PALEOSEISMOLOGY: SITES (17)

Schedule Updates and Reminders:
Reading for this lecture: Big Picture - Skim "Applications" in PP 1360
Reading for next lecture: Handouts from Active Tectonics, statistics book
Questions from last time?

I Main Topics
- A Reasons for investigating the prehistoric record
- B Characterization objectives of a paleoseismology investigation
- C Reason for targeting paleoseismology investigations
- D Criteria for siting paleoseismology investigations

II Reasons for investigating the prehistoric record
- A Nearly all ruptures occur along pre-existing faults
- B Historical record is too short to rely on entirely (e.g. historic inactivity is a poor way to gauge seismic hazard and risk)
- C <u>Past is key to future</u>

III Characterization objectives of a paleoseismology investigation
- A <u>Location of fault(s)</u>
- B <u>Geometry of fault</u> (including segmentation)
  - 1 Behavior of fault may hinge on its geometry
  - 2 Most large faults do not rupture end-to-end during an earthquake.
  - 3 Rupture in a given quake commonly confined to certain segments of a fault. Geomorphology and geometry of a given segment may be uniform, implying consistent behavior over large time frames.
  - 4 **Significance**: Segment geometry controls size of earthquake {Mo = (μ)(average slip)(Area of rupture)}
- C <u>Measurement of slip</u>
  - 1 Relative displacement (slip): a vector with magnitude & direction
  - 2 Requirements to determine slip
    - a Orientation (and usually position) of fault
    - b Continuity of feature across fault (<u>before and after</u> offset)
    - c Piercing points (linear features, problems with streams)
    - d Piercing "curve" (e.g. cinder cone); <u>not</u> piercing planes

D <u>Bracketing the timing of slip</u>

1 Ages of offset units usually measured, <u>not</u> dates of earthquakes

2 Age of units above and below

3 Need to have time frame in mind to collect appropriate material for dating and to apply the proper technique

4 Some radiometric techniques for Quaternary dating
^{14}C, K-Ar, ^{39}Ar-^{40}Ar, U-Th, ^{36}Cl,
Amino acid racemization, Desert varnish

5 Relative dating techniques

a Fossils

b Geomorphic/weathering effects

6 Scarp degradation techniques

E <u>Estimatation of slip rate</u>(s)

<u>Average</u> slip rate at fault = Slip change/time interval

F <u>Measurement of slip/event</u>

G <u>Estimation of recurrence intervals</u> (Time between consecutive events)

a Date (bracket) individual events
(Uncertainties with dates, missed events)

b Divide slip rate by slip/event
(Uncertainties with variation in slip rate and slip-per-event)

H <u>Estimation of "size" of past quakes</u>

a Intensity/Liquefaction/Ground response

b Amount of slip per event*

IV Reason for targeting paleoseismology investigations: One can't get the desired information in most places along a fault!

V Criteria for siting paleoseismology investigations
(Focus on faults with surface rupture [$M_W \geq$ ~6])

A Fault must be located

B Simple fault expression

C Marker units (preferably several)

D Young materials (to allow a record of recent behavior)

E Datable materials (Dating techniques)

F Need to understand the geomorphology at the site
(Interaction of erosional, depositional, and faulting processes)

<u>Useful References</u>

Allen, C.R., 1968, The tectonic environments of seismically active and inactive areas along the San Andreas fault system: Conference on Geological Problems of the San Andreas fault system, Proceedings, Stanford University Publications in the Geological Sciences, v. 11, p. 70-82,

