ERSC 1F90

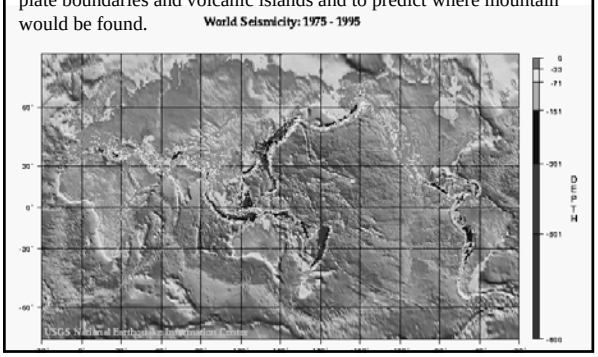
Assignment 5. Locating plate boundaries on Trafalmador.

The aim of this assignment is to identify plate boundaries and the location of various geological features on the basis of the spatial distribution of earthquakes.

Detailed instructions are given in the assignment itself which can be downloaded from this link.

The following slides were used to give several detailed hints, in class, as to how to successfully complete the assignment.

Tectonic plate boundaries on Earth are delineated by the distribution of earthquakes. In this assignment you will look for patterns of earthquakes on the fictitious planet of Trafalmador in order to identify plate boundaries and volcanic islands and to predict where mountain would be found.



Important Points

1. Oceanic trenches

•Deep earthquakes only occur in association with oceanic trenches.

•They are a associated with BOTH shallow and intermediate earthquake.

•Shallow, intermediate and deep earthquakes occur in linear distributions that are parallel to each other and parallel to the trench.

•The trench is parallel to and ALWAYS on the side of the line or band of shallow earthquakes where earthquakes are absent.

•This pattern from shallower to deeper earthquakes may extend beneath continents (a major land mass) or island arc (linear islands that parallel the trench).

•Earthquake foci become progressively deeper in the direction of subduction.

2. Oceanic ridges and transform faults

•Oceanic ridges display a linear pattern of earthquakes, all of which have relatively shallow foci.

•If deep or intermediate earthquakes lie parallel to the band of shallow earthquakes, it is not a ridge, it is a trench.

•Transform faults displace the oceanic ridge and these faults are also characterized by a linear pattern of shallow earthquakes.

•Combined the ridge and transform faults form two approximately perpendicular trending linear patterns of shallow earthquakes.

•Plate movement is away from the ridge axis, in opposite directions on either side of the ridge.

•If you know the direction of plate movement based on the location of the trenches and the direction of subduction you can distinguish ridges from transform faults.

For this assignment you should identify the trenches first.

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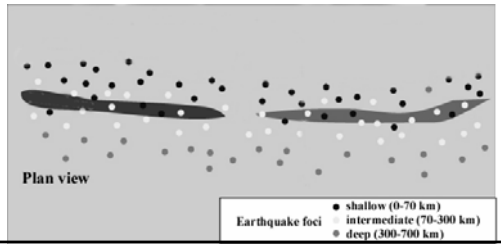
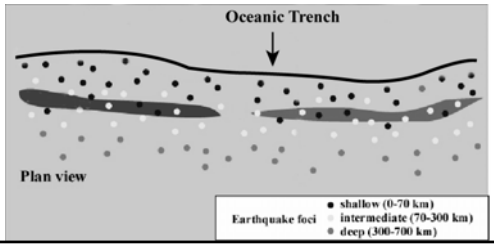
They are a associated with BOTH shallow and intermediate earthquake.

Shallow, intermediate and deep earthquakes occur in linear distributions that are parallel to each other and parallel to the trench.



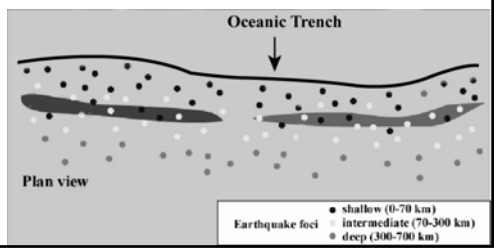
The trench is parallel to and ALWAYS on the side of the line or band of shallow earthquakes where earthquakes are absent.



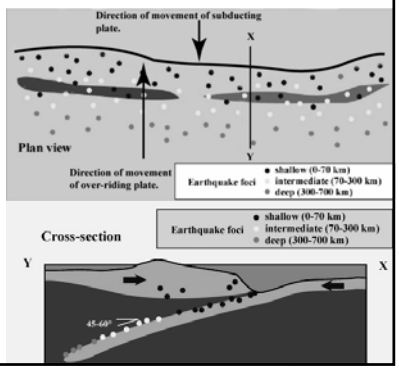
Earthquake foci become progressively deeper in the direction of subduction.

Important point: if, along a line that is perpendicular to what you believe to be there trench, the pattern is not one of shallow, to intermediate to deep earthquakes along that line (e.g., if it is shallow to deep or only shallow to intermediate) you are not observing a simple trench but possibly a more complex situation where two plate boundaries are in close proximity to each other.

Direction of subduction

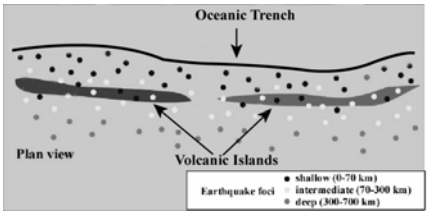


You can use the direction of subduction to distinguish the subducting plate from the over-riding plate.



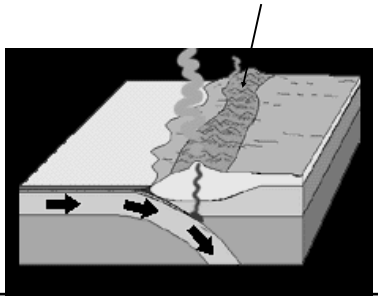
This pattern from shallower to deeper earthquakes away from the trench may extend beneath continents (a major land mass) or island arc (linear islands that parallel the trench).

