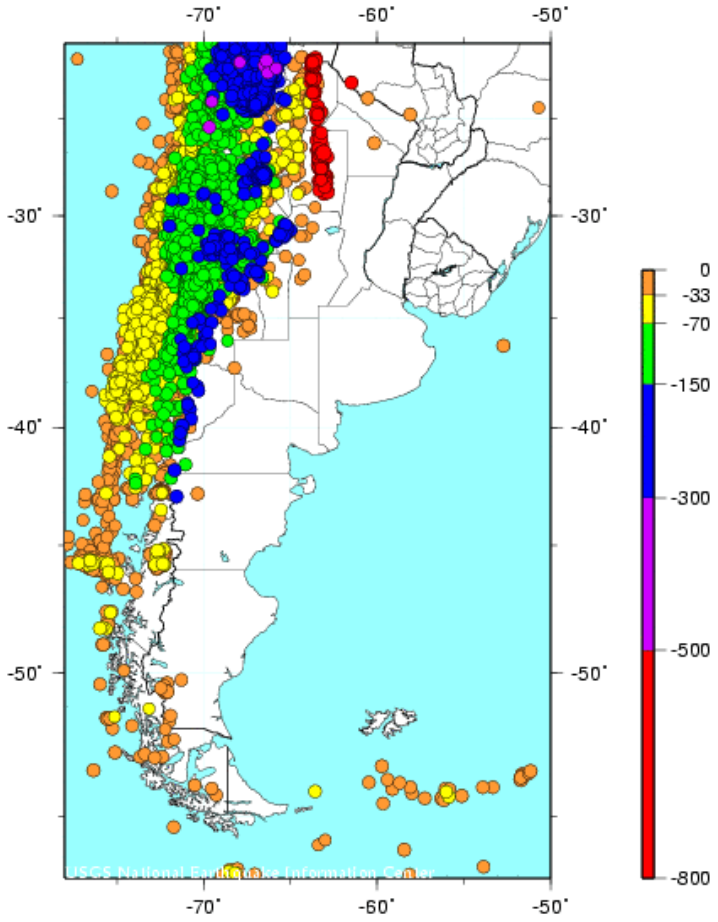
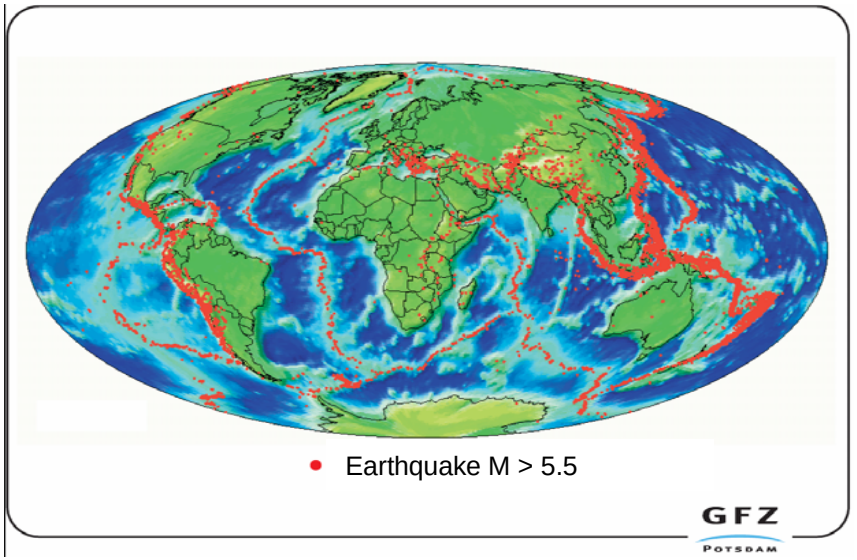
Instituto Geofísico Sismológico Volponi
Universidad Nacional de San Juan

Seismological laboratory in Agua Negra tunnel

Buenos Aires, Abril 2011

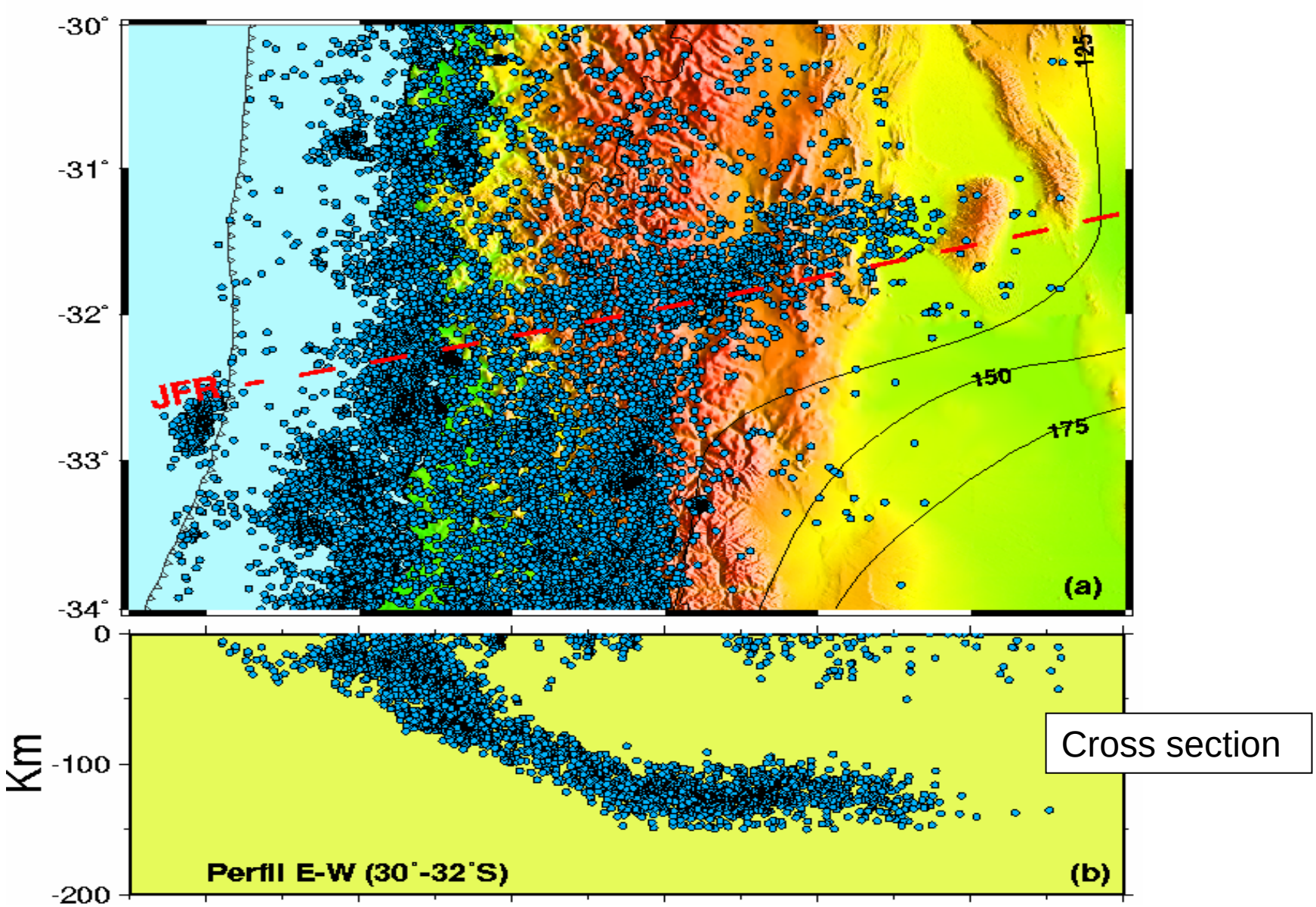
¿Why a Seismological laboratory in Agua Negra tunnel ?





