THE 2007 PISCO EARTHQUAKE (MW=8.0), CENTRAL PERU: FIELD INVESTIGATIONS AND SEISMOTECTONIC CONTEXT

Audin L., Farber D., Tavera H.

This epicentral area of the 2007 Pisco earthquake marks a major transition in the characteristics of the Nazca subduction zone: 1) the obliquity of the main cordillera with the convergence is higher to the south 2) the distance between the trench and the coastline changes abruptly from ~180km to the north to ~80km to the south 2) the megathrust dip angle is shallower (10-20°) to the north than to the south (25-30°); 3) megathrust earthquakes have distinctly smaller magnitudes, recurrence time, occur at deeper depth and are more fragmented to the north (Figure 1)… Most but not all of these observations are related to the oblique subduction of the Nazca ridge - a major bathymetric high - beneath the continental margin.

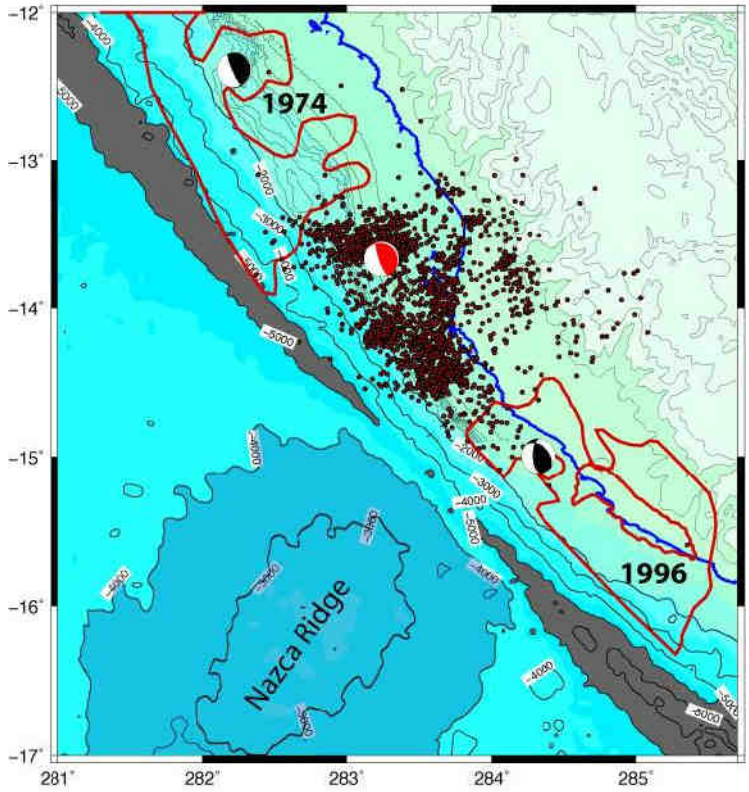


Figure 1: Spatial dispersion of two weeks of aftershocks along the coastline. In red the focal mecanism showing a13° dipping plane (Tavera et al., 2008).

The effect of the Nazca ridge subduction is also observed in the morphology – river changing course - and tectonics of the forearc (Figure 2, Macharé and Ortlieb, 1992). In particular, around the Paracas Peninsula where Miocene and Pliocene marine formations are uplifted and the forearc tectonic regime changes from compression to extension (Figure 2).

