

The Cold Earth

- 4/5ths of the surface at $T < 5^{\circ}\text{C}$ all the time
- Most of the ocean (90-95%) is at $T < 2^{\circ}\text{C}$ all the time
- Lowest recorded Temp -90°C Vostok, Antarctica

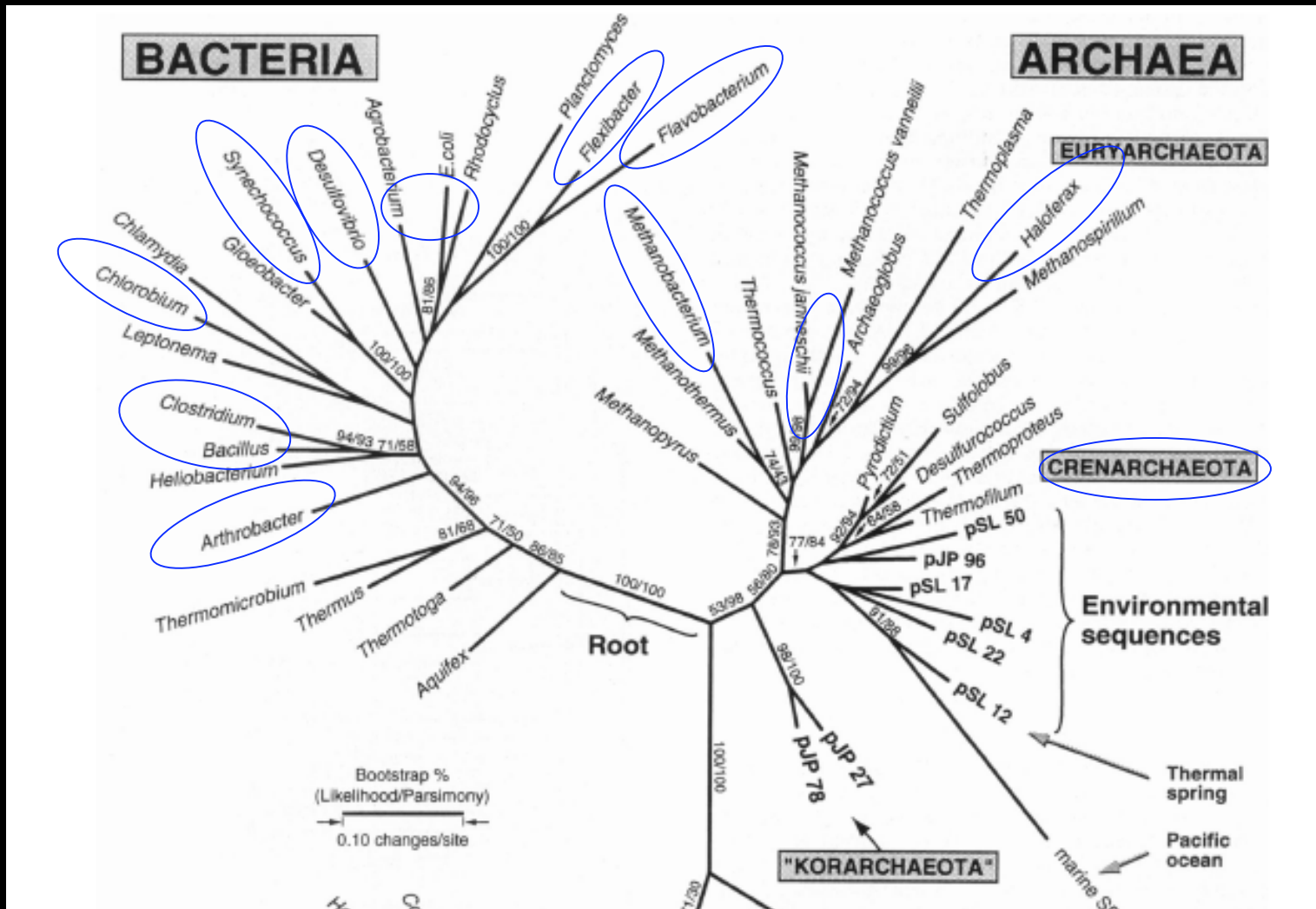


Low-Temperature Environments

- True psychrophiles more commonly isolated from stable thermal environments
- Psychrotolerant microbes (psychrotrophs) isolated from less stable (fluctuating) thermal environments