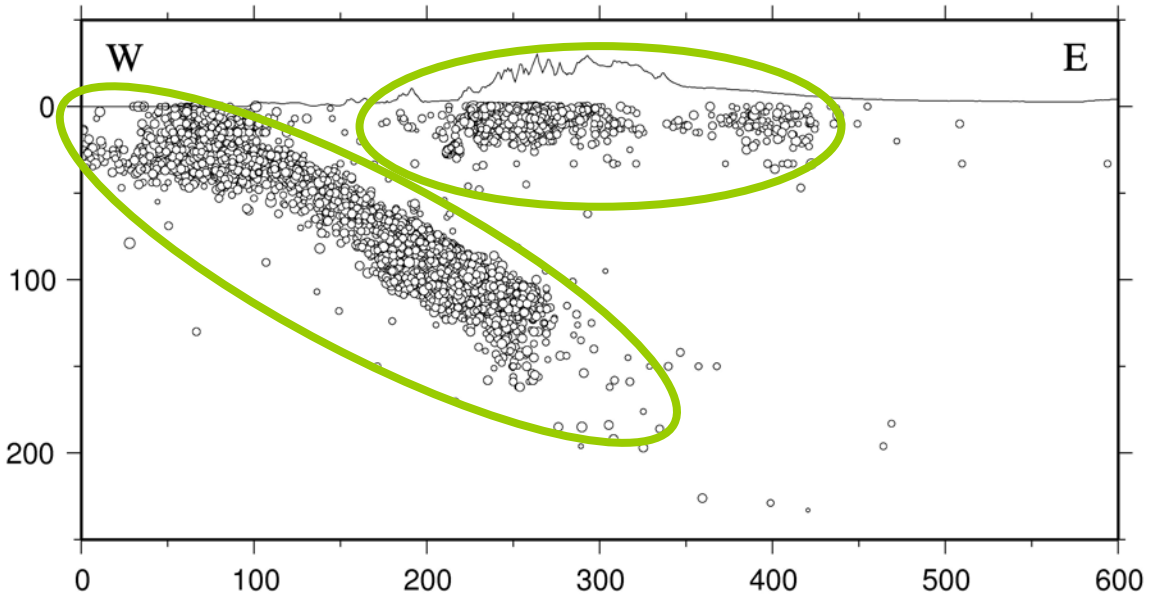
Earthquake between 1973-2011 with M>4.
NEIC-USGS catalog.

