GS104 Lab 8 Answer Key - Geological Time

Pre-Lab Questions

1. stratigraphy - study of spatial and temporal relationships between layers of sedimentary rock. Involves placing rock layers in the proper context of geologic time.

2. Unconformity - a surface of erosion or nondeposition that represents a break in the rock-time geologic record.

3. Cross-cutting relationships - a relative geologic dating technique that states if a geologic feature (e.g. a fault or igneous dike) cross-cuts another geologic feature (e.g. beds of sedimentary rock), then the geologic features that have been cross-cut, must be older than feature that cut them

4. Original Horizontality - a principle of stratigraphy that states: layers of sediment are deposited in horizontal layers, as dictated by gravitation.

5. Lateral Continuity - suggests that rock layers that have been eroded, were once laterally continuous layers (e.g. layers projected across a river valley).

6. Superposition - states that in a stacked sequence of sedimentary rocks, layers on the bottom are oldest, layers on the top are youngest (the layer-cake approach).

7. Bed - a layer of sedimentary rock (greater than 10 cm thick).

8. Half-Life- the amount of time that it takes for 50% of the mass of a parent (radioactive) isotope to decay into the daughter product (stable isotope).

9. Periods of the Paleozoic Era: Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian
Periods of the Mesozoic Era: Triassic, Jurassic, Cretaceous
Periods of the Cenozoic Era: Tertiary (Paleogene, Neogene), Quaternary
Epochs of the Tertiary Period: Paleocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene, Holocene

(all of the above are in order of decreasing geologic age)

Part 1 Time and Stratigraphy

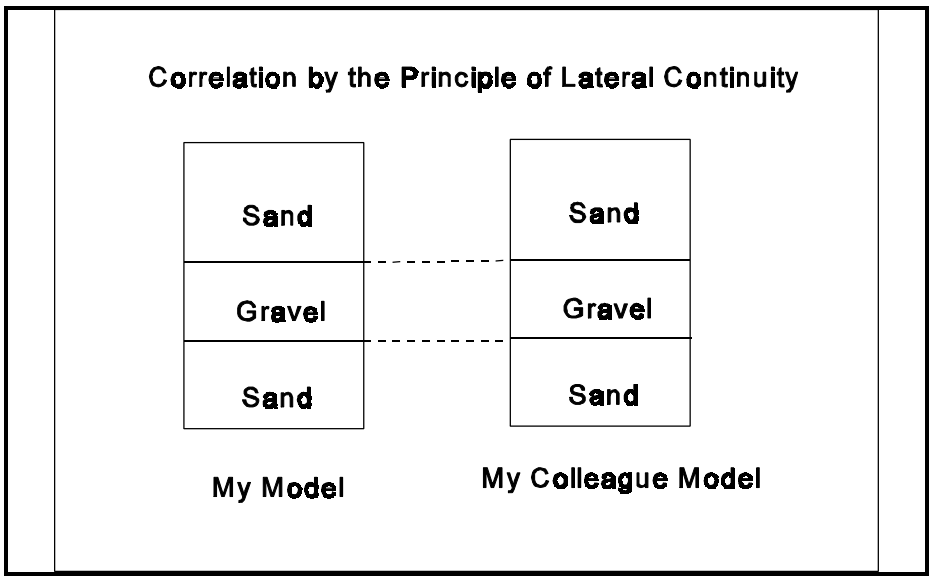
a) grain size of sand ~ 0.25 mm
- minimum thickness of a 1-grain sand bed = 0.25 mm
- thickness of my model sand layer ~ 3 cm (30 mm)
- rate of model deposition = 0.25 mm /yr
-time to deposit 3 cm bed of sand = 30 mm (1 yr / 0.25 mm) = 120 years

b) o.k., a shell is on top of my sand layer, and 2 cm (20 mm) layer of gravel
- average gravel size = 4 mm
- rate of model deposition = 4 mm/yr
- time to deposit a 2 cm bed of gravel = 20 mm (1yr / 4 mm) = 5 years

- the bottom sand bed is older than the fossil on top of it.

