

# Temperature, Salinity and Acidification



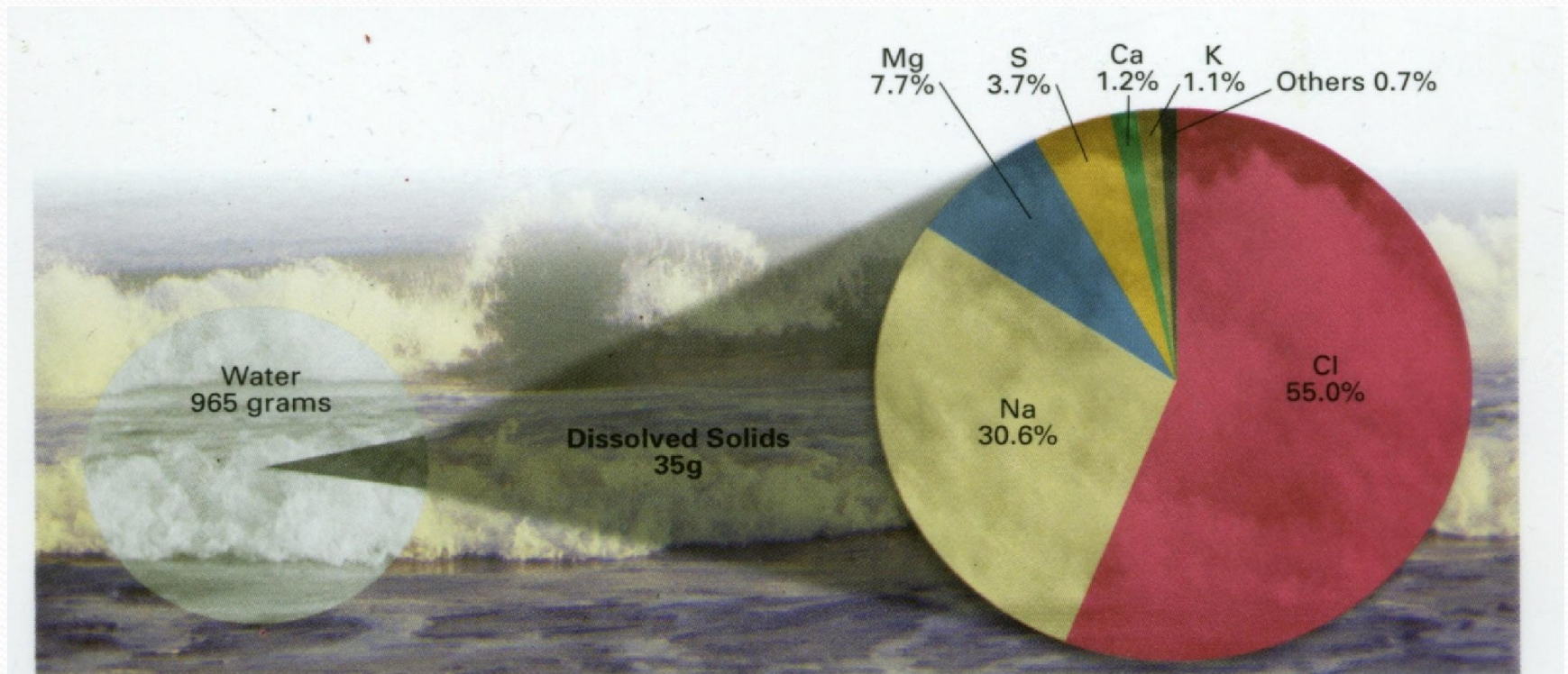
# TEMPERATURE

- Sunlight heats the surface of ocean water (H<sub>2</sub>O)
- 3 temperature zones of ocean water:
  - Surface zone: warmest; sea level to 300m; sunlight only penetrates a few meters, but wind and waves mix heat evenly throughout the surface zone.
  - **Thermocline zone: marked by a rapid temperature change with depth**; marks the boundary change between the surface zone and the deep zone; 300-800m below sea level.
  - Deep zone: temperatures continue to decrease slowly; 800m-ocean floor.



