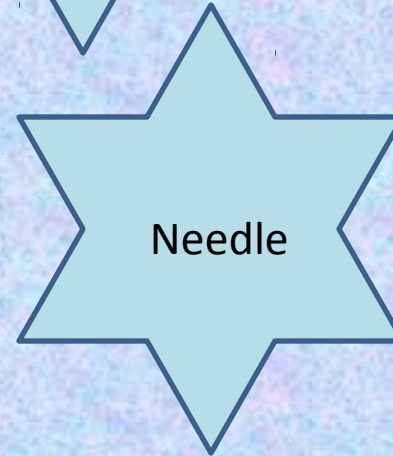
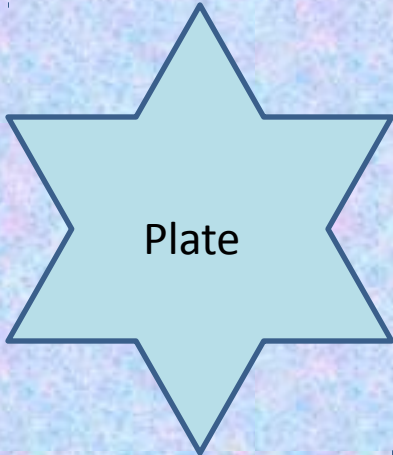
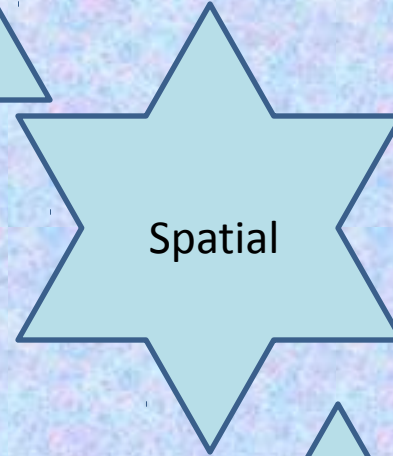
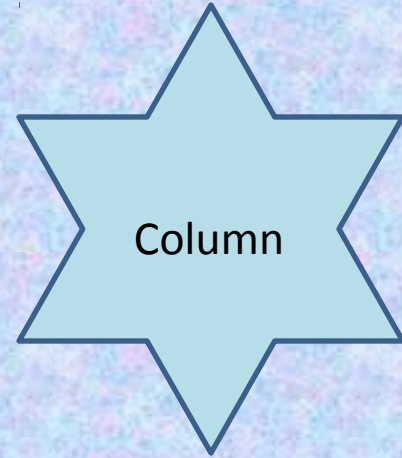
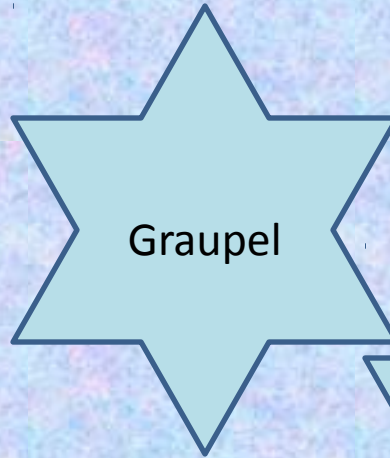


Basic Snow Characterization

Russ Alger
Institute of Snow Research
Michigan Tech University
Snow Test Consulting



