- Lithification: processes that convert loose sediment to hard rock
  -compaction: weight compacts sediments resulting in a loss of pore space
  -cementation: dissolved minerals precipitate in pore spaces w/in rock

Types of sedimentary rocks
- Clastic: composed of fragments of weathered rocks- sandstone, shale, conglomerate
- Chemical/biochemical: precipitation of minerals from a solution- carbonate (limestone), gypsum, rock salt
- Carbonaceous: soft tissues of organisms- coal & oil
- Structures formed during or shortly after deposition tell about processes transporting sediment that became rock
- Common structures: ripples, cross-bedding, mud cracks, grading, flutes

2/2
- Midterm: Tues. Feb. 7; big red scantron; #2 pencils; student ID; SG online; review quiz
- Relative geological time:
  -Original horizontality: sediments usually accumulate as horizontal layers
  -Superposition: layers on bottom usually older than layers on top
  -Cross-cutting relationships: a rock must first form before it can be cross cut by something else
- Absolute geological time: radiometric dating
- Original horizontality: sediments were originally horizontall (ex: Bryce Canyon in Zion Park)
- Superposition: oldest layers are deposited first (youngest on top, oldest on bottom)
- Cross-cutting: a layer must be older than the layer dissecting it
- Unconformities: an interruption in deposition, usually of a long duration
  Angular unconformity, nonconformity, disconformity
- Disconformity: Superposition → erosion event which removed sediment above it → time is missing
- Angular unconformity: Original horizontality → layers tilted → erosion event → gap in time → deposited sediment layers on top
- Only difference between ^ is that layers on bottom are tilted on angular unconformity
- Nonconformity: doesn't conform to typical sedimentary cross section

Faunal succession
- Fossils: remains & other traces of prehistoric life
- Fossil organisms succeeded each other thru time in a definite & recognizable order and that relative age of rocks can therefore be recognized based on their fossil content
- Index fossil: indicates age of rocks containing it

Review for Midterm
- ACC is same as West Wind Drift (clockwise); keeps Antarctica cold
- Antarctic Coastal Current is same as East Wind Drift (counterclockwise)

Igneous rocks
- Felsic: high silica, iron & magnesium poor- colder temp

- Rest of E Antarctica craton assmedlbed by about 1 billion years ago by a series of ~6 orogenies
- After Pangea, took ~175 Mya to move continents from Pangea to where they are today
- Lots of crust subducted and additional orogenies
- Small passages of open ocean between continents
- Opening & closing thought to control global ocean circulation changes
- Important Antarctic Gateways: Drakes Passage
  -Antarctica & S America
  -opened 41 Mya
  -Atlantic & Pacific were separated
  -Antarctic MUCH warmer (no ice captured)
  -started ACC
- Between Antarctica & Australia (separation ~30 Mya)
- Glaciation: interval of time(thousand of years) within an ice age that's marked by colder temps and glacier advances
- Throughout most of Gondwana (500 Mya) supercontinent has around w/respect to the south pole
- 2 major Phanerozoic glaciations
  -late Paleozoic (Carboniferous-Permian) 260-420 Mya
  -Late Cenozoic (Oligocene+) 30 Mya

2/14

- Geologic time: come over some day maybe play poker two jacks call
- Sort of invasive species in Antarctica but not many
- As late as mid-late Cretaceous (~85 Ma)Antarctica has had flowering plants in a subtropical climate
  -Summer temps average 20-24 C (68-76 F)
- Paleocene (~60 Ma)
  -starts to cool, gradual loss of warm plants
- Late Paleocene (~50 Ma)
  -cooled to average of 13 C
  -strong seasonality (25 C summer, 2 C winter)
  -like SF
- Eocene (~40 Ma)
  -cool marine maritime climate (10 C)
  -plant community dominated by Nothofagus
  -like New England coast