Regional Seismicity

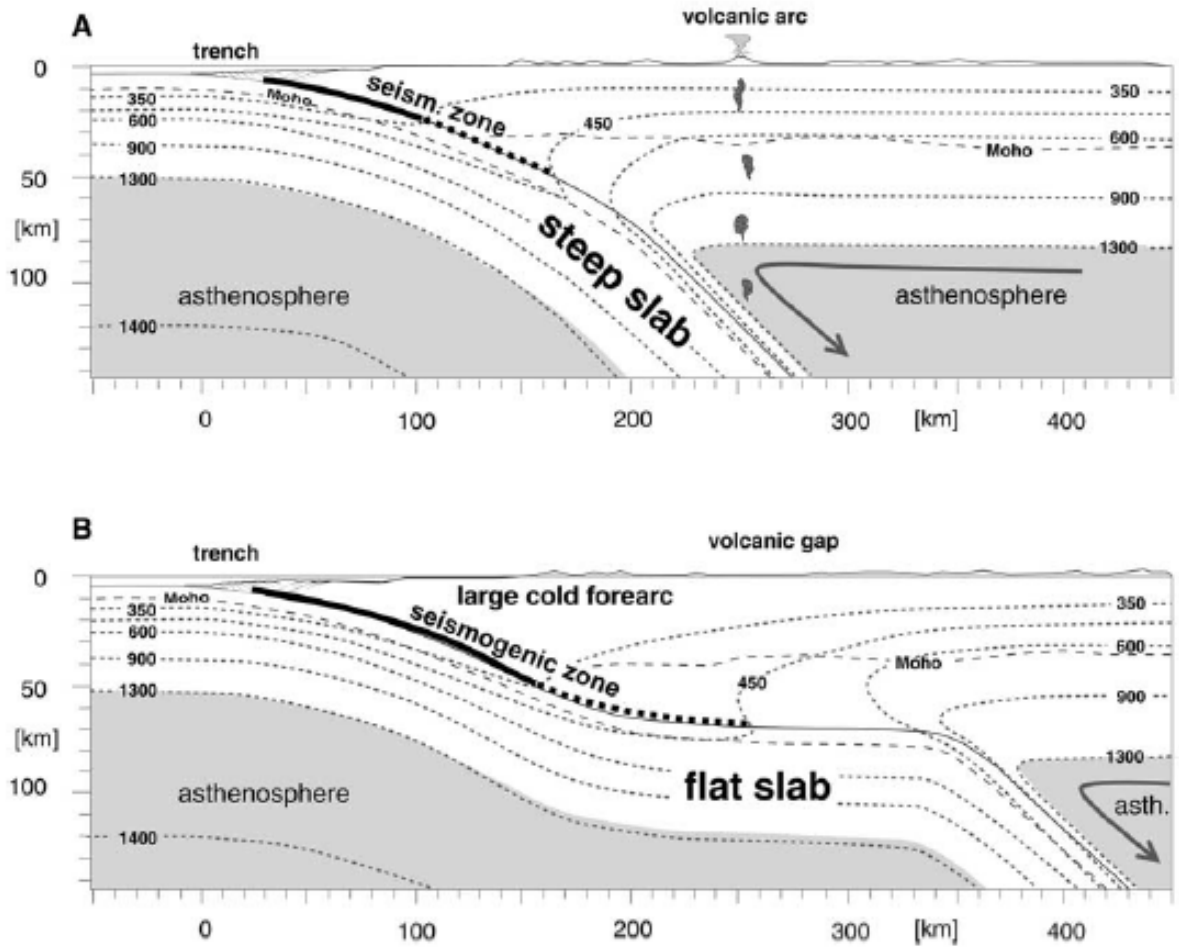


Cross section

Crustal and subducted plate seismicity



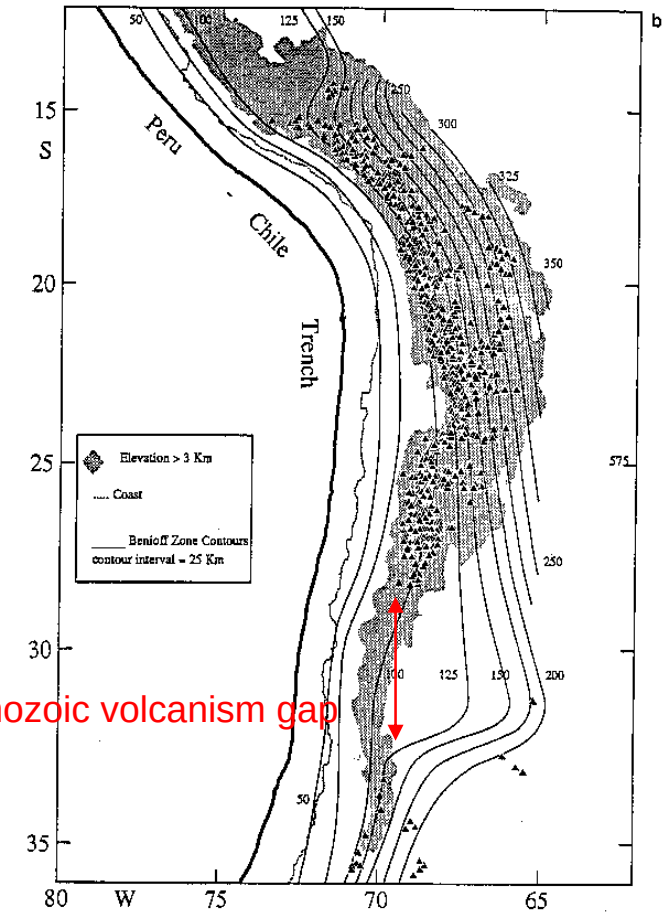
No flat slab South of 33°S



Gutscher, 2002

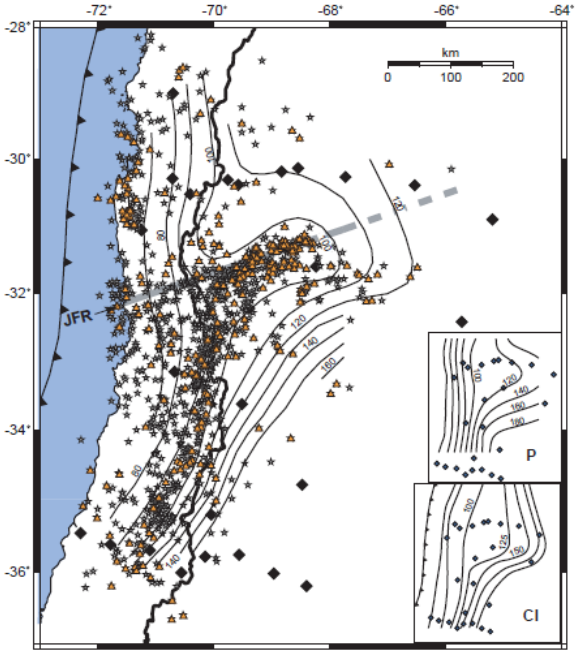
Geometry of the flat slab increases the mechanical interaction between both plates resulting in cooler upper plate with higher seismicity.

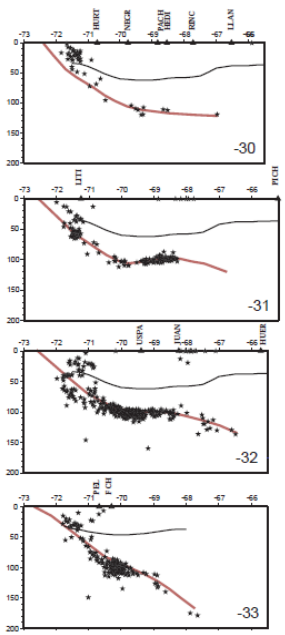
Nazca Plate Morphology



Cenozoic volcanism gap

Cahill and Isacks, 1992



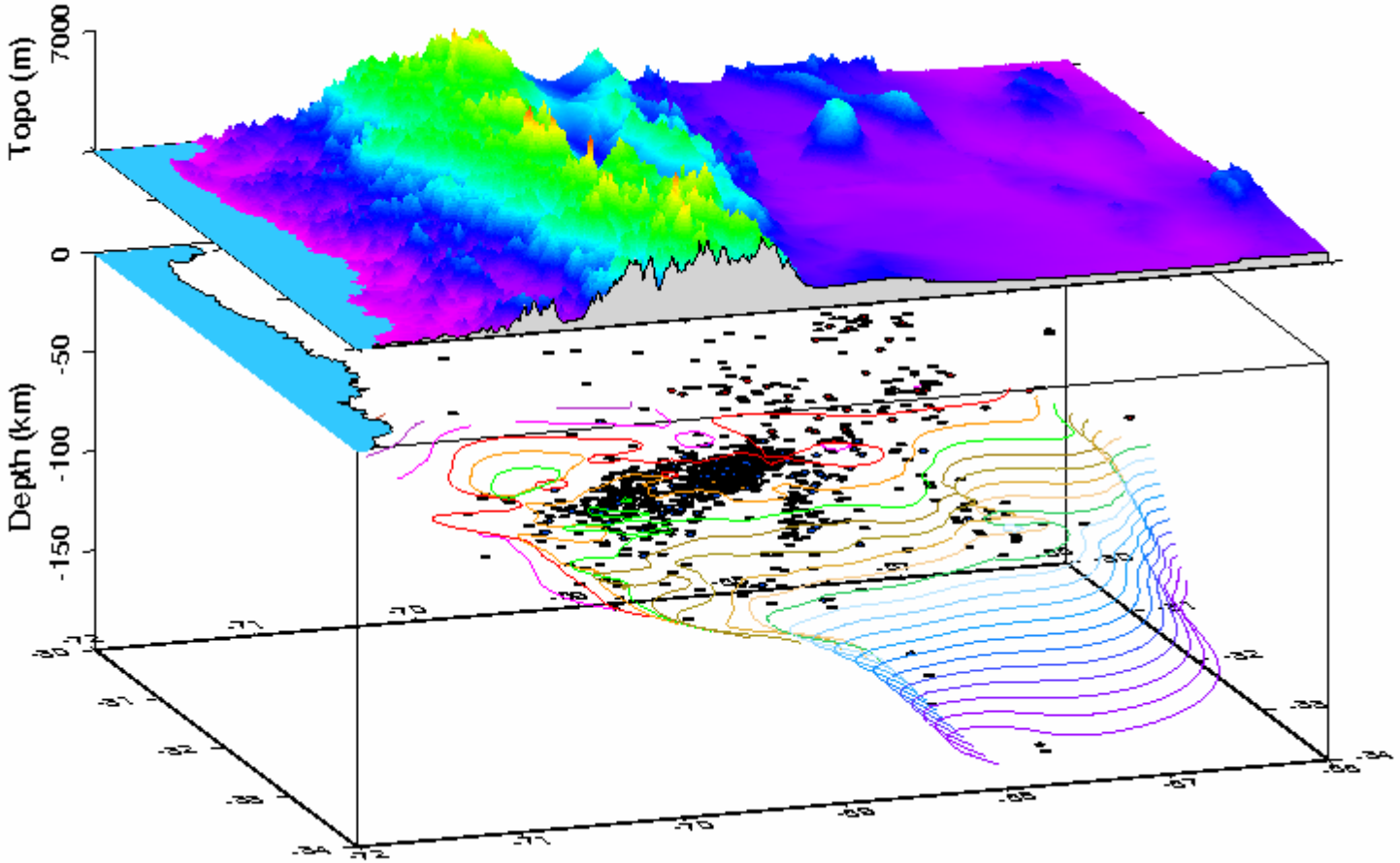


Anderson et al, 2007

Nazca plate seismicity strongly decrease north of 31° South.

Morphology of the subdacted plate not well known at tunnel latitude.

