Week of October 1st to October 5th
Note Taker: Julia Winberg
October 1st: Sediment

~There are not any notes for Week Three because we had Review (Monday), Exam (Wednesday) and no class/ at-home video (Friday)~

- Sediment is **underrated**
- Ocean sediment is thickest in oldest crust areas, near where rivers deposit to the sea
- Thinnest in open-ocean mid-ocean ridges
- As the seafloor moves away from the ridge in sea floor spreading, layers of different types of sediment form and grow.
    - Calcareous ($CaCO_3$) Ooze
    - Siliacious (SiO_2) Ooze
    - Abyssal Clay

Marine Sediments

- Eroded particles of rocks and land fragments
- Transported to ocean
- Settling through water column

- Transporting the material into the ocean
    - Weathering (most common)
        - Changes the material, making it more movable
    - Physical Weathering
        - Heat
        - Water
        - Ice
        - Pressure
        - Rain, Wind, Animals
        - Breaks a unit down into smaller and smaller bits
        - More Surface Area: More chemically erodible as you go on
    - Chemical Weathering
        - Changing the composition of a substance
        - Type of soil, pH, temperature, precipitation, mineral composition of the rock
- Example: Tree respiration through roots: Making carbonic acid, which can dissolve the material around it, Grasses also do this.
- Respiration is the most common chemical weathering on land
- Adding oxygens, acids, altering the substance
- Congruent weathering:
    - Only dissolved ions
- Incongruent weathering:
    - New minerals AND dissolved ions

- Example: Florida Sinkholes big local problem, due to chemical weathering of limestone in the ground
- Classifying Sediment by size
    - Big to little
    - Gravel → Sand → Mud (Mud can be super fine)
    - Proportional to energy of transportation and deposition
    - Boulders largest, clays tiniest
    - Clays can be picked up and moved very easily. However, clay also hangs out in the water column for a long period of time.
        - Boulder → → → Sinks very fast
        - Sand → → Sinks slower but still fast, takes about two days to reach bottom of the ocean from the surface
        - Clays → Takes 50 years for them to reach the bottom. **Long** time in water column.
- Classifying Sediment by Origin
    - **Terrigenous** or **Lithogenous:** Land
    - **Biogenous**: From biology or animal, biological origin
    - **Hydrogenous** or **Authigenic:** Ocean (Precipitate in ocean)
    - **Cosmogenous**: From cosmos or space
    - **Volcanogenous**: From volcanoes, magma
- **Terrigenous**
    - Coarser sediments close to shore
    - Finer sediments further from shore
    - Mineral Quartz: SiO_2- Highly weathered: Can't get much more weathered than this
    - Agents of Transport
        - Wind: **Aolian Transport**
        - Water
        - Ice
        - Gravity: **Turbidity Current**
        - Eroded rock fragments from land
    - Sediment Satellite Photo shown in class shows wind blowing sediment off of California into water, coast of Africa as well
    - What does wind dust look like?
        - Fine-grained clay from wind is **38% of deep sea sediment.** Its prevalence matches wind pockets shown in satellite images.
- **Turbidities**
    - Underwater landslides
    - Water and current transport sediment and material
    - Taking it from coast or shelf to deeper sea floor
    - Underwater "rivers" carry sediment across ocean

