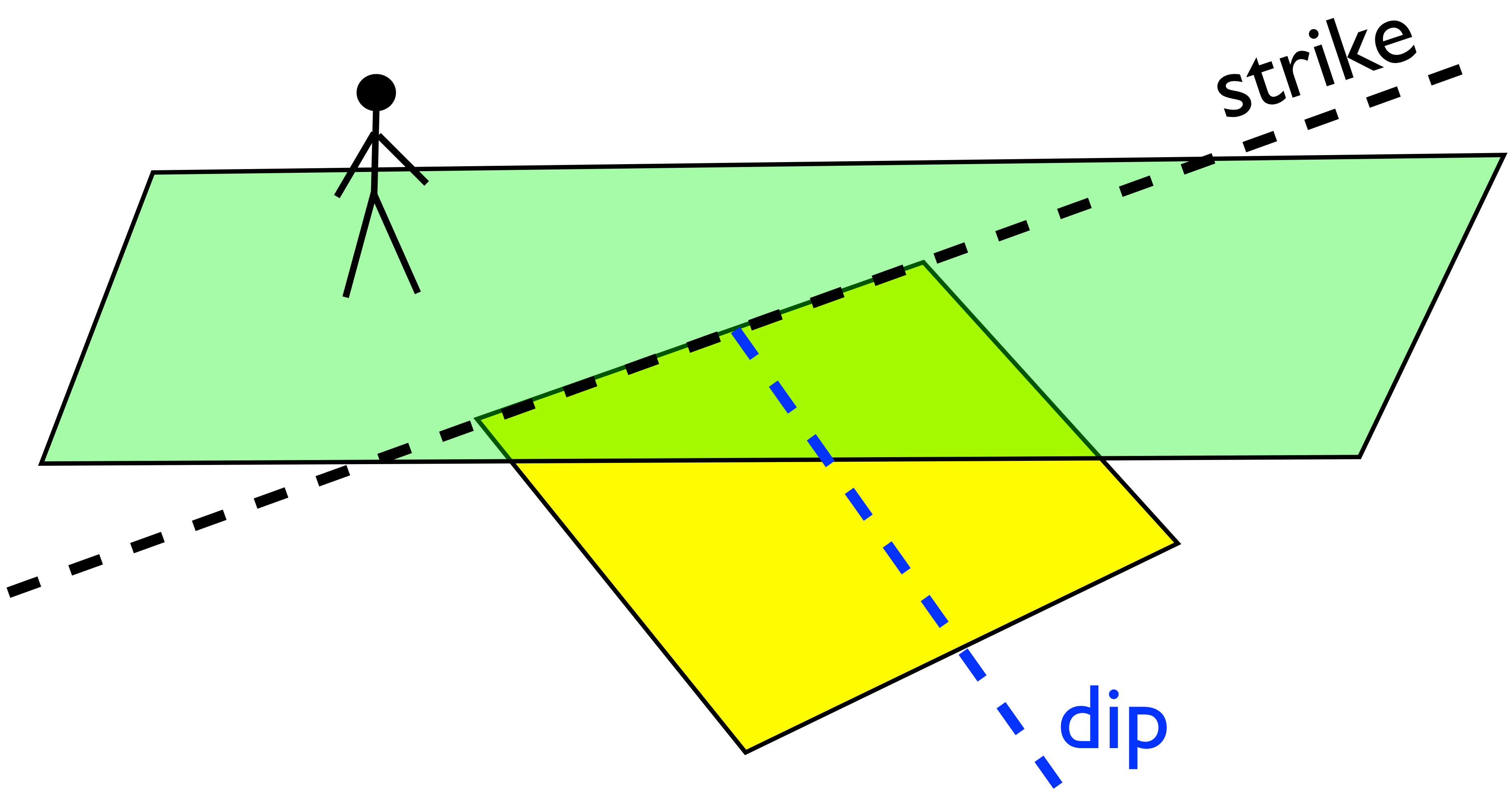
Describing the fault geometry

How do you usually describe a plane (with lines)?

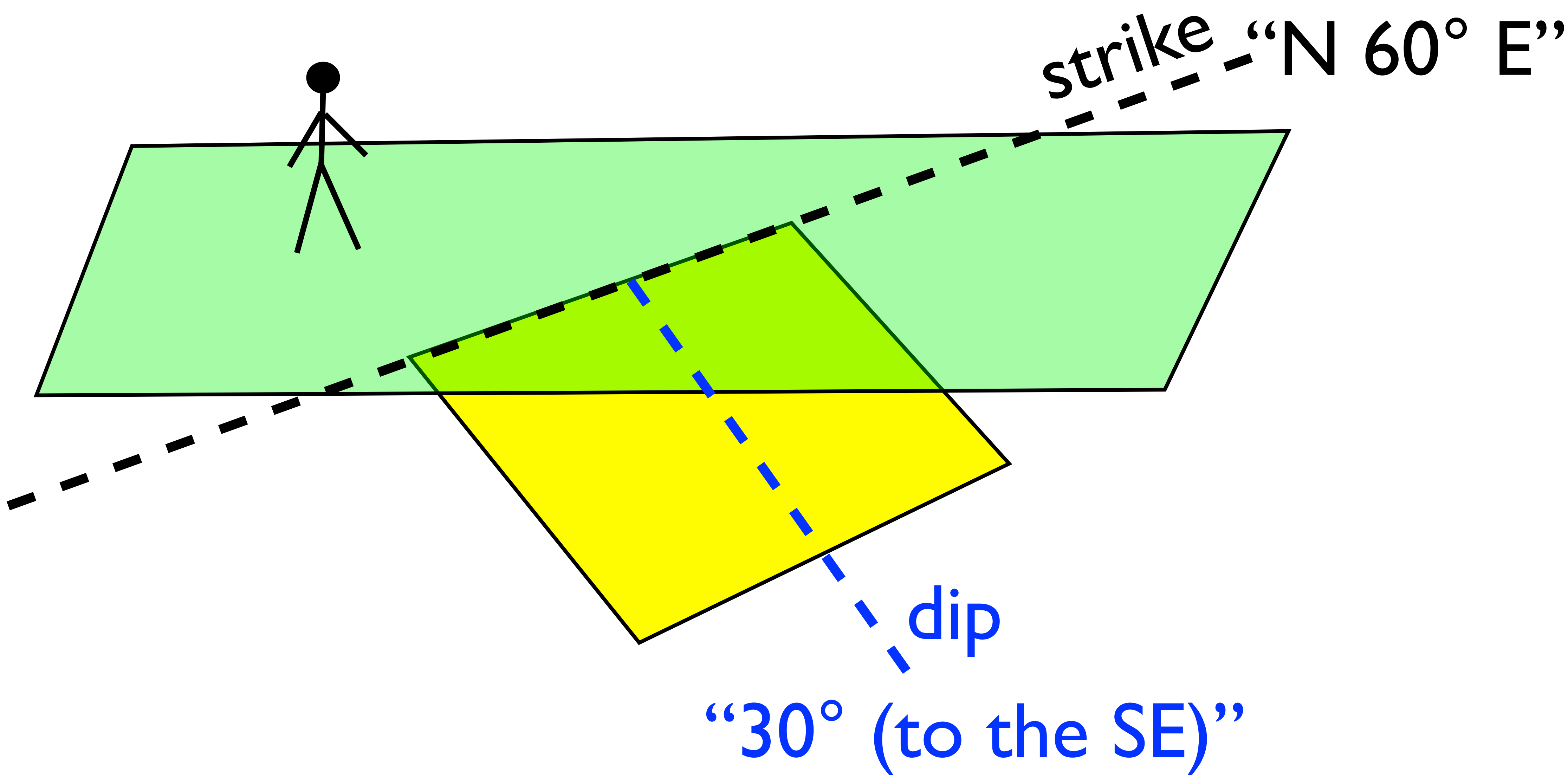
In geology, we choose these two lines to be:

- strike
- dip

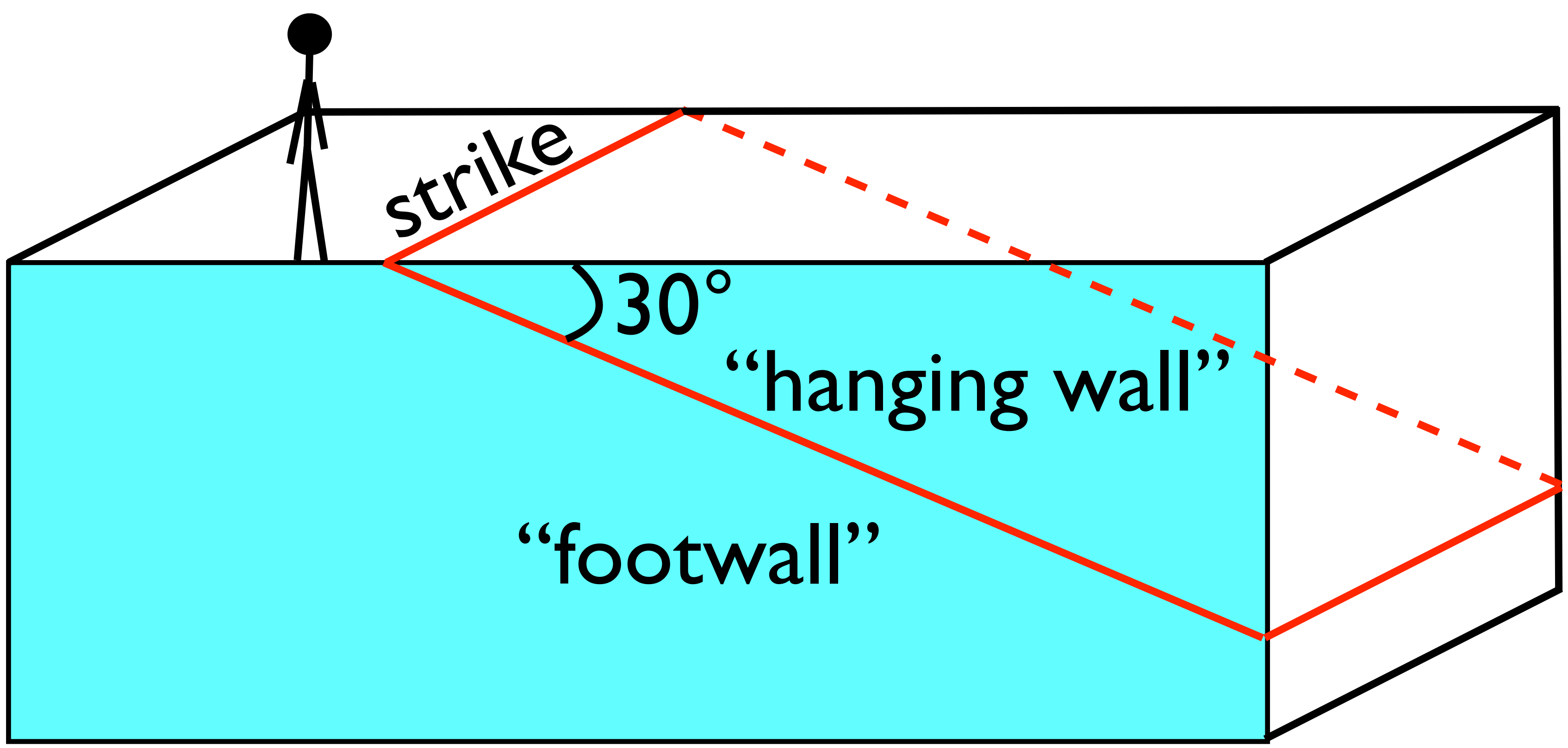


- strike is the orientation of the line where the fault plane intersects the horizontal plane

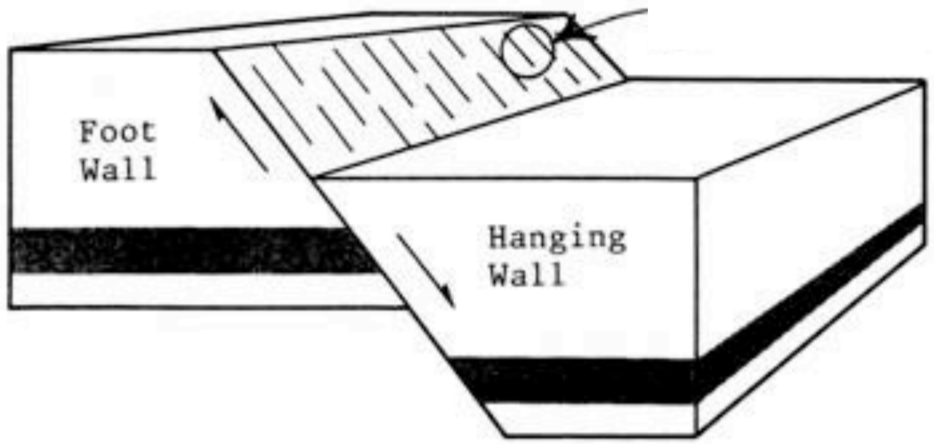
- dip is the orientation of the line on the fault plane that is *perpendicular to strike*. It makes the steepest angle with respect to the horizontal (a ball would roll down it).



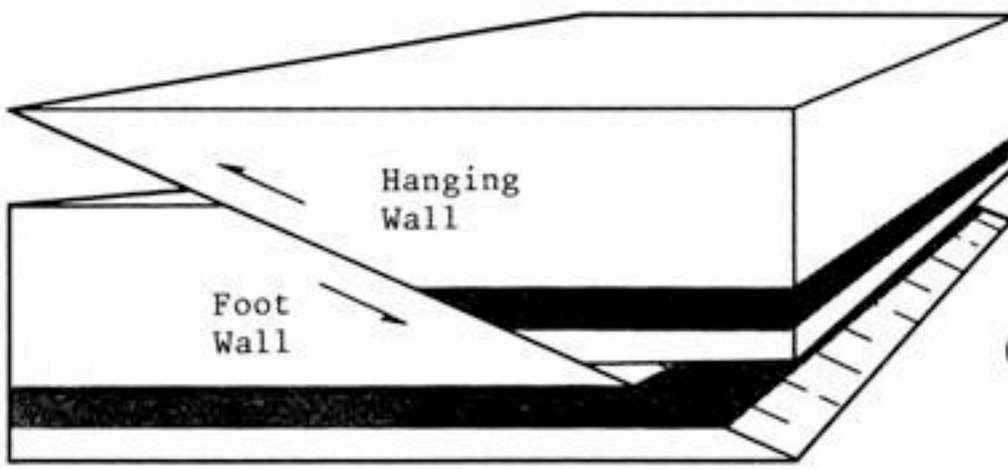
Profile view, as often shown on block diagrams



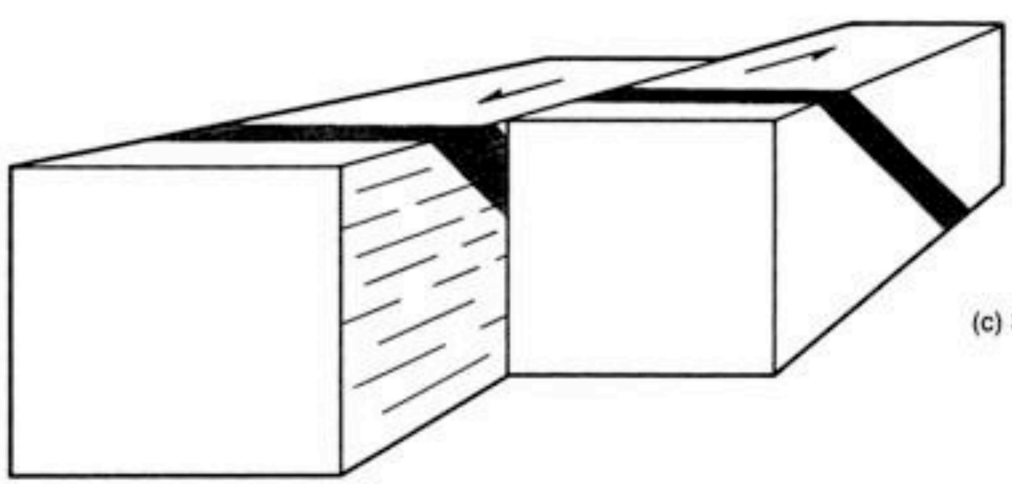
Categories of Faults



(a) Normal fault



(b) Thrust fault



(c) Strike-slip fault

"Dip-slip" faults:

slip is parallel to fault dip

- "Normal" fault

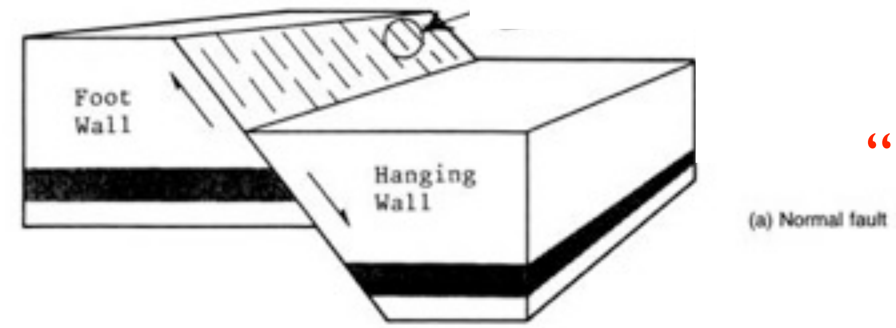
- "Thrust" or "reverse" fault

"Strike-slip" or "transform" faults

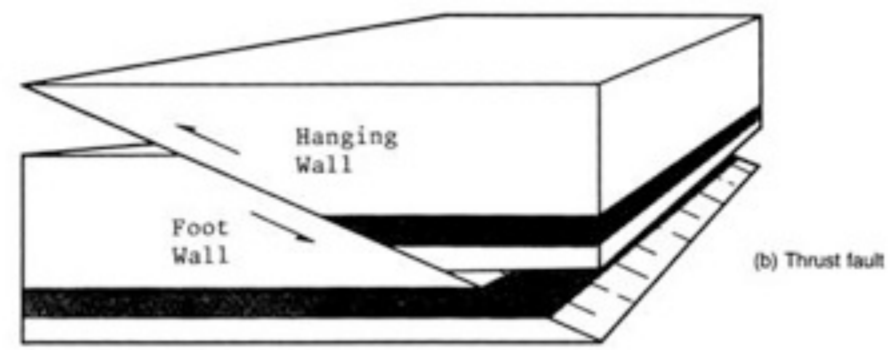
slip is parallel to fault strike

http://geology.csupomona.edu/janourse/TectonicsFieldTrips.htm

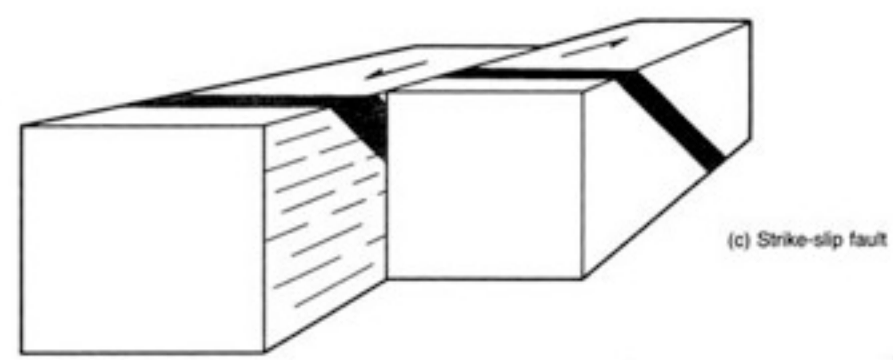
Assume we are looking along strike
(like the diagrams)



"Normal" fault



"Thrust" or
"reverse" fault



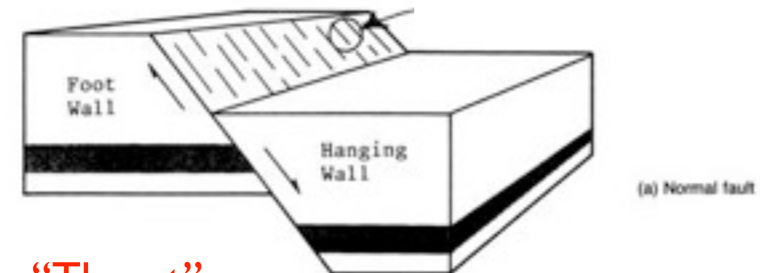
"Strike-slip" or
"transform"
fault

This one may be an "oblique" fault:
normal plus SS (in and out of the screen)

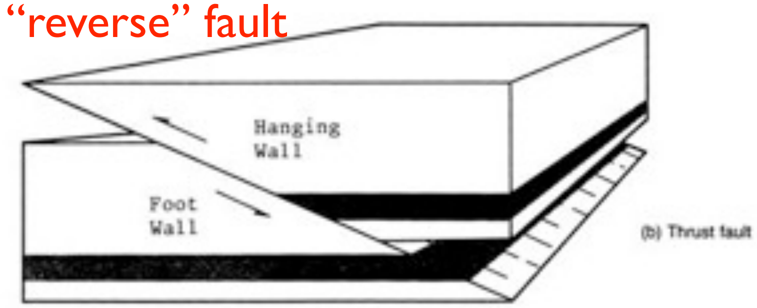
Assume we are looking along strike (like the diagrams)

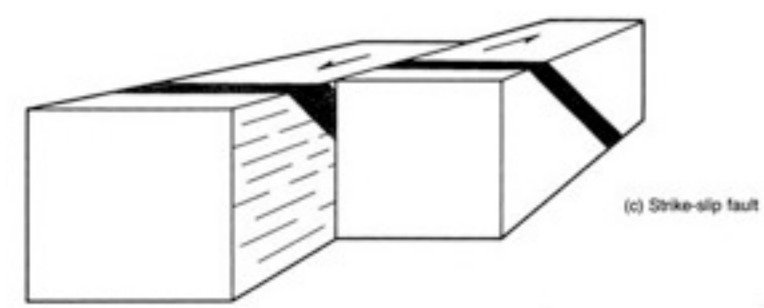
http://geology.csupomona.edu/janourse/TectonicsFieldTrips.htm