Eocene/Oligocene Boundary

- Glaciers take over
- Drop in oxygen isotope records
- A few “refugia” still exist & ice sheets were largely “temperate”
- Experienced periods of waxing & waning

Miocene and Pliocene

3/2

Ocean Acidification w/Rob Dunbar- Video

- 4 natural causes of climate change?
  -air sea interaction, ocean circulation, volcanic aerosol & dust, solar output
- 3 ways humans affect global climate?
  -change surface of land, inject aerosols into atmosphere, trace gases (meth, sulfur, etc)
- Where did scientist drill for records?
  -Ross Sea Ice Shelf, in sea bed; S of Antarctic Circle
- Did they collect ice or sediment cores?
  -sediment
- How many alterations did they discover between open water & ice covered water?
- How many years did this occur?
- Amount of sea level change each time?
- How many meters do scientists expect current sea levels to rise by end of century?
  2-3m
- Air temps warming in many parts of Antarctica
  -W Antarctica: 0.47+/-0.23 C per decade
  Antarctic Peninsula: 0.58+/-0.31 C per decade
- Antarctic Peninsula one of the fastest warming places on Earth
  -global avg: 0.13+/-0.03 C
- W Antarctic Ice Sheet contributing to sea-level rise
- Record reveals a linear increase in annual temp from 1958-2010 by 2.4+/-1.2 C
- Central W Antarctica one of fastest warming regions globally
- Statically significant warming during Australia summer (Dec-Jan), peak of melting season
- Southern Ocean: +1 C over last 80 years down to 3000 m

West Antarctica- Pine Island Glacier (PIG)

- “Weak underbelly of Antarctic Ice Sheet”
- Responsible for about 25% of Antarctica's ice loss
- Fastest melting glacier in Antarctica
- Mass losses from PIG and Thwaites Glacier dominate Antarctic ICe Sheet ice losses
- Mass loss from this basin doubled from 1996-2006 and it’s largest ice loss in Antarctica
- Other observations of change: temp, wind, sea-ice, biology, glaciers, ice shelves, sea-level rise

Changing winds

- Circum-Antarctic Winds increased by 15-20% in last 20 years
  -driven by warmer sea surface temps in winter
  -driven by more storms during summer
- Impact ocean mixing
  -more mixing, less CO_2 uptake by oceans

Sea ice trends

- Williams, later hired by British admiralty
- Explored S SHetland islands
- Arguably first to see Antarctic Peninsula

Nathaniel B Palmer
- U.S. Sealer
- Sent by boss to find good harbors for sealing
- 1 ship: *Hero*
- Discovered Deception Island had an interior harbor
- Nov 17, 1820- first or 3rd to see mainland
- Got as far as 66 south

James Weddell
- British Sealer
- 1820-21, 1822-23
- *Jane and Beaufoy*
- Sealing in area of S Orkneys (unaware of their discovery the year before)
- Ventured farther South

Enderby Voyages
- British Sealing and Whaling Company
  -curious to geographic exploration
  -sent voyages to Antarctica
- John Biscoe
  -3rd to circumnavigate globe at high S latitudes
  -discovered Enderby Land and Adelaide Island
  -landed on Anvers Island (Palmer Station today)
- Peter Kemp- Heard Island
- John Bellany- Bellany Islands

Jules S.-C. Dumont D'Urville
- French (1837-40)
- Commissioned to do scientific work- look for magnetic S pole
- *L'Astrolabe* and *La Zelee*
- Discovered E Antarctic Peninsula- Joinville Island and Trinity Peninsula
- Magnetic pole actually on land

Charles Wilkes
- U.S. Expedition (1838-42)
- 6 ships, 400 men
- Epored coast of S Australia
  -landed on an iceberg, 8 mi offshore

James Clark Ross (British)
- Study earth's magnetic field near magnetic S pole
- Discovered Ross Sea, Victoria Land, Trnas Kantarci Mountains, Ross Ice Shelf, Mount Erebus (lots of capes & mountains)