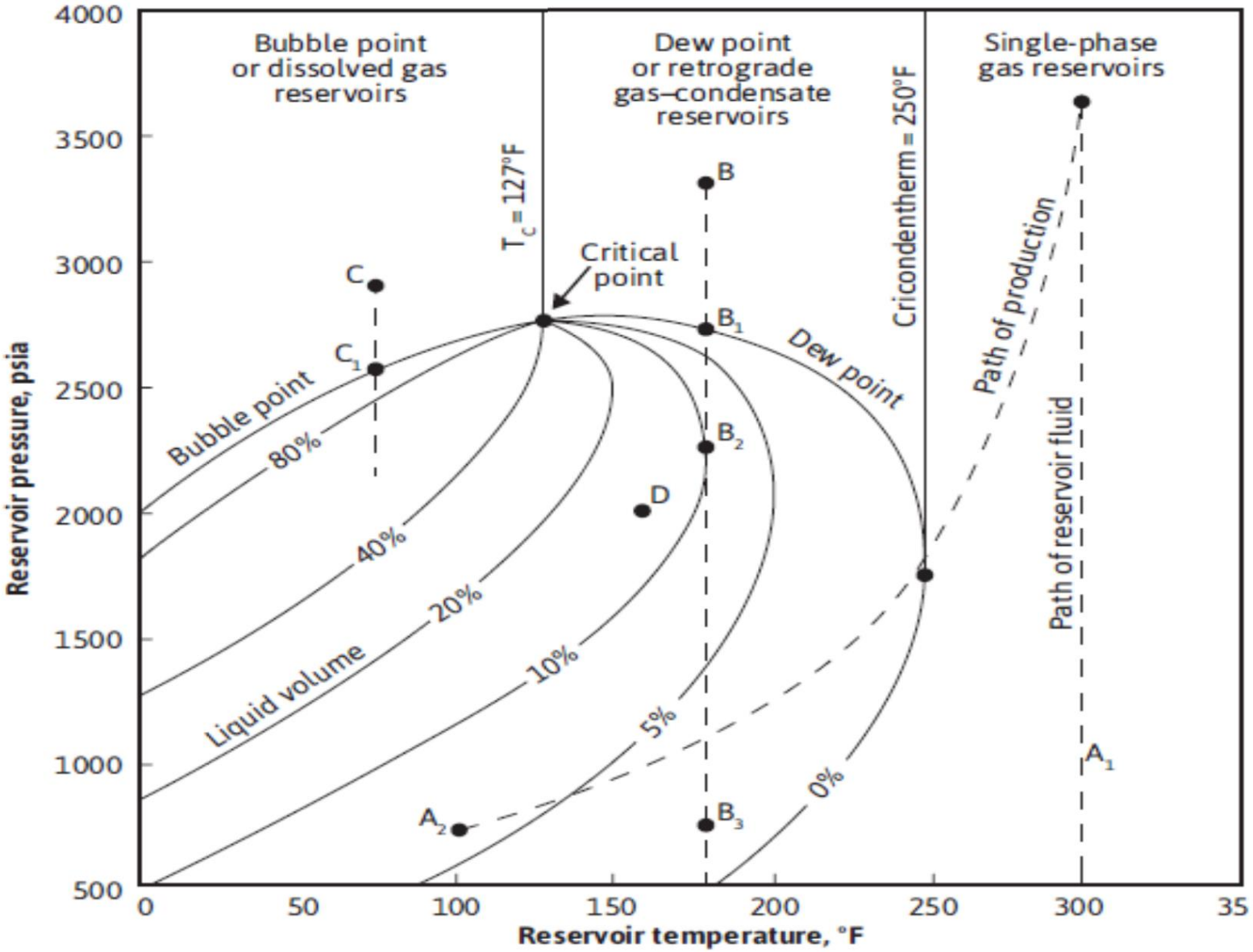
Phase Diagram of Water

Phase Behavior of a Multi-Component System



50:50 mixture of two pure hydrocarbon components on the P-T plane

Phase Diagram – Mixture



◉ Why Predict Fluid Behavior ?

- In oil and gas production systems, all models—whether reservoir, well, surface network, or processing facility, have at least one common input between them –

> "How the fluid properties change with pressure and temperature as it travels from location A to B"

- As this is a basic input, it is imperative we have a good understanding/description of how the fluid behaves at different conditions.

Fluid Models

BO Correlations

- Relates fluid properties at surface (API, GOR, Gas gravity) to properties at downhole (Bo, Pb, Rs, etc.)

Pros:

- Fast and accurate

Cons:

- Not Valid outside their Experimental ranges
- No output composition

Equation of State

- Thermodynamic equations that predict the behavior of fluids based on their composition

Pros:

- Get composition of fluid at any P and T

Cons:

- Slow in calculations
- Weak for density calculations
- Does not respect Mass balance

◉ Workflow Summary in PVT Program

QC Lab Data	• Composition • Mass Balance • Experiments Consistency
Define Pure Components	• Select Components • Enter Composition
Define Pseudo Components	• Mw, SG & BPT • Pseudo Splitting • BICs
Enter Lab Data	• Select Data for Regression • Select Weighting
Regression	• Develop Regression Strategy • Regress • Quality Check
EOS Validation	• Reproduce Lab Experiments

◉Q/C the EOS Model – Phase Envelope/CCE/SEP prediction