Seismic Experiments in Southern Peru

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Abstract

The subduction of the Nazca Plate in Northern Chile and Southern Peru is a transition zone from standard subduction to “flat” subduction. We are going to be installing a network of seismic stations this year between Mollendo and Juliaca in conjunction with UCLA/CENS. Another line will be installed between Cusco and Juliaca over the next few years and a group from France is installing an extension of the line between Mollendo and Juliaca. The information from these stations will be valuable for detecting local events as well as teleseismic events which will allow the construction of receiver functions. Receiver functions can show the location of interfaces with an impedance contrast across them as well as velocity contrasts between different interfaces. Such information can be used to compare flat and normal (dipping more steeply) regions of subduction, thus providing insight into physical parameters controlling the process of flat subduction.

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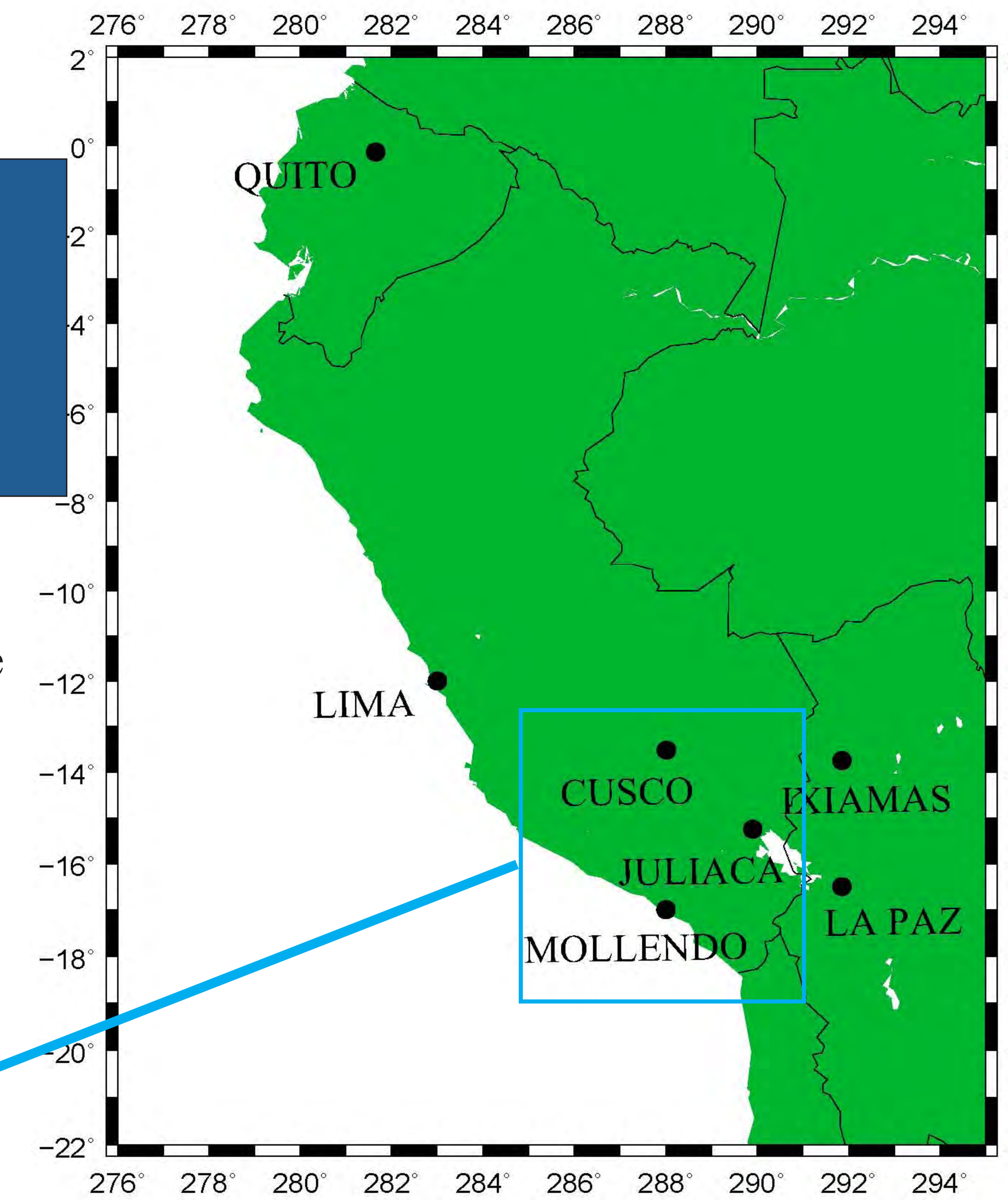
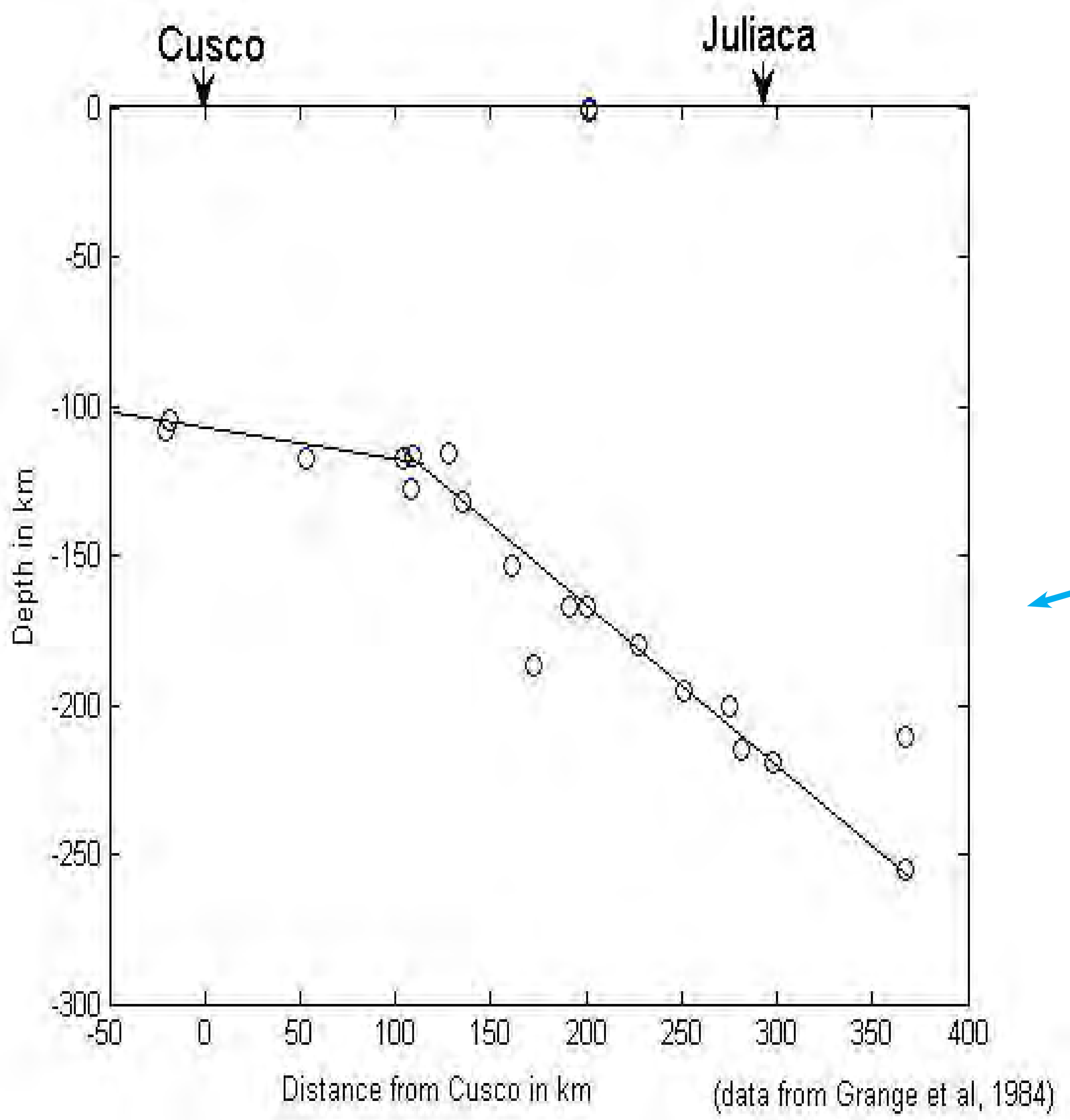
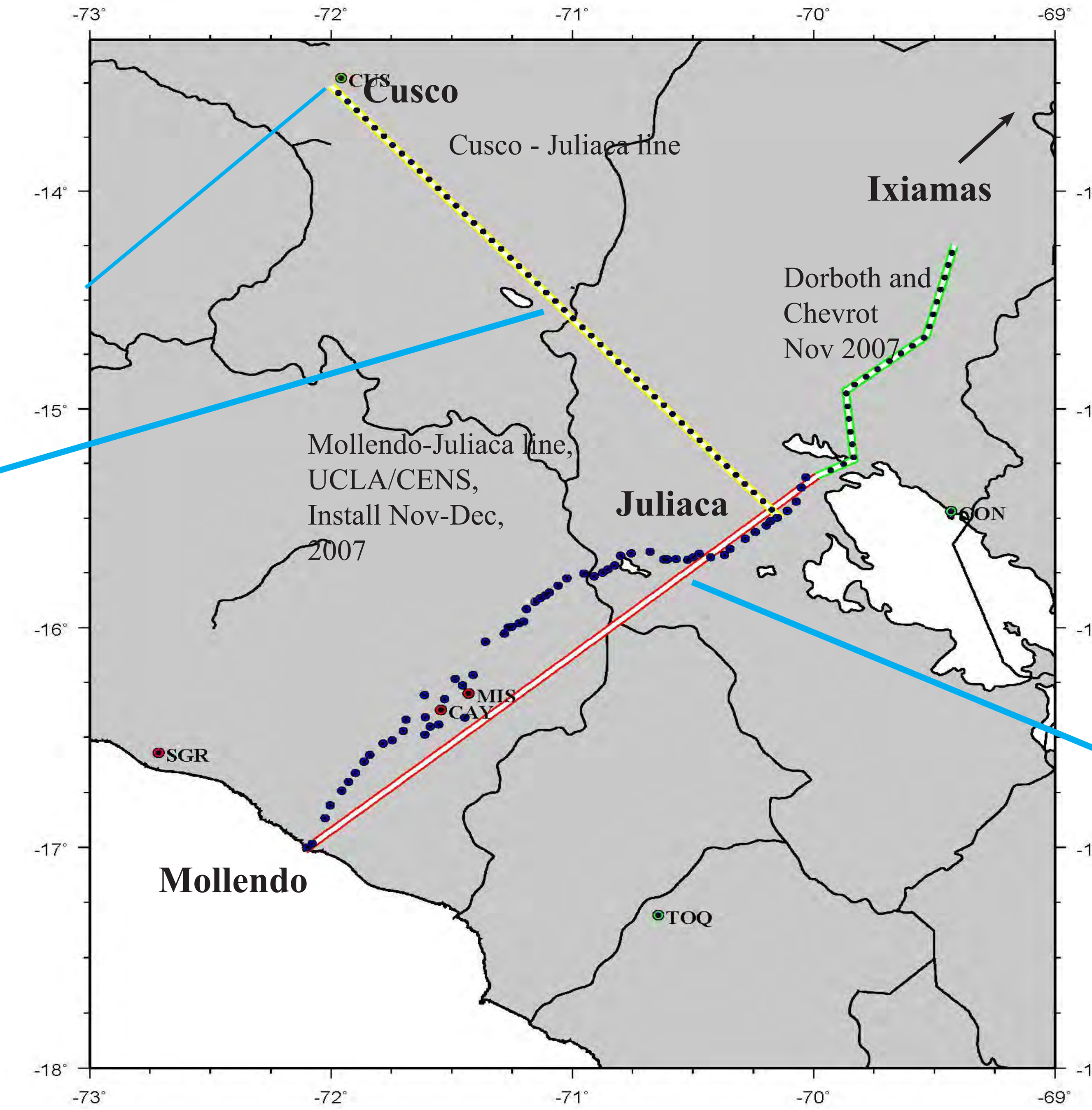
Flat subduction

