CINCA '95: PASSIVE SEISMOLOGY ON- AND OFFSHORE IN NORTHERN CHILE

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INTRODUCTION

During the months August to October 1995 within the CINCA[1]-Project the natural seismicity in an area north of Antofagasta was observed. The network is a continuation of the PISCO '94 experiment towards the Coastal Cordillera. PISCO '94 was a combined active and passive seismological campaign in the area of the Pre- and Western Cordillera at the same latitude. It was carried out by the SFB[2] 267 in spring 1994. The aim of both projects is a detailed investigation of the velocity structure of the crust and upper mantle in this region. The results of the passive seismology during the CINCA-Project will be supported and supplemented by off-shore reflection profiles and on- and off-shore refraction profiles in the same area as additional parts of the CINCA-Project.

FIELD OPERATION

In the beginning the network was designed with 22 PDAS-seismometers onshore and 9 OBH[3] offshore located between the trench and the coast. The situation changed by the 30th of July when an earthquake of magnitude m_W=8.1 (HRV) occurred north of Antafogasta. Fortunately no big damage was reported and only a few people were killed. An earthquake in this order causes a huge amount of aftershocks and due to this new situation the network was redesigned. Additional 13 REFTEK-seismometers were installed by the *German Task Force for Earthquakes*, increasing the total number of onshore stations to 35. The final network design is shown in figure 1.
All onshore recording sites were equipped with 3-component Seismometers (Mark L4-3D 1Hz) and each channel was recorded at 100 Hz samplerate. Because there is no way to check the coincidence of the signal against neighbouring stations, it is rather difficult and often impossible to detect events by a single station. Due to this problematic nature all stations were run in continous mode. The raw data were collected on hard disk and for the land stations archived an CDROM. The OBH data were collected and

[1] Crustal Investigation on- and off-shore Nazca Plate and Central Andes
[2] Collaborative Research Group 267, FUB - TUB - GFZ, Deformation processes in the Andes
[3] Ocean Bottom Hydrophon

archieved on DAT tapes. The land stations were checked every six days by two groups, collecting hard disk and changing batteries. The OBH were deployed by the research vessel SONNE in two parts. Each consisted of 12 days and the maximum depth of the OBH was 5500 m.

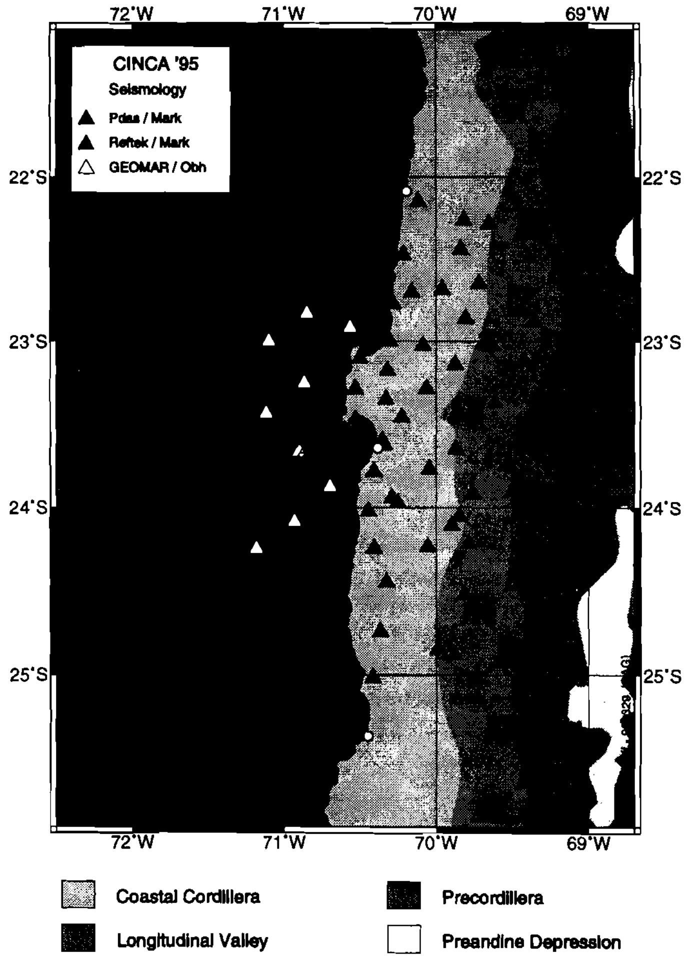

Figure 1: network design of the CINCA array

Once the data were achieved on CDROM in the field a triggerlist was created for each day. A criterium for an event was defined by a LTA[4] to STA ratio of 8 and a coincidence of 5 stations. In general about 200 events per day (figure 2) were observed. This unusual high seismicity is caused by the aftershock activity of the Antofagasta earthquake. In contrast to other aftershock studies we do not observe a significant decrease in the number of events per day over the whole observation period.

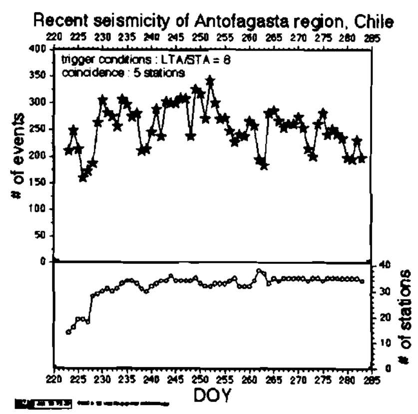

Figure 2: regional seismicity during the field campaign

[4] LTA=Long Time Average, STA=Short Time Average

DATA EVALUATION AND PRELIMINARY RESULTS

After the field campaign all available data (PDAS, Reftek and OBH) were merged together. Based on the triggerlist, which has been recalculated with LTA to STA ratio of 8 and a coincidence of 15 Stations, records of 130s length based on the earliest arrival were cut out of the continous data streams for all three channels. These timepieces have been sorted for each event and stored on CDROMs. In total we produced a catalog consisting of 4500 Events stored on 22 CDROMs, which leads to a data capacity of 13 GByte. All Events have to be localized with the PITSA based package GIANT[5]. Parallel to the localisation procedure a 1D minimum V_P-model is calculated through a 1D inversion with the VELEST[6]-Software. For a significant subset of 500 Events the epicenters, a longitudinal section in east-west and north-south direction and the used 1D V_P model is shown in figure 3.

