6th International Symposium on Andean Geodynamics (ISAG 2005, Barcelona), Extended Abstracts: 799-801

Seismic imaging of the seismogenic coupling zone within the Project TIPTEQ: A 3-component reflection seismic experiment across the Chilean subduction zone at 38 ° S

Peter Wigger for the TIPTEQ research group*

Freie Universität Berlin, Malteserstrasse 74, 12249 Berlin, Germany (wigger@geophysik.fu-berlin.de)

*TIPTEQ research group, alphabetical listing:
Manuel Araneda [1], Klaus Bataille [2], Jens Bribach [3], Stefan Buske [4], Kolja Groß [4], Charlotte M. Krawczyk [3], Stefan Lueth [4], James Mechie [3], Uli Micksch [3], Albrecht Schulze [3], Serge Shapiro [4], Manfred Stiller [3], Peter Wigger [4], Thomas Ziegenhagen [3]
[1] SEGMI, Santiago, Chile; [2] Universidad de Concepción, Concepción, Chile; [3] GeoForschungsZentrum Potsdam, Potsdam, Germany; [4] Free University, Berlin, Germany

Convergent continental margins are the Earth's principal locus of important earthquake hazards. Some 90% of global seismicity and nearly all interplate megathrust earthquakes with magnitudes >8 occur in the seismogenic coupling zone between the converging plates. At the southern Chilean convergent margin the largest instrumentally recorded earthquake occurred in 1960 (Mw = 9.5). It ruptured the margin starting at 38°S at a hypocentral depth of some 30 km below the continental forearc towards the south for approximately 1000 km with a coseismic slip of up to 40 m, up to 2 m vertical displacement and a tsunami up to 15 m high that affected the entire Pacific.

The TIPTEQ project** (from The Incoming Plate to mega-Thrust EarthQuake processes) is created to study the processes which generates these large earthquakes. One of the main task in this research is to identify the key properties and processes in the seismogenic zone related to large subduction earthquakes, e.g. that image a complete seismogenic plate interface at the resolution of the expected scale of the associated processes from the updip to below the downdip end and that yield key petrophysical and mechanical properties which may be linked to mechanical and fluid-assisted processes and asperities in the seismogenic zone. I the first stage of the TIPTEQ project a number of geophysical experiments (seismological nets, seismic profil, magnetotelluric and gravity surveys), geodetic and geological fieldwork were and will be still carried out. Figure 1 show the TIPTEQ working area as well the morphological and tectonic setting of the south Chilean subduction zone.

Amongst 13 sub-projects within the TIPTEQ project, the reflection seismic sub-project aims at the imaging and identification of processes in the seismogenic coupling zone of the present state of the ruptured plate interface at the southern Central Chilean margin. Together with the marine SPOC data (1), the newly acquired high-resolution 3-component reflection seismic land data will yield a reflection seismic section that will cover the entire seismogenic coupling zone from its up-dip to its down-dip end. In addition, an expanding spread experiment component focuses on the down-dip limit (30-50 km depth). S-wave source signals will be generated and S-waves obtained with 3-component recordings to yield an improved picture of the petrophysical contrasts within the subduction zone system.