Snow as Precipitation

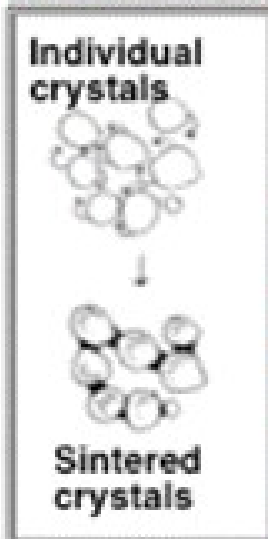
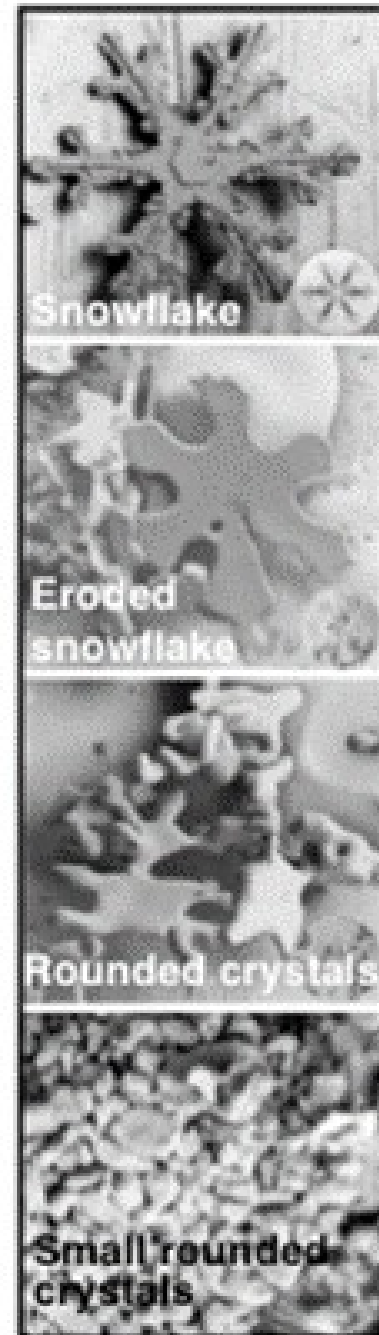
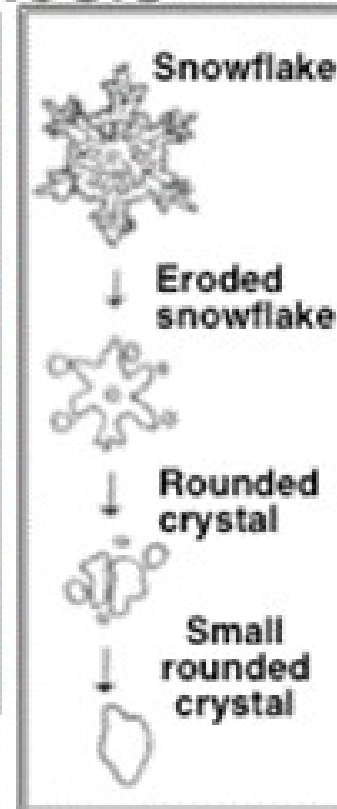
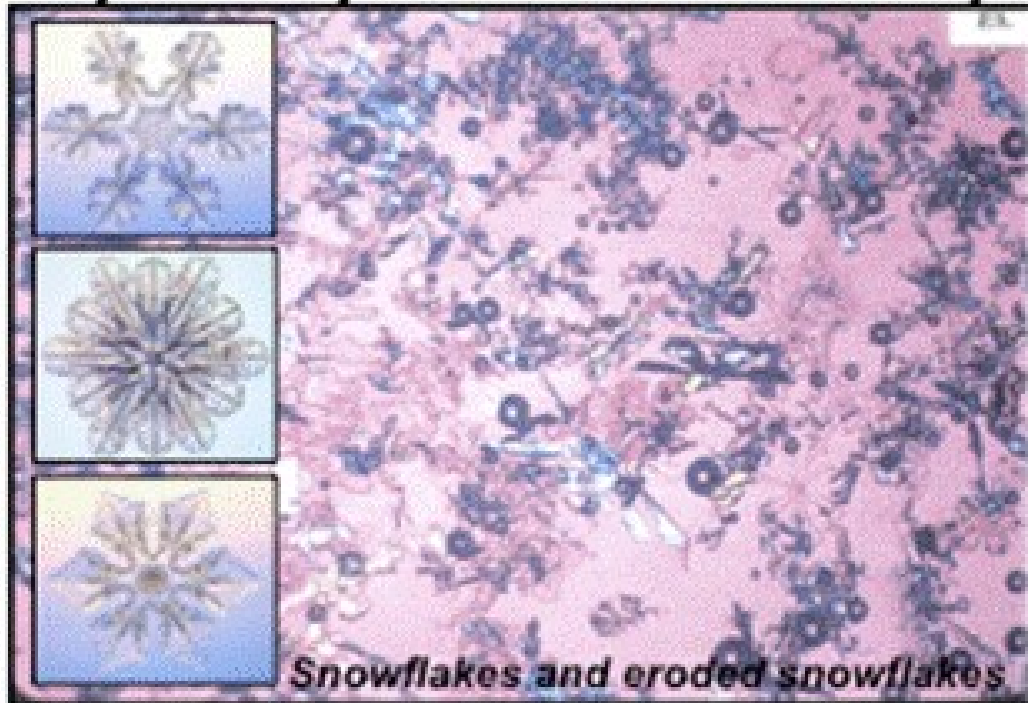


