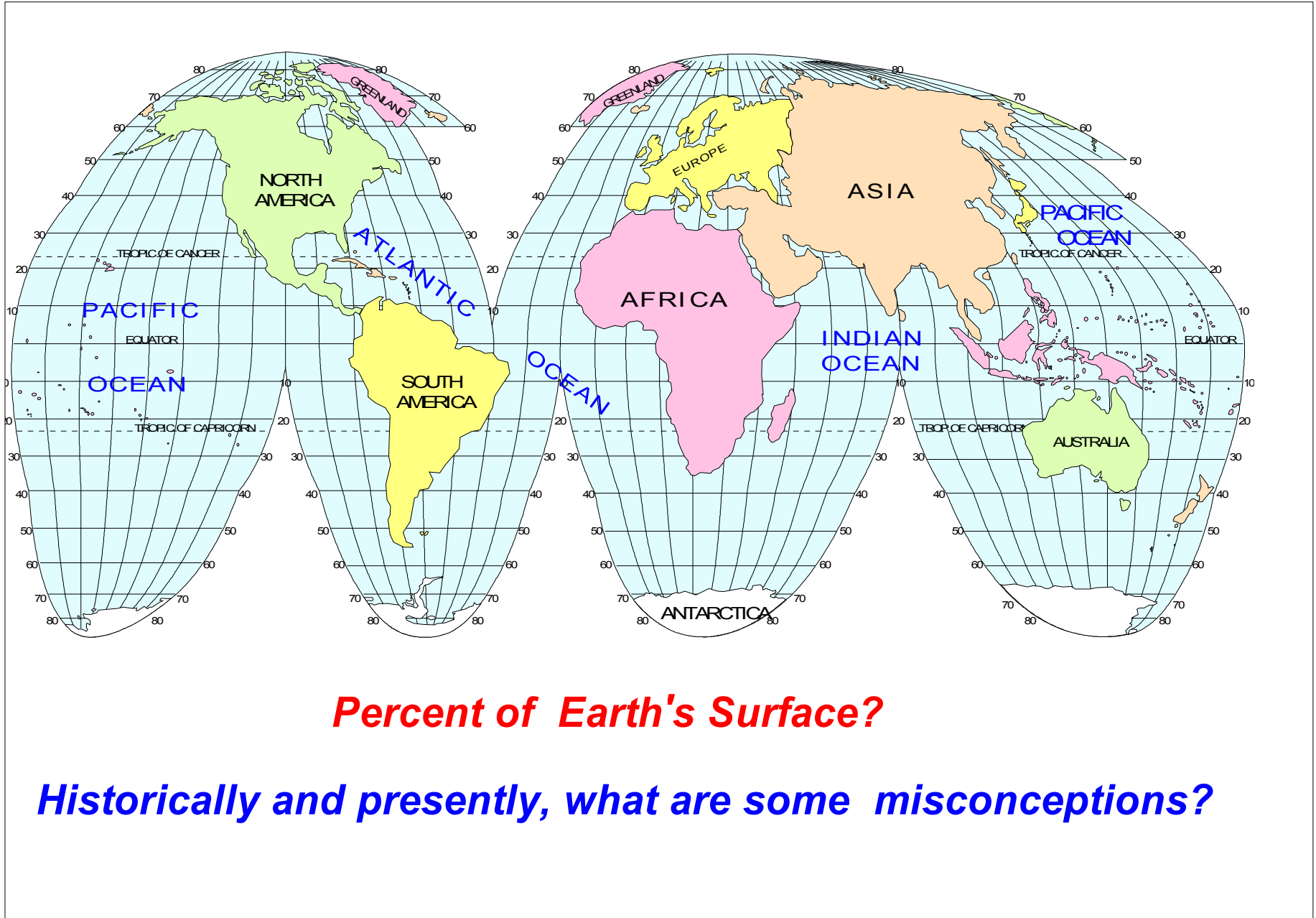


# OCEANOGRAPHY

*Biological*  
*Geological*  
*Chemical*  
*Physical*



**Southern Ocean, Anarctica**



**Percent of Earth's Surface?**

**Historically and presently, what are some misconceptions?**

## **COLLECTING DATA FROM THE OCEANS**

### **Geological**

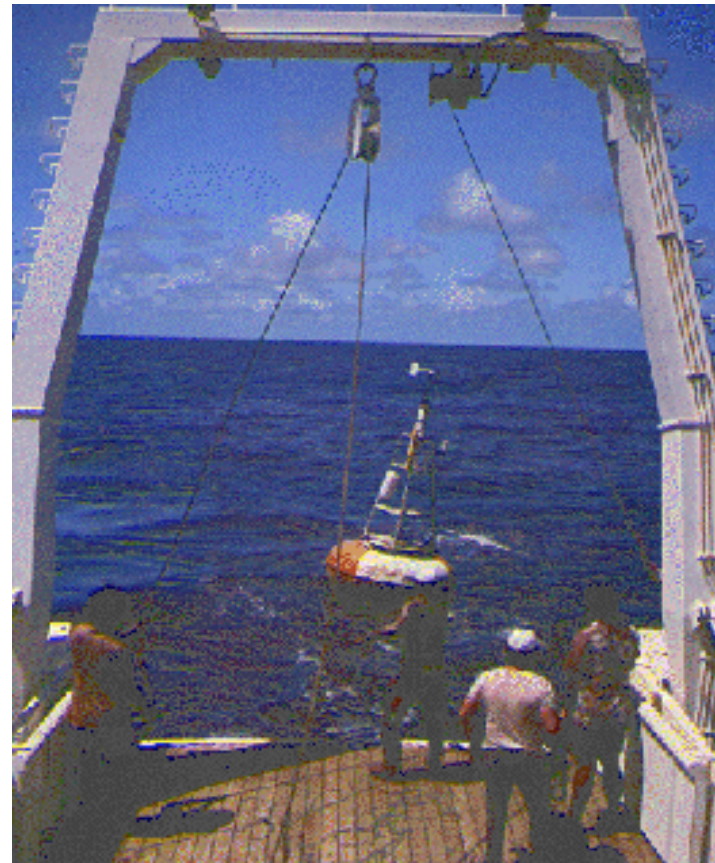
*depth recording, dredging,  