“Normal” fault



“Thrust” or “reverse” fault



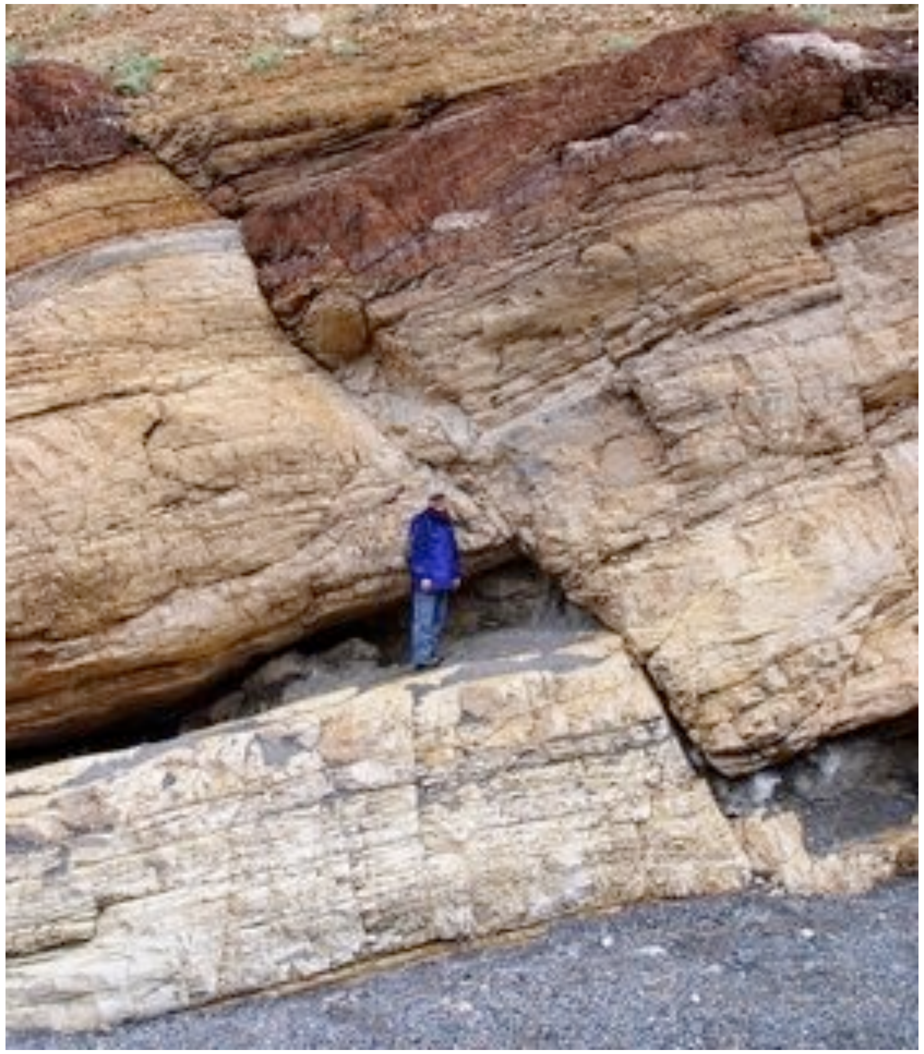


“Strike-slip” or “transform” fault

“Strike-slip” or “transform” fault?

“Normal” fault?

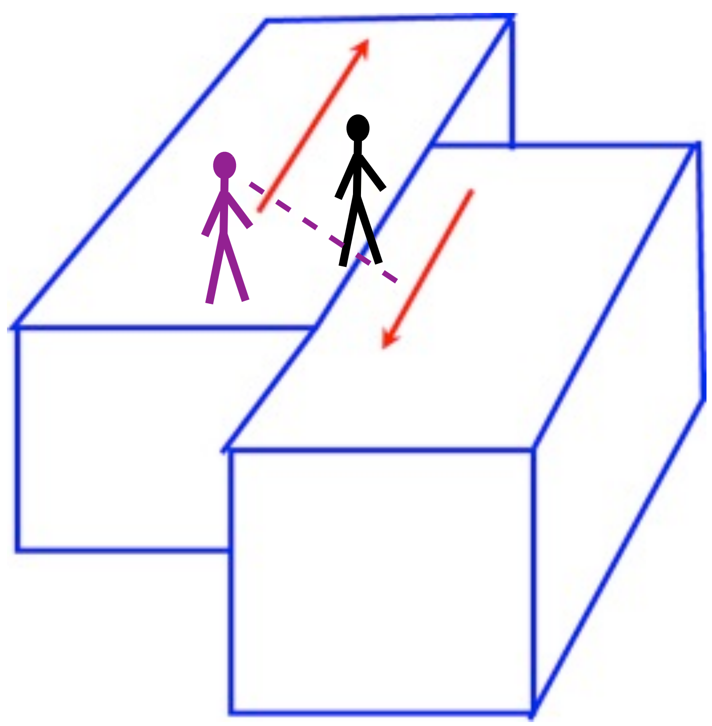
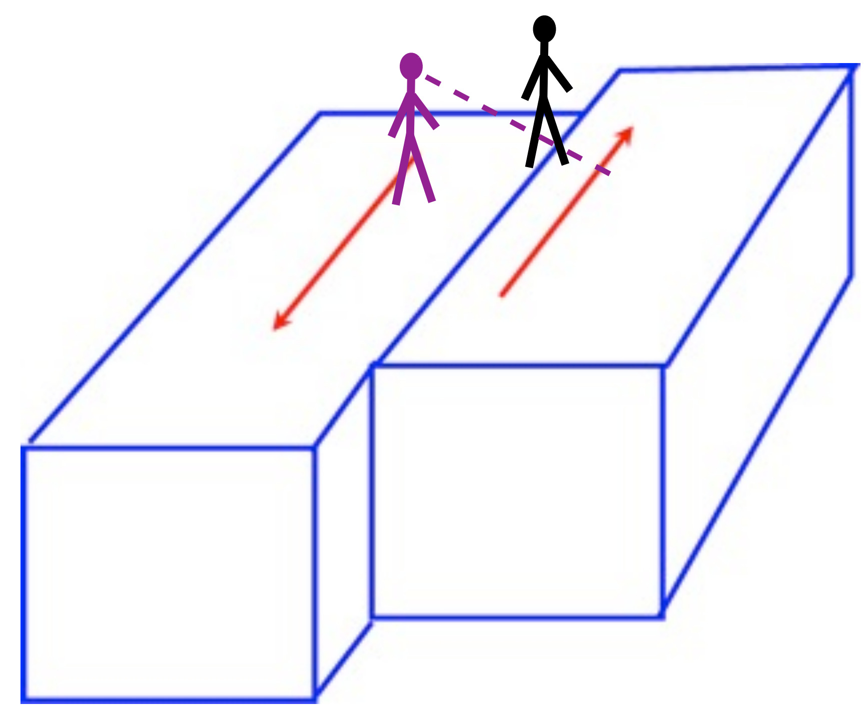
“Thrust” or “reverse” fault?



there’s just one answer

here, can we really tell?

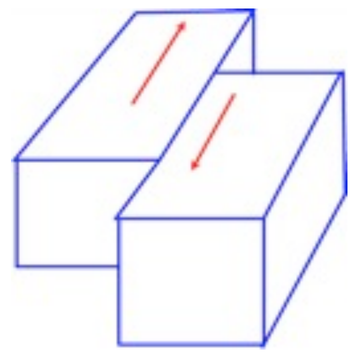
Two kinds of strike-slip faults

Right-lateral (dextral)	Left-lateral (sinistral)
	

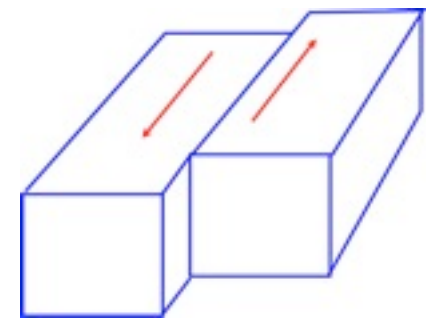
Stand with your feet on either side of the fault. Which side comes toward you when the fault slips?