Several theories have been put forward to explain flat subduction such as the idea that the system was disrupted by the subduction of a seamount or large igneous province (LIP) which could encourage flat subduction due to buoyancy effects of thickened crust (Gutscher et al, 2000). Obtaining information about important physical parameters (such as velocity, temperature, and attenuation) in different types of subduction areas allows the determination of the tectonic evolution of a region (such as the change in dip angle over time) and provides input for geodynamical models.





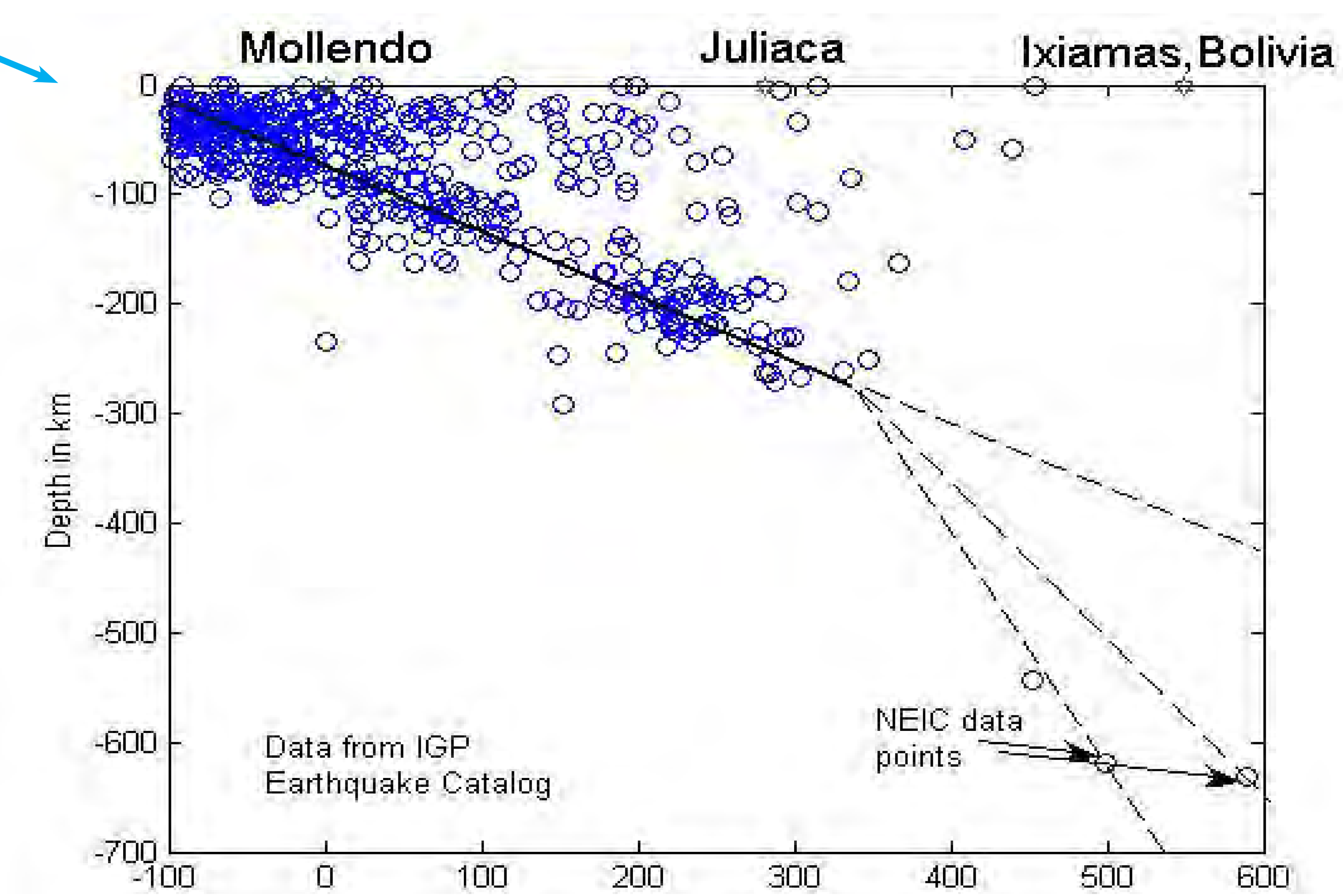
(left): Cross section of seismicity between Cusco and Juliaca. May show change from flat to more normal subduction



