SEISMICITY AND FOCAL PARAMETERS IN NORTHERN CHILE AS OBSERVERD BY TEMPORARY LOCAL NETWORKS

Alexander F. RUDLOFF & Günter ASCH

GeoForschungsZentrum Potsdam, Dept. 2.4 "Seismology & Tomography",
Telegrafenberg A17, D-14473 Potsdam, Germany; email: rudloff@gfz-potsdam.de

KEY WORDS: Seismology, Seismicity, Stress regime, Focal Parameters, Northern Chile

INTRODUCTION

This paper will report about two local networks which have been operating in northern Chile in the years 1994 and 1995. The regional geodynamic setting is dominated by the fast subduction (more than 9 cm/a) of the oceanic Nazca plate beneath the South American continent. This process is accompanied by recent volcanic and seismological activity.

The first network, PISCO '94 (*Proyecto de Investigación Sismológica de la Cordillera Occidental*) was part of the studies of the Collaborative Research Center 267 "Deformation processes in the Andes" from Berlin and Potsdam/Germany. A temporary network was installed covering an area between 21° and 25° S and 67° and 70° W. It was situated a little further east than the Chilean network of 1988, described by Comte et al. [1994]. For a period of 100 days, more than 30 digital seismological stations were recording continously (see Figure 1, black triangles). The preliminary catalogue contains more than 5.000 events, mostly of local origin. Its distribution is concentrated in two parts: one, uniformly distributed over a large area at an average depth of about 100 km; and a second, smaller but dense cluster at about 200 km depth. The magnitude distribution ranges from - 0.2 to 6.0 (M_{PISCO}), with a threshold magnitude of about 2.0 and a maximum number of events between 0.7 and 2.5. From broadband seismograms data of teleseismic events are used to get information about anisotropy and upper mantle discontinuities. Results from a subset of the data will be also presented by Comte et al. [1996] (this issue).

The second project was deployed in the middle of 1995. On July 30 a $M_W = 8.1$ (HRV) earthquake struck Antofagasta and the whole north of Chile. At this time the active part of the project CINCA '95 (*Crustal Investigations and on- and off-shore Nazca Plate/Central Andes*) was at full operation. It was a combined land and sea program with a participation of several German groups, working with different geophysical methods. The seismological network on land was operating between August and October 1995, covering an area of 250 km north-south and 100 km east-west. More than 30 digital stations plus 6 strong motion recorder were used. From the end of September on, the network was extended towards the trench by nine Ocean Bottom Hydrophones (see Figure 1, white squares). The analyses of the data from this project is in its beginning (Husen et al. [1996], this issue).

Further more two projects are planned in the near future (see Figure 1, dashed lines). The ANCORP '96 network will be an extension of the PISCO '94 network towards the north. It will be placed both on Chilean and Bolivian territory. The network will also support the ANCORP seismic traverse which will go along the 21° S latitude, from the coast to the high mountain

ranges. The PUNA '97 network is planned to extend the PISCO '94 network towards the east, on the Argentinian side.