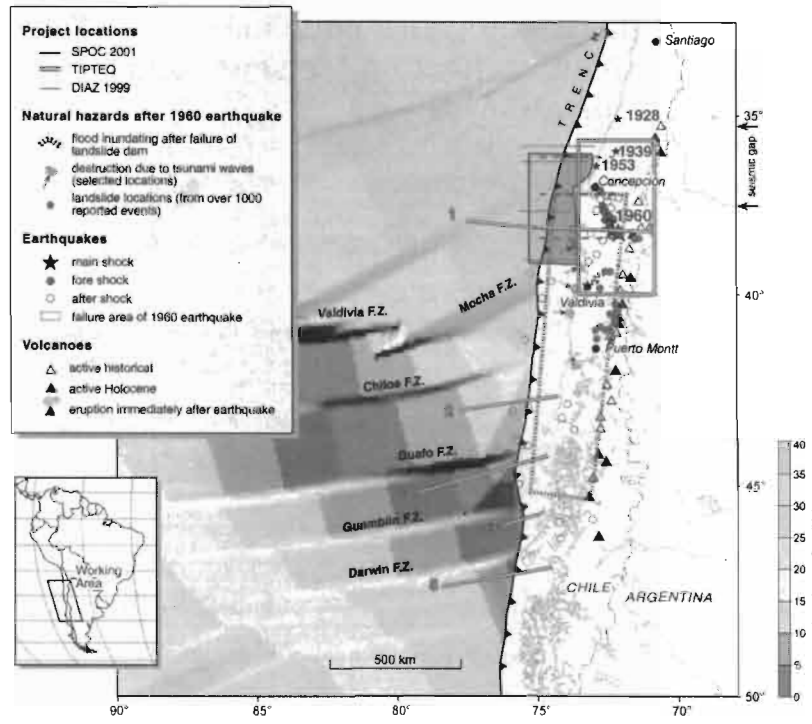

Fig. 1: The TIPTEQ working area and the principal setting of the south Chilean subduction zone.

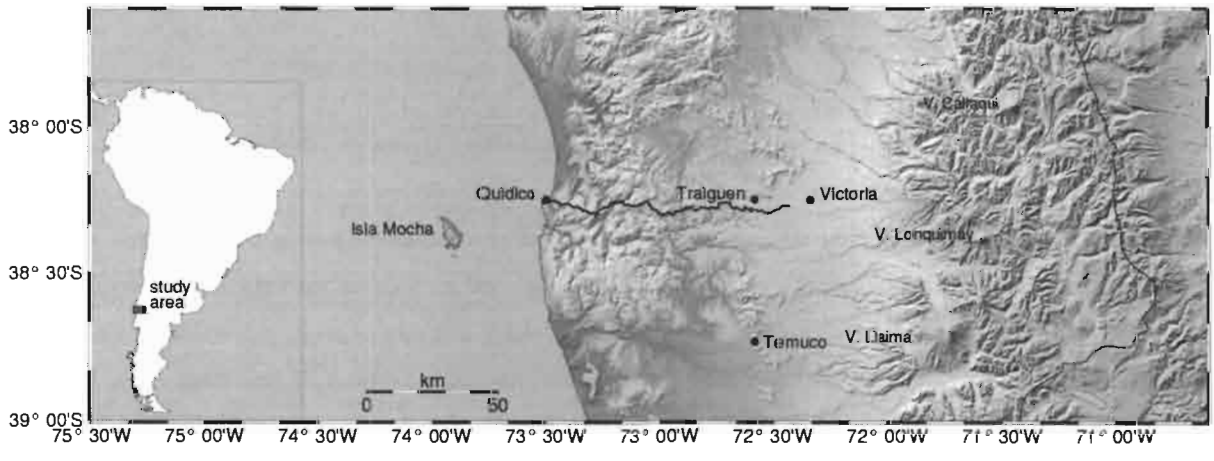

Fig. 2: Position map of the 3-component reflection seismic experiment (red line).

In January 2005, the 90 km long reflection seismic profile was shot in southern Central Chile at c. 38° S. 180 three-component geophones were deployed along an 18 km long spread, moving 4.5 km in a daily-roll along for three weeks. Explosive shots, with a spacing of 1.5 km, allowed an up to 8-fold CDP coverage for the NVR part (Near Vertical Reflection) of the experiment (fig. 3).