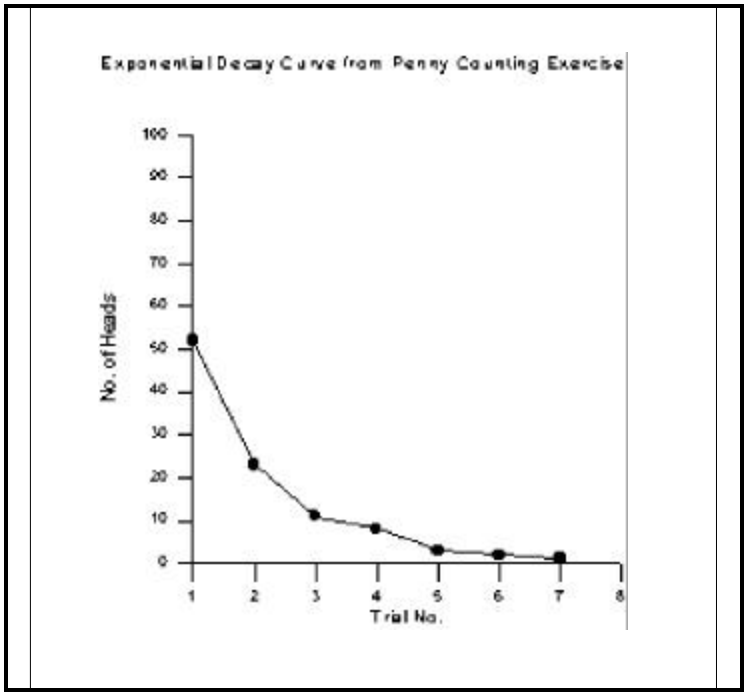
- the gravel layer is younger than the fossil below it
-this is an example of the law of superposition (neato)
- Assume the fossil is Ordovician in age, the oldest that the gravel bed could be is Silurian
- the youngest the sand bed could be is Cambrian
- the youngest the gravel bed on top could be is "Recent"

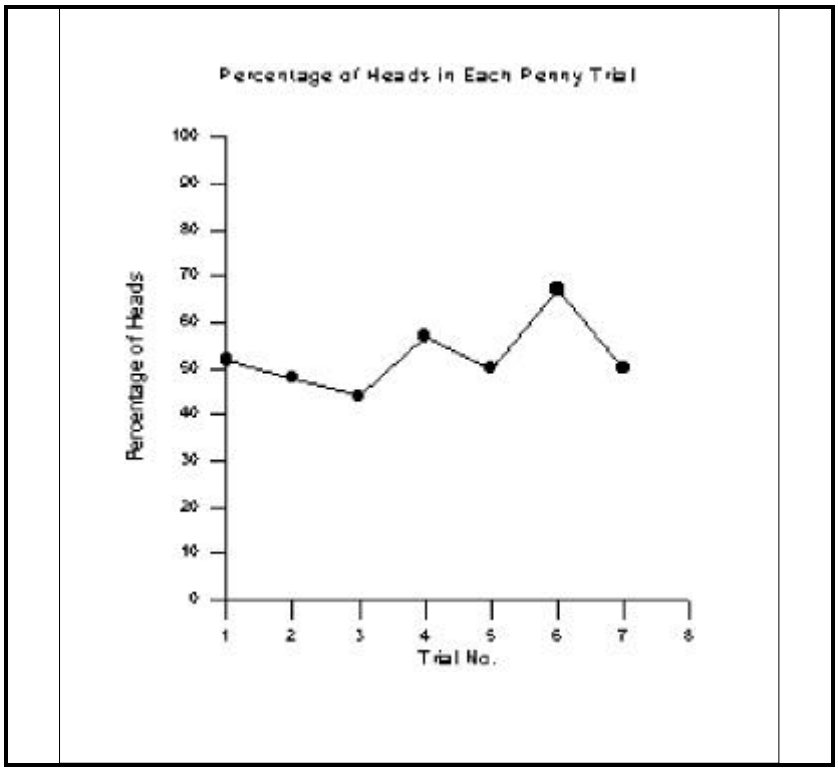
c) o.k. fossil and sand layers are on top of gravel
- the youngest the gravel layer now can be is Silurian
- the oldest possible age of the top sand layer is now Carboniferous
- the fossils provide a better tool for correlation, as they relate to the law of faunal succession



Part 2 Radiometric Dating

Graphs of Penny Exercise





a) Graph 1 is an example of exponential decay, just like the half-life of a radioactive isotope.

b) The predicted statistic is that Graph 2 would show 50% heads / tails for each trial. The data approximate a 50-50 probability at the higher number of pennies, but deviates from 50% as less pennies are counted.