coring, seismic profiling*

### **Biological**

*scuba, submersible,  
tow, depth sampling*

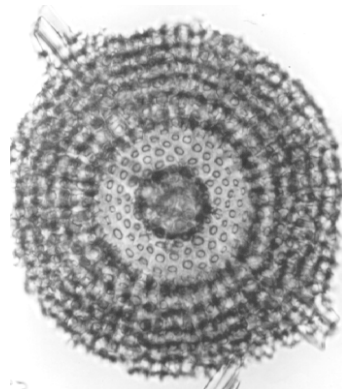
### **Physical and Chemical**

*Nansen bottles,  
Reversing thermometers,  
wind direction, current  
meters, drift bottles*



# **Biological Oceanography**

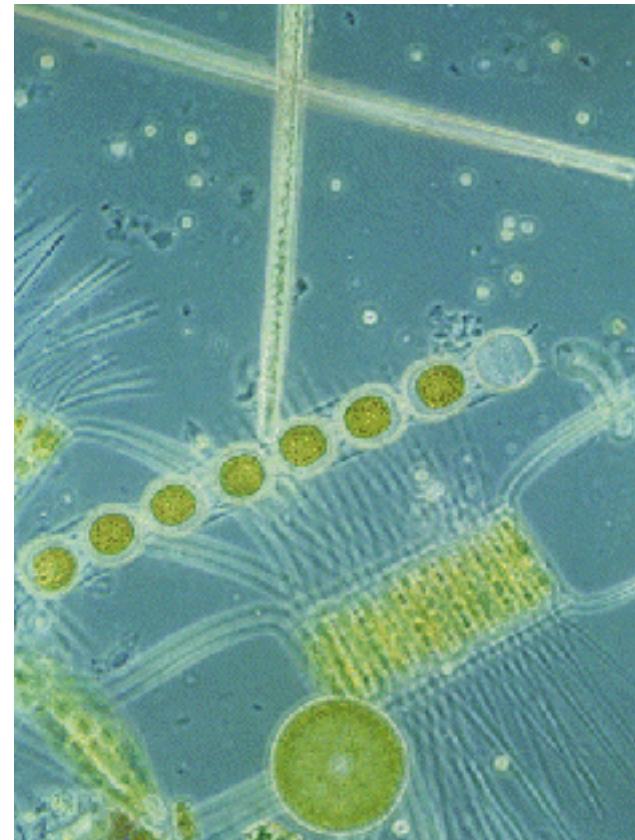
**little critters to big critters  
productivity  
ecosystems**



