NORSAR

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VI.7 Do Geological Surface Features Have a Counterpart in the Deeper Part of the Lithosphere

Questions of the kind indicated in the heading of this section are frequently raised when efficiency of Lg-propagation along certain source-receiver paths are discussed. For example, mountain ranges like the Urals and Himalayas are intuitively associated with roots in the deeper lithosphere and thus act as barriers to Lg-propagation across such features. As regards the Himalayas there are, as also reported in a previous section, considerable observational evidence in support of the above hypothesis

In this context it may be appropriate to ask whether manifestations of less prominent tectonic activities like taphrogenesis have a counterpart in the lower lithosphere and thus affect the efficiency of Lg-propagation across such structures. As part of such an experiment we have tried to find out whether the Oslo graben has a seismic counterpart in the crust and upper mantle below the NORSAR array - the problem was mainly unsettled - in the Aki, Christoffersson and Husebye (ACH) (1977) travel time inversion experiment and this also applies to the amplitude modelling experiments by Haddon and Husebye (1978).

In order to answer the above question, we have modified the ACH-inversion techniques by imposing two types of restrictions on the parameter vector m:

- Some of the elements or blocks are zero, e.g., all m_i's within a particular layer are zero, which physically means that the layer represents homogeneous structures.
- Some of the elements are equalized, e.g., the blocks encompassed by the surface contours of the Oslo graben are made equal and thus constitute a <u>large</u> structural unit.

The above modified version of the ACH-inversion technique has been tested in the Oslo graben using the Haddon and Husebye time residual data base (more than 4000 observations). Relevant results are shown in Figs. VI.7.1 and VI.7.2 for which we have concluded that the surface graben contours have a seismic counterpart in the crust but probably not below Moho or at best it is very weakly represented here. This result is in good agreement with those derived from corresponding gravity observations as demonstrated by Husebye et al (1978).

The next step is, as mentioned above, to analyze proper observational data in order to check the propagation efficiency of high-frequency waves across a minor crustal tectonic feature.

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References

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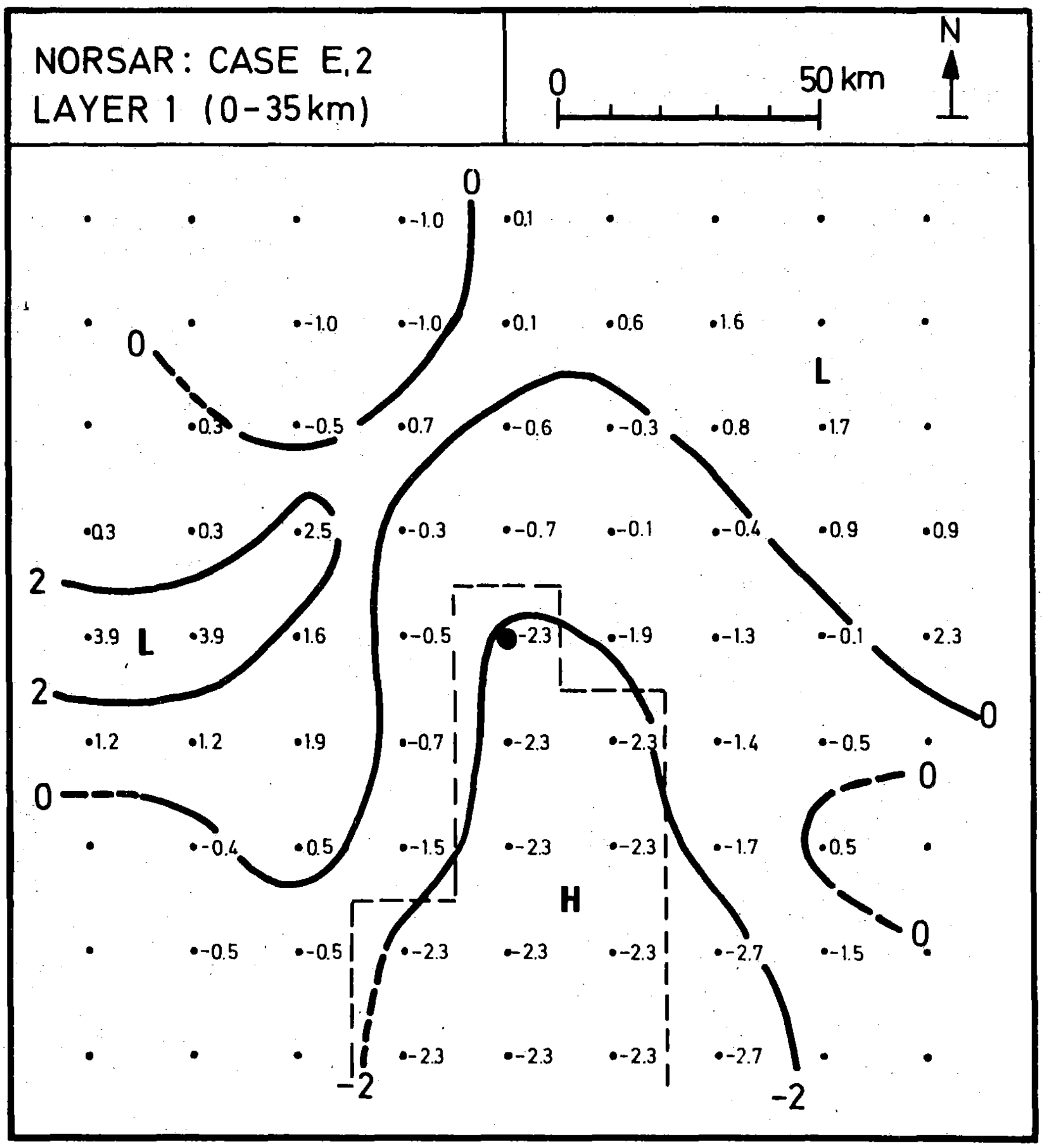