- **Biogenous Marine Sediments**
  - Hard remains of once living organisms: shell, skeleton, test, teeth, bones. Both **macroscopic** (large) and **microscopic** (small)
  - **Ooze:** 30% or more biogenous material, mainly algae and protozoans (planktonic, protist)
  - **Siliceous Ooze**: animal had silica in it
  - Ooze is pretty much all dead, not many living things in ooze
  - Animals with **Silica**
    - **Diatoms (photosynthetic)**
    - **Radiolarians**
  - Animals with **Calcium Carbonate** ($CaCO_3$)
    - **Forams (protozoans)**
    - **Coccolithophores**: photosynthetic, tests called coccoliths, fix carbon in the ocean
  - White Cliffs of Dover
    - 350 feet high
    - Made entirely of coccolithophores
    - Millions of years old
    - 1 Coccolithophore= 10 microns (a lot are needed to make up a whole set of cliffs)
  - How? Factors and Conditions
    - Goldilocks situation
    - Productivity → number of organisms in surface water above sea floor
    - Destructions → How much of dead biomass remains in the seawater
    - Dilution → Deposition of other, non biogenous sediments decreases presence of biogenous sediments
- **Pelagic Deposits**
  - Open ocean; Low productivity: few tests sinking, no ooze, no buildup
  - High productivity: many texts sinking, accumulation, a lot of ooze, accumulating faster too
- **Cosmogenous Marine Sediments**
  - Not a large amount, but quantifiable
  - Debris from meteors
  - Macroscopic
- **Volcanogenous**
  - Ash
  - Distributed by abiotic factors in the atmosphere and ocean: wind, streams, currents, etc.
- **Hydrogenous**
  - AKA Authigenic
  - Come from Hydrothermal Vents
  - Releasing lots of metal ions: oxidation combined with silica
  - Less common

- **Pelagic:** Deep ocean water column
- **Neritic:** shallow, close to shore, continental shelf area
- SILICEOUS vs. CALCAREOUS
  - **CCD: Calcite Compensation Depth**
    - $CaCO_3$ will readily dissolve at a certain depth
    - Below 5000m or 16,400 feet, in a low temperature and under high pressure. Area is high in CO_2, more acidic. $CaCO_3$ will dissolve.
    - Warm, Shallow ocean will be saturated with calcium carbonate

October 3rd, 2018

Properties of Water I (Chapters 6 and 7)

- Most of Earth's Water is in the oceans and seas. **70.8%** of Earth is covered by water.
  - 97% oceans and seas
  - 2% fresh water
  - 1% snow and ice
  - 0.000057% atmospheric H_2O
- We would not have life without water
- Chem Review:
  - **Ion:** Number of electrons does not equal number of protons
  - **Bonds**
    - **Ionic:** electrons gained, lost
    - **Covalent:** electrons shared
    - **Hydrogen:** Intermolecular bond of H with an electronegative ion
  - **Cation:** Positive ion (like Sodium)
  - **Anion:** Negative (like Chlorine)
  - Thus, **Sodium chloride is an ionic bond.**
- The Water Molecule
  - Two Hydrogen atoms, one Oxygen atom. Hydrogen atoms stick to oxygen atom at **105 degree angle.**
  - Less dense when frozen! This is very rare and due to the lattice-like structure it has when frozen
  - Water is a **covalent bond** because they are sharing electrons
  - **Dipole:** Polar molecule. Such as water.
- Hydrogen Bonds (present in water)
  - Weaker bonds between water molecules
  - Covalent bond way stronger, which is why atoms don't "unstick." **Hydrogen between, Covalent within.**
  - H bonds are responsible for water molecules sticking to surfaces, like the photo of dew on grass shown in lecture.
  - Cohesion: beading of water
    - Surface Tension: Water gliders, allows them to not break through water molecules because of weight displacement

- Dew on Grass
    - Adhesion is responsible for water molecules adhering to solids
- Water can exist as a Liquid, Solid and a Gas. This is **driven by the absorption or emission of heat. Adding or removing heat to water will change it.**
- There is a difference between **Temperature** and **Heat**
    - **Heat:** Energy produced by random vibration of atoms or molecules
    - **Temperature:** Object's response to input or removal of heat, categorized in a standard gage like Celsius, Fahrenheit, or Kelvin.
    - Heat is burning, friction, exothermic or chemical burning, or nuclear.
    - **Calorie: Amount of heat required to raise temperature of one gram of water by one degree C**. Has to be pure water.
- **Heat Capacity**
    - Amount of heat required to raise the temperature of **any substance** by one degree C
    - High heat capacity? Then the substance can absorb or lose large quantities of heat with only a small change of temperature
- **Latent Heat**
    - Amount of heat gained or lost per unit of mass as a substance undergoes a change of state, or:
    - The amount of heat it takes to change something's state.
        - Liquid → Molecules move freely.
        - Add heat, get Vaporization → molecules are super far away, super fast, independent. In their deposition, they will eventually cool down, removing heat.
        - Freezing→ extracting and releasing heat, molecules form a lattice, locked in place.
    - It takes a lot of heat for water to turn into a gas.
    - Density of water changes with temperature
- Movement of water vapor
    - Pattern: poles cold, equator warm, constant movement
    - **The ability of water to move and hold heat dictates a lot about life on Earth.**