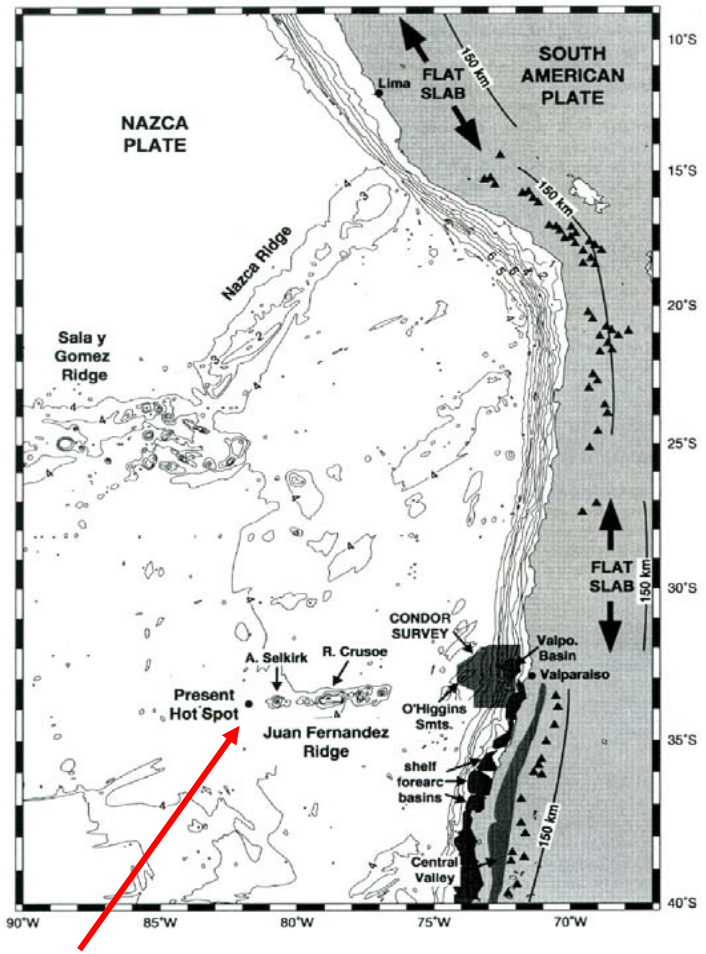
Nazca Plate Morphology & Surface Topography



Furlani & Triep 2007

¿How we can explain the flat slab section?

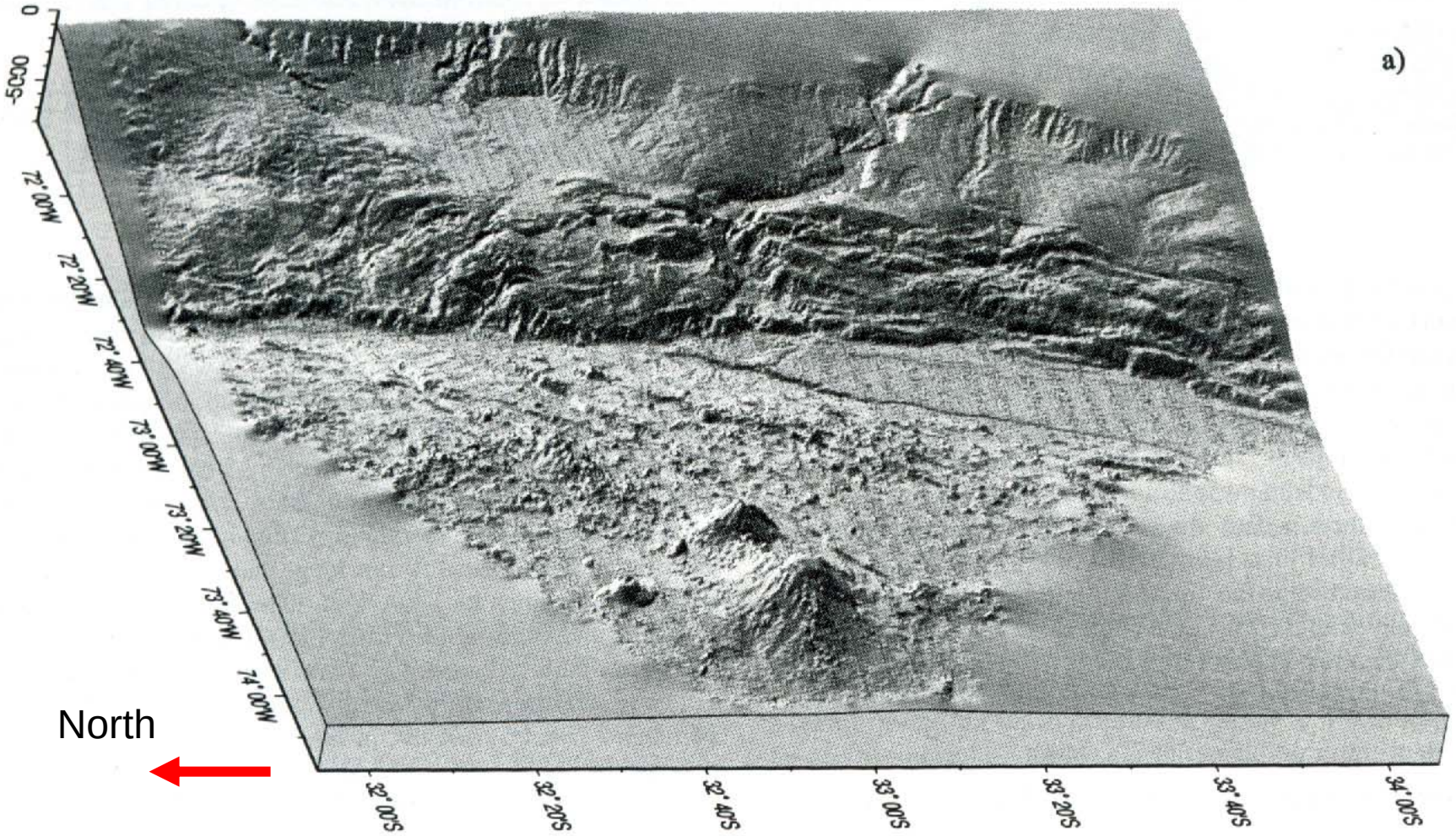
Juan Fernández Ridge location in relation to continental margin & flat slab region.