**radiolarians**

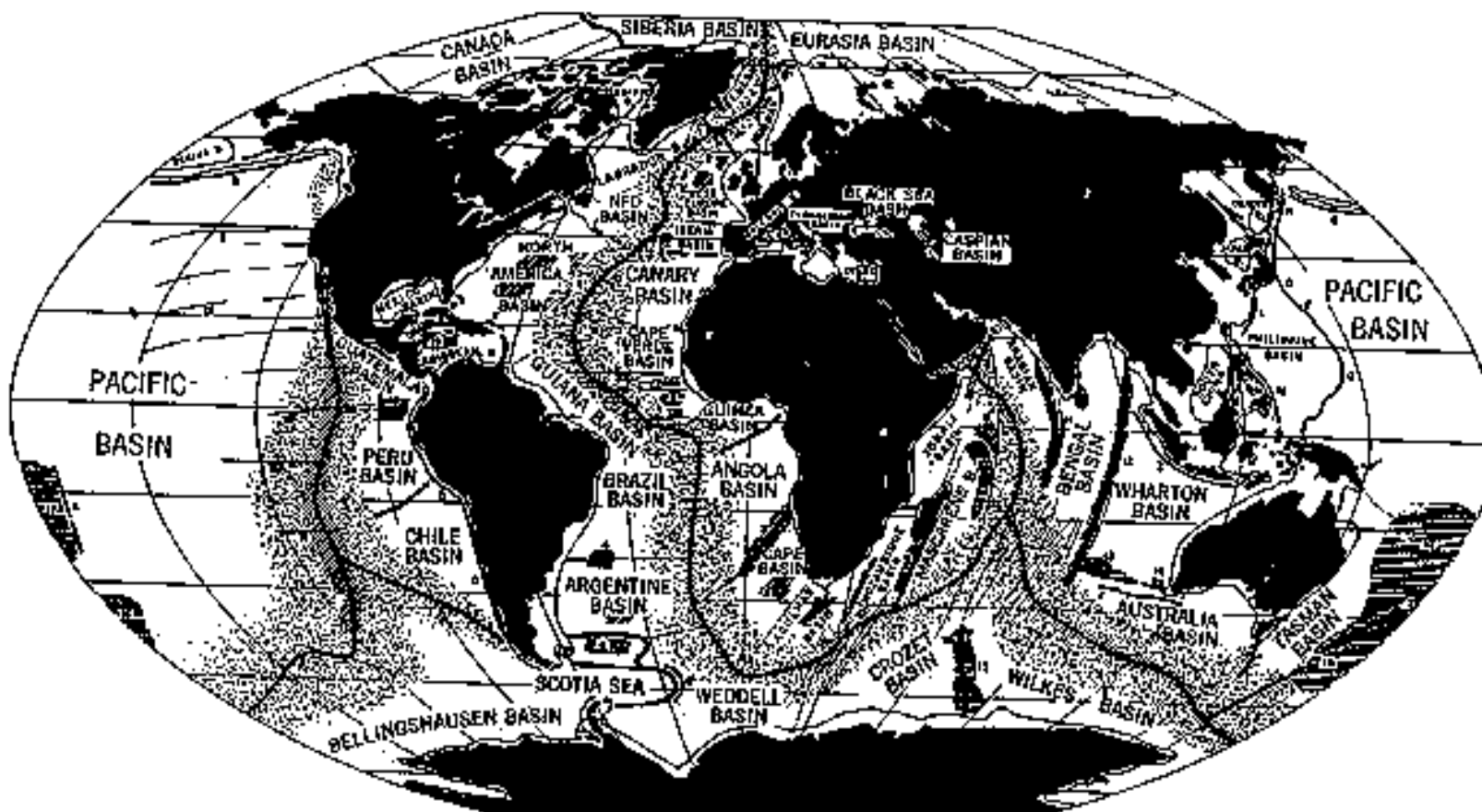


**sea slug**



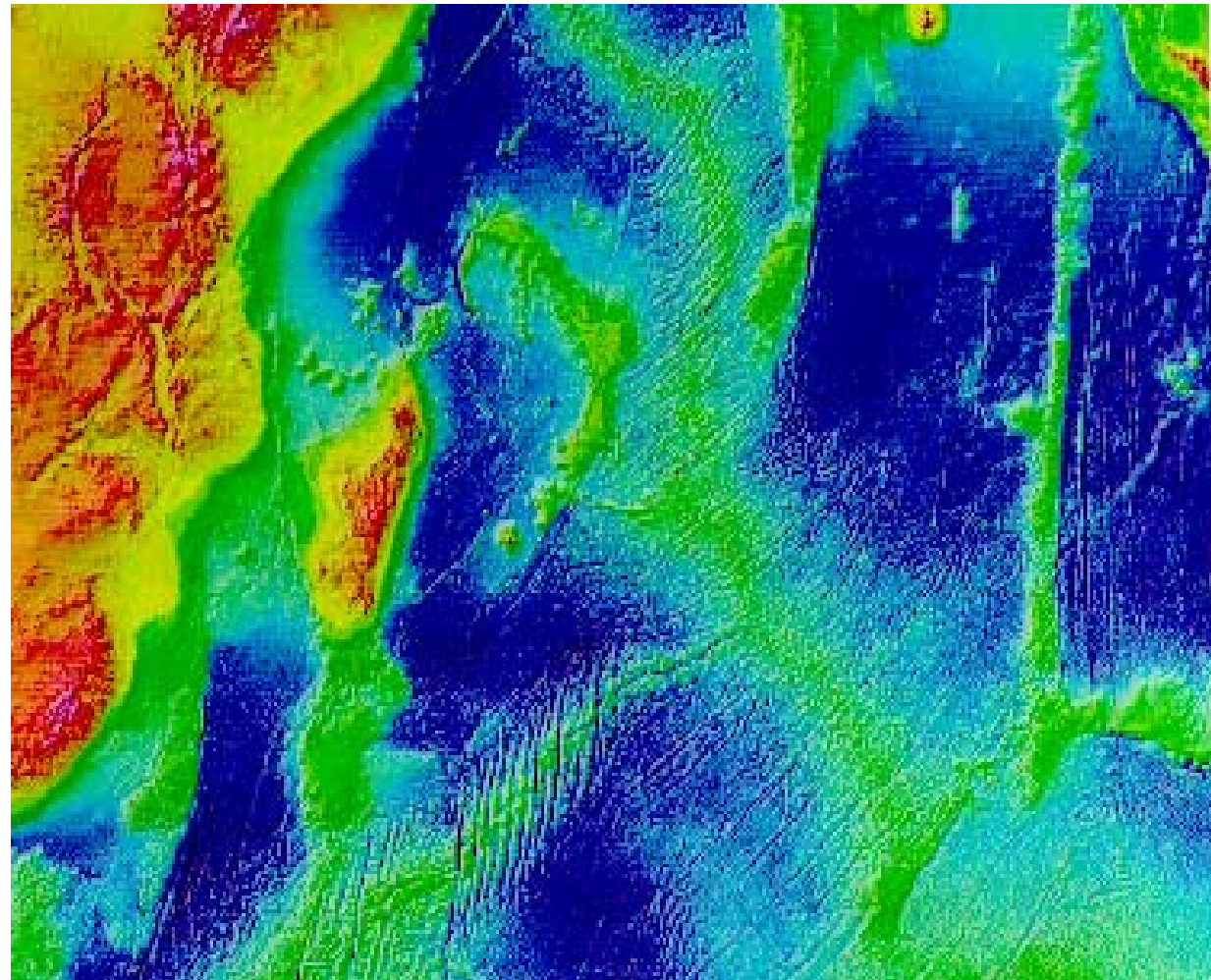
**diatoms**

# *Geological Oceanography*



*contributed to the study of plate tectonics*

## ***Indian Ocean***



***Islands***  
***Ocean Sediments***  
***Mining***  
***Thermal Vents***

# Chemical Oceanography

**Salinity**  
**Solar Radiation**  
**Temperature**  
**Density**  
**Pressure**  
**Nutrients**  
 $PO_4$   
 $NO_3$

H																			He
Li	Be											B	C	N	O	F		Ne	
Na	Mg											Al	Si	P	S	Cl		Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br		Kr	
Rb	Sr	Y	Zr	Nb	Mo					Ag	Cd	In	Sn	Sb		I		Xe	
Cs	Ba		Hf	Ta	W					Au	Hg	Tl	Pb	Bi				Rn	
	Ra																		
			La	Ce	Pr	Nd		Sm	Eu	Gd		Dy	Ho	Er	Tm	Yb	Lu		
				Th	Pa	U													