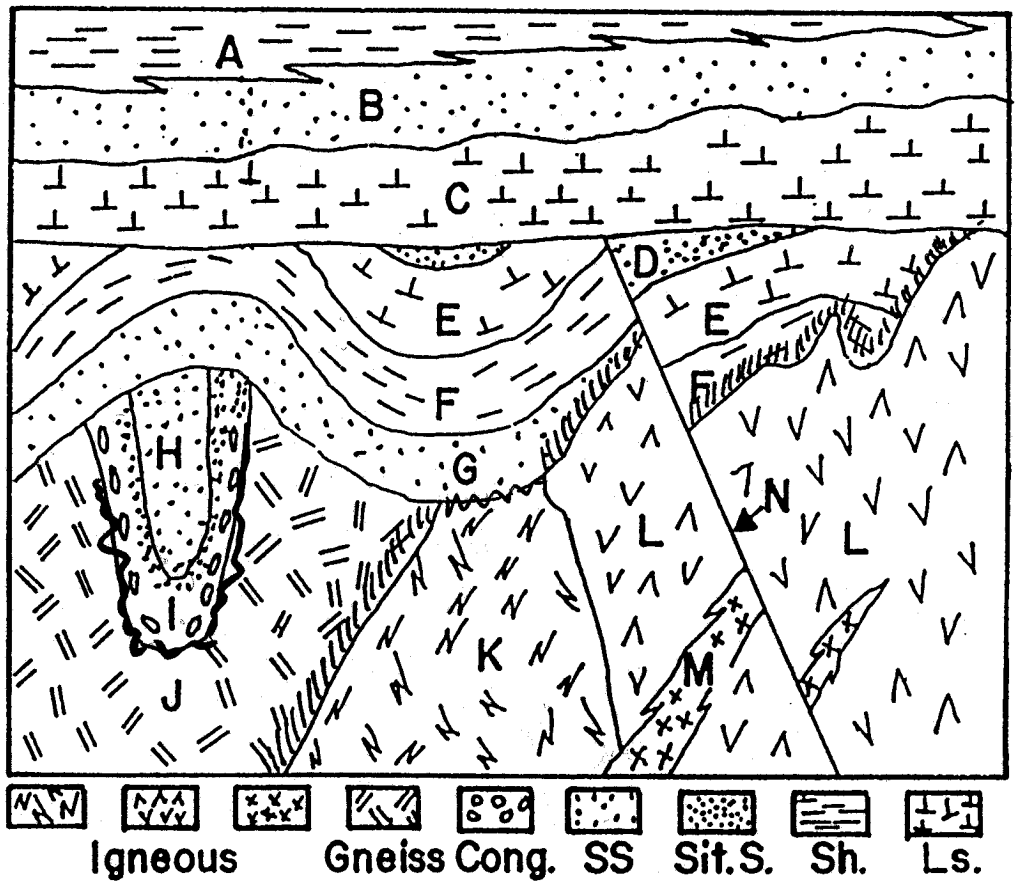
- the greater the number of pennies counted will result in greater statistical reliability, less vice versa
- Billions of pennies would be most reliable
- moral of story, the less the amount of isotope present in a rock sample, the more statistically unreliable the radiometric age will be.

c) K-Ar half life is 1.4 billion years. 50% of the K will be converted to the Ar after 1 half life

d) After two half lives, 75% of the K will be converted to the daughter Ar.

e) For very young rocks, one would need an isotope with very short half-life (e.g. C-14 is 5730 yrs). The younger the rock, the shorter the half-life needed. Large half-life isotopes would work best for very old rocks.

Part 3 - see cross-sections below.