Hot spot

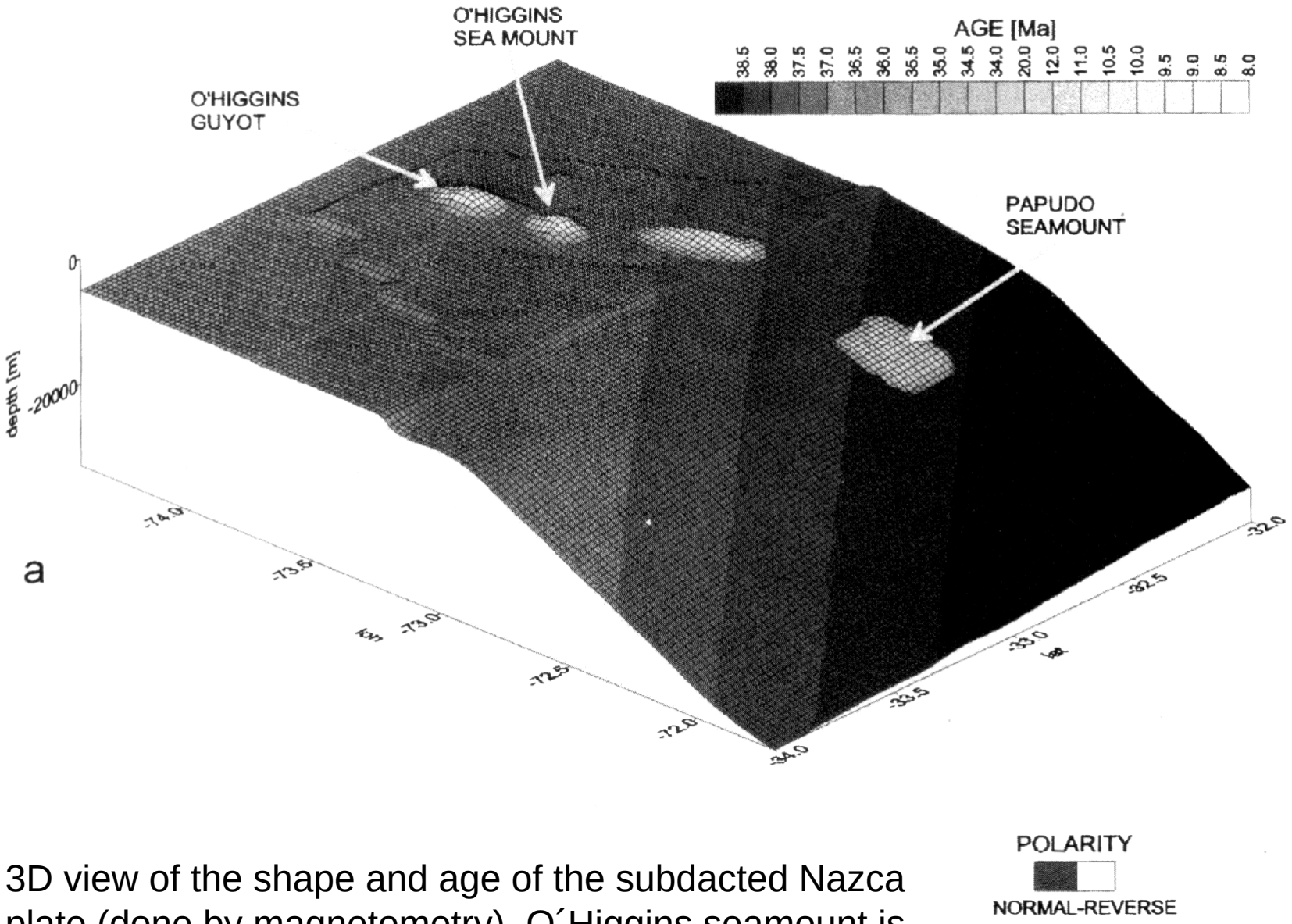
Convergent margin long South america showing location research survey area, the northern ends of the quaternary volcanos (solid triangles), the Central valley and the forearc basins on the shelf. The 150 km benioff depth countour is indicated. From the beginning of the flat slab area to Valparaiso Basin marks the segment boundary opposite Juan Fernandez Ridge which subducts beneath Chile.

Von Huene, 1997



JFR Submarine volcanos on the Nazca plate near to be subdacted under South American plate

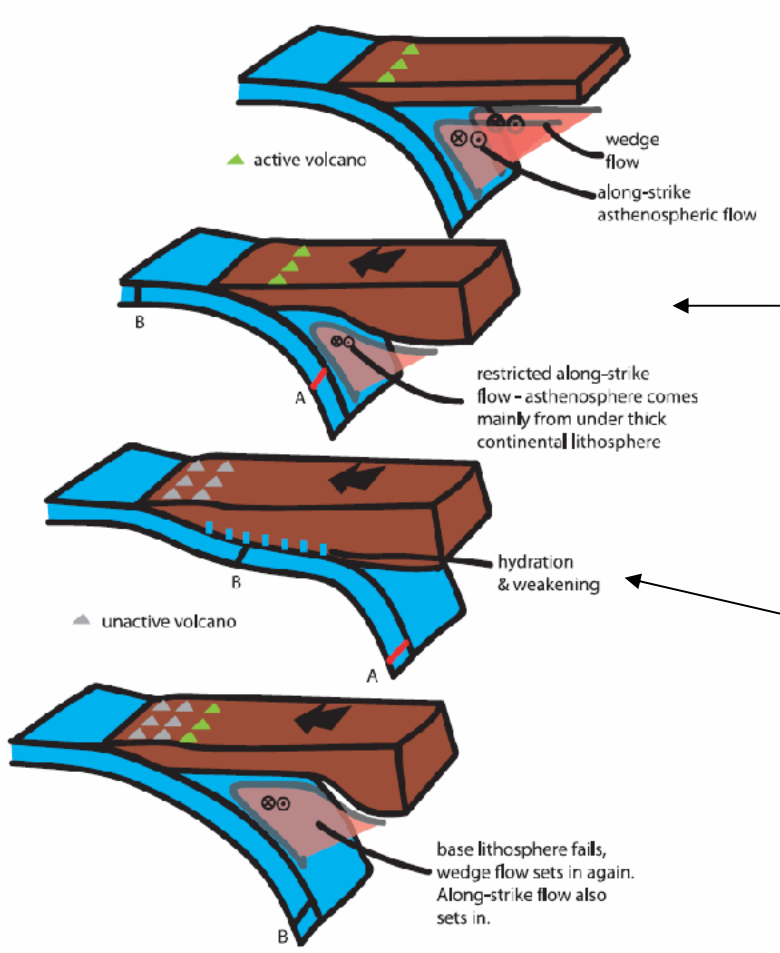
Von Huene, 1997



3D view of the shape and age of the subdacted Nazca plate (done by magnetometry). O´Higgins seamount is younger than the Papudo seamount.