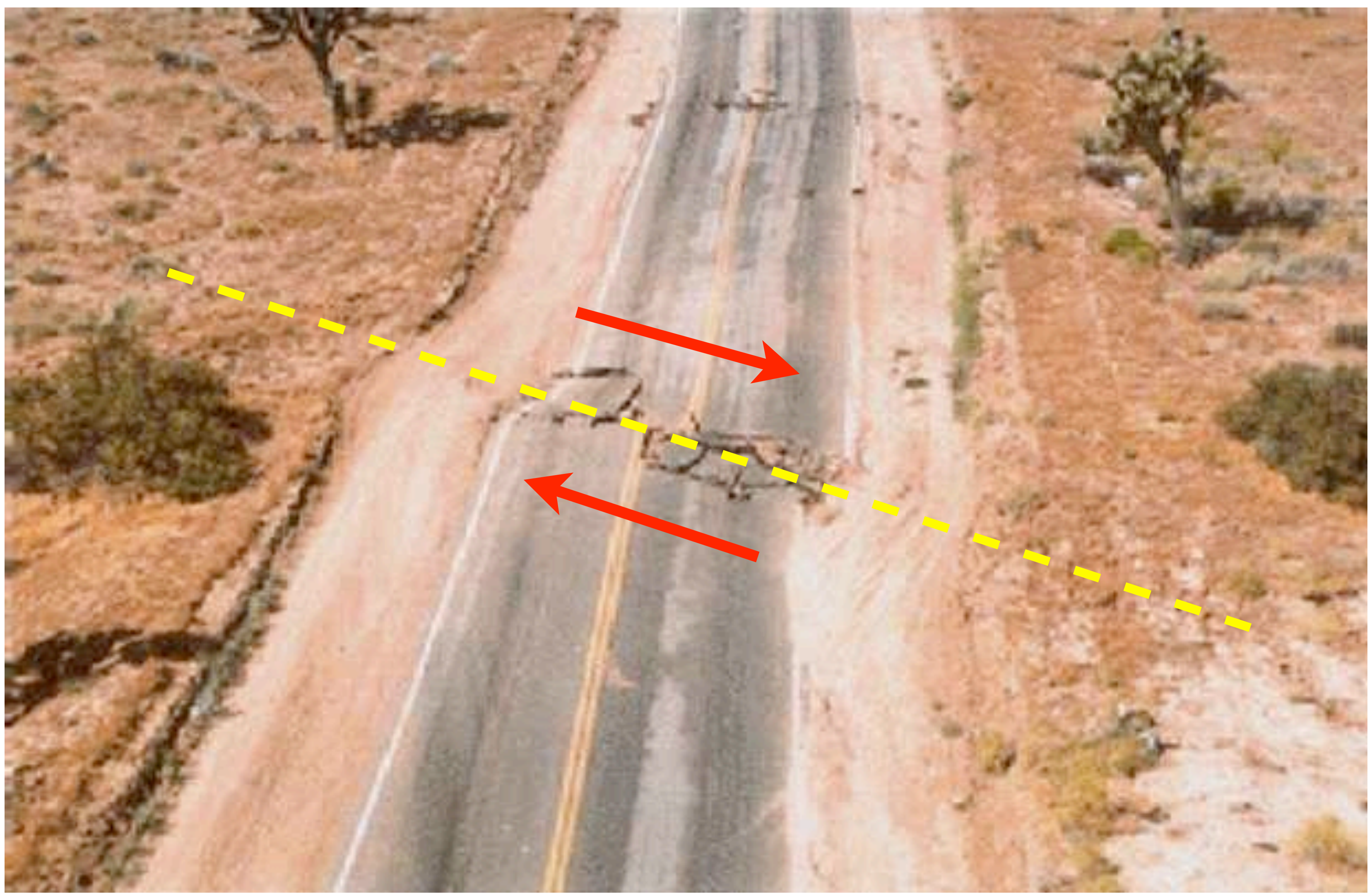
Another way to tell: stand on one side of the fault looking toward it. Which way does the block on the other side move?

Right-lateral
(dextral)



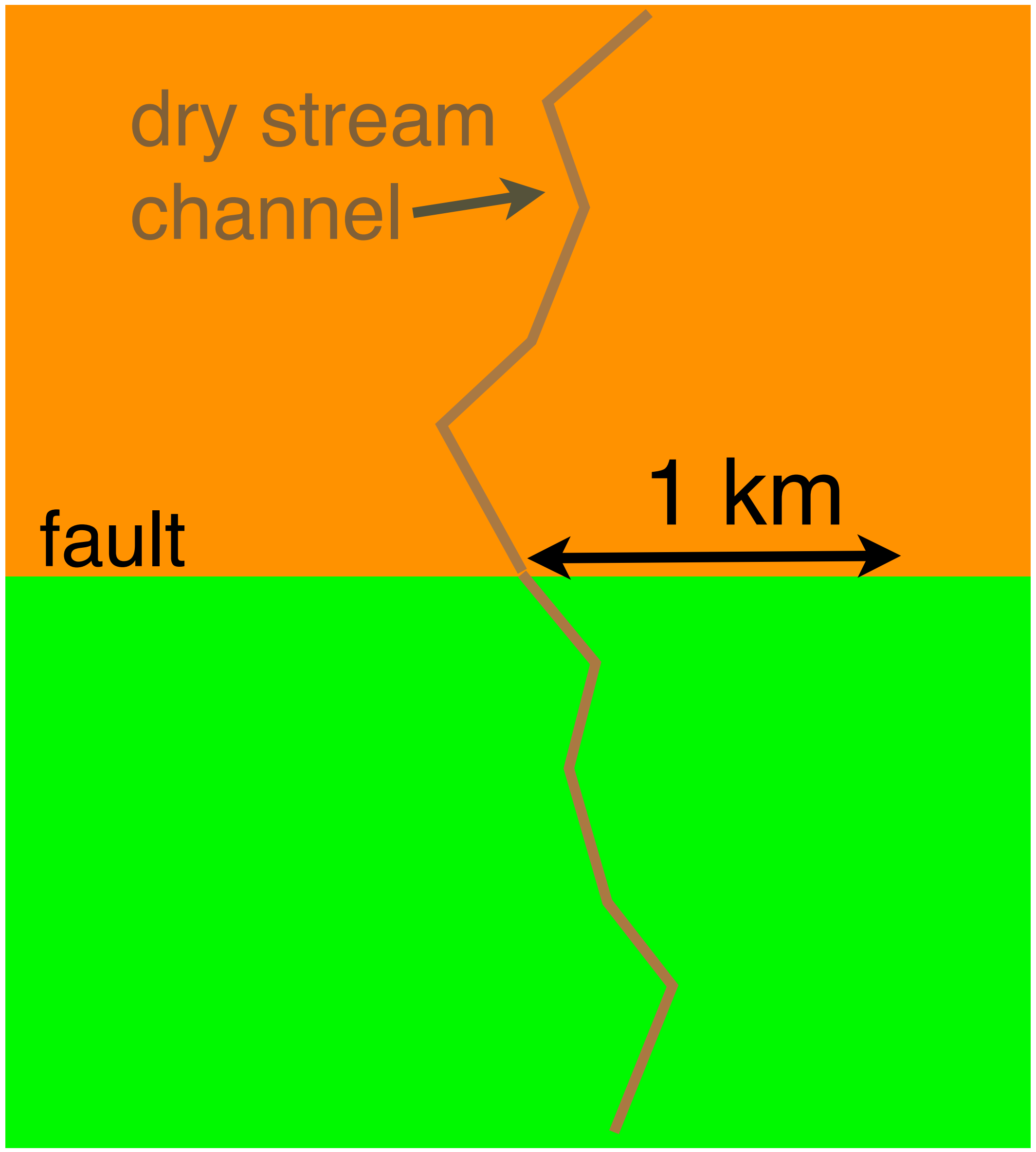
Left-lateral
(sinistral)





1992 M 7.4 Landers, California Earthquake rupture
(SCEC)

Fault slip over geologic time



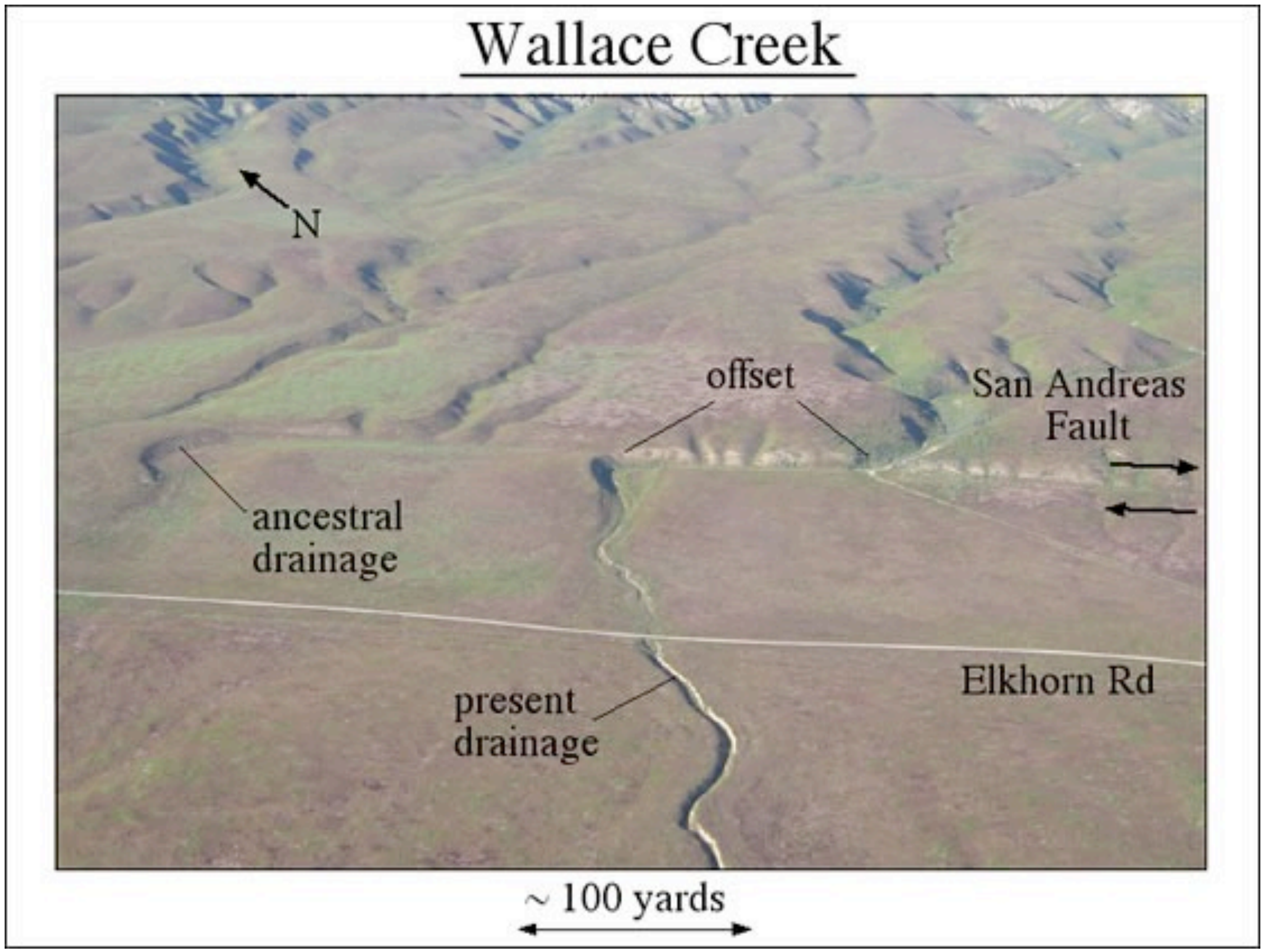
LL or RL?