- Pattern of Evaporation and Precipitation Latitudes→ constantly moving energy and temperature
- Living by the ocean, weather and temp are moderated → coastal temperatures are far more uniform
- Latitude, Temperature and Salinity defined by location: Tropical, Temperate or Polar
- The ocean is stratified by density
    - Water is not well mixed
    - Heat layers the ocean
    - 2% → Surface zone, mixed layer, more buoyant or light water
    - 18% → Pycnocline
    - 80% → Deep zone, heavy water

    - Pycnocline and Thermocline positively related
- Higher evaporation in environment means higher salinity at the surface: Think Dead Sea
- The Rime of The Ancient Mariner: They drink seawater. Don't do it. Chemicals and Salt dissolved in ocean water will dehydrate you
- **Humans are 65% water**
- Jellyfish are 99% water, Plants are 95%
- Our blood is 83% water. We are water!
- Universal solvent: Can dissolve anything
- Water hydrating ions
    - Sodium or Chloride
    - (Sodium Chloride)
    - Dipole attraction
    - This matters for salinity: Makes water marine, salty
- Salinity
    - Total amount of dissolved solid material in water
    - Ratio of mass dissolved to mass of water
    - Does not include anything particulate
- Rain dissolves rocks: Weathering, ions accumulate in ocean basins, ocean salinity is based on the balance between the input and output of these ions.

October 5, 2018

Special Thanks to Allie Cole for taking notes while I was absent :)

Properties of Water II (topics in this lecture can be found in chapters 6 and 7)

Started off with talking about a paper found by Hayden about the presence of water in the mantle, textbook numbers about how much water is on the earth aren't very good, they aren't up to date.

Water

-water is special because it is polar, has a negative and a positive part

-the angle being 105 between hydrogens.

Salinity

- Salinity = the total amount of dissolved solid material in water not including dissolved organic substances.

-Our thinking of dissolved changes as our technology gets better, operational definition

- dissolved compounds come from weathering and go to the ocean by rivers and streams.

- some can travel faster than others. (chlorine will get faster because it's not needed, nitrogen gets pulled up and used before it can make it)
- rivers are not pipes
- ocean salinity is based on balance
- average salinity is 35 PSU can also be seen in PPT (same thing)

Dominate ions = chloride, sodium, sulfate

- proportion is always the same, amounts can differ but the % will stay the same.
- before we knew salinity we could measure chloride

The principle of constant proportions

- the major dissolved components responsible for the salinity of water occur everywhere in the ocean in exact same proportions, regardless of salinity
- so the proportions always stay the same, doesn't matter what water you have

How to measure salinity

- The 1800s you had to dry water and weigh out the salt (problem because some important salts can evaporate) used on Challenger expedition
- Salinity = 1.80655 x chlorinity (%0) go out and find the amount of chlorine in water and multiply by this number to get salinity, but you have to do titrations
- now we use refractometers (higher salinity higher refractive index), conductivity probe (electrical signal, better electric flow more dissolved more salinity), CTD and rosette conductivity temp and depth (bottles will close at the depth you want so you can measure certain depths)

In class assignment about graphs

- Thermocline = a steep temperature gradient in a body of water
- Pycnocline = a steep density gradient in a body of water
- Halocline = a steep salinity gradient in a body of water

Important takeaways from activity

- Salinity will change with depth and with where you are in the ocean
- Temp and salinity effect density
- Season shifts in density due to storms (pulse events) and wind. Polar regions are very mixed, tropical regions are very stratified