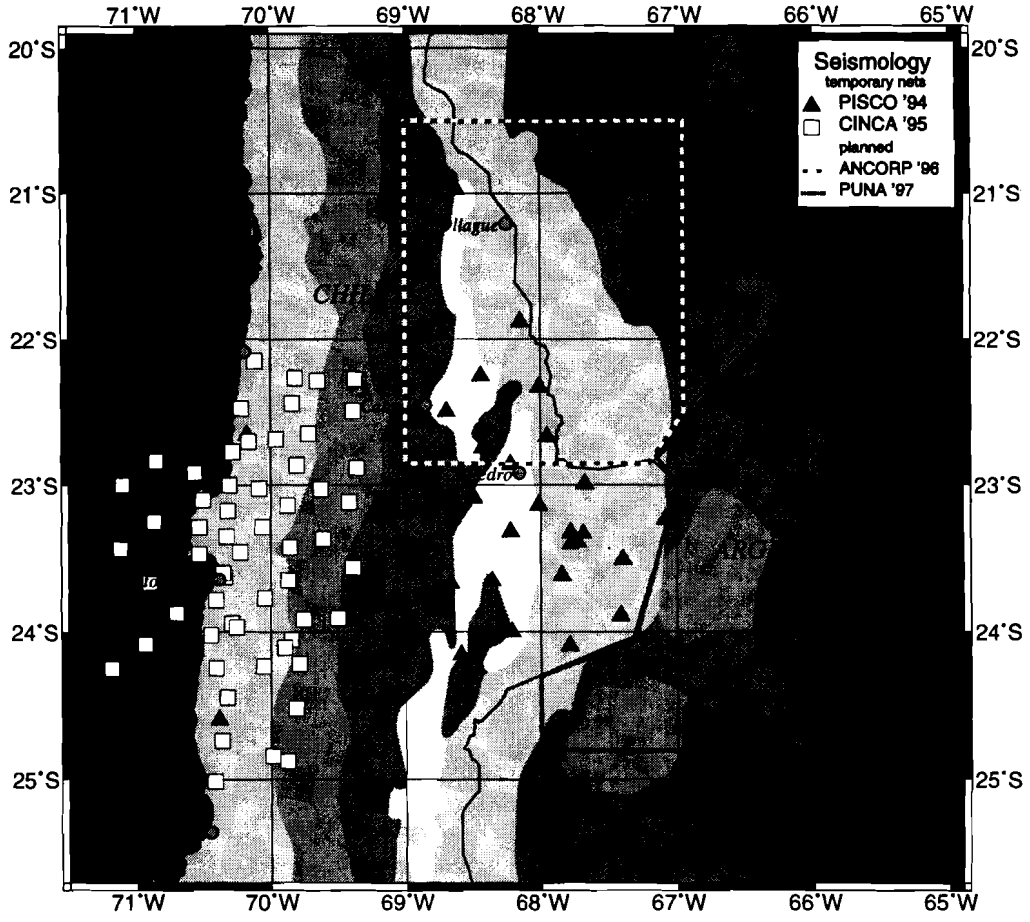

Figure 1: Map of temporary local networks in northern Chile (past & future)

RESULTS

About 40% (~ 2100) of the events from the PISCO '94 network are quite well located and lay within the borders of the network or at least close to it. We use events with medium size magnitudes and stronger to calculate fault plain solutions (by now 41). All these events lie along the subducting plate, between 50 and 150 km. To a depth of 70 km fault plain solutions describe a compressional regime. Within the region of the strongest activity, between 80 and 120 km, nearly all events are extensional, with their t-axis pointing in the direction of subduction. Plunge values vary between 0° and 40°, with azimuths of 50-120°. The stress regime for this depth region seems to be mainly of extensional type. The tomographic studies are presented by Graeber [1996] within this issue. From Figure 2 one gets a good impression what temporary seismological nets can be good for. Two sections are shown, each half-a-degree wide, projected on a east-west-profile. The seismicity presented is taken from a period of less than 4 month. The Wadati-Benioff-Zone can be seen very clearly, as a sharp line

One of the most interesting results of the CINCA '95 project is the high activity following the main shock, even after 60 days later. There is no descrease during the whole period. More than 200 events were triggered each day, which is twice the amount detected by the PISCO '94 project.