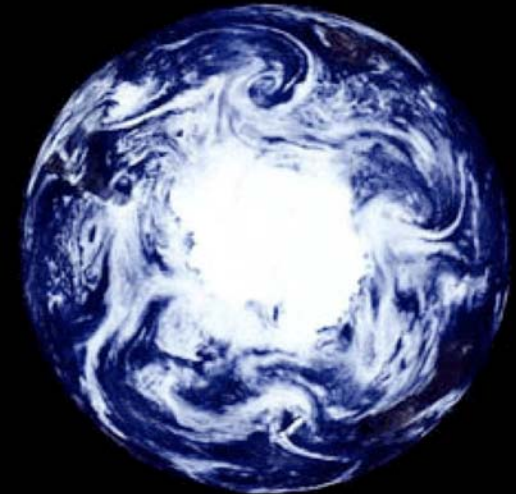
Deming and Huston, 2000

Tree of Life



Arctic and Antarctic

- Seawater
 - Diverse Bacteria
 - CFB dominant in surface waters
 - Ammonia-oxidizers present
 - Euryarchaeota
- Marine Sediments
 - Diverse Bacteria
 - Sulfate reducers
 - CFB
 - Low numbers and diversity of Archaea



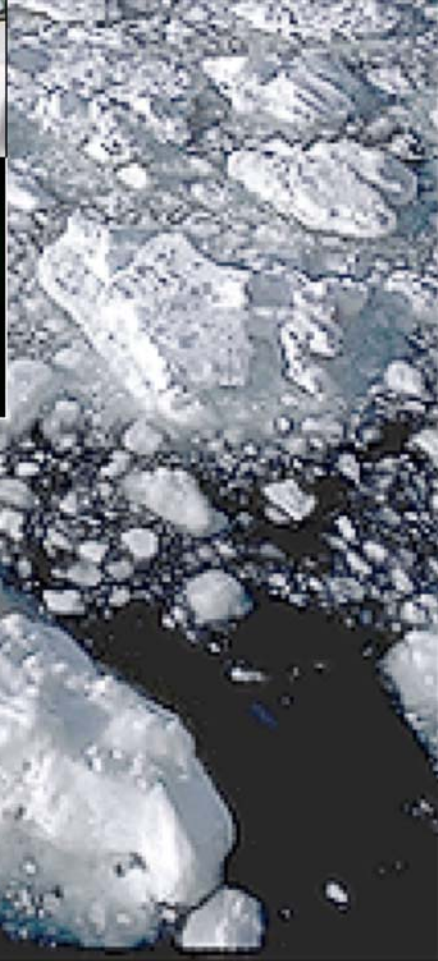
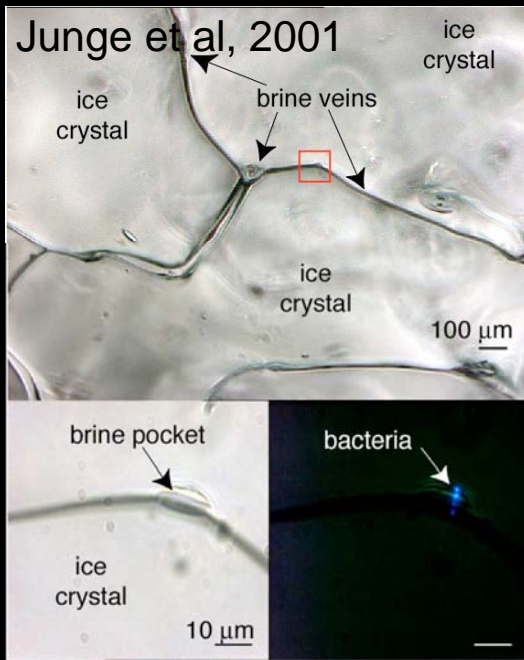
Antarctica

- Ice-covered lakes
 - Mats: diverse Bacteria, limited Archaea
- Rocks
 - endoliths
- Dry Valleys
- Ice shelves
- Glaciers
- Snow



Taylor Valley and Glacier w/ Lake Fryxell

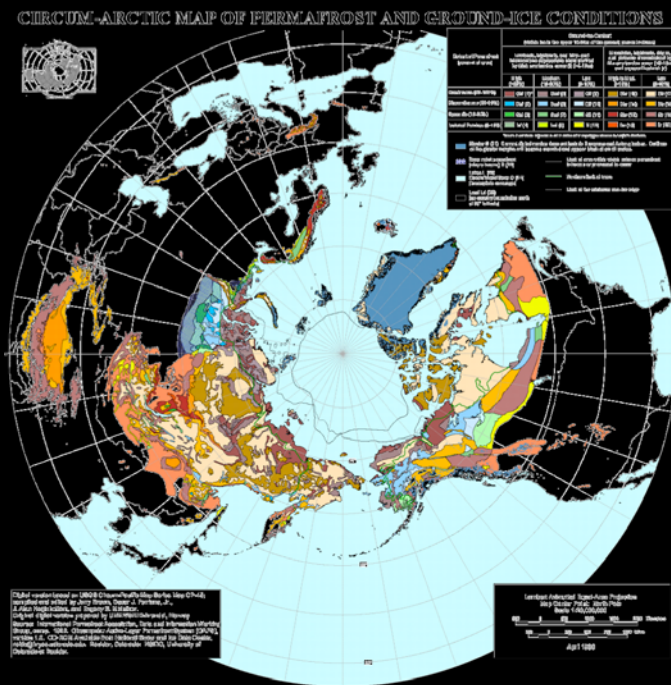
Sea Ice



- $T = -2$ to -35°C
- 13% of Earth's surface (max)
- Diverse Bacteria (some common to both poles), No Archaea
- Activity demonstrated to -20°C

