ANCORP '96: Velocity Image of the Central Andes derived from Refraction and Wide-Angle Observations

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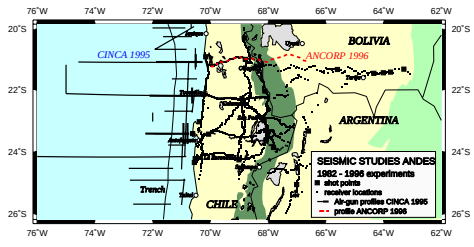

Fig.1: Overview Map of seismic profiles measured since 1982

Introduction

Active and passive seismological investigations in the Southern Central Andes in the framework of the Special Research Project 267 and previous initiatives have a long tradition, reaching at least back into the early 1980s. Since this period a net of mainly refraction seismic profiles and also on- and offshore reflection measurements and several seismological networks have been realized (sea fig. 1). The registrations made during the project ANCORP 96 are the prolongation of one of the airgun-profiles of the CINCA 95 campaign. These airgun-profiles also had been registered at wide-angle-distance by means of receivers installed onshore.
The wide-angle registrations on the ANCORP 96 profile consist of eight shotgathers. In addition to the borehole-shots at the marked locations, eight offshore-explosions and several mine blasts from the copper mine Quebrada Blanca were registered. Especially these registrations proved to be very usefull due to their good quality and the high amount of energy.
Data examples, correlations and a velocity model coming from evaluation of CINCA wide-angle data (Patzwahl) and ANCORP wide-angle data are presented. Furtheron, a velocity model of the subsurface of the ANCORP profile using the first arrivals of the steep-angle data has been computed.

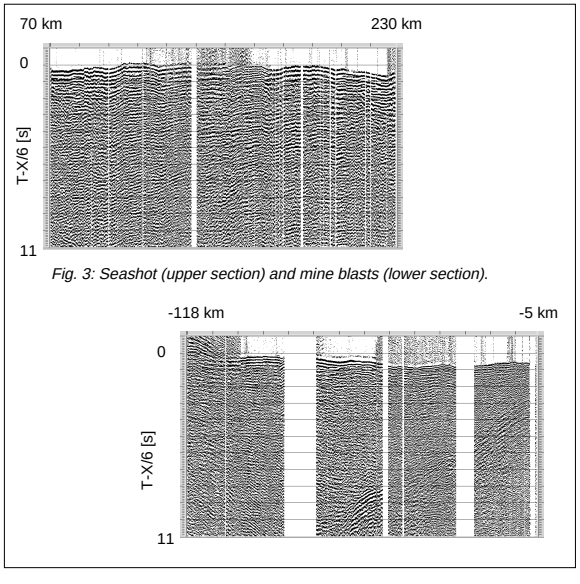

Fig. 3: Seashot (upper section) and mine blasts (lower section).

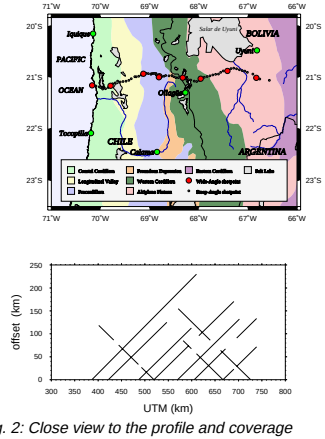

Fig. 2: Close view to the profile and coverage of wide-angle-shots

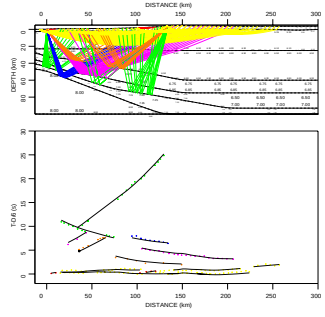

Fig. 4: Ray-tracing and traveltime fit

Near Surface Velocity Model

The velocity image of the subsurface of the ANCORP profile has been computed with the first arrivals of the 65 steep-angle reflection shots. A laterally homogeneous initial model consisting of two layers (with respect to the topographic surface) has been used. The plot shows the result after six inversion-iterations of the algorithm by Zelt (1992). Although this algorithm had been designed for wide-angle refraction and reflection data with a relatively low number of model parameters to be inverted it proved to be stable also in this attempt with a very high discretization of the model. Velocity nodes are specified each 5 km, average receiver distance is 100 m.

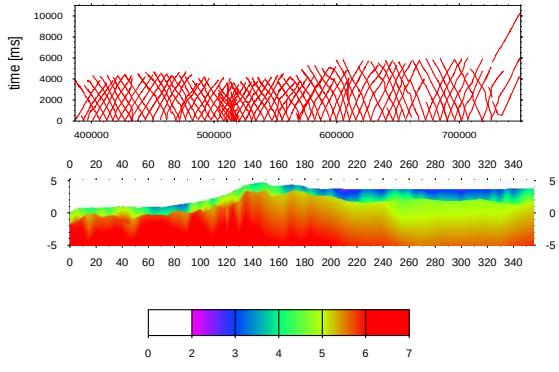

Fig. 6: Traveltimes and velocity model from inversion of first arrivals

Correlations

Steep and wide-angle reflections in the shot sections of the seashot and the registrations from the copper mine Quebrada Blanca have been correlated and used for a forward modeling. The reflections are:
- oceanic Moho (blue rays)
- upper frontier of the west-east dipping reflecting band (green rays)
- continental Moho (?) (pink rays)
- border between upper and lower crust (orange rays).

Velocity Model of the Subduction Zone

The combined velocity model (fig. 5) consists in fact of three models put together. On the right side, from -190 km to 0 km, the result of wide-angle registrations of the CINCA airgun-profile at 21° S is plotted. the continuation on the left side is delivered by the velocity model obtained from the evaluation of the forearc data of the ANCORP profile.
Both parts have been obtained from manual interactive forward modelling following the trial and error method. The ray-tracing program by C. Zelt (1992) has been used. Due to the low and very irregular ray-coverage the traveltimes have not been inverted.
The isovelocity-lines plotted over the left half of the model represent the first result of a 2D tomographic inversion of the earthquake traveltime data registered during the passive seismological campaign in ANCORP 96. The dots show locations of earthquakes between 20.5° S and 21.5° S. In depths greater than 100 km, the center of the cluster coincides with the prolongation of the correlated oceanic Moho.

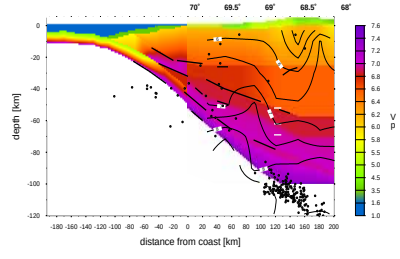

Fig. 5: Velocity model from wide-angle and seismological data (isolines)