Yañez et al, 2001

An independent hypothesis maybe may help the flat subduction process

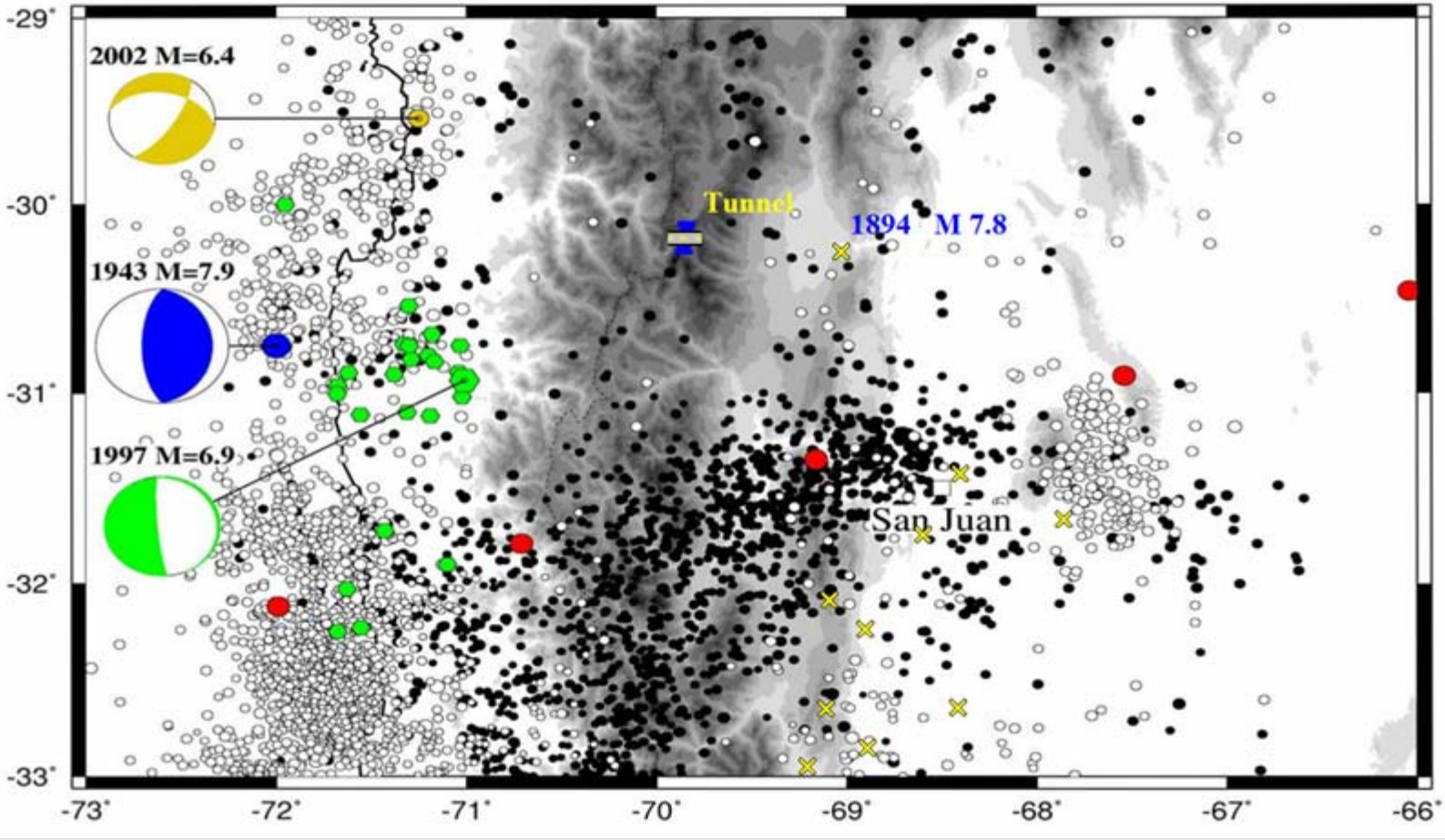


Thick continental lithosphere, higher viscosity and narrowing of the asthenospheric wedge increase upward suction force.

Hydration weakens the base of the continental lithosphere and promotes detachment of the slab.

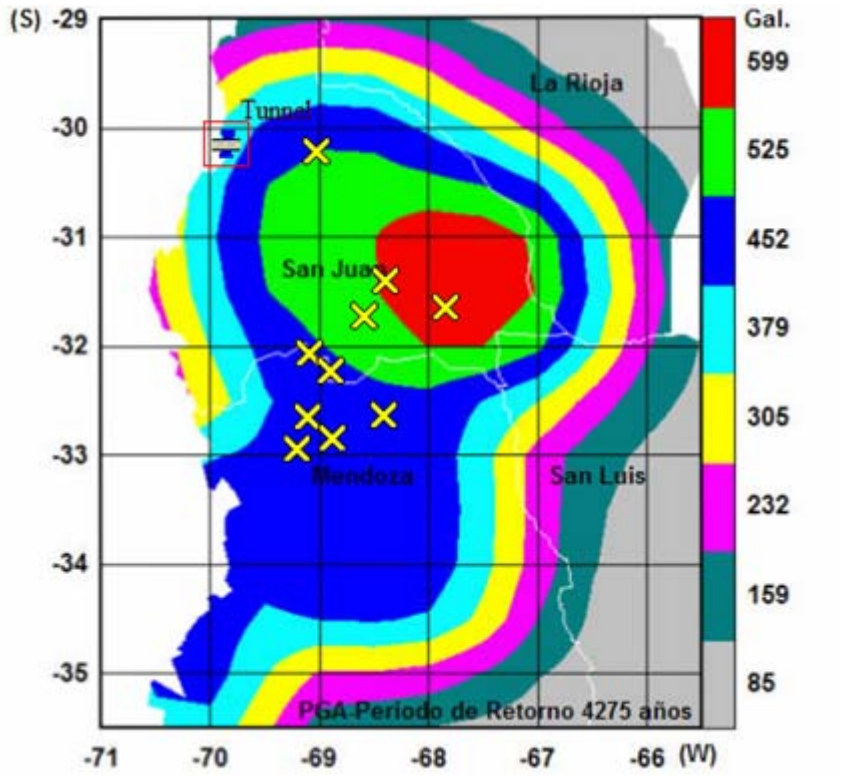
Peréz Gussinye et al, 2008

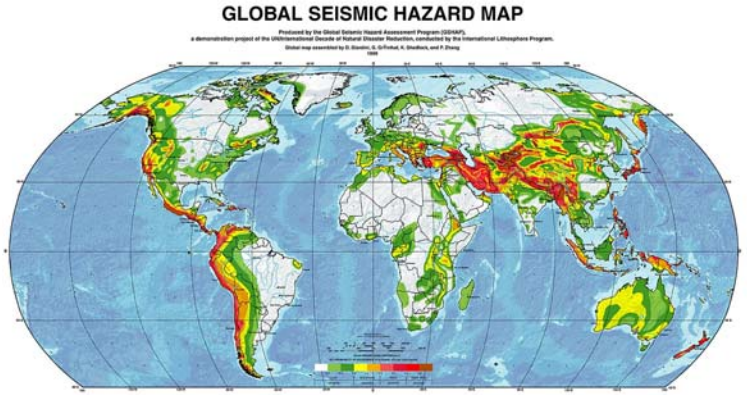
Regional Seismicity & known destructive earthquakes



- Juan Fernández Ridge track
- Crustal earthquakes
- Nazca plate earthquakes
- Beach Balls are focal mechanisms diagrams
- Earthquakes 6 < Magnitude < 8

Hazard Map

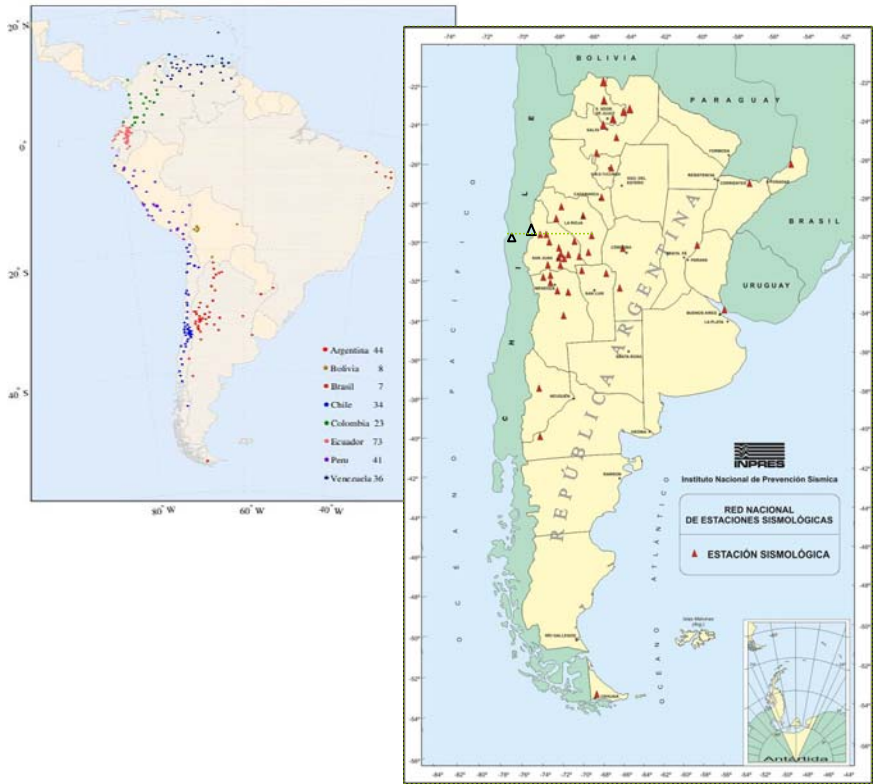


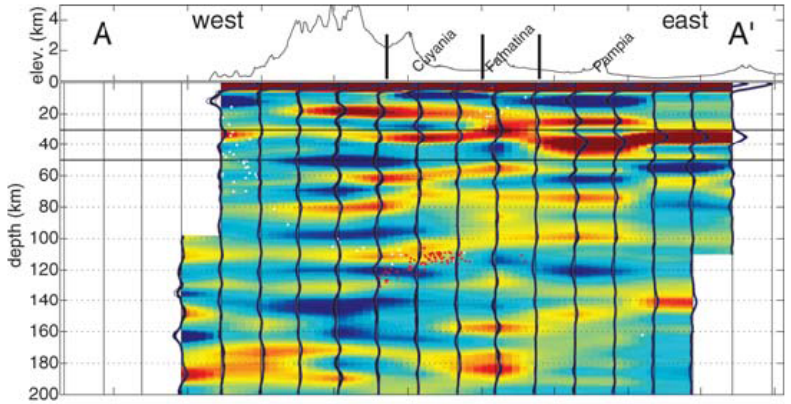


Expected maximun acceleration ~0.4 g

Gregori et al., 2008.