Metamorphism

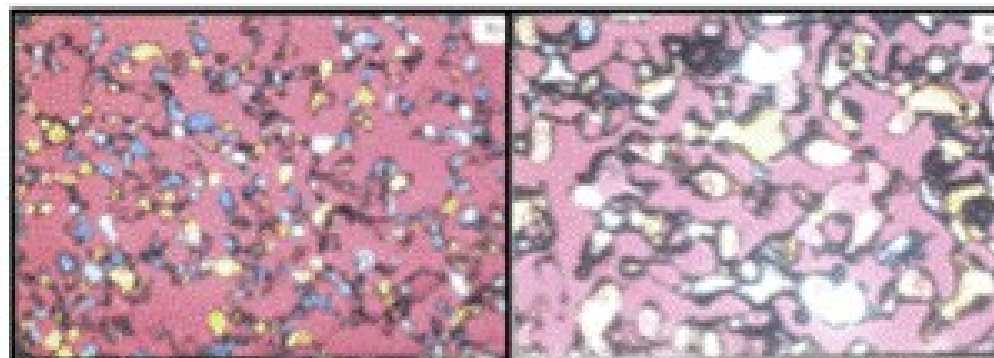
Equi-Temperature

A photograph of a snow-covered mountain peak with rocky outcrops, serving as a background for the text. The mountain is the central focus, with a sharp peak and steep slopes covered in snow and scattered rocks. The sky is a pale, overcast blue.

Equi-temperature Metamorphism



(Destructive Metamorphism)



Small rounded crystals

Well-rounded crystals

Metamorphism



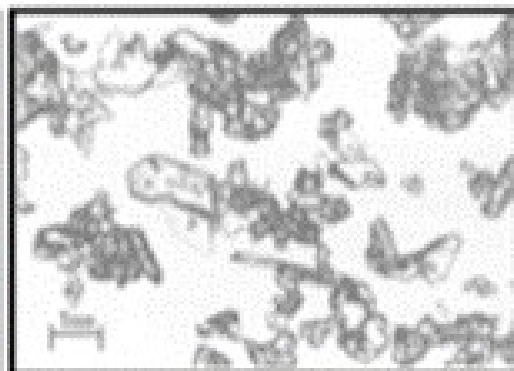
Equi-Temperature
Temperature Gradient

Temperature Gradient Metamorphism

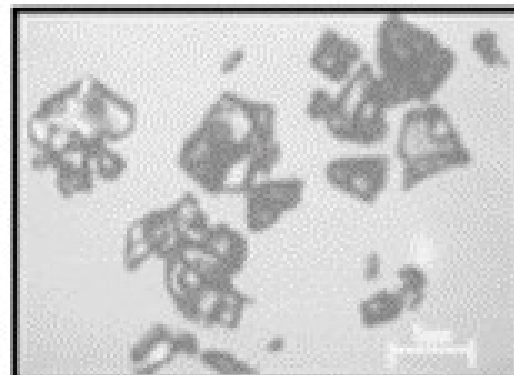
(Constructive Metamorphism)