# What is in ocean water?

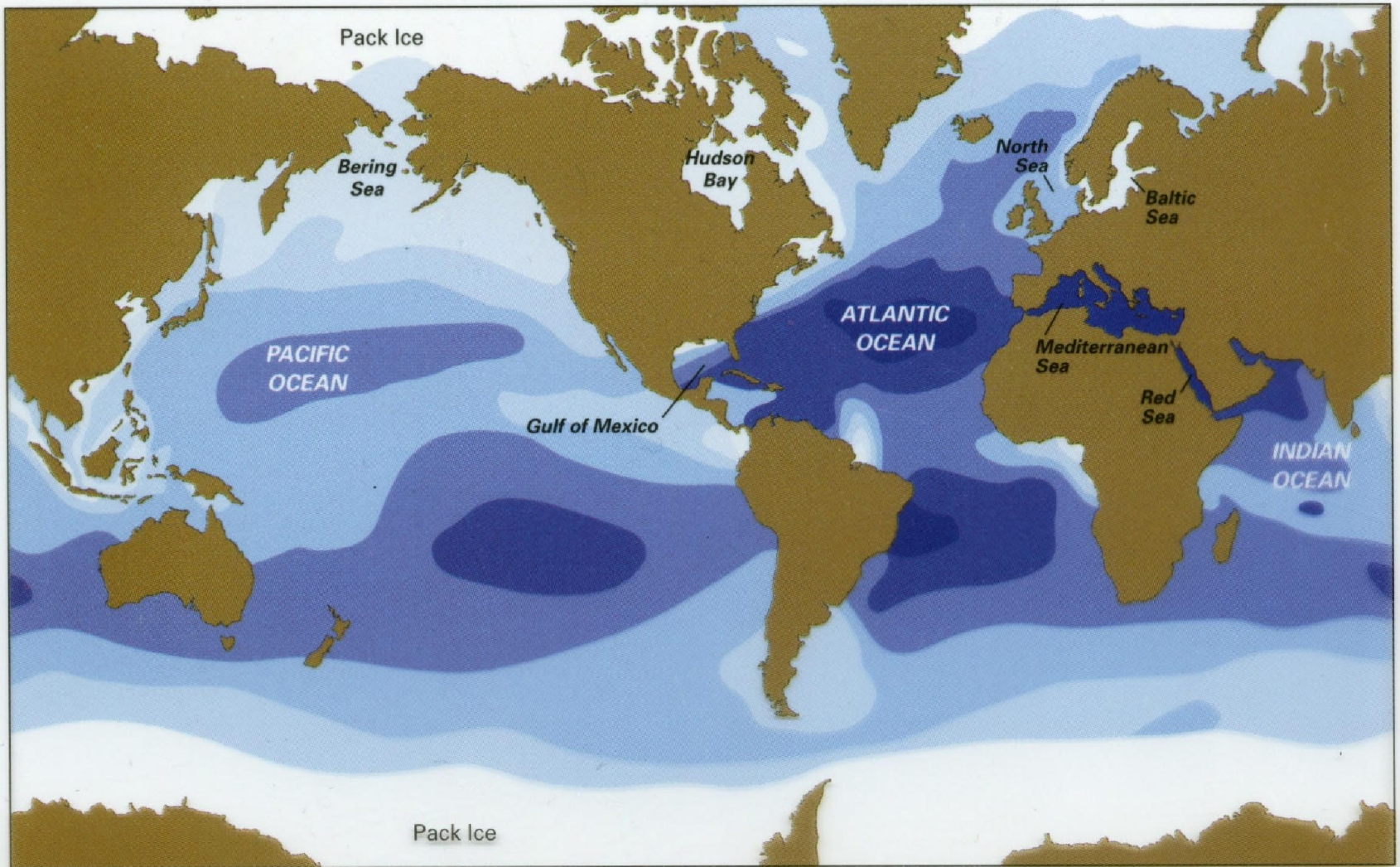
- 96.5% of ocean water is H<sub>2</sub>O
- The other 3.5% is dissolved gases and solids such as salt
  - (NaCl) Sodium Chloride is the main salt in the ocean



# Salinity

- Salinity - the amount of dissolved solids (mainly salts) present in ocean water.
- Average salinity of ocean water is 35‰
  - ‰ = parts per thousand (ppt)
  - 50 million billion tons of salt in our seas
- **1,000g of seawater consists of 35g of dissolved salts**





Proportion of salt per  
1000 parts of sea water



- **Large amounts of evaporation will increase salinity.**
- Large amounts of precipitation, melting ice, and runoff from land will decrease salinity.