(right): Proposed locations for stations to be deployed

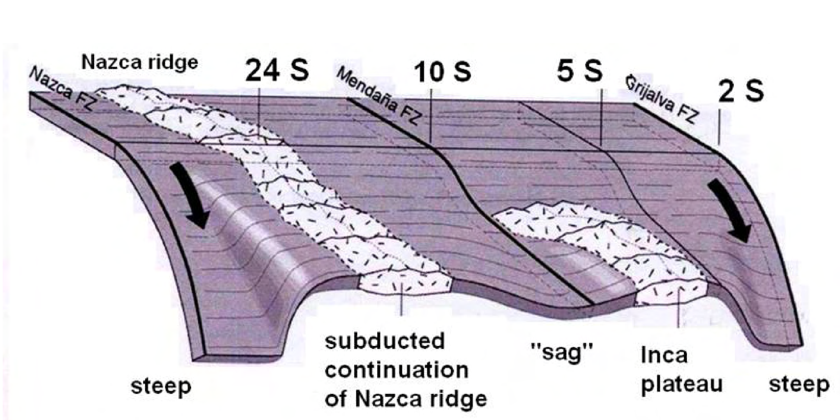
Receiver Function Methodology

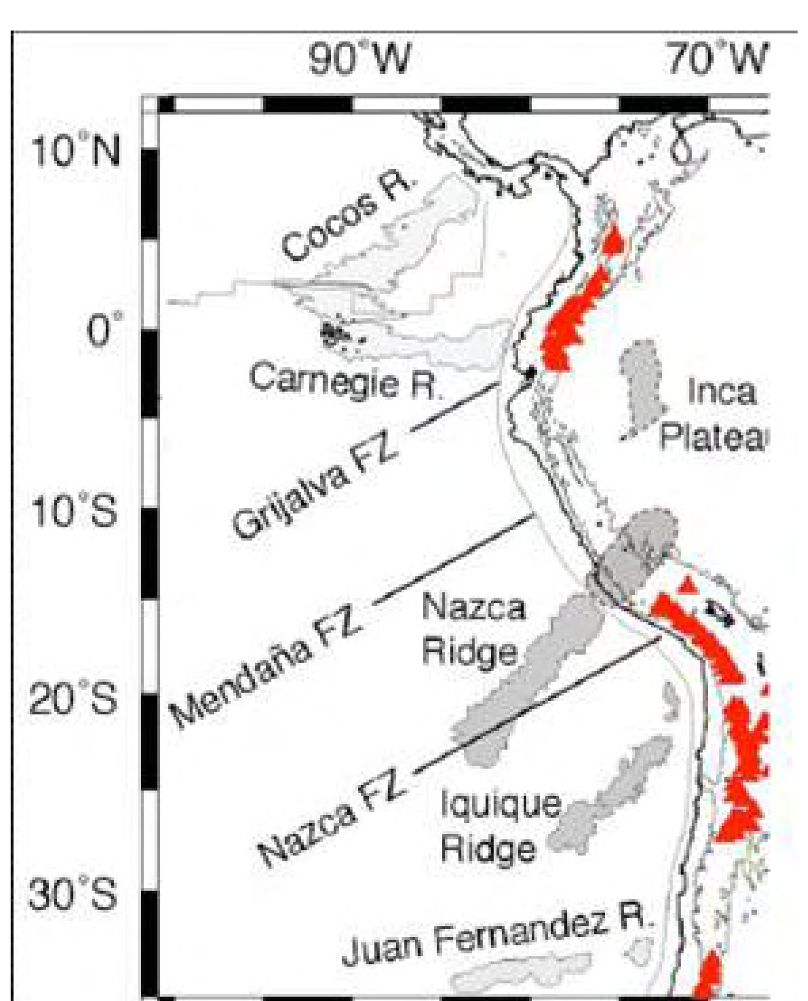
Receiver functions determine the depth of a discontinuity (such as the Moho or top of a subducting slab) below a station from the travel time difference between the direct p-wave and the Ps converted phase. A method of deconvolution (Langston, 1979) which assumes teleseismic waves come up vertically to the station removes instrument and source response and the effects of propagation of the mantle so that the receiver function is only sensitive to structure directly below the station.