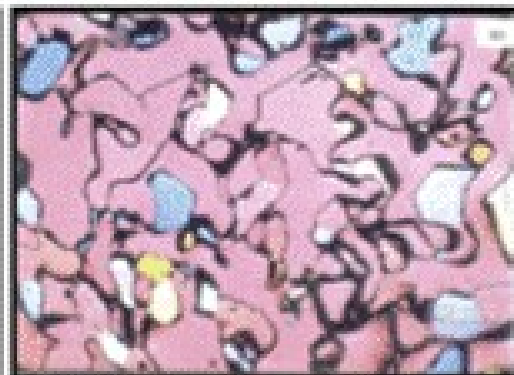
Well-rounded crystals



Rounded crystals with developing facets



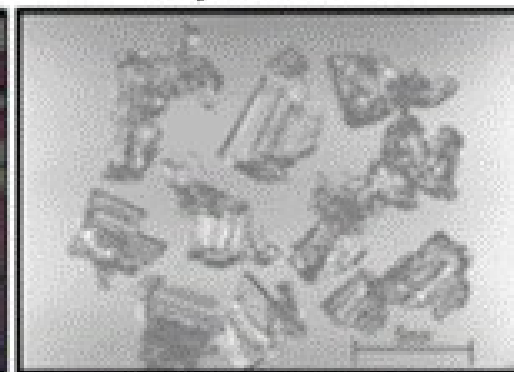
Solid faceted crystals



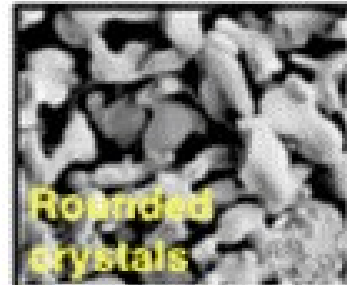
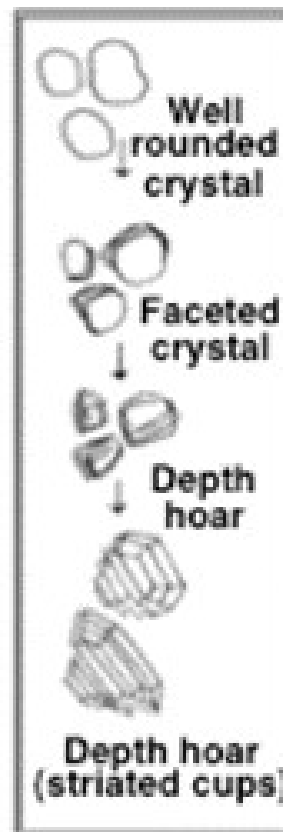
Depth hoar



Large depth hoar



Cup-shaped, striated crystals (depth hoar)