Hint - I contains inclusions of J and K

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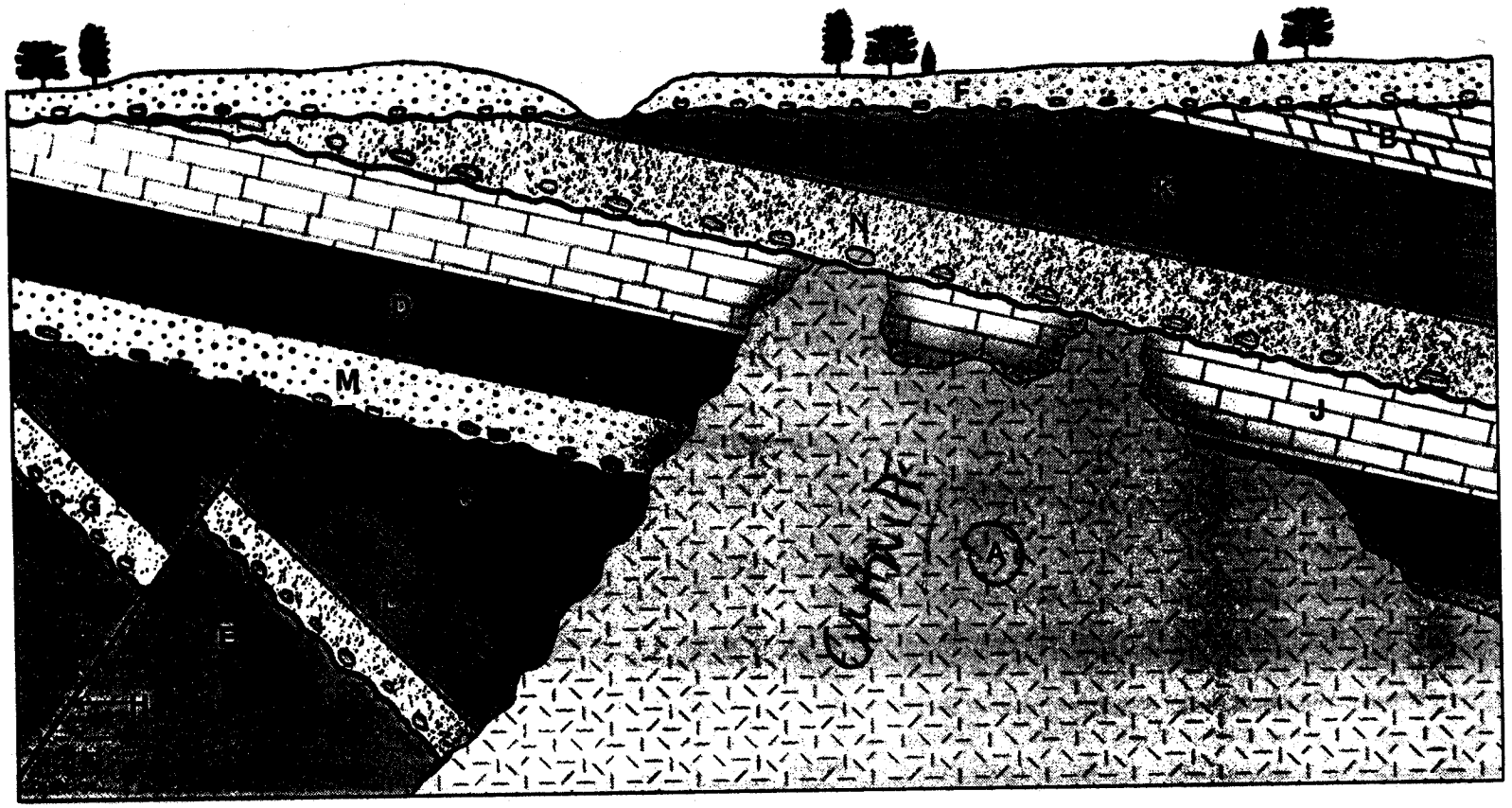
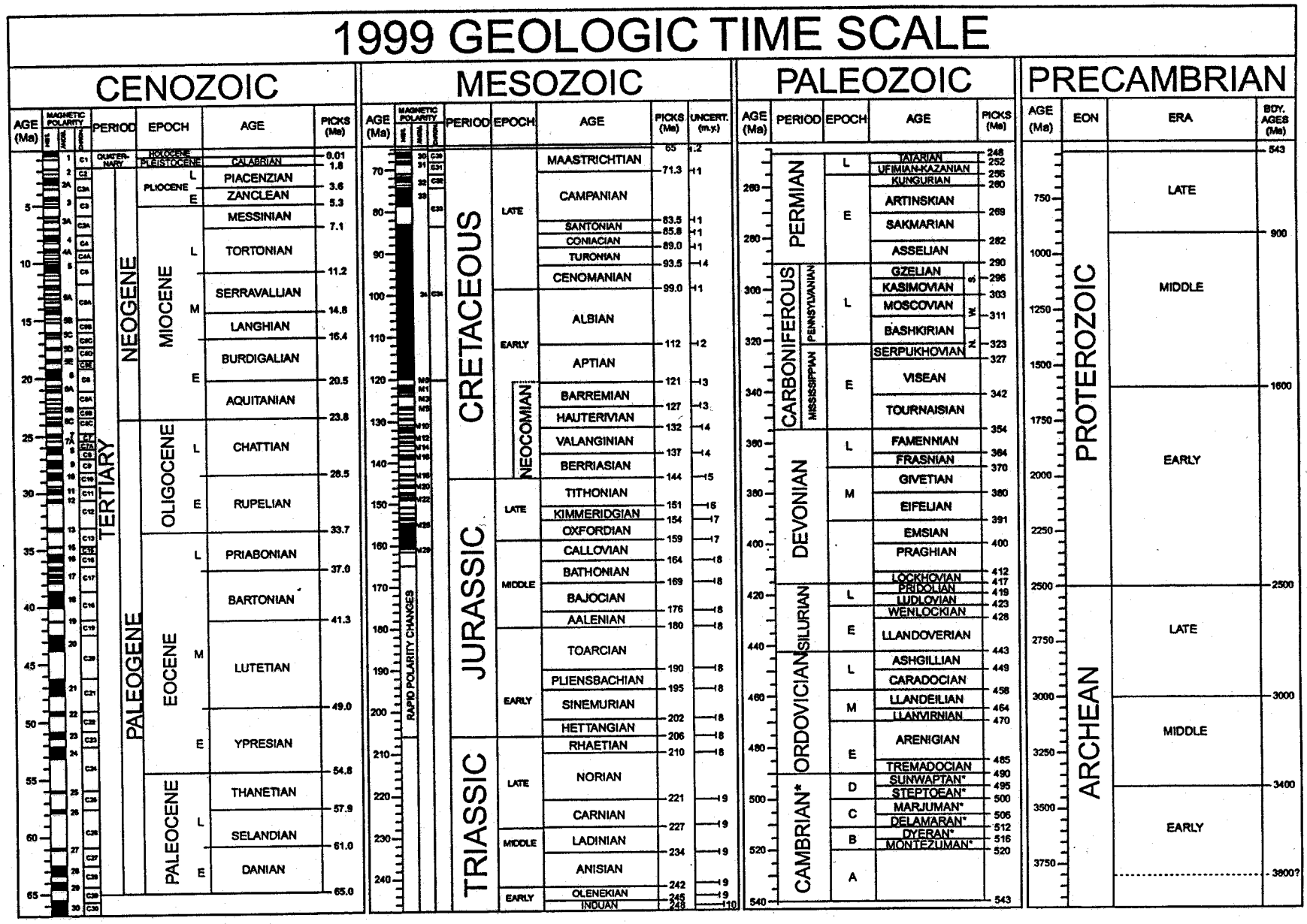


Youngest F B unc. K N unc. A J D M unc. H C L G E unc. Oldest

FIGURE 7.9 Geologic cross section for relative age analysis. Place letters on the lines along the right side of the cross section to indicate the relative ages of the rock units, from oldest (first) to youngest (last).



*International ages have not been established. These are regional (Laurentian) only.

Sources for nomenclature and ages: Primarily from Gradstein, F., and Ogg, J., 1996, *Episodes*, v. 19, nos. 1 & 2; Gradstein, F., et al., 1995, SEPM Special Pub. 54, p. 95–128; Berggren, W. A., et al., 1995, SEPM Special Pub. 54, p. 129–212; Cambrian and basal Ordovician ages adapted from Landing, E., 1998, *Canadian Journal of Earth Sciences*, v. 35, p. 329–338; and Davidek, K., et al., 1998, *Geological Magazine*, v. 135, p. 305–309. Cambrian age names from Palmer, A. R., 1998, *Canadian Journal of Earth Sciences*, v. 35, p. 323–328.

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