Preliminary Interpretation of the 3D-Seismic Survey at the KTB-Location

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One, maybe the biggest, part of the experiment Integrated Seismics Oberpfalz 1989 (ISO89) was the measurement of a 3D steep-angle, deep-seismic survey at the KTB location. An area of 17.85 km x 19.1 km was covered by this survey. For a more detailed description of the survey and its acquisition see Rehling and Stiller (1990). In a first step the first seven seconds of the recorded twelve seconds reflection time have been processed at the DEKORP Processing Center (DPC) at the Institute for Geophysics of the Technical University Clausthal. In the sketch of the survey area (Fig. 1) the numbering of the inlines (I 185 - I 541) and the crosslines (C 172 - C 553) is shown at the outside of the area. The inline direction SW - NE is parallel to the geophone lines. The crossline direction NW - SE is parallel to the shotpoint lines that means they are almost parallel to the strike direction of the Frankonian Line, which seperates a crystalline basement area in the northeast from a smaller area covered with Mesozoic and Paleozoic sediments in the southwest.

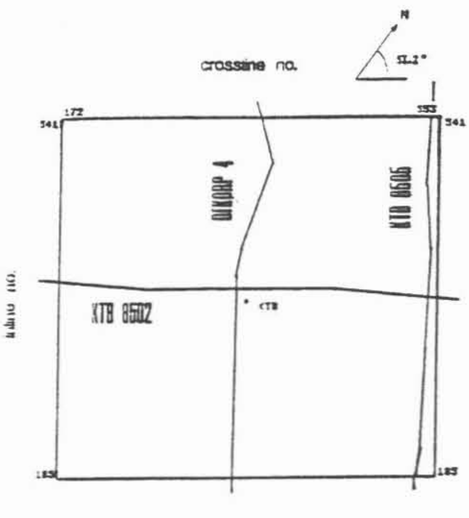

Figure 1: Sketch of the area covered by the three-dimensional seismic subsurface data. The two-dimensional seismic lines which are crossing the area are displayed, too.

The processing of the seismic data showed that the conventional three-dimensional processing scheme based on seismics in sedimentary areas failed in such a complicated crystalline area as it was found around the KTB drill site. Therefore, the first stack of the whole survey has been done as an envelope stack. More details of this processing procedure can be find by Stiller (1992). This envelope stack of the three-dimensional survey has been interpreted on a COMSEIS station with two main aims:

Firstly, the interpretation should give support to the drilling crew at the KTB. There should be hints for zones critical for drilling as well as information about the possible casing emplacements in the deeper part of the drill hole.

Besides the special informations about the surrounding of the KTB the structure of the whole area covered by the survey should be evaluated. These results should be reconciled with the results of the interpretation of the two-dimensional seismic lines in this area (Schmoll, et al., 1989) or should correct the interpretations done earlier.

It was necessary to do the interpretation in two blocks. The first block contains the crystalline area northeast the Franconian Line, the second block is the area southwest covered with sediments. This division into two blocks is necessary because of the seismic pull-down effect caused by the sediments, which show a thickness of up to 3000 m. This effect of about 700 ms here can only be removed from the data by a depth migration, but at this time the data are still unmigrated and so the events underneath the sediments have to be considered seperately.

Figures 2 to 4 show examples for the interpretation of the three-dimensional data. There are only some of the interpretations displayed to keep the clearness of the picture. Figure 2 shows the inline 291 located almost in the center of the survey. The line is displayed in the direction SW - NE. In the sedimentary area the horizons A-1 (the lower one) and A-4 are marked. Underneath the sediments there are two horizons marked which are each an example for a number of similar horizons. The upper one (M-3) belongs to group of southeast dipping elements which can be detected only underneath the sediments. The lower one (H-3) is one of three horizons which occur almost horizontally in the area of 5 s TWT. The connection with the horizons in the crystalline part of the survey area is not clear, yet. In the part northeast of the Franconian Line there are two steep dipping elements (SE-1 and SE-2) marked. They are the lower and upper bound of a bundle of similar elements. Besides these horizons the elements B-1, B-2, G-1, G-4 are marked. These horizons will be described and explained below.

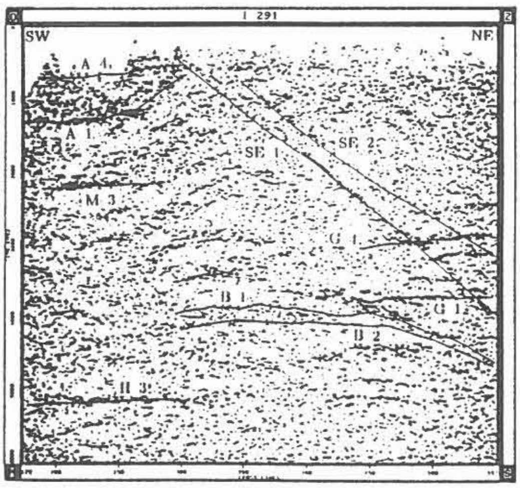

Figure 2: Inline 291 with some interpreted horizons marked (more details in the text).