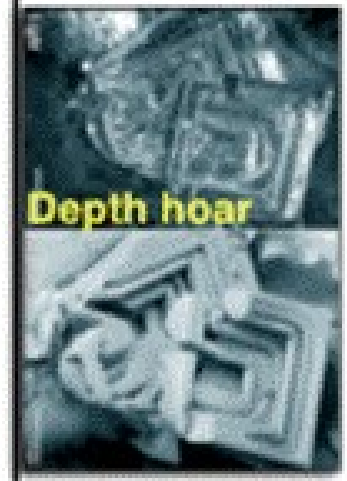
Rounded crystals



Faceted crystals



Depth hoar



Depth hoar

Metamorphism



Equi-Temperature
Temperature Gradient
Melt Freeze
Pressure

Basic Properties

Depth

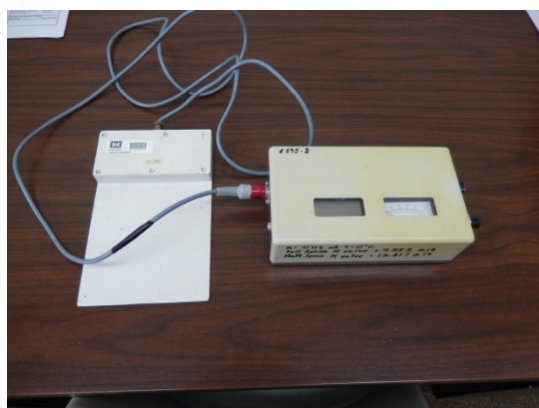
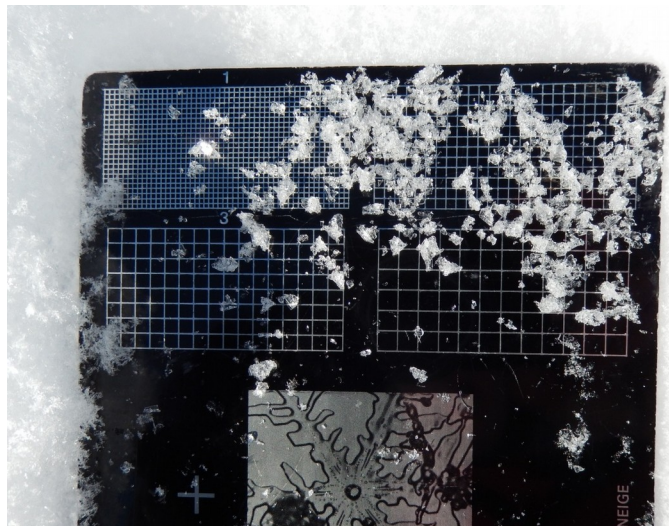
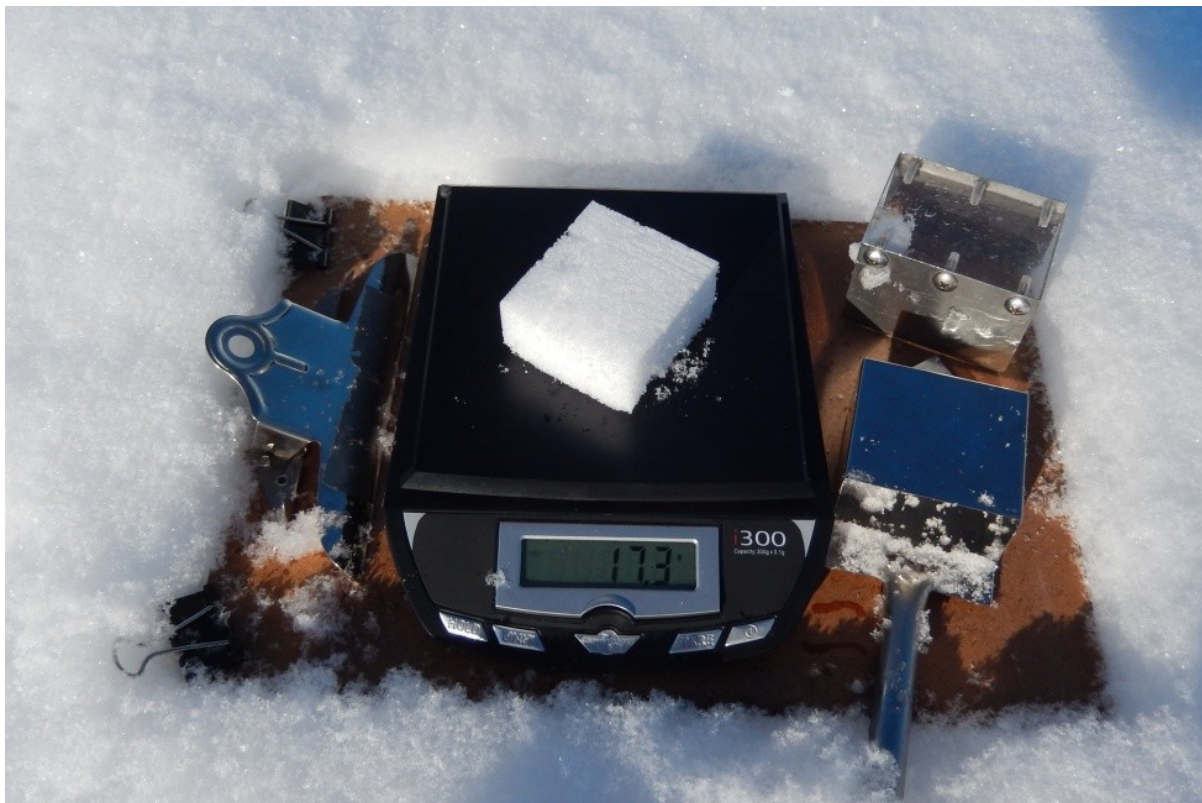
Layering / Lenses