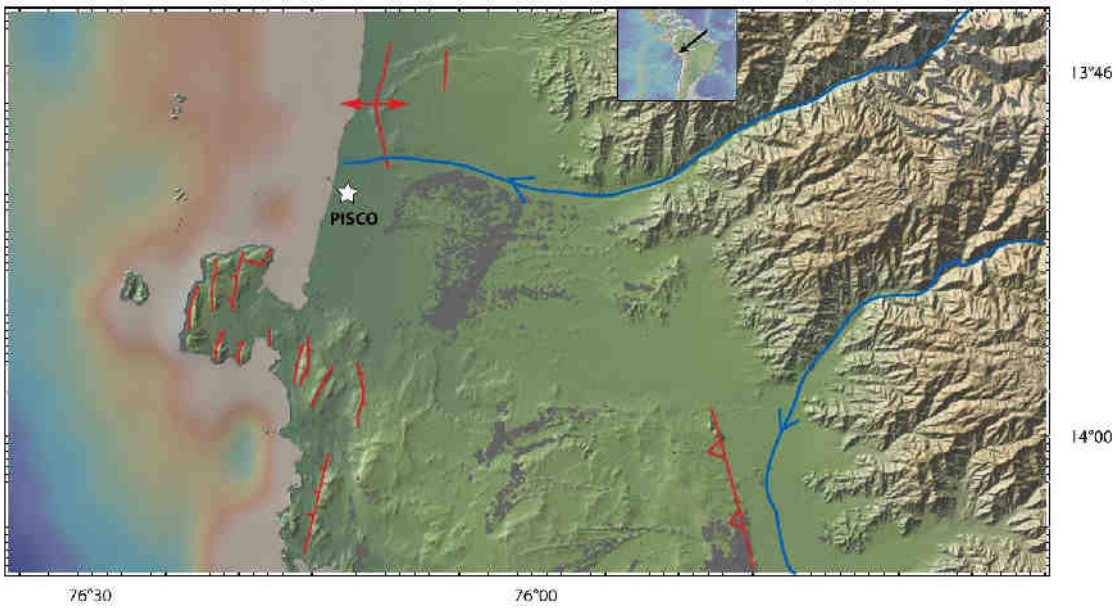
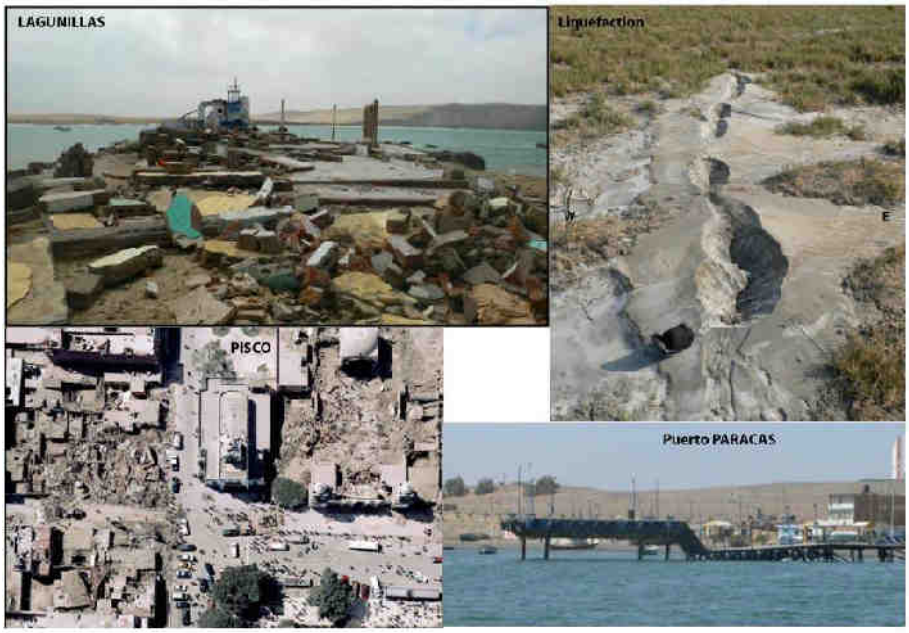


Figure 2: Topography and fault systems in Pisco and Paracas Peninsula region.

Just after the earthquake, our preliminary field survey investigated evidence for uplift or subsidence along the coast. We found that the coastline didn't experience any significant vertical displacement compared to the tide range (~40cm). None of the typical example of uplifted coastal side were available: no reported change in the coastal line, no exposed and dried algae's, no major changes in drinkable wells… Anyway right after the earthquake, the fishermen reported a small subsidence, about 15 to 30 cm that was hard to decipher in the middle of the damages. 6 months after the earthquake, this coastal subsidence is confirmed and stable from field observations north of the Paracas Peninsula, in the Chaco harbour.

The coastline approximately correspond in general from north to south in Peru to a pivot line marking the transition from coastal uplift in the south to subsidence in the north, as the distance from the trench increases or decreases. This model is consistent with the co-seismic slip distribution inferred from waveform modeling (Pritchard et al., 2008), and with the distribution of aftershocks which suggests that the subduction interface ruptured mainly updip of the coastline (Tavera et., 2008). Old inactive perpendicular to the trench faults affects the subducting plate and may constitute a barrier to the propagation of ruptures along the subduction plane and traduce some coupling variations.



Finally, our field surveys have also revealed evidence for intense and widespread ground-failure effects and maybe active faulting of the forearc, a lot of liquefaction, collapse and extensional features. In particular, the production of coseismic pressure ridges, with up to 50cm of vertical throw suggests that the east dipping Puente Huamani thrust fault system maybe reactivated over a distance of about 20km during this event. However, we didn't find evidence for clear reactivation of any of the normal faults on the Paracas Peninsula, although some had been reactivated by the 2006 Pisco earthquake (Mw6.4). It appears that the structure and deformation of the Peruvian forearc and coastline seems to contain important information on lateral variations of the coupling along the subduction zone just like south as observed along 2001 earthquake rupture zone (Audin et al., 2008).

REFERENCES

Audin L., Lacan P., Tavera H., Bondoux F. 2088. Upperplate deformation and seismic barrier in front of Nazca subduction zone: The Chololo Fault System and active tectonics along the Coastal Cordillera, southern Peru, *Tectonophysics*, doi:10.1016/j.tecto.2007.11.070 (in press)

Audin Et al. 2007. El Terremoto De Pisco Del 15 De Agosto 2007 Volumen Especial Igp, Lima Peru.

D'Ercole R., J. Chandes, H. Perfettini et L. Audin. 2007. Le séisme de Pisco du 15 août 2007 : entre urgence et reconstruction, 18 décembre 2007, ECHOGEO.

Machare and Ortlieb. 2005. Plio-Quaternary vertical motions and the subduction of the Nazca Ridge, central coast of Peru. Tectonophysics, p. 97–108.

Pritchard and Fielding. 2008. A study of the 2006 and 2007 earthquake sequence of Pisco, Peru, with InSAR and Teleseismic data, GRL (in press)

Tavera and Bernal. 2008. The Pisco (peru) earthquake of August 15th, 2007. Seismol. Res. Lett., (in press)