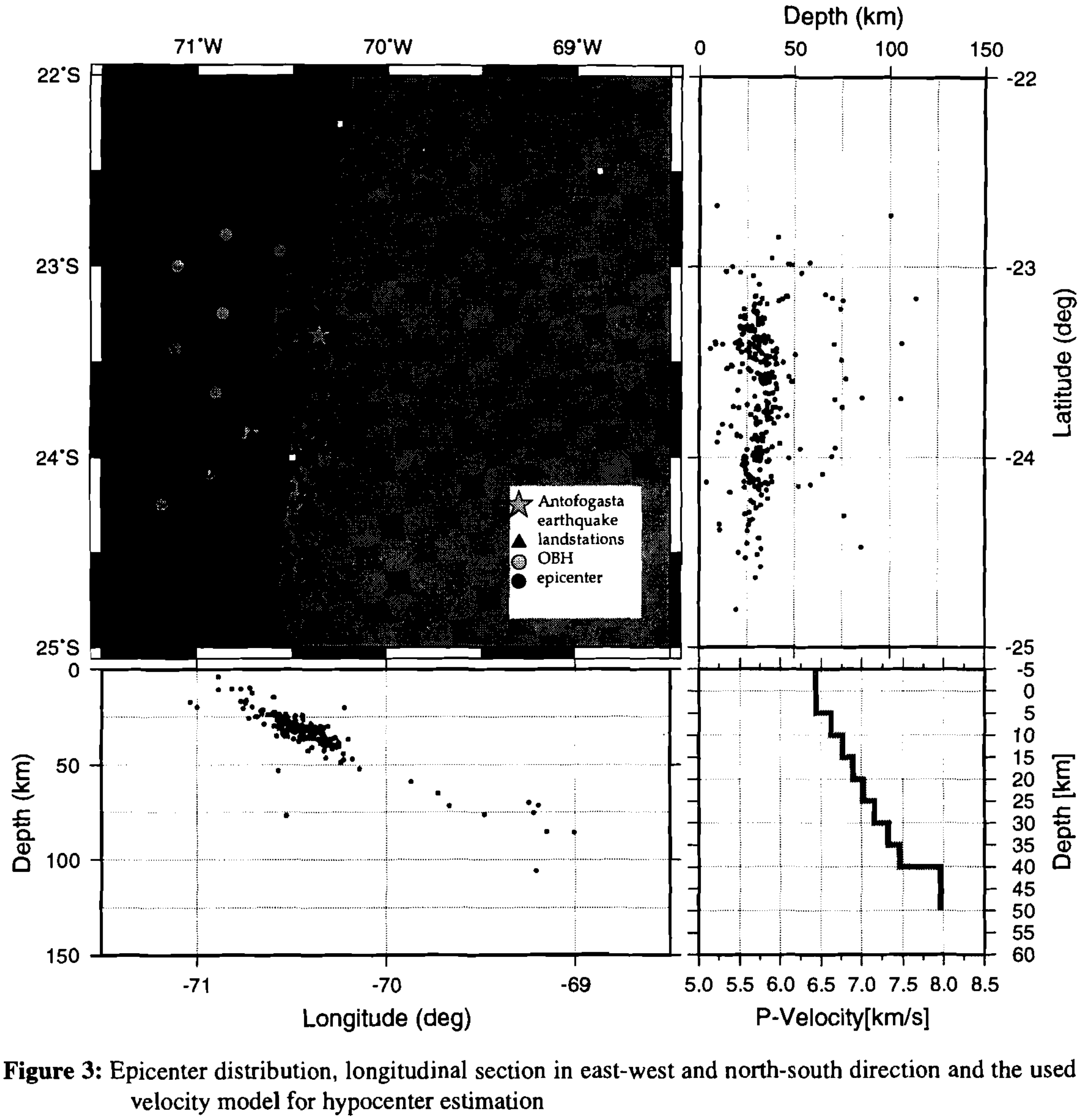

Figure 3: Epicenter distribution, longitudinal section in east-west and north-south direction and the used velocity model for hypocenter estimation

[5] A.Rietbrook, LMU-Munich

[6] E. Kissling, ETH Zurich

The epicenter distribution shows a region of high event density in a area south of the Antofagasta earthquake. These events concentrate in a depth at 30km as indicated by the longitudinal section in figure 3. This improves the assumption that the observed unusual high seismicity has been triggered by the main shock.

Most of the events concentrate in a stretch along the coast. This area lies in the border region of the land network and will give uncertanties in the localisation of these events because of the bad coverage of the azimuth. Using the OBH data improves the localisation because of the better azimuth coverage. A good precision in the epicenter estimation is essential for a detailed study of this area.

A longitudinal section in east-west direction (figure 3) gives a good image of the subducting slab. Just a few events occur beside the main trend, which can be caused by uncertanties in estimating the depth. The dip of the subducting slab can be estimated with 12-13^0, which is in close agreement to the results of the refraction profiles (Patzwahl et al., this issue).

In the near future we will use this excellent data set for a detailed 3D tomogaphy study. Based on this results an interpretaion of the geodymanic situation will be done.