Minor constituent (more than 1 gram per ton)



Major constituent (more than 20 grams per ton)



Essential for plant growth



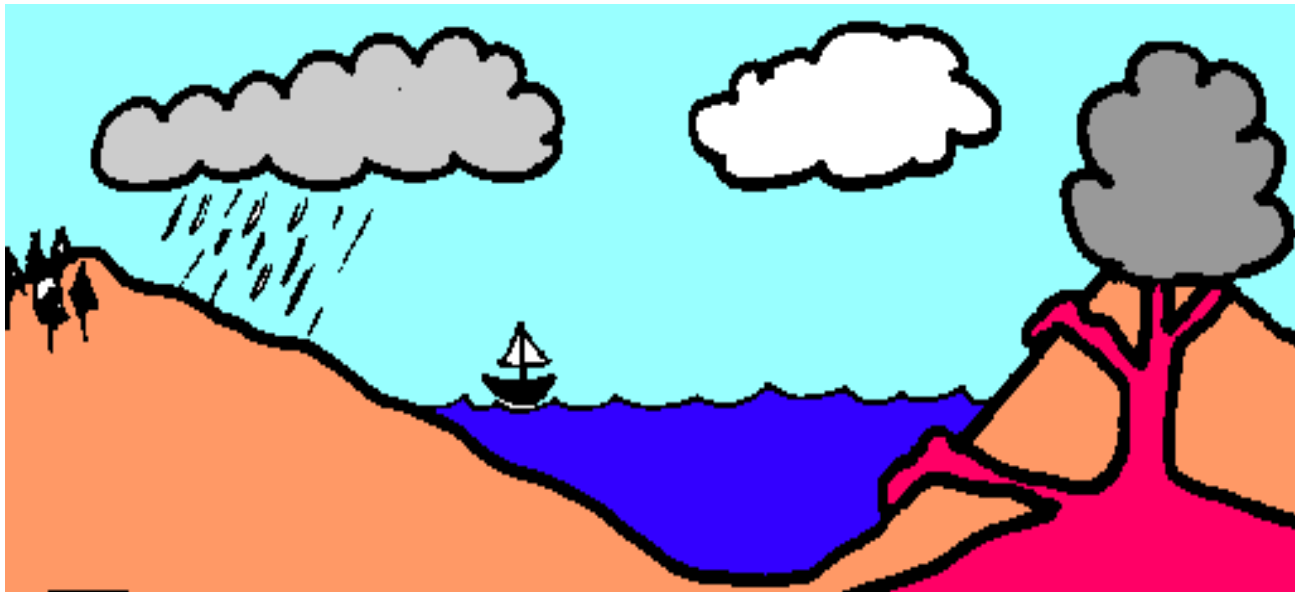
Trace constituent (less than 1 gram per ton)



