

The Basics: Review of the Cascadia Region

This is an image of the Cascadia region:

Let's review a few things:

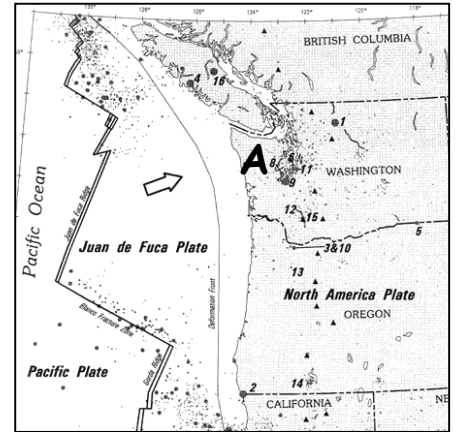
1. What type of boundary exists between the Juan de Fuca plate and the North American plate?

CONVERGING BOUNDARY

2. What types of tectonic plates are they?

Juan de Fuca: OCEANIC

North American: CONTINENTAL



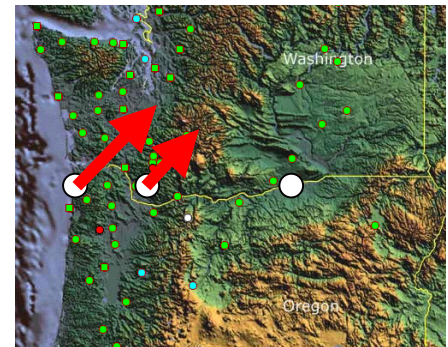
3. The Juan de Fuca Plate is more dense than the North American Plate, so it's slipping below the North American Plate. What is the name of this process?

SUBDUCTION

4. a. Compare the animation to the Cascadia region. What overall direction would you expect point A (on the map above) to be moving due to the deformation? How do you know that?

WOULD EXPECT POINT A TO MOVE NORTHEAST AS JUAN DE FUCA PLATE SUBDUCTS AND PUSHES ON CONTINENTAL MARGIN

- b. Think about the Gumdrop Introduction To GPS & Cascadia GPS Analysis activities we did with the GPS data from the coast, the urban corridor, and eastern areas. From the white dots, draw arrows showing approximate direction and distance moved using the scale provided.



Evidence #1: Hmmm . . . What's Happening Here?

Strange seismic signals that lasted a really long time - weeks - as opposed to seconds or minutes. They released the same amount of energy as a sudden earthquake - it was just spread out over a longer time.

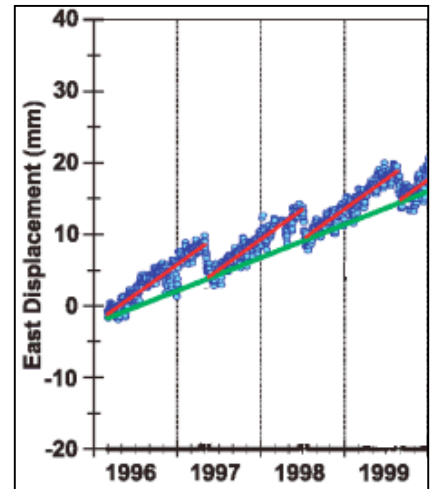
Evidence #2: What was that???

GPS monuments in certain areas were showing reversals of their long term northeast movement. Every so often they'd move southwest.

Evidence #3: A Pattern Seems to Emerge . . .

5. From looking at the data, describe the direction of movement of the western edge of the North American Plate between 1996 and 1999. Remember this is a time series plot - look carefully at what is being measured on the Y-axis!

OVER THE 3 YEARS IT WAS MOVING EAST GENERALLY, BUT EVERY SO OFTEN MOVED WEST IN A TOOTH-LIKE REPEATING PATTERN



6. About how often is the reverse motion happening?

IT'S HAPPENING ABOUT EVERY 14-15 MONTHS

7. Approximately how many millimeters of reverse motion occurs during each slip event?

REVERSE MOTION IS ABOUT 6 MM WEST EACH TIME

Evidence #4: Putting the Pieces Together

8. Now, what do you notice about the seismograms?

ALL THE SEISMOGRAPHS SHOW SIMILAR TREMOR PATTERNS ACROSS A WIDE AREA

Now What? The Implications of What We've Learned

9. What is the data showing here? Did PABH experience a reverse motion or slow slip event?

NO, THERE WAS NO SOUTHWEST MOTION

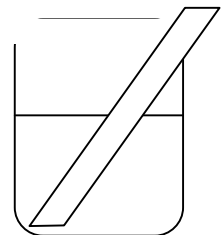
10. Explain how the data from PABH are different from observations at ALBH.

PABH DIDN'T SEEM TO BE AFFECTED - IT WAS LOCKED COMPARED TO A SLIP EVENT FOR ALBH

Let's try to model what's happening with the Juan de Fuca Plate as it moves under the North American Plate.

11. Take the noodle out of the water. Gently bend the lasagna on the part that was under the warm water. Describe what happens.

NOODLE IS EASY TO MOVE WHERE IT'S BEEN HEATED



12. Now, using the same amount of pressure as you did in number 11, try to bend the part that was not in the water. What happens?