1 km in 50,000 years
= 20 mm/yr

during this time, ~200
major earthquakes

San Andreas Fault from above

right lateral or left-lateral?



cumulative offset from many earthquakes can be tens of kilometers or more

strike-slip faults can be hard to see from above - why?

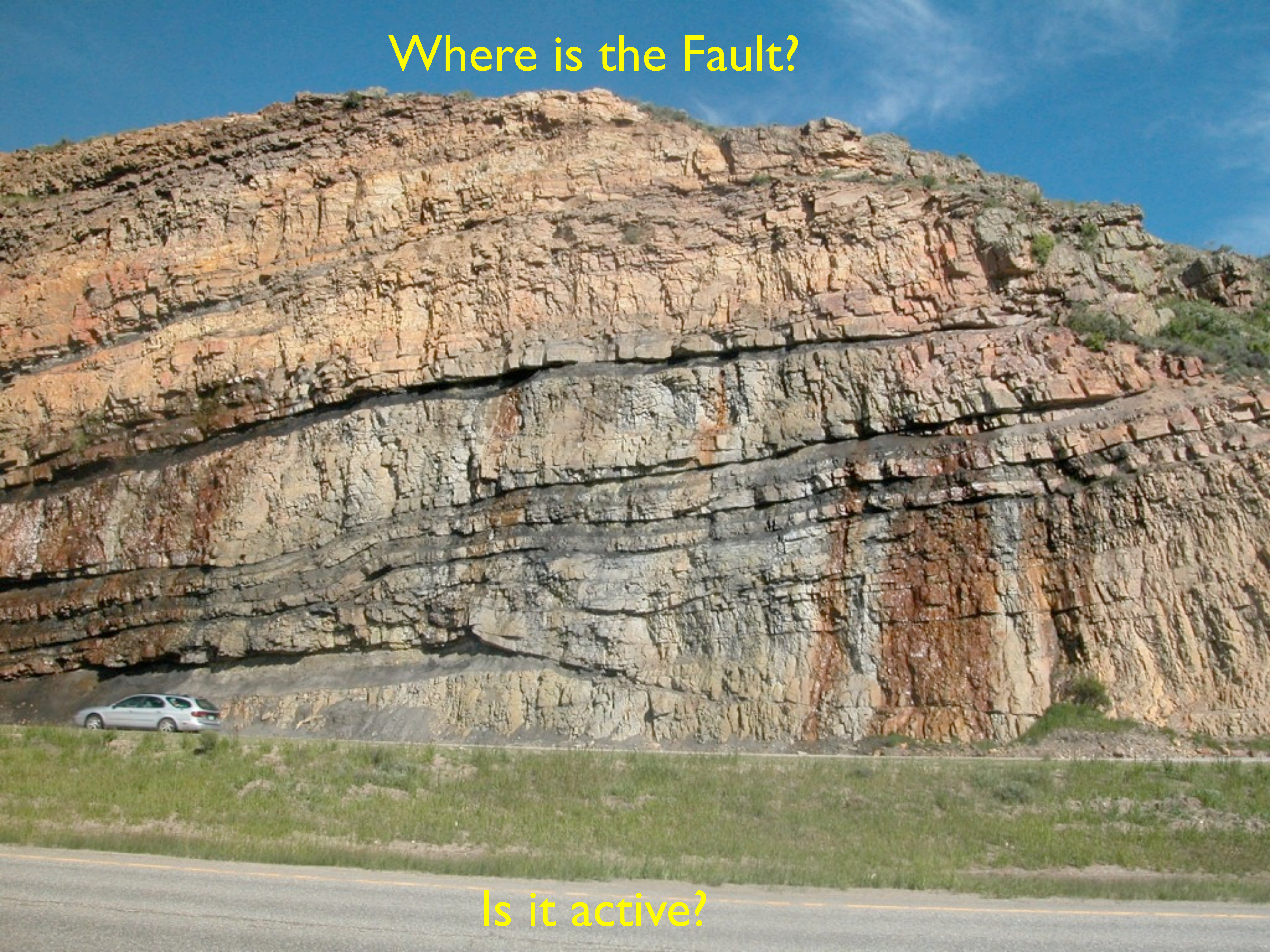
offsets of features with different ages...

choosing where to dig a trench and find the fault surface

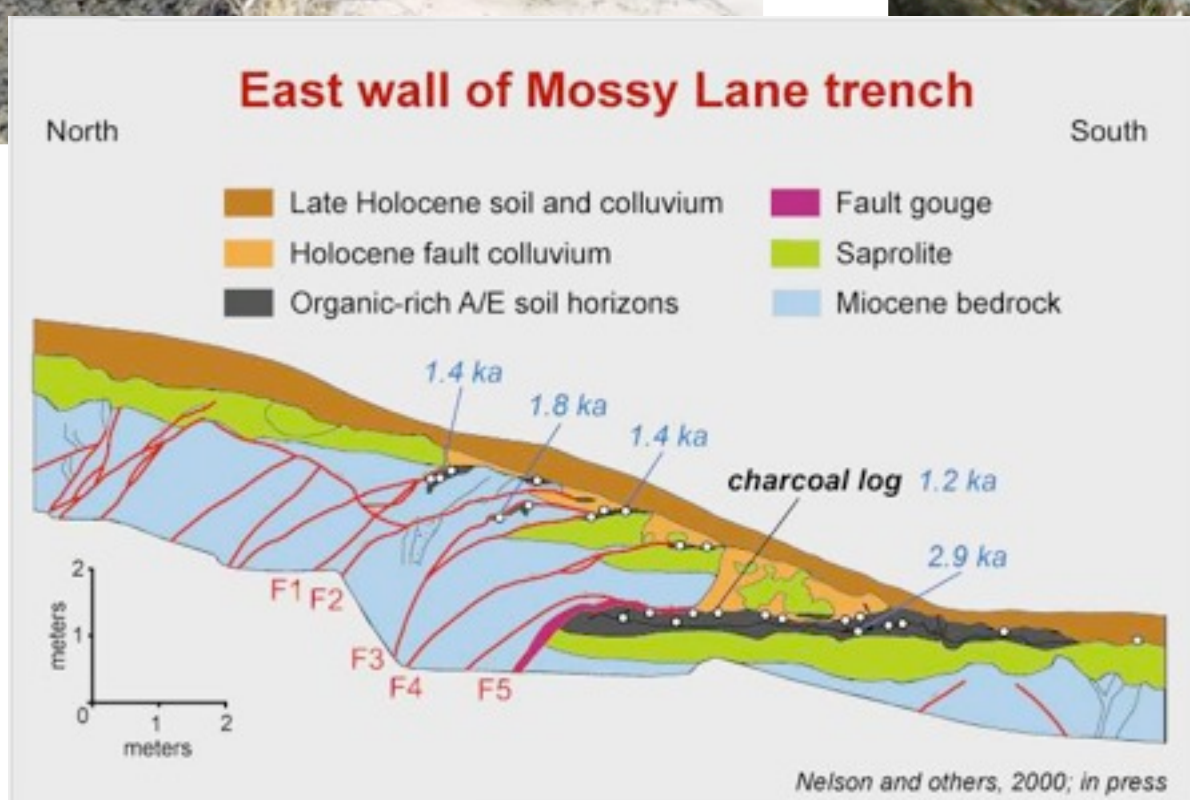
Close-up view: gouge and breccia in the fault zone (major, active fault)