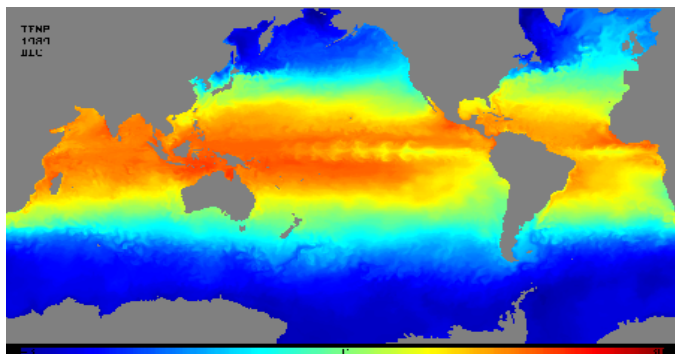
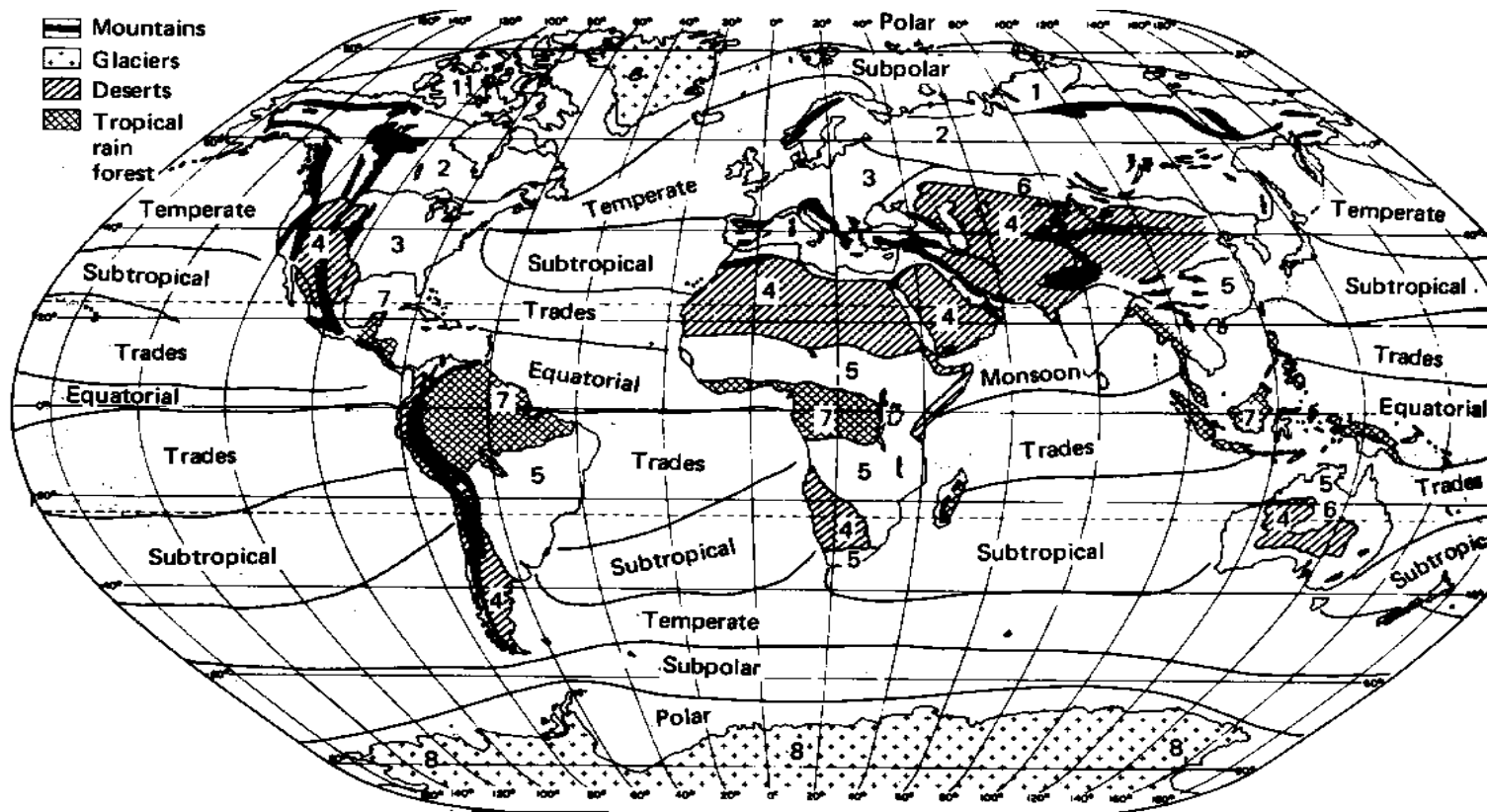
Dissolved gases, in part