(right): Location of subducting Nazca ridge and proposed location of Inca plateau (Gutscher et al, 1999). Active South American volcanoes are marked in red. Volcanic gaps appear to correspond with areas of flat subduction.

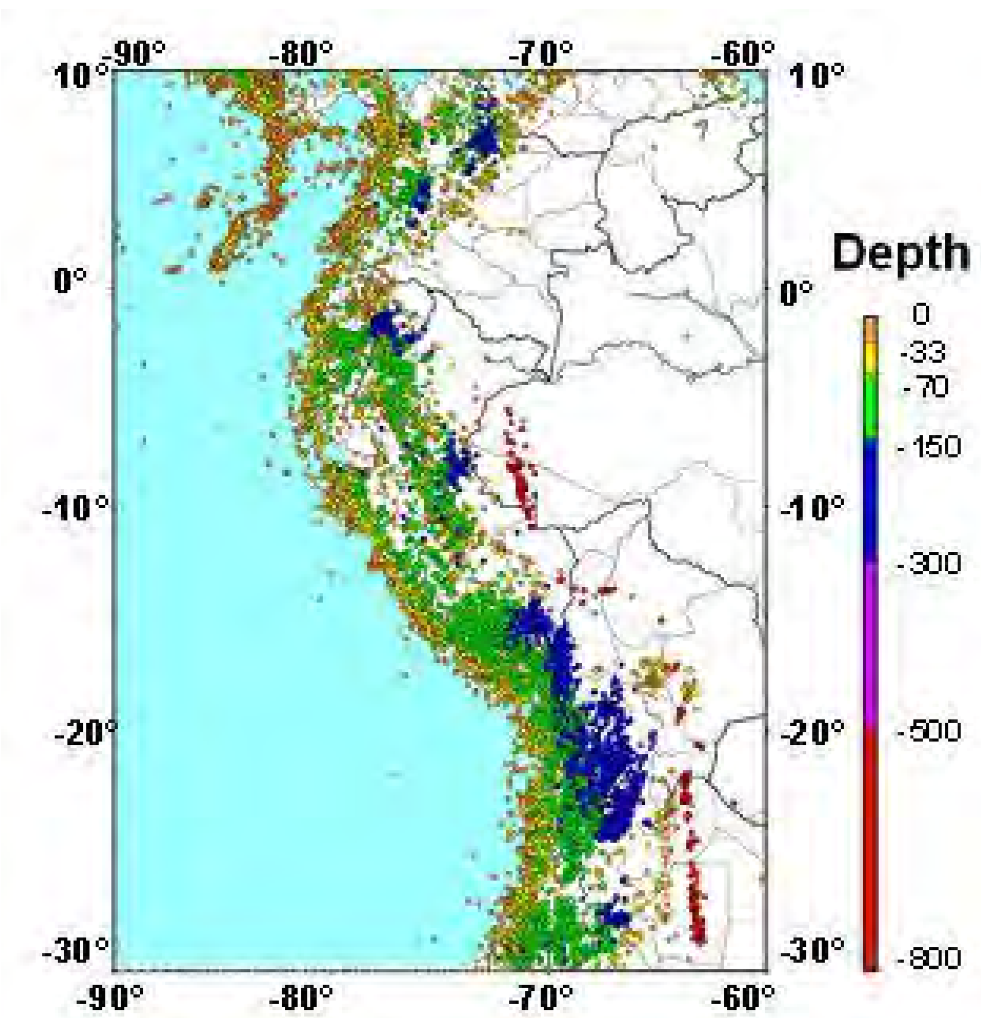
(below): Model of Gutscher et al, 1999 showing the relationship between structure of the subducting slab and the location of subducted ridges.





(right): 2D view of seismicity in Peru from an NEIC global seismicity search

(far right): Cross section of seismicity within 100km of the line between Mollendo and Ixiamas. Data comes from the IGP (Instituto Geofisico del Peru) earthquake catalogue with several deeper points from an NEIC search included.



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