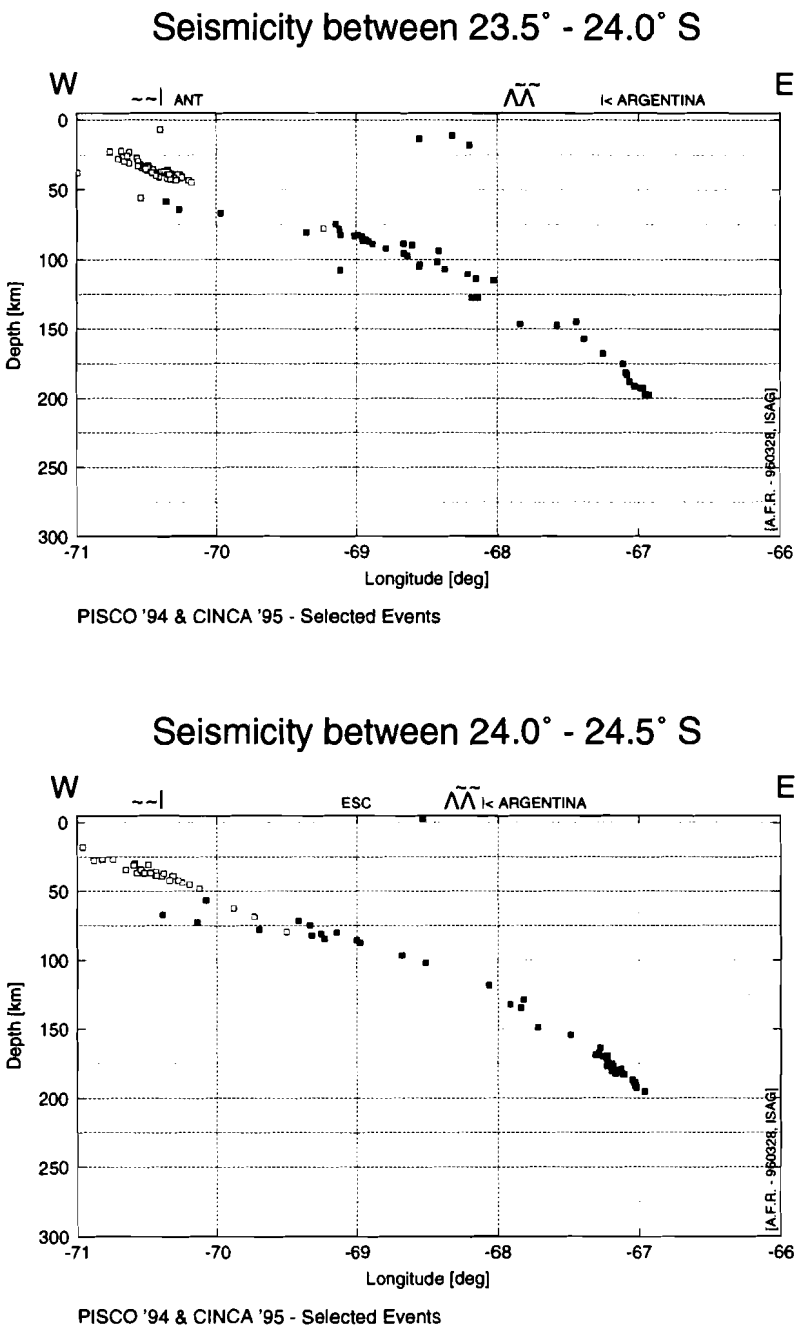

Figure 2: Vertical sections of the merged data set (PISCO: black, CINCA: white)

CONCLUSION

Up to now a double seismic zone could not be identified as clear as by Comte & Suaréz [1994]. This is mainly caused by the fact, that we found only two compressional events at a depth of about 100 km. Comte & Suaréz estimated a double seismic zone, derived from the results of a local network and the existance of two different zones of stress.

With data from all projects as marked in Figure 1 a unique set of information will be formed for a large area. For local seismological studies a period of 3 months seems to be the minimum, if a broad scale analyses is planned (especially for tomography). Studies with teleseismic methods make poor sense for shorter than a year.

REFERENCES

Comte D. & Suaréz G. 1994. An Inverted Double Seismic Zone in Chile: Evidence of Phase Transformation in the Subducted Slab. *Science*, Vol. 263, 212-215.

Comte D., Pardo M., Dorbath L., Dorbath C., Haessler H., Rivera L., Cisternas A. & Ponce L. 1994. Determination of seismogenic interplate contact zone and crustal seismicity around Antofagasta, northern Chile using local data. *Geophys. J. Int.*, Vol. 116, No. 3, 553-561.

Comte D., Pardo M., Monfret T., Asch G., Graeber F., & Rudloff A. 1996. Three dimensional P-wave tomography around Antofagasta, northern Chile: Stress distribution along the deeper part of the subducting Nazca plate. *this issue*

Graeber F.M. & Asch G. 1996. A three-dimensional model of seismic velocities beneath northern Chile from local earthquake tomography. *this issue*

Husen S., Asch G., Baumbach M., Haberland Chr., Rietbrook A., Rudloff A., & Wylegalla K. 1996. CINCA '95: Passive seismology on- and off-shore in northern Chile. *this issue*