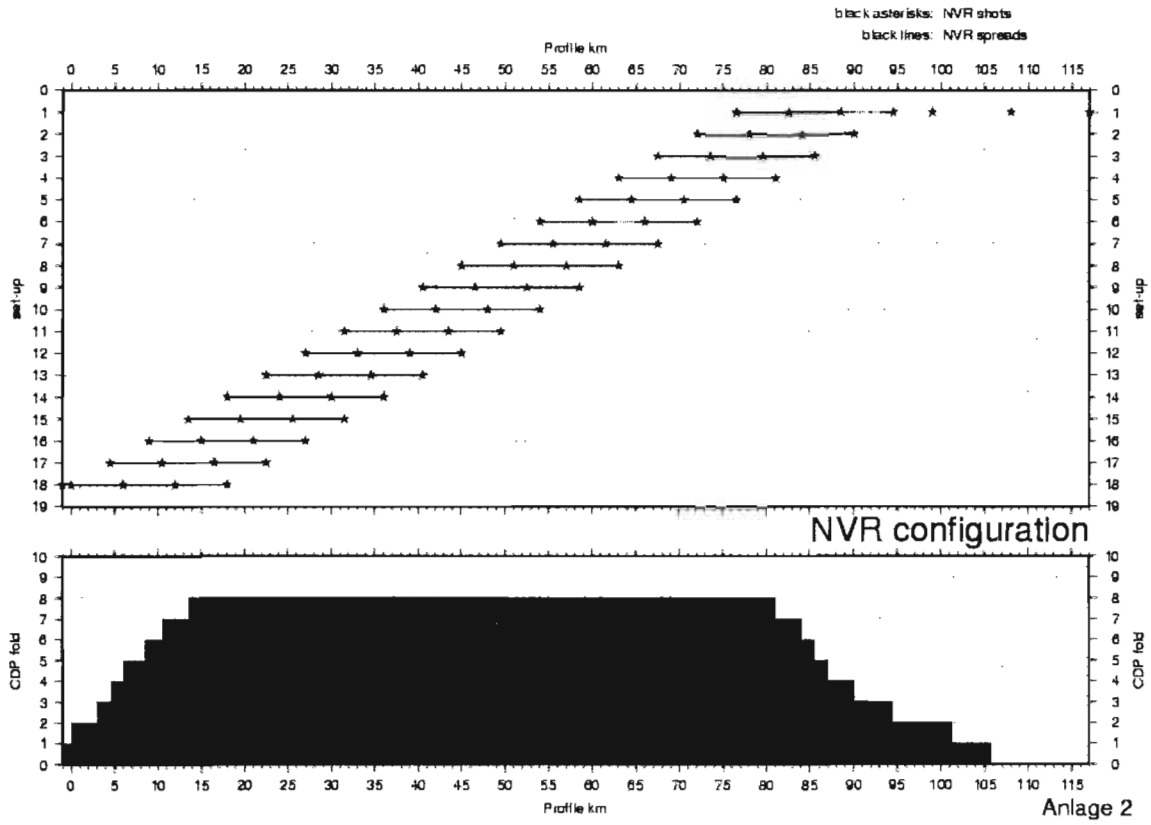

Fig. 3: Set up scheme for the NVR recordings (Near Vertical Reflection). Profil km 0 is situated at the Pacific coast, km 115 at the Longitudinal Valley.

The E-W trending line runs across part of the Central Valley (starting west of Victoria) and continued over the costal cordillera towards the Pacific, thereby passing the relocated hypocenter of the 1960 Valdivia earthquake. Here, we will present the first reflection seismic data and preliminary results from the January 2005 experiment which should deliver a high-resolution image of the seismogenic coupling zone between the subducting Nazca Plate and the South American continent (see also Gross et al., this volume).

The TIPTEQ project is funded by the German Federal Ministry of Education and Research (BMBF), grant no. 03G0594B

Reference

[1] Krawczyk, C. and the SPOC Team, 2003: Amphibious Seismic Survey Images Plate Interface at 1960 Chile Earthquake. Eos, Transactions, A. Geophys. Union, Vol 84, No. 32, pp 301, 304-305.