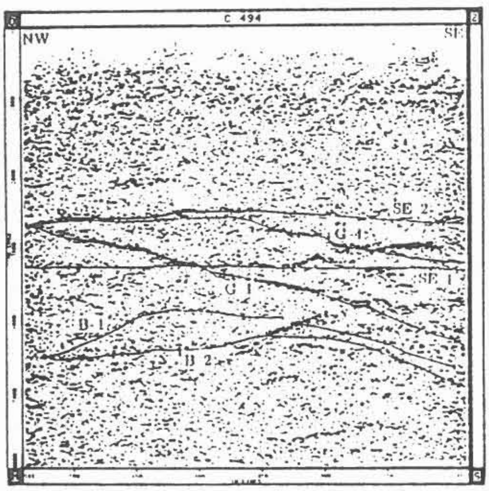

Figure 3: Crossline 494 with some interpreted horizons marked (more details in the text).

In Figure 3 the crossline located at the northeastern edge of the survey is displayed in NW - SE direction. In this crossline the same elements are marked as in the inline as far as they can be seen here. The rhomboid structure formed by the horizons G-1 and G-4 can be seen clearly. This picture gives an impression of the complexity of the interpretation work which has to be done on this data. The 3576 ms slice displayed in Figure 4 has been used to control the interpretation done in the in- and crosslines. This controling has been done with the tie-points which are displayed for horizon B-1 in this Figure. The horizon with the shape of a pear can be detected in the northwestern part of the survey area. The results of the preliminary interpretation can be summarized in five main groups:

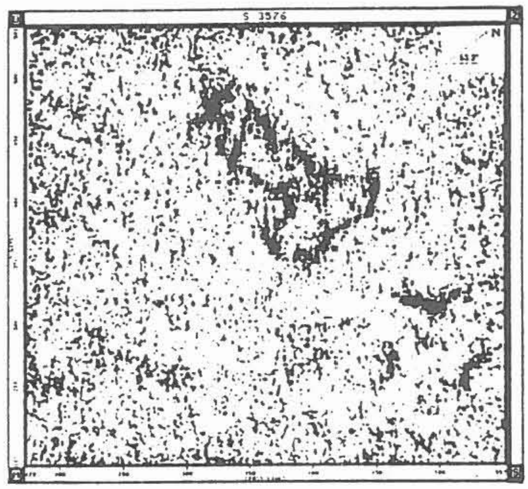

Figure 4: Time slice at 3576 ms twoway-time of the 3D-survey. The tie-points of horizon B-1 are displayed.

The first group consists of steeply dipping events with a true dip up to 60 degrees to northeast. This events which have partially a parallel, partially a split structure, are named SE (steep event)-1, SE-2, SE-3 and SE-5. The origin of those reflections may be overthrust planes, which reach the surface in the area of the Franconian Line.

The second group contains two slightly curved, almost parallel major events and a diffraction like event in the time range 3.5 - 5.0 s TWT. These reflections seems to be continuous in the envelope stack, but there are severe hints that these events consist of a number of overlapping diffractions. This can be caused by a very rough or broken surface of a body (Erbendorf body ?). The elements are named B-1, B-2 and R-1.

The third group consists of five reflections interpretable in northeastern part of the survey in the time range 2.5 - 4.0 s TWT. These reflections are well known as the rhomboid structure named Erbendorf body in the two-dimensional line KTB 8502 (Schmoll, et al., 1989). These reflections are named G1- to G-5.

The fourth group is composed of the reflections of the sediments in the southwest. In the envelope stack five horizons named A-1 to A-5 are interpretable.

The events underneath the sediments form the fifth group. In the envelope stack it is quite difficult to decide which one is a multiple of the sediments and which one is a true reflection. It is quite difficult to interpret the connection of these events with the events in the crystalline block, too. So these events are not interpreted clearly, yet.

The most remarkable element in the whole 3D-survey is the event named SE-1. This event can be seen in a great number of inlines and crosslines around the location of the KTB. At an early stage of data processing this event raised a lot of questions. To ensure a reliable interpretation different possible explanations had to checked. It could be a true reflection, a reflected refraction, a diffraction or some other kind of artifact. The investigations on this problem were made regarding the seismic data of the 3D-survey and the seismic lines DEKORP 4 and KTB 8502. These lines cross each other almost at the location of the KTB.

The analysis of the two-dimensional data, especially of the KTB 8502 profile, gave strong evidence against the reflected refractor model already. Moreover the model of an extended line diffractor could definitely be ruled out by numerical calculations. Inspection of isochron maps of the SE-1 event from three-dimensional data excluded man-made artifacts as well as the point diffractor model. Further calculations and basic considerations on traveltimes, slopes, velocities and dip angles enable us to rule out the reflected refractor model, too. Thus it can be stated definitely that the SE-1 event represents reflected energy related to a reflector with some 55 degree dip on average and intersecting the surface close to the Franconian Line. More details to this investigations can be find by Körbe and Reichert (1992).

Literatur:

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