EARTH AND SPACE SCIENCE
431 *PRINCIPLES OF GLACIOLOGY*
505 *THE CRYOSPHERE*

Autumn 2017
4 Credits, SLN 14841
4 Credits, SLN 14862

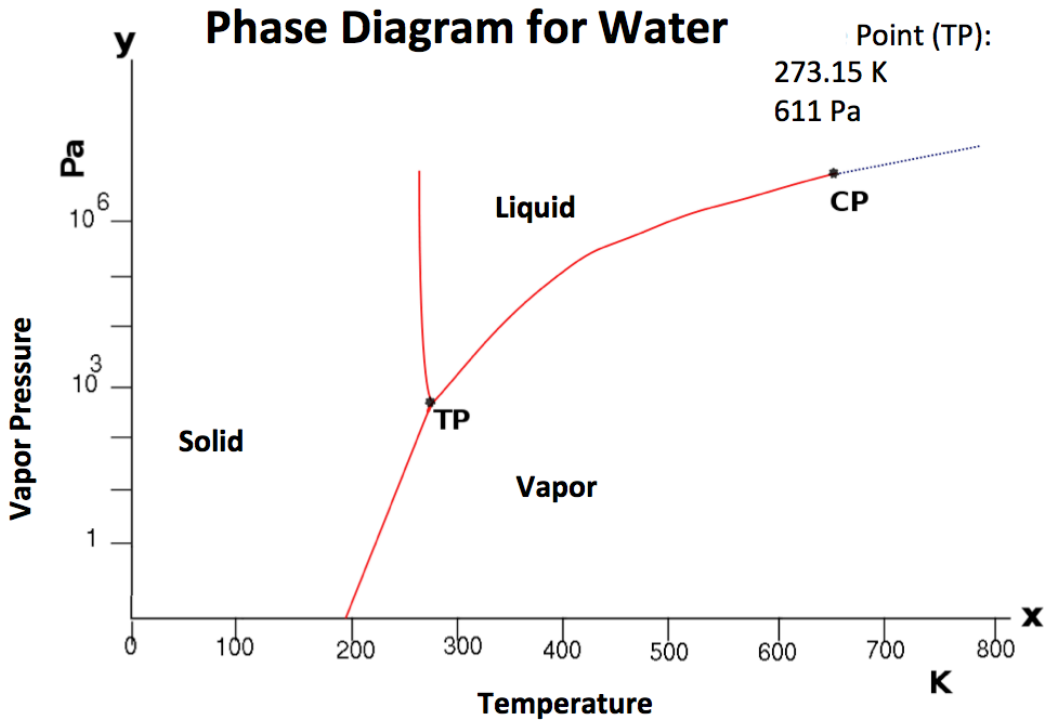
Lab Week 2 – Phase Changes and Water Behavior

Question 1: Liquid, Solid or Vapor?

a) Plot the following on the provided phase diagram using any resources available:

Earth at sea level
Martian surface on the equator during summer
Martian surface at the North Pole during winter
Venus surface

Hint: $P_v = VMR \times P_a$
P_v = vapor pressure
VMR = Volumetric Mixing Ratio *(amount of water in atmosphere)*
P_a = atmospheric pressure



b) Based on your calculations, what phases of water are stable on the Earth's surface? Martian surface? Venusian surface?

c) The Phoenix Martian Lander has observed vapor water pressures over 100 times of what is expected from your calculation in part a). Given that information, is liquid water stable on Mars? Why?

d) There has been some recent evidence for flowing liquid water on Mars that quickly disappears. How is liquid water possible given what you know?

Question 2: Supercooled Water

We will visit the freezer in the ISOLab up on the 3rd floor, where several bottles of SMART Water were placed yesterday.

- What is the temperature in the freezer?
- Why did we empty out some of the water before starting the experiment?
- What are the observed states of the water in the various bottles?
- What happened when we handled the liquid bottle, and why?
- Why is SMART Water a good medium for this supercooling demonstration? (You can read the label.)
- Speculate on what might have been different between the two bottles.
- Calculate the amount of energy required to bring the water back to 0°C. How does this compare to the amount of energy required to freeze the entire volume?
- With the knowledge that freezing releases heat energy, calculate the fraction of the water that turned into ice.
- Water cannot supercool below -40°C. With that in mind, is it ever possible for a volume of supercooled water to freeze entirely? Why or why not?