**SALT + H<sub>2</sub>O = SEAWATER**

**(SOLUTE) +(SOLVENT) = (SOLUTION)**



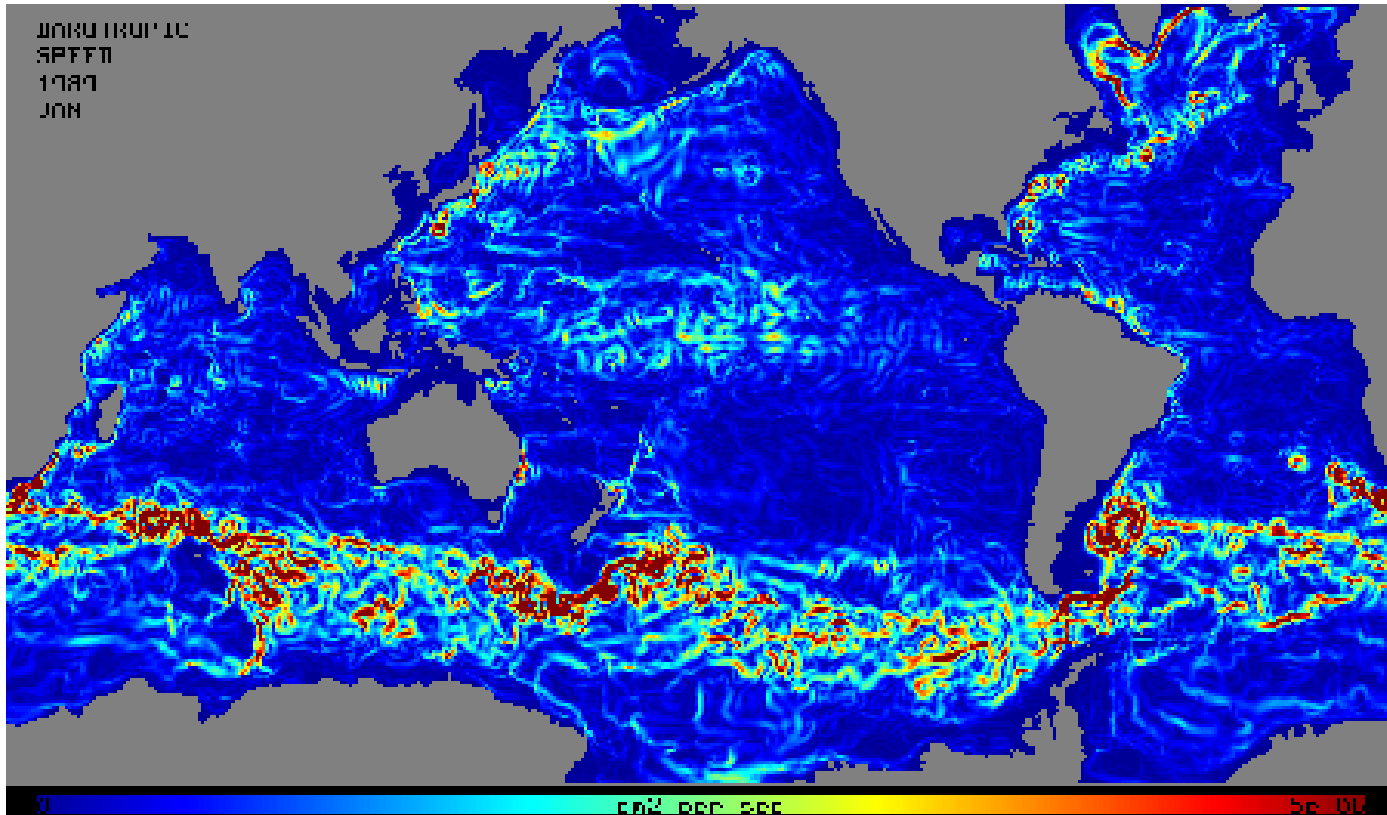
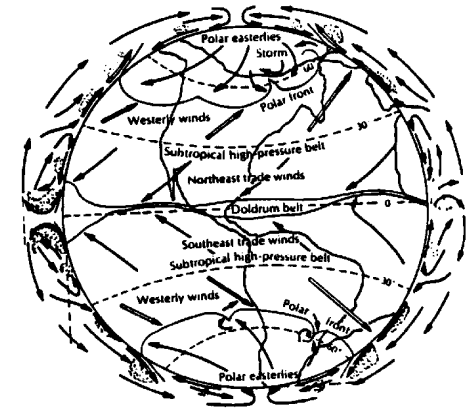




# Physical Oceanography

# ***MOTION IN THE OCEAN***

*currents, waves, tides*



***ice, topography, winds, temperature, density, Coriolis***

