Wednesday, February 27, 2019

Geology midterm 3 (missed last class) lec 11

Geologic time (geochronology)

•
Earth is ~4.6 Ga (billion years old)
Jan 1: Earth formed
Feb 21: life formed
Oct 25: complex organisms
Dec 7: reptiles evolved
Dec 25: dinosaurs extinct
Dec 31, 11:00 pm:
homo sapiens
appear
Dec 31, 11:59:59.97: Columbus discovers Americas
•
typical university course: 0.0000011% of Earth's history

1)
relative dating
–
compare 2 or more
entities to determine which is older
2)
numerical dating
–
specifying the
actual number of years (± years) that
have passed since an event occurred
(also known as
absolute age dating

Principle of relative Dating

Rules to compare rocks that are not located near one another:
1)
Principal of Uniformitarism
(Hutton) ..
"present is key to past"
•
same
processes
act throughout time,
but possibly at different rates

more influential than catastrophes -
hurricanes, floods, impacts
•
for general cases: OK
(rivers flow downhill; volcanoes erupt lava)
• specific cases?
(there has not always been rivers; volcanoes not always erupt same composition lava)
e.g. ancient Earth spun more rapidly than does modern Earth (440 'days' v 365 days)
But still useful to determine how rocks are 'positioned'

2)
Law of Superposition
•
most sediments settle from water / wind
•
young rock material (sediment) is deposited on top of earlier, older deposits

3)
Principle of Horizontality
•
layers of sediment (& lava) are generally deposited in a ~
horizontal position
•
when/if tilted, how identify upper or top surface?
(beach) generally flat and horizontal

4) **Principle of Cross-cutting Relationships**
•
intrusive
(igneous) formation must be younger than rock it
cuts across; also used for faults

Matching of rocks of similar ages in different regions

is known as correlation
• Lithostratigraphic
- matching up continuous rock
sequences
• Chronostratigraphic
- matching up rocks of the same
age; usually done with fossils using biostratigraphy
•often relies upon
fossils
•William Smith (late 1700s) noted that
sedimentary strata in widely separated area
could be identified & correlated by their
distinctive fossil content

• fossils: remains of ancient organisms, or other evidence of their existence, that became preserved in rock
• only 1% of all species ever existed are preserved as fossils
• use superposition & horizontality to determine age of rock/fossil within = relative age of fossils

5) Principle of Fossil Succession

•fossil organisms succeed one another in a definite and determinable order, and therefore any time period can be recognized by its fossil content
•short-lived, widespread organisms =index fossils
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Correlation of rock layers

- Vertical and horizontal relationships of rocks
- • How about their regional rock unit boundaries?

1)

Conformable sequences

•layers of rock deposited w/o interruption

2)

Unconformity

•a gap or break in the rock record produced by erosion and/or nondeposition of rock units
•implies tectonic movements (uplift)

A) Disconformity

– strata on either side of the unconformity are parallel, but ages differ

B) *Angular unconformity*

– tilted/folded rocks are overlain by flat-lying rocks

C) *Nonconformity*

– metamorphic or igneous rocks in contact with sedimentary strata (crystal rock, meapmorphic, next to a sedimentary (grand canyon)

Go through 6 square will be on exam!! Best way to do it is to go backward

1. Rocks are tilted , before b was deposited rocks are tilted (have to rotate rocks), we have to rotate the mhorizontally, tilting even that caused tilting, just before we had c, d, e, and g (have no clue when g happened) (g is younger than f)
2. What happened before what? Will be seeing these, understand principals and order
3. Can have faults and shit look into it

Common numerical dating Relies on rate of decay of Radioactive isotopes w/in minerals

Parent- an unstable (decaying) radioactive isotope
Daughter- the isotope resulting from decay of parent
Half life - defined by the decay constant wave for each isotope- the time required for one-half of the radioactive nuclei in a sample to decay

Do not know exactly when decay will happen , do understand probability of decay happening

1) alpha emission
2) Beta emission
3) Electron capture

See diagram

6)

Principle of radiogenic dating

- percentage of radioactive atoms that decay during one half-life is always the same (50%)
- **however, actual number of atoms that decay continually decreases**

rates of decay have been measured and do not vary through time

- **assume closed system (initial mineral has only parent material; no loss of daughter after mineral forms)**
- radiometric clock in minerals starts when daughter product begins to be trapped in mineral (usually controlled thermally)

Counting half-lives:

- Half-lives: 1 2 3 4
- Parent: 1/2, 1/4, 1/8, 1/16, etc.
- Daughter: 1/2, 3/4, 7/8, 15/16, etc.
- P:D: 1:1, 1:3, 1:7, 1:15

Ratios of 1:3, 1:7, 1:15, etc. are for whole half lives, but any ratios can be measured; e.g. 1:4.2, or 8.6:1

If there is some daughter lost, the age will be younger