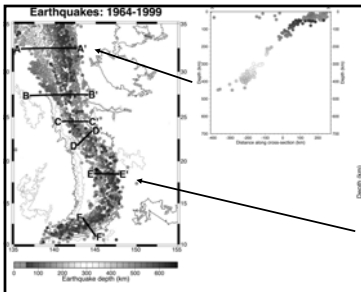
In this example there are long, narrow islands parallel to the trench and on the over-riding plate. Therefore, these are volcanic islands of an Island Arc Complex.



When trenches lie parallel to continental masses, the compressive forces and volcanic activity form linear mountain belts, on the continent, that parallel the trench like the Andes along the western side of North America.

Mountain Belt

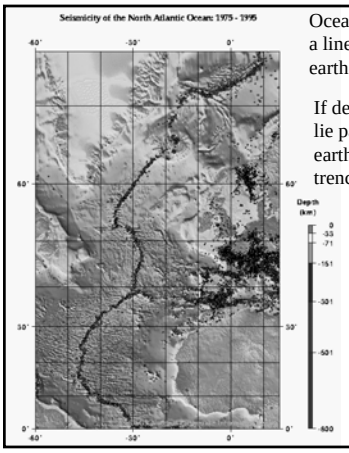




How steep is Subduction?

As seen on a map, the narrower the band of earthquakes on the map, the steeper the angle of subduction.

Important: These cross-sections are comparable to the cross-sections that you plotted in the assignment. However, do NOT rely on them to find location highest and lowest angle of subduction. Look at the map.

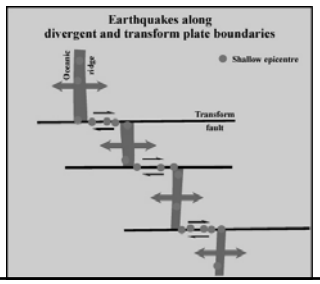


Oceanic ridges are delineated by a linear pattern of shallow earthquakes.

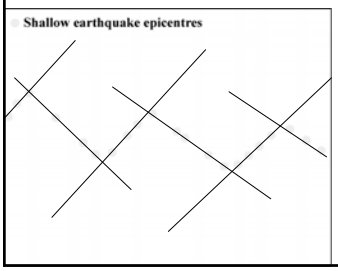
If deep or intermediate earthquakes lie parallel to the band of shallow earthquake, it is not a ridge, it is a trench.

Note that Iceland is a volcanic island that is a part of the North Atlantic Ridge.

Transform faults displace the oceanic ridge and these faults are also characterized by a linear pattern of shallow earthquakes.



Combined the ridge and transform faults form two approximately perpendicular trending linear patterns of shallow earthquakes.



The question is: which of the linear trends of shallow earthquakes is along the ridge and which is along transform faults?

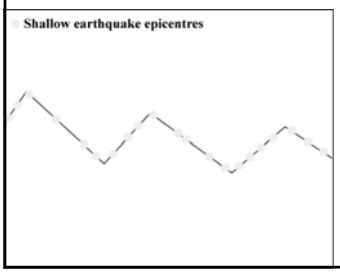
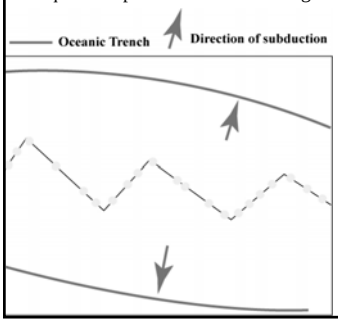
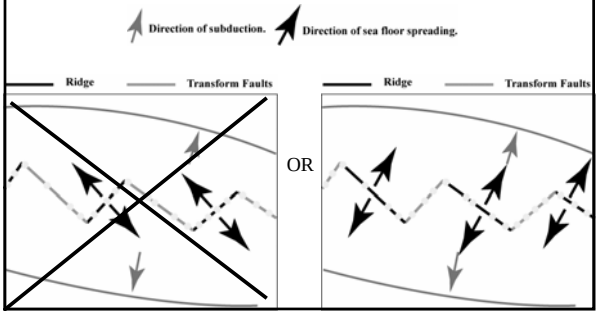


Plate movement is away from the ridge axis, in opposite directions on either side of the ridge.

You know the direction of plate movement based on the location of the trenches so you can determine which linear trending shallow earthquakes represent the oceanic ridge.



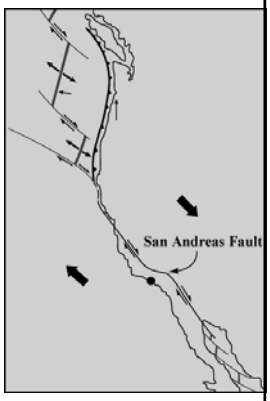
Decide for yourself which of the following figures are correct based on the direction of plate movement.

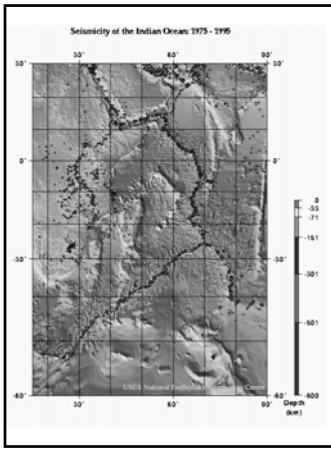


Remember:

Transform faults can pass though continents to connect ridges.

Ridges do not pass through continents to connect transform faults.





There are no failed rifts on the map for assignment 5.