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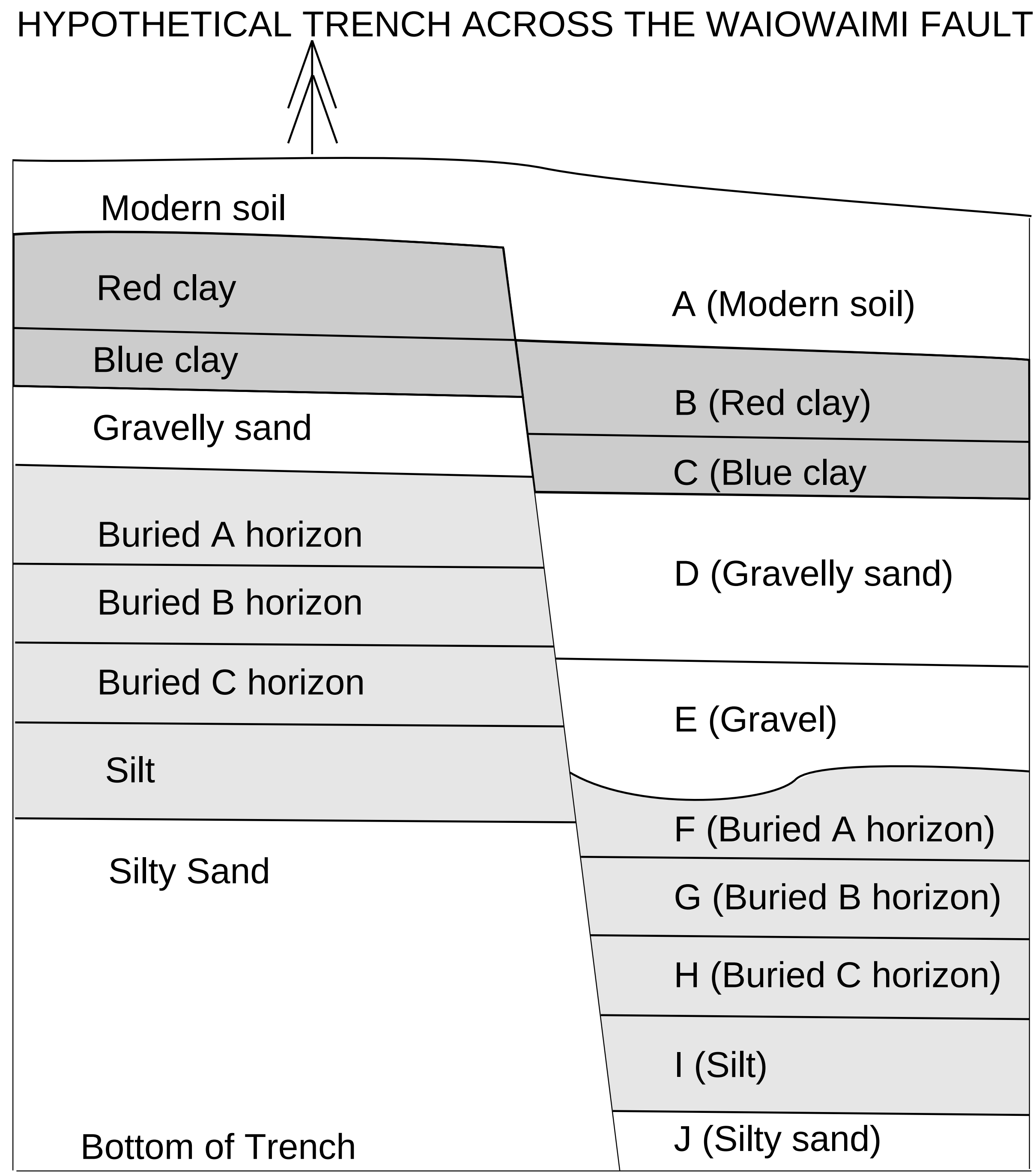
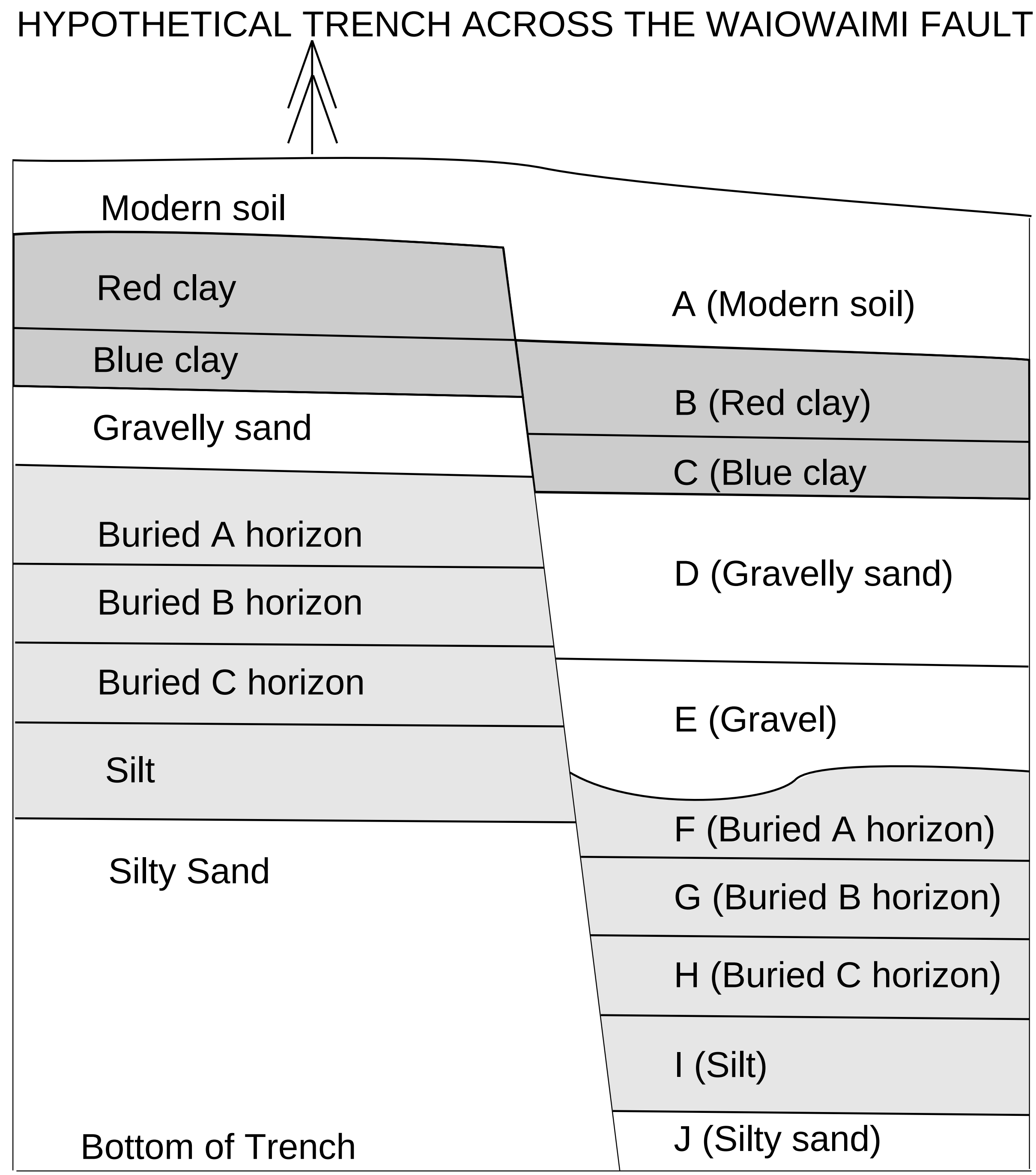


Geologic History: The upper grey package is offset more than the lower grey package, so there have been at least two faulting events. One occurred after the formation of F and before deposition of C; the other after deposition of B. The gravelly sand is thicker on the right than on the left; either D was deposited over an old fault scarp or some faulting occurred while D was deposited.



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