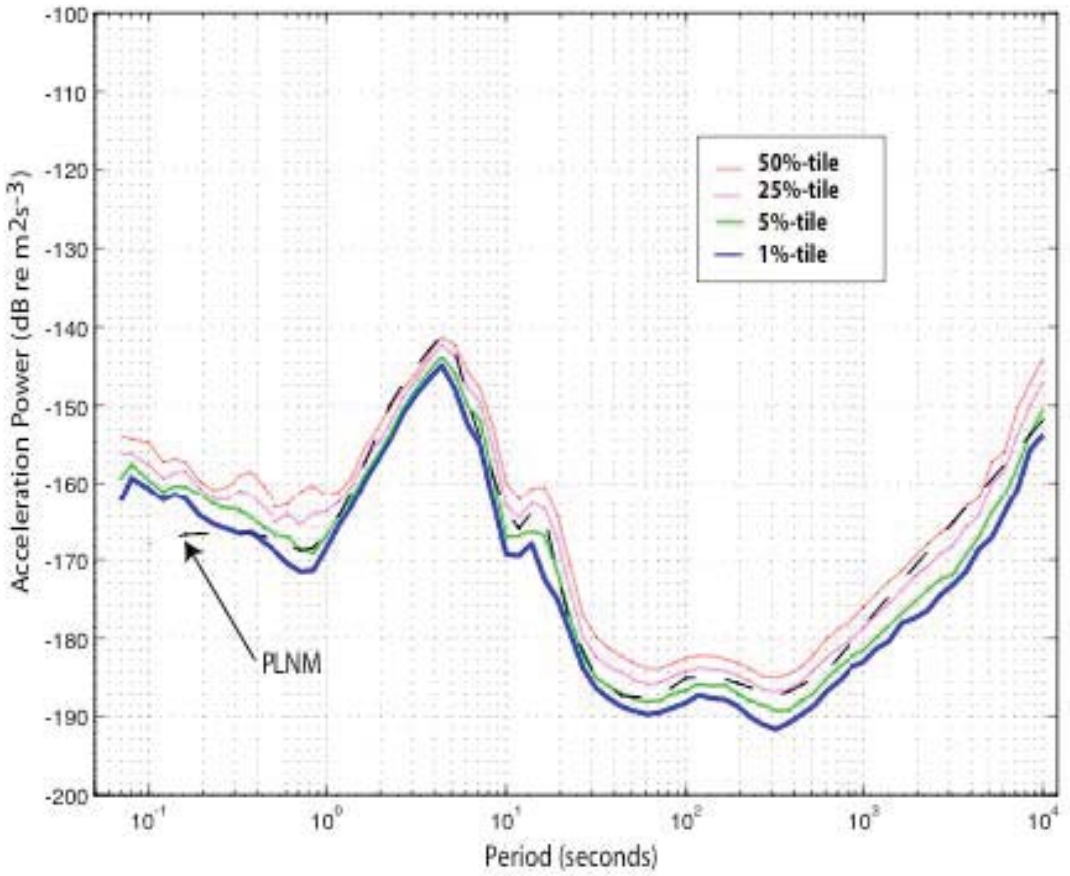
Agua Negra station will complement the existent areal distribution of seismic networks in Argentina and Chile, and also a transect at ~30°S will be naturally established wich will be usefull for local, regional and global studies.





Gilbert et al, 2006

Ambient Earth Noise



The lowest horizontal-component noise levels are observed at stations where the seismometers are located in tunnels or very well-insulated vaults. Minimum noise levels, both horizontal and vertical, are observed on STS-1.

Sensor type – Distribution of observations

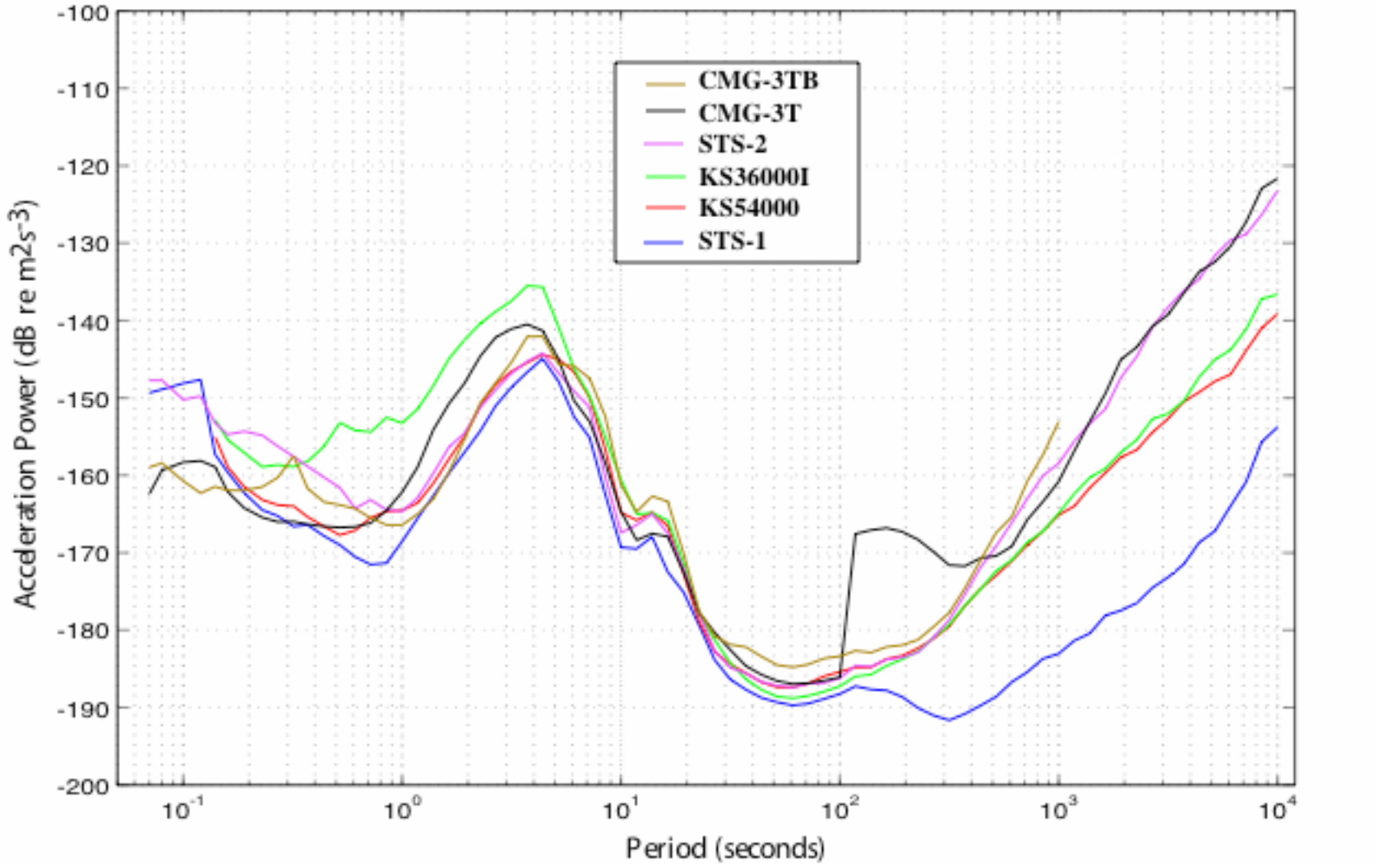
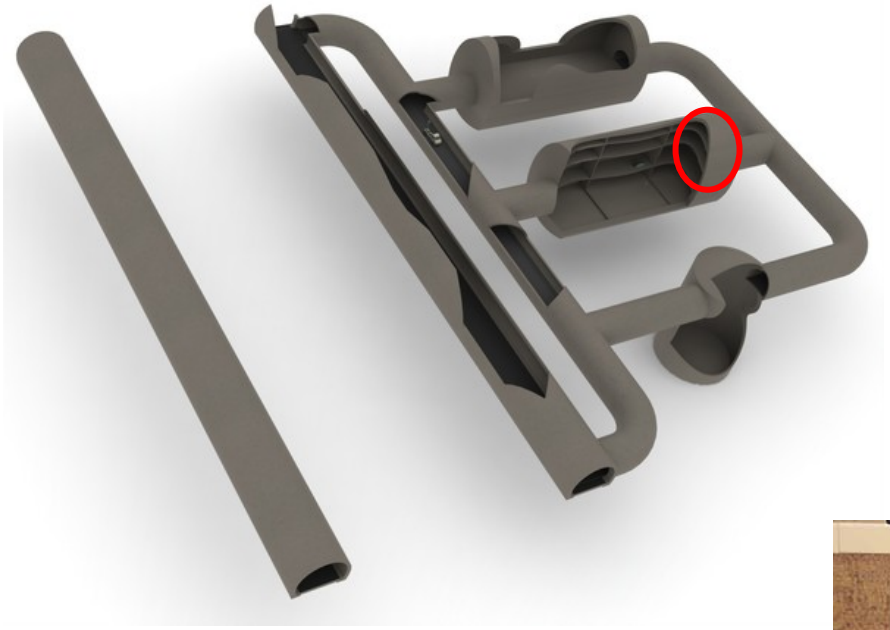
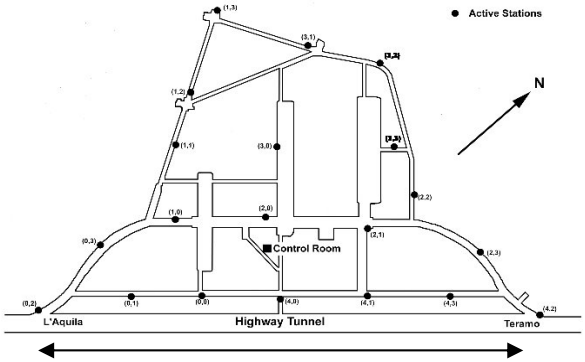