# How the oceans became salty...

Each year, Earth's rivers carry more and more salt into the ocean. The water evaporates, but the salt is left behind in the ocean.

- **The principle source of dissolved salts in the ocean is the weathering and erosion of rocks on land.**

Since the oceans were first formed, the oceans have gotten saltier.

- Now more salt is being deposited on the ocean floor as is coming from rivers reaching a general equilibrium

# Ocean Resources

- Desalination – taking the salt out of salt water.





# Ocean acidification



2016



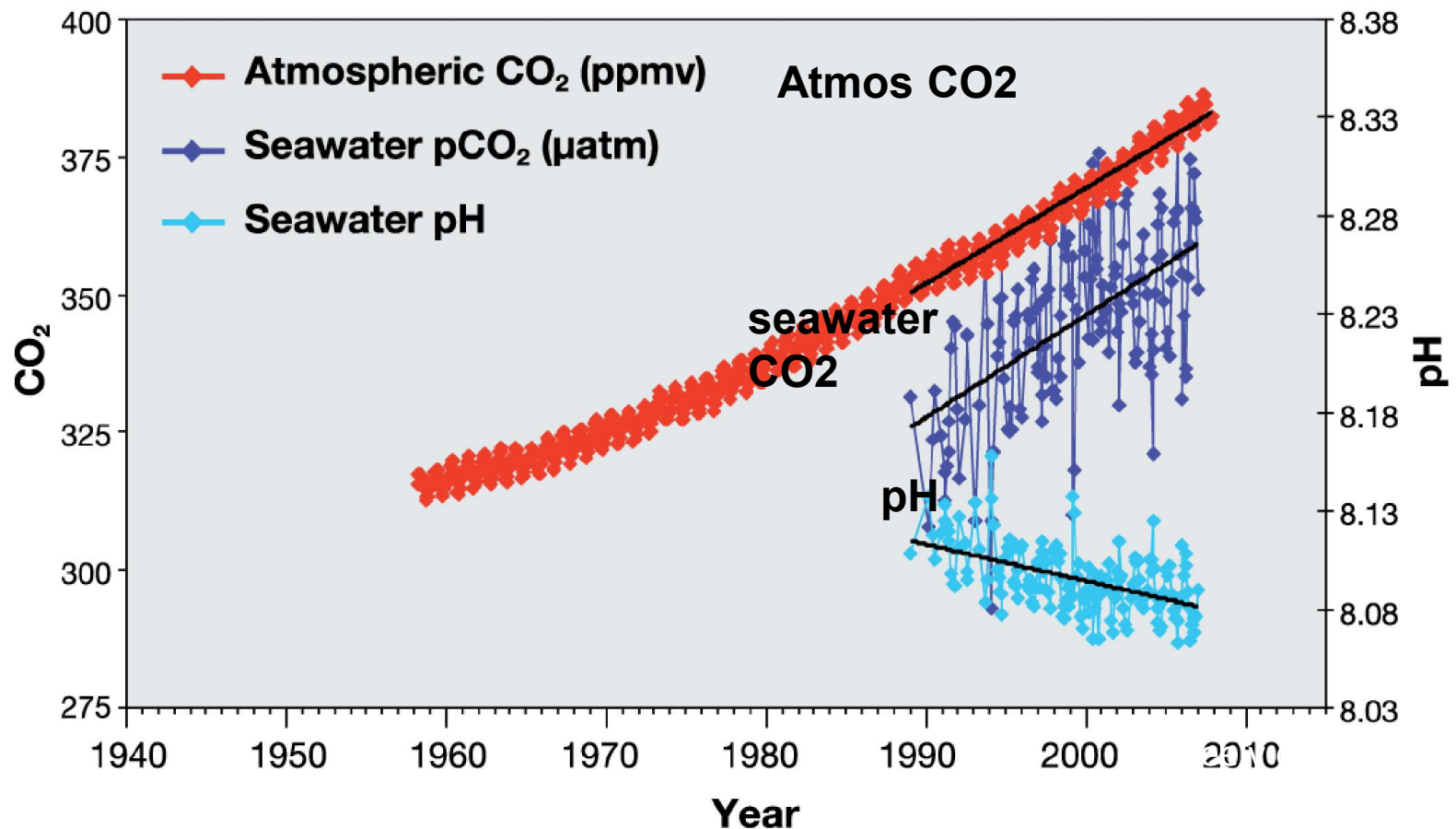
# Ocean Acidification

- Excess carbon dioxide from the atmosphere makes its way to the oceans.
  - **The oceans are a sink for atmospheric CO<sub>2</sub>**
- CO<sub>2</sub> increases acidity of ocean water
- **Ocean organisms suffer especially CaCO<sub>3</sub> organisms (calcium carbonate)**