Close-up of breccia: broken up and re-cemented rock. Not as powdered as gouge.

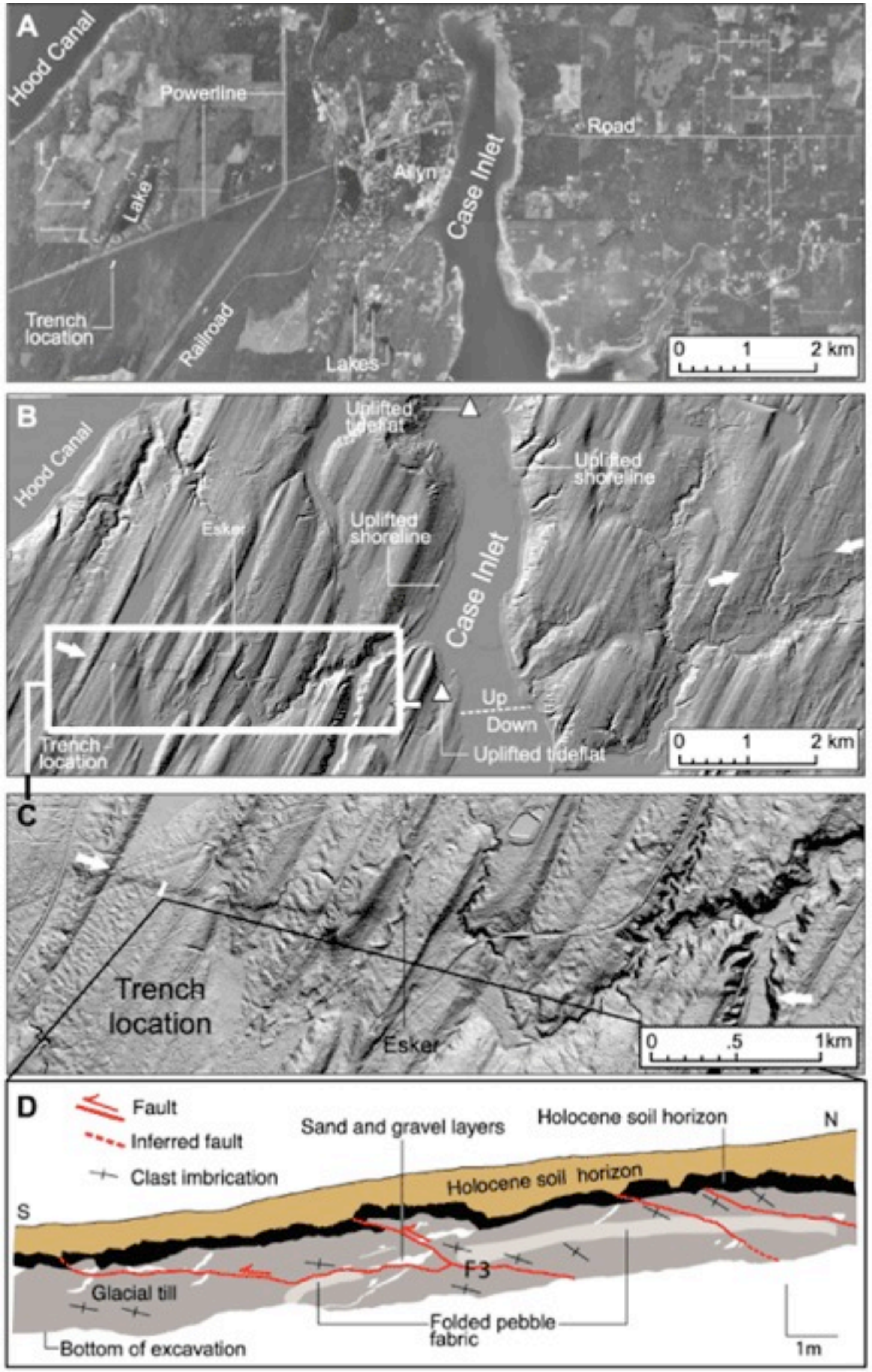
The Elsinore fault, a strike-slip fault in California: powdery gouge in bedrock


Where is the Fault?
Is it active?

No road cut?
Dig a trench (DIY roadcut)



Trenching in Seattle: Looking for the fault in soil, and getting timing and size of prehistoric earthquakes



http://earthquake.usgs.gov/regional/pacnw/ships/results/tacoma.html

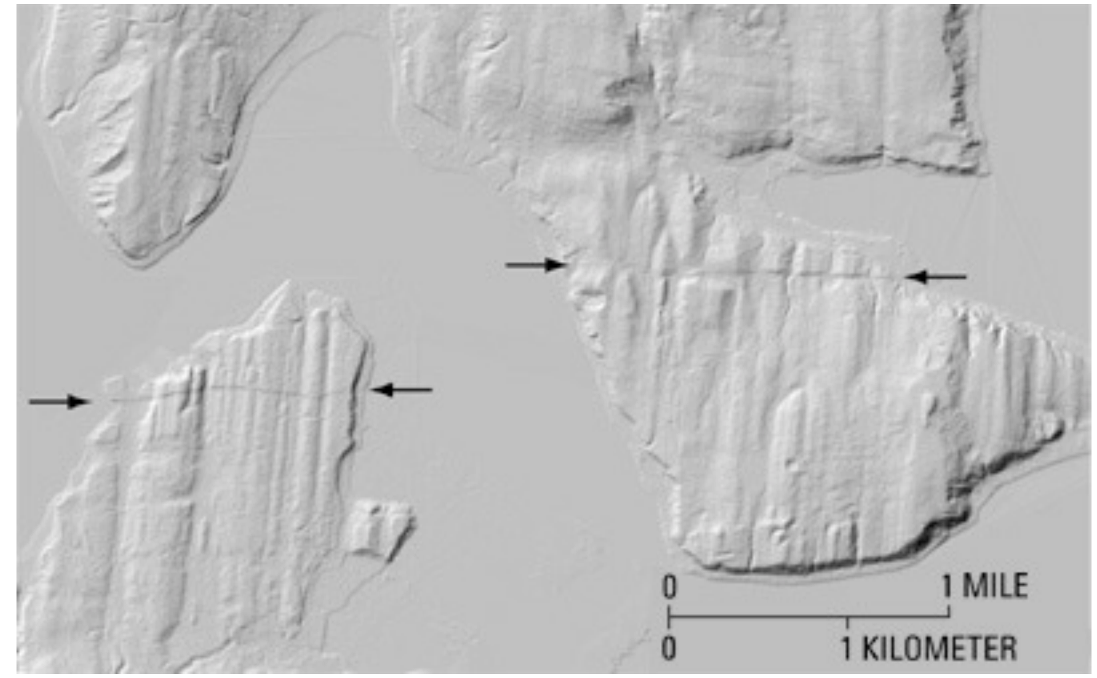
Sometimes we just can't see faults, especially if they do not have a recently formed scarp