Temperature

Density

Free Water Content

Crystal Structure



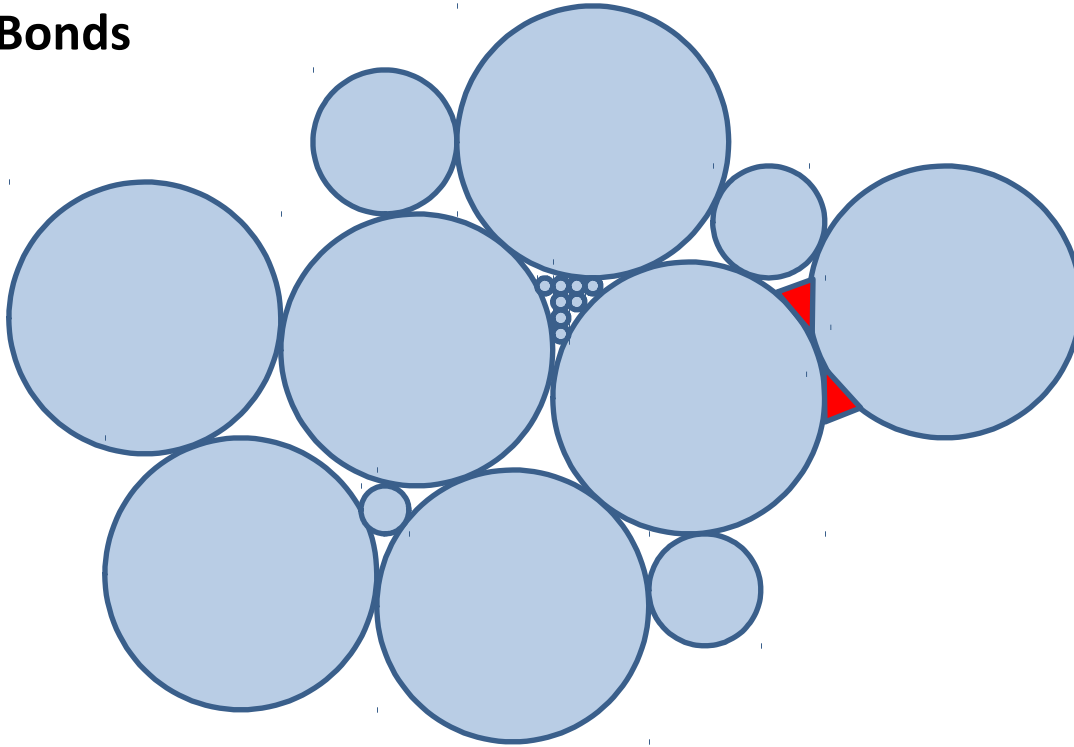
Strength Measurements

Shear and Compression



Bonding

Road Mix with Bonds



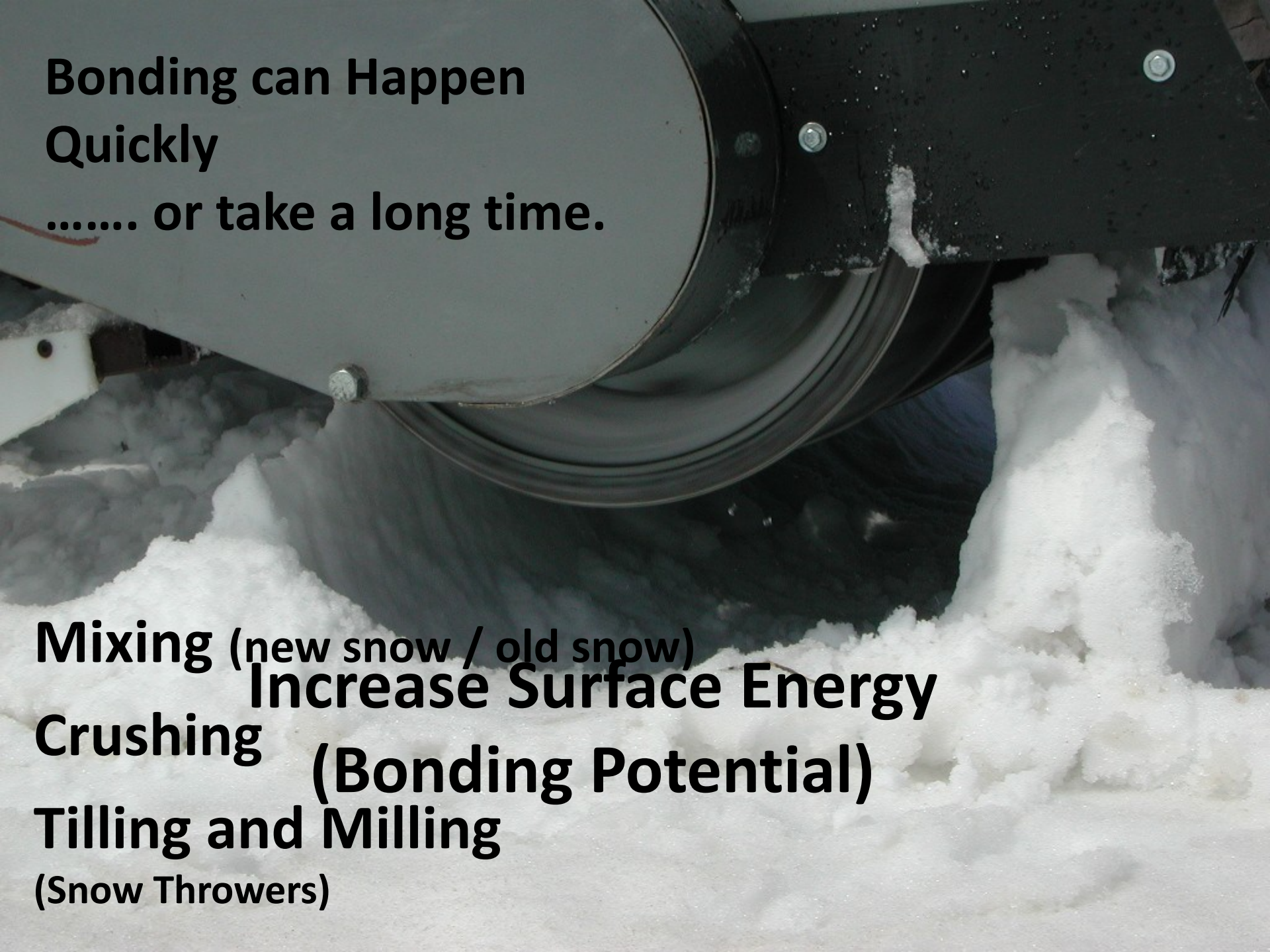
Increase Density

Increase Surface Energy

Increase Temperature (to a point)

Inject Water

Particulate (Dirt, Dust, Exhaust = Albedo and Lack of Bond)



**Bonding can Happen
Quickly
..... or take a long time.**

Mixing (new snow / old snow)
Increase Surface Energy
Crushing (Bonding Potential)
Tilling and Milling
(Snow Throwers)

Compaction

(Increase Density)

