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SHALLOW HIGH-RESOLUTION SEISMICS – A LINK FROM QUATERNARY TO TERTIARY ALONG THE TRANSALP PROFILE IN SOUTHERN BAVARIA

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Introduction

In its northern part the east-alpine reflection seismic traverse TRANSALP crosses the complicated transition zones from the Foreland Molasse to the Folded Molasse and from the Folded Molasse to the tectonically superposed alpidic thrust units. The contact zones are covered totally by Quaternary sediments. The deep-reflection seismics of the TRANSALP project and the exploration seismic profiles (THOMAS et al., 2001) do not provide any information from surface down to about 300 to 500 ms two-way travel time (TWT).

Acquisition and Processing

Three high-resolution reflection seismic profiles were surveyed to explore the near-surface structures in the transition zones. During the survey the acquisition parameters of geophone spread, spacing and frequency range were particularly adjusted to reflectors which are expected to dip steeply southwards. A high-frequency vibrator was used (BUNESS et al., 1997; VAN DER VEEN et al., 2000), designed for shallow reflection surveys.

An end-on spread configuration was selected. In case of southward dipping layers the vibration points have been positioned south of the geophone array. With this a favourable angle of incident for p-wave registration of steeply dipping events at the geophone was assumed.

The common problem of the Quaternary cover with glacial deposits complicates the data processing to a large extent. To this the complicated geological/tectonical conditions and the unfortunate circumstances for energy distribution are added. The consequences are that in most cases evaluation of reflection hyperbolic functions is not possible in raw data. Only after a time-demanding prestack processing, reflections with a travel-time up to 300 ms TWT can be interpreted in unstacked sections.

Consequently, that part of the hyperbolic reflection function next to the first arrival is vital for an optimum stacking result. Therefore, refraction energy has been carefully muted as close as possible to the first arrivals. In order to enlarge and optimally use the effective window between first arrival of refraction and surface waves all available techniques regarding noise suppression have been applied. This affords a sensitive combination of air blast attenuation, spectral balancing, bandpass filtering and amplitude scaling. This combination proved to work successfully when permanently adjusted to the quickly changing data quality along the profile. The muting zone has to be estimated for each vibration location separately, so that in addition, small spatial and near-surface velocity variations could be taken into account.

The main aspect of data processing can be seen in the determination of velocities. They play a distinctive role in computing static corrections, the NMO-correction for CMP-stacking and, finally, in migration.

The data of this project shall redress the lack of interpretation of deep and exploration seismics at the uppermost 300-500 ms TWT. To connect the overlapping interpretations it is necessary, however, to include larger travel times as good as possible, too. Combining refraction statics and residual static corrections has shown to be best suited. Thereby, the usable band-width of the signal as well as the stacking velocity was improved iteratively.

Results

This project of high-resolution reflection seismics in complicated geological transition zones of the Bavarian alp rim shows, that even in areas, which are strongly folded and faulted by imbricate thrusts, seismic information can be gained. Three high-resolution seismic profiles reveal a detailed image of the transition zones from the unfolded Foreland Molasse to the Folded Molasse as well as from the Folded Molasse to the Helveticum/Flysch zone. Even the Quaternary cover in the vicinity of the Foreland Molasse and the Folded Molasse could not only be (seismically) observed, but also seismic information could be gained down to 1.3 s TWT in this area. The dipping events of the transition zone Folded Molasse/Helveticum/Rhenodanubian Flysch are much lesser than expected.

Data processing had to be attentive to steeply dipping structures. For this all means of noise suppression had to be employed in order to enlarge the effective window between refraction events and surface waves and to use this most effectively. Hence, a precise processing of single traces was necessary, yielding the best results.

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