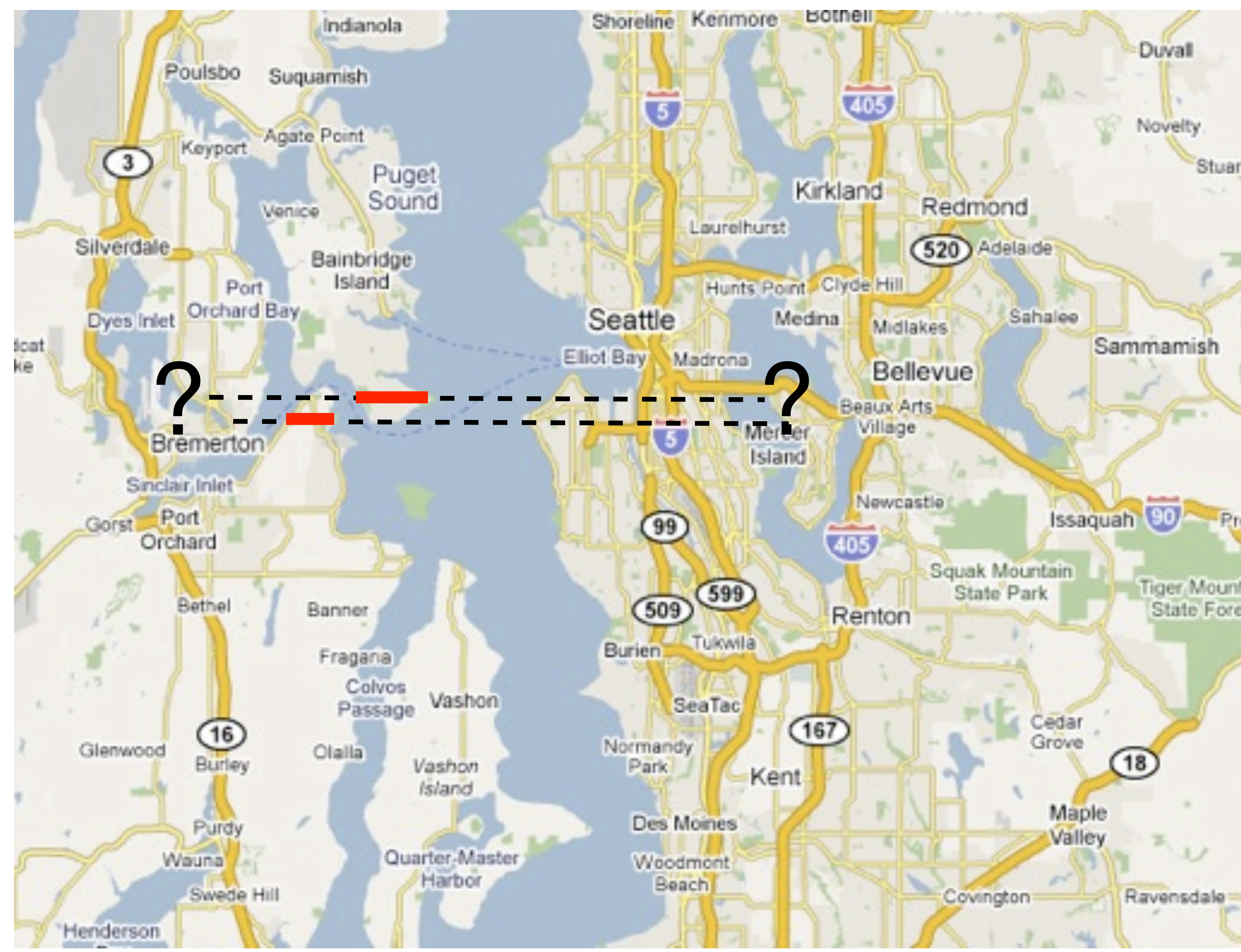
LIDAR (LIght Detection And Ranging) imaging strips the trees, houses, etc.

Now we can see the (obscured, partly eroded) Tacoma Fault scarp

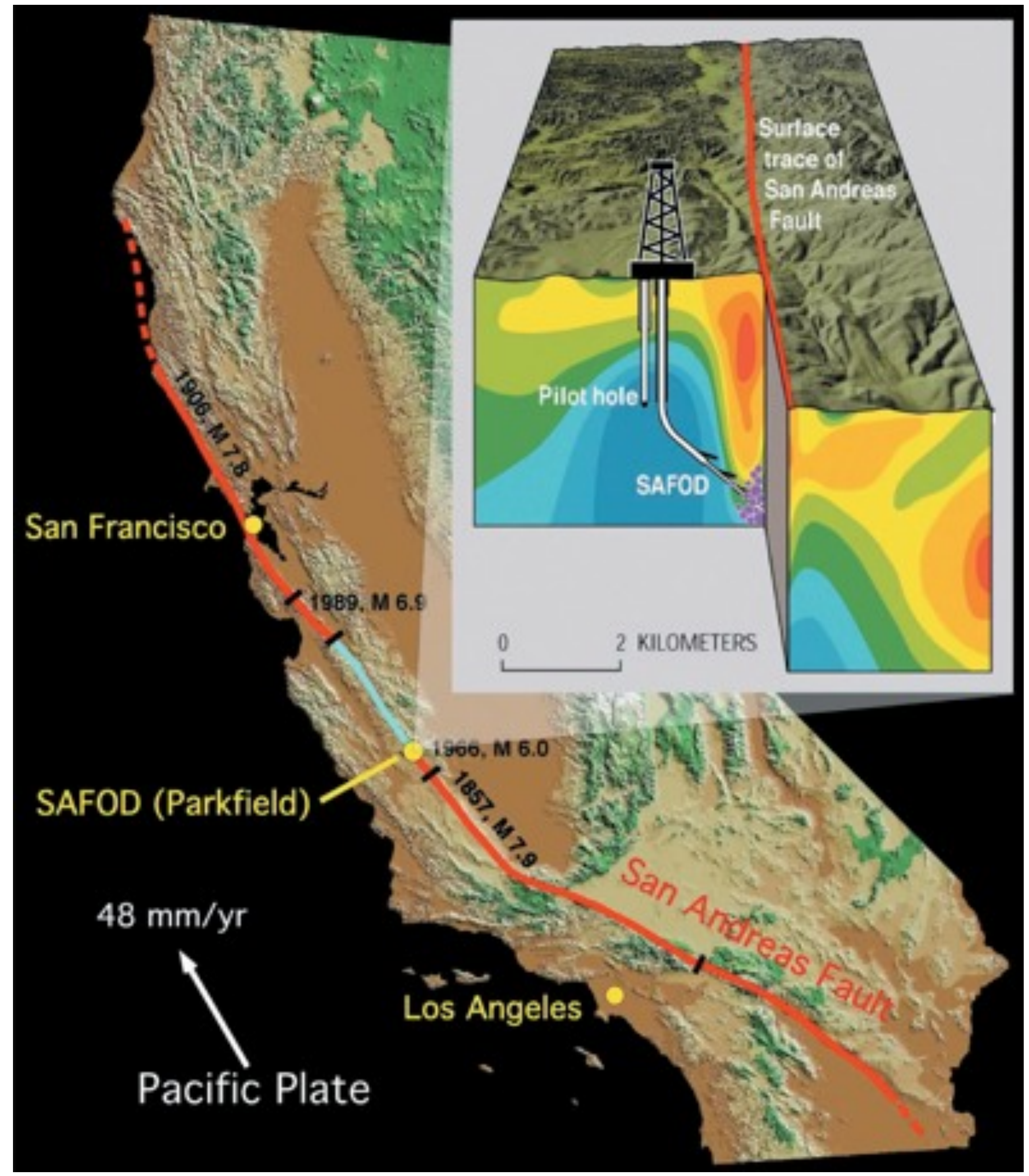
This shows geologists where to dig a trench...red lines are branches of the fault exposed in a trench

Another LIDAR example from Seattle





How do we know the geometry of faults at depth?



SAFOD: San Andreas Fault Observatory at Depth. Valuable, but prohibitively expensive for most places!

Next week: Prof. Bostock will explain one way we find out a lot about subsurface structure without drilling (examples from our region: Cascadia)