# Ocean Acidification

## CO<sub>2</sub> and pH time series in the North Pacific Ocean

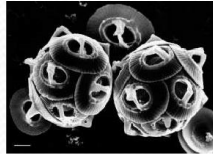




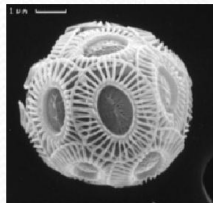
# pH disrupts shell formation

Ambient pH

pH



*Coccolithus sp.*



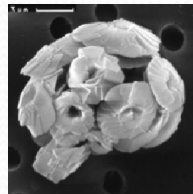
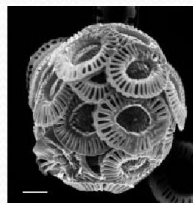
*Eurythoe sp.*



*C. quadricornatus*



*C. braconii*



Coccolithophores largest producer of calcite on Earth



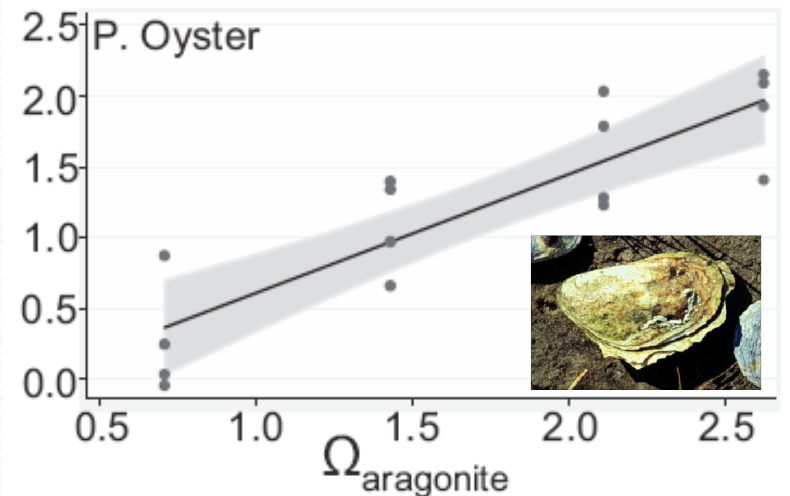
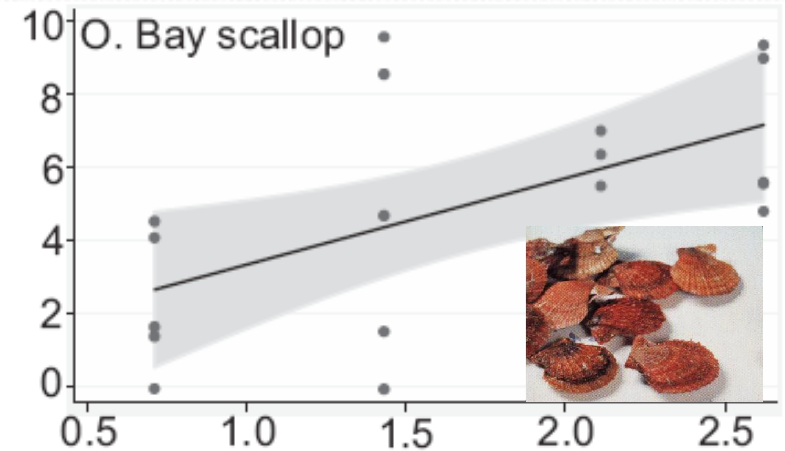
NASA image



# Negative impact on fisheries

- economic losses
- global shellfish prod.  
10.5 billion US\$
- disruption livelihoods

Net calcification rate  
(wt% per 60 d)



Decreasing pH