Permafrost

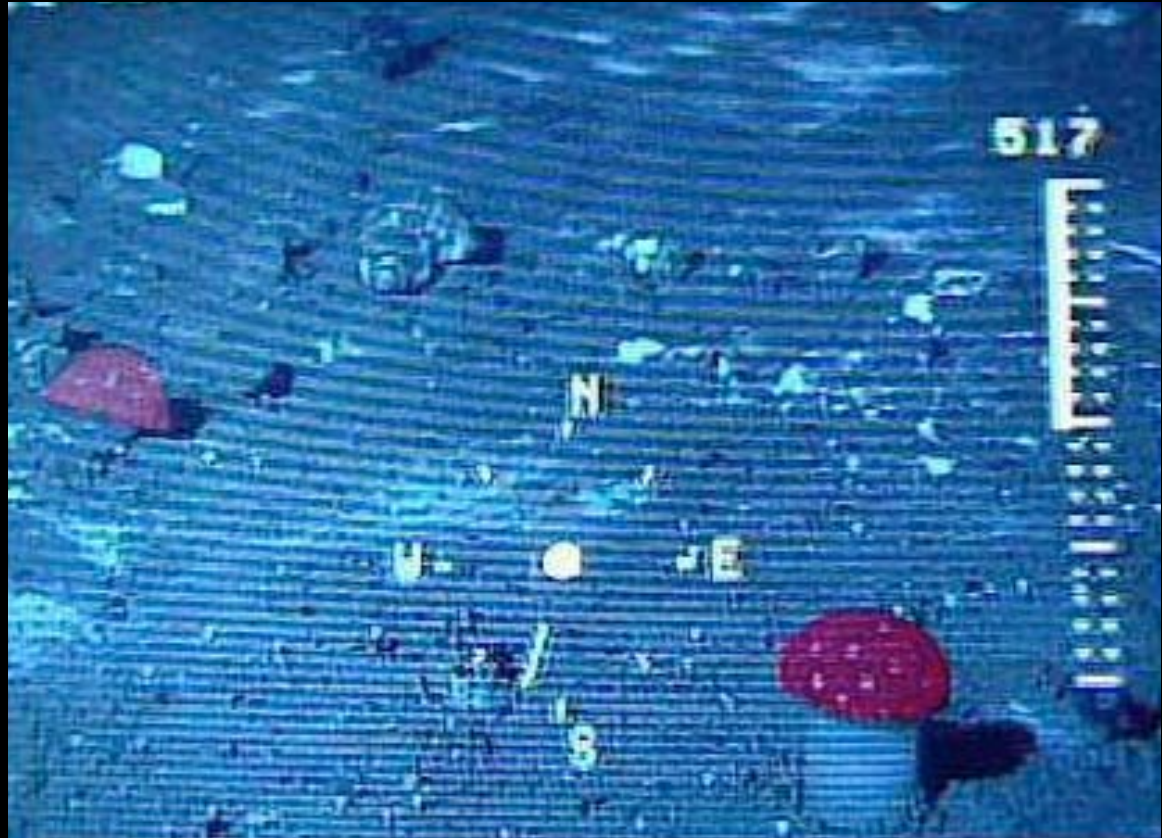
- $T = 0$ to -14°C
- 20% of land surface
- Activity to -15°C
- Diverse Bacteria
- No psychrophiles isolated, psychrotolerant microbes only



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Deep Sea

- $T = -1$ to 4°C
- 90% of ocean floor
- >95% of ocean volume
- Archaea dominant (especially Crenarchaeota)
- Halomonas, haloarchaea
- Deep Antarctic seawaters:
 - Diverse Bacteria, γ -proteobacteria dominant
 - Only Euryarchaeota



Other Environments

- Glaciers
 - $T = 0$ to -40°C
 - 10% of land surface
- Alpine Regions



- Seasonally Ice and Snow Covered
 - 3% of Earth's surface

Summary

- Low-temperature environments are not just frozen storage—growth is possible!
- Many places to continue exploring
- More diversity to uncover