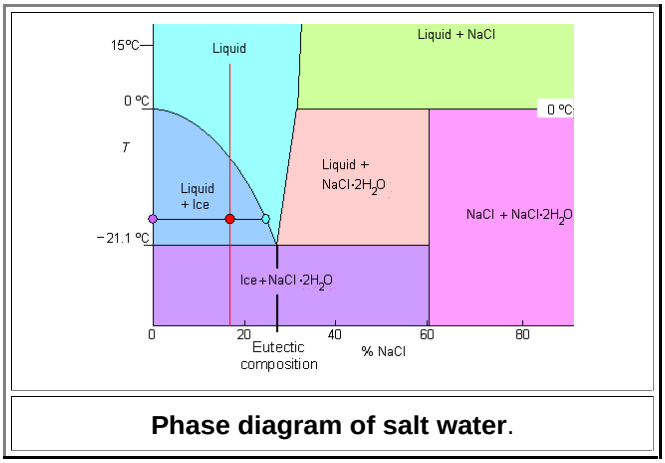
Phase Diagram of Salt Water

Illustration

- Here is the phase diagram of salt water, i.e. water (H_2O) with some dissolved salt (NaCl).
  - Now let the mixture freeze or solidify. The fact that this happens at rather low temperatures compared to the freezing temperature of steel, for example, is completely irrelevant for the general considerations we are doing here.
    You should now be able to draw some conclusion on your own.



Phase diagram of salt water.

  - "Ice" means solid and rather pure H_2O with almost no dissolved salt in this case.
    Never mind the NaCl end! NaCl · 2 H_2O means that you have a rock salt crystal with water molecules as a kind of dissolved impurity (2 H_2O molecules occupying the place of one NaCl unit). The key word in this context is "**crystal water**" - look it up!
- OK—I help you. What we see for low salt concentrations up to 30 % or so, is:
  - There is an eutectic composition around 27 wt % NaCl or salt dissolved in the water.
  - At the eutectic point, the melting or freezing temperature is as low as it will get: -21.1 °C (- 6°F)
  - The maximum amount of salt you can dissolve in water is around 30 %, slightly increasing with temperature.
  - If your salt concentration is, for example, lower than the eutectic concentration (i.e. it is below about 27 %), the system will decompose into salt-free ice and liquid water with an increased salt concentration as shown for the "red" composition around 18 % salt
  - The last drop to solidify will do so at -21.1 °C (- 6°F) and contains about 27 % salt in liquid and ice.
  - Now you know why the ice swimming in the oceans is sweet, why salting ice and snow will melt the stuff (provided the temperature is not below the eutectic temperature), how much salt you need to thaw a given amount of ice or snow, and how much salt you can dissolve in some amount of water.