Fig. VI.7.1 a) Estimated seismic velocity anomalies in the crust of the NORSAR siting area. The Oslo graben contours are outlined and considered as one structural unit in the inversion experiment. A 3-layered standard earth model was used with Layer 2 removed or 'declared' homogeneous. Average layer velocity was 6.9 km s^{-1}, block size or horizontal extent of blocks is 20 x 20 km^2, and non-hit blocks are marked by a dot. High and low velocity areas are marked by the letter H and L respectively. For computational details, we refer to Aki et al (1977) and Christoffersson and Husebye (in preparation). We take these results to indicate that the surface contours of the Oslo graben have a seismic counterpart in the crust.

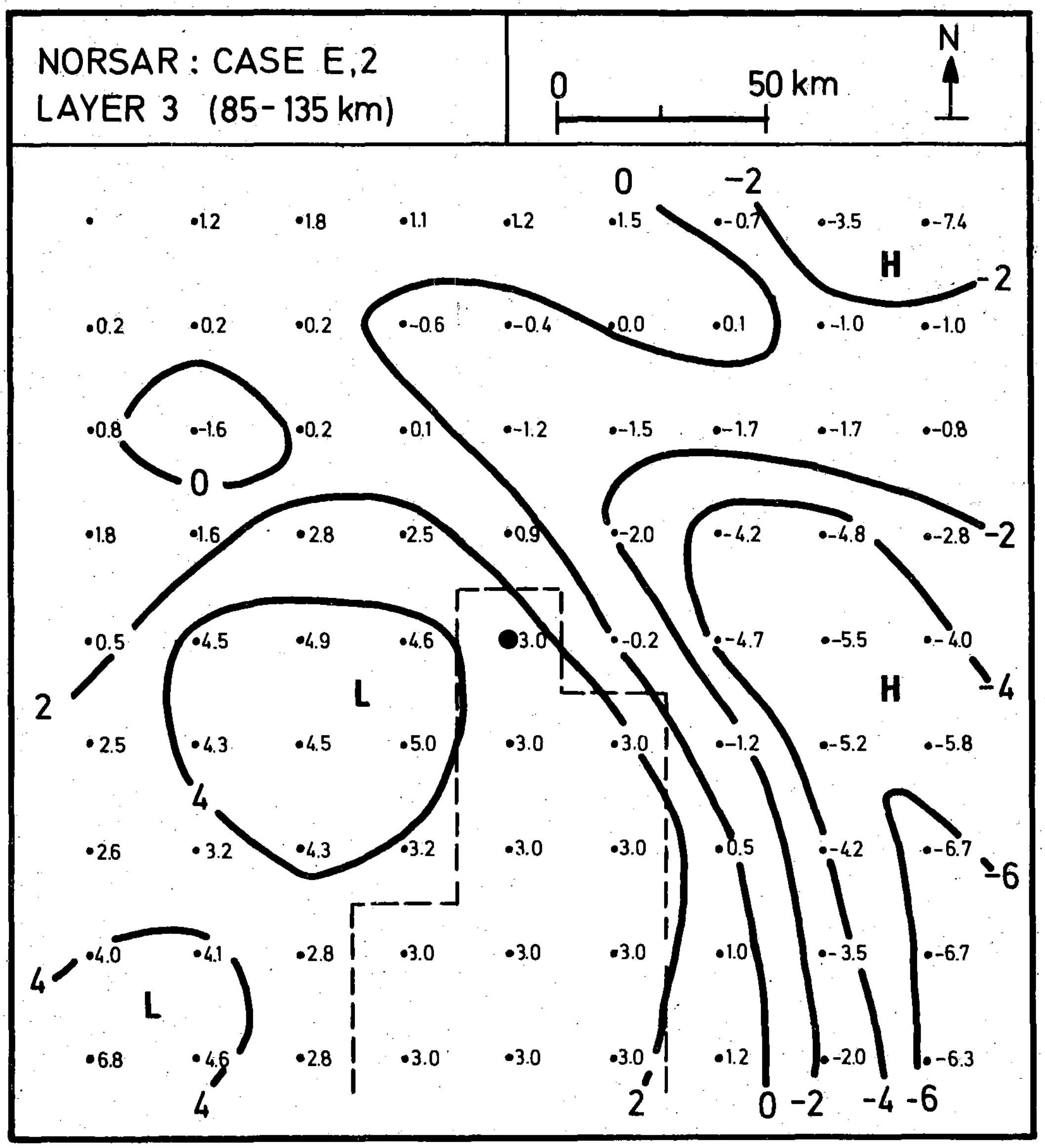

Fig. VI.7.2 These results plus estimated model fit parameters are taken to indicate that the graben imprints on the lower lithosphere are at best modest. Otherwise, caption as for Fig. VI.7.1.