NOODLE DOESN'T MOVE EASILY IN COLD PART - IT'S VERY BRITTLE

13. Keep applying pressure to the cool, dry lasagna. What eventually happens?

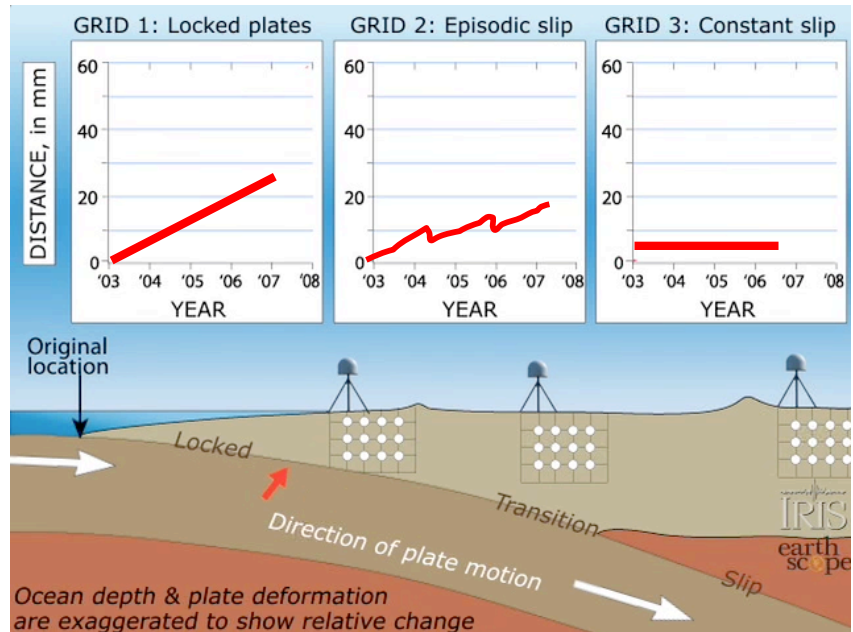
NOODLE EVENTUALLY BREAKS VIOLENTLY

14. How do you think this models what's happening with the subducting Juan de Fuca plate?
Tie in the idea of the 'locked' zone and the 'slip' zone.

LOCKED ZONE EQUATES TO COLD LASAGNA - AREA IS MORE BRITTLE AND PRODUCES LOTS OF ENERGY WHEN BROKEN. SLIP AREA IS DEEPER AND WARMER AND SO MOVES EASIER. IT'S ABLE TO SLIP RATHER THAN RUPTURE

15. After watching the animation, draw in what the time series plots look like for the 3 areas:

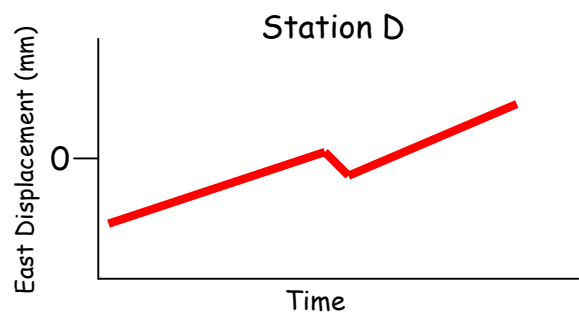
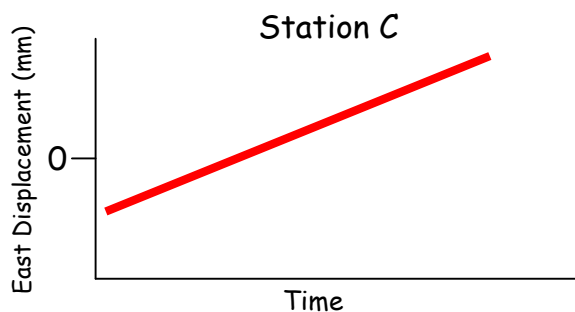
- Locked
- Slow slip
- No slip



Predicting the Future!

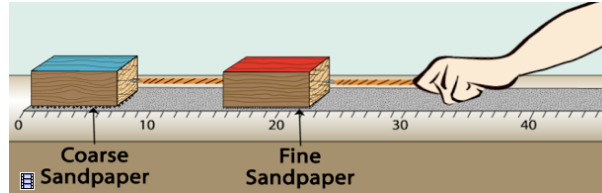
Why Episodic Tremor and Slip Matters

16. Draw a sketch of what the time series plots looked like for Stations located at C and D on the map. This is just one campaign of one slow-slip event. Don't worry about where to start the line - you can start it either below the 0 line or right on it.



**The BIG Picture:
Why You NEED to Know This!**

17. Draw a quick sketch of the setup of the blocks demonstration.



18. Describe what happens as you pull on the rubber band attached to the red block.

RED BLOCK MOVES IN SMALL JERKY MOTIONS TO RELIEVE STRAIN, WHILE BLUE BLOCK DOESN'T MOVE. FINALLY, WHEN ENOUGH STRAIN HAS BUILT UP IN RUBBER BAND BETWEEN RED AND BLUE BLOCKS, THE BLUE BLOCK WILL MOVE SUDDENLY, AND VERY FAR, COMPARED TO RED BLOCK.

19. Given a 'slip-deficit' of 3 centimeters per year, how much would accumulate in 500 years?
About how many feet is that?

AT 3 CENTIMETERS PER YEAR, 1500 CENTIMETERS WOULD BUILD UP OVER 500 YEARS. THAT'S 15 METERS, OR ABOUT 45 FEET.

20. Why would predicting when a great earthquake and tsunami would happen be so important?

PREDICTING A GREAT EARTHQUAKE AND SUBSEQUENT TSUNAMI COULD SAVE THOUSANDS AND LIVES. PROPERTY COULD BE SAVED, AND BUILDINGS RETROFITTED TO SUSTAIN THE GREATER SHAKING.