Figure from Berger, Davis and Ekstrom (2004)

Recommended seismometer type



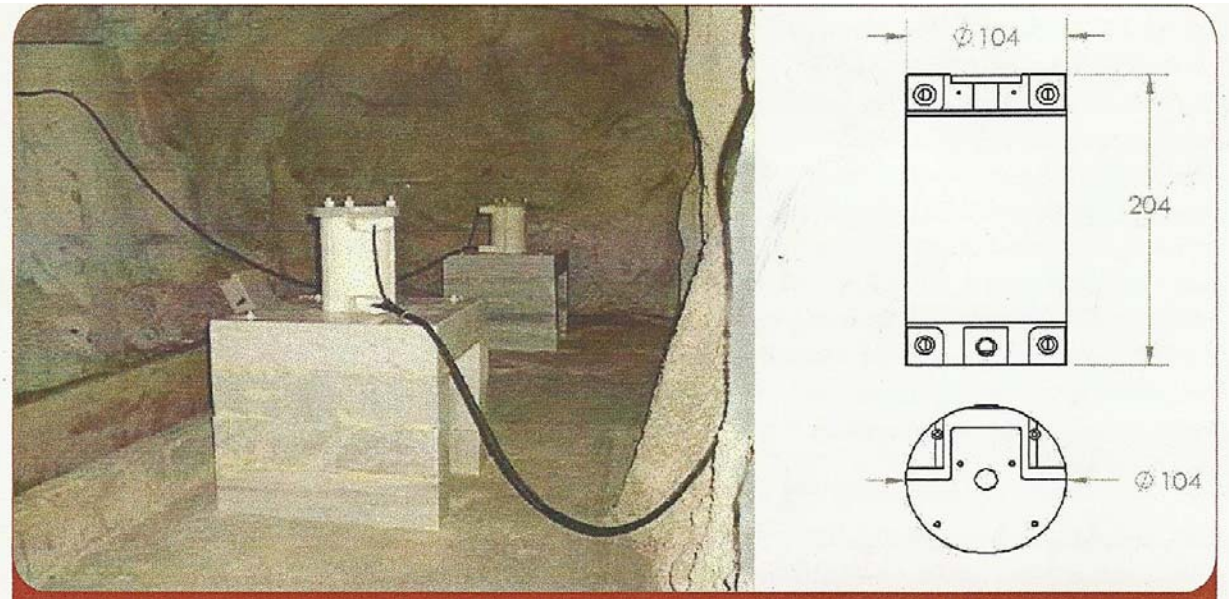


600 m

Small seismometer array in Gran Sasso

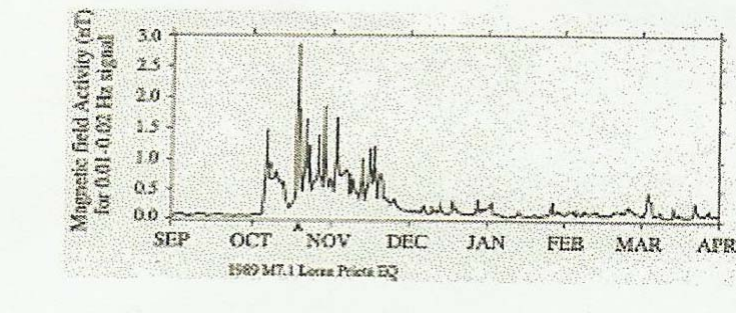
For the dimention of Agua Negra Laboratory we suggest at least one broadband seismometer similar to STS-1 (flat response up to 360 sec), a 26 bit digital recorder with capacity to transmite data by internet.

Magnetic Observatory



Thrust earthquakes are ideal for studying seismic gravity changes because they vertically displace adjacent blocks of mass and produce permanent changes in the gravity field around the epicentre.

It offers a possibility of detection of precursors to earthquakes due to gradual pressure build-up.



Magnetic data before & after the Loma Prieta earthquake in California, 1989.

Gravimetry

- **An ultra-high-precision *continuous* gravity reference station for studying a wide variety of geophysical phenomena.**
- **Monitoring volcanoes**
- **Measurement of ocean-loading corrections to gravity for improving global ocean tide models**
- **Measurement of subsidence caused by oil, gas, or water extraction**
- **Long term tectonic effects-either post-glacial uplift or subsidence**
- **Subduction-induced silent earthquakes**

Conclusions

Continuous seismic monitoring at the Agua Negra tunnel will help to understand better the local and regional seismicity, and contribute to the global data completeness.

Aditional gravimetric and magnetometric monitoring will complement the seismological one.

Tectonic and the more general geodynamical comprehension related to flat subduction will be greatly inproved.