Tracks

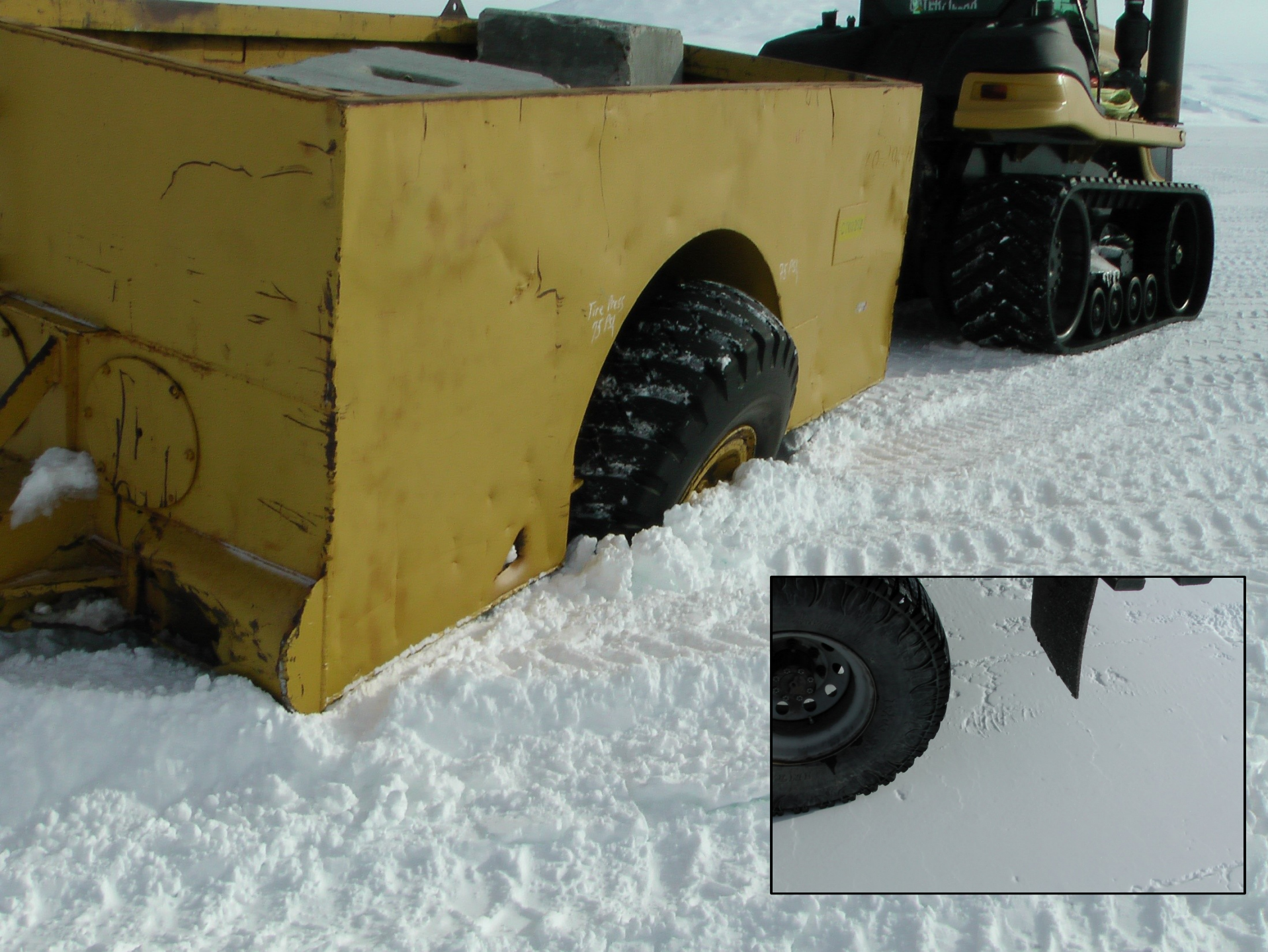
Plate

Jump up and Down!
Deep snow
Roller

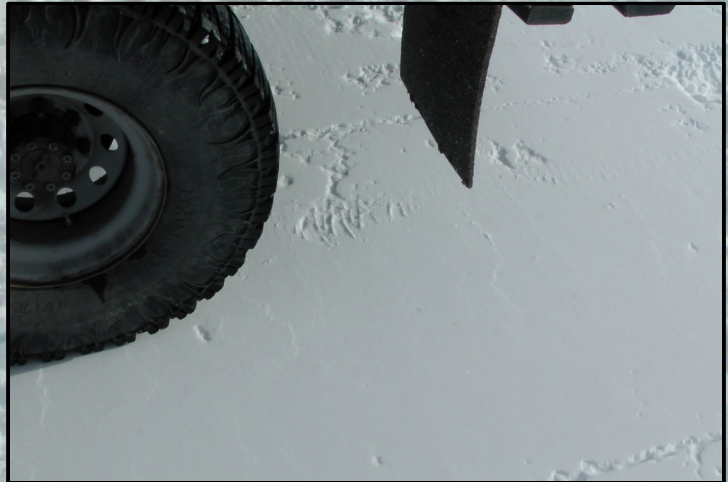
Shallow Snow
Wheels (Roller or Vehicle)

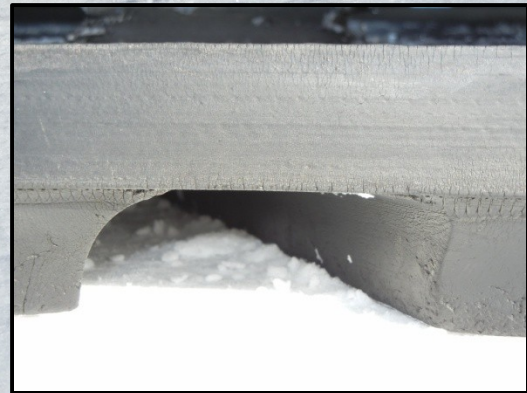
Vibration





Fire Press
75 199

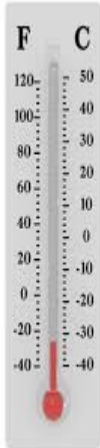






Cape Evans, Antarctica

Snow and Ice Melting



Energy to raise the temperature of ice 1o F is 0.51 BTU/lb.



Let's say we want to make 100 gallons of cold water in the field. First we would want to raise the temperature of the snow to just below 32o F. If the density of the snow is 0.25 we would need about 54 ft³ of snow (about 850 lb).

If the snow is 0o F, it would take about 14,000 BTU to accomplish the 32o change in temp.

Once the snow is brought to near the melting point, it takes a larger input of energy to move from solid to liquid (latent heat of fusion). This amount of energy is about 144 BTU/lb or about 122,400 BTU for the above example. This makes a total of about 136,400 BTU to make 100 gallons of water. At an efficiency of 0.9, this becomes about 150,000 BTU. This equates to 1.3 gallons of jet fuel or 1.8 gallons of propane.



**I still say – Jump Up and Down!!
Questions????**