P045 SPECIAL ASPECTS OF ACQUISITION OF 2D HRS DATA USING DYNAMITE AND VIBROSEIS SOURCES

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Introduction

A large 2D High Resolution Seismic (HRS) survey has been carried out in the Northern part of Belgium consisting of 12 lines over a total length of 60 km. The geological target is two-fold (shallow as well as deep), namely:

- The high resolution continuity of the "Boomse" clay at depths of approximately 200 m.
- The geological structure to a maximum depth of (approximately) 1500 m.

To obtain full fold data in urban zones with hard pavements, a new method for planting geophones has been developed and validated ("clay-pots"). Furthermore IVI-minivibrators have been used for the first time at a large scale in Europe in the HRS frequency range.
In this presentation these aspects of the acquisition, including processing in the field as part of the data quality control, will be discussed.

Data Acquisition for a deep and shallow target

Good quality seismic data can only be obtained by choosing optimum acquisition parameters with respect to the target zone. Important parameters are the source type (i.e. dynamite, vibroseis), the source depth and charge size in case of dynamite, the length of the sweep and the number of stacks in case of vibroseis and of course the source and geophone spacing.
In this survey both a shallow and a deep target have been identified, making the optimum choice more tedious. Using a state-of-the-art data acquisition system (SUMMIT) however ensures a large dynamic range and optimum geometry quality control. The field crew enters channel locations and possible offsets from the planned positions directly in the field, which is written into the trace headers and stored on tape with the data. Detailed surveying incorporated a dual frequency DGPS geodetic network and accurate theodolite measurements of every station location.
A total of 240 active channels (split spread, 2 s registration time) with strings of six 10 Hz geophones (SM-7 to ensure spurious-free recording) has been used (receiver spacing 5 m, source spacing 10 m). The geophones were planted in the soft soil where possible.

"Clay-pots"

In the urban zones with only hard pavements, use has been made of new designed "clay-pots". The geophones are stuck in a small pot filled with bentonite, which is then put on the ground (Figure 1) ensuring a good coupling. Validation and testing showed, that good results are obtained with this relatively cheap method in comparison with other available techniques (i.e. developed by Geomecanique or Sensor).

Sources

Two source types have been used. It was decided to use dynamite sources (sample rate of 0.5 ms) as much as possible because of a better SNR, a deeper penetration and a larger frequency content with respect to vibroseis data. Only on the lines crossing urban zones, where dynamite is not permitted, vibroseis (sample rate of 1 ms) has been used.
For the first time in Europe vibroseis sources (a truck and a trailer mounted Minivib from IVI Inc.) have been used at a large scale in the HRS frequency-range. A linear sweep of 8 - 250 Hz (duration 16 ms) has been selected after extensive testing. To increase the SNR generally 4 times stacking prooved sufficient. Only when very noisy areas were identified by the operator 6 or 8 times stacking have been applied.
For the dynamite sources different charges (1 cap, 125 g dynamite and 250 g dynamite) at different shot hole depths (4 m, 6 m and 8 m) have been tested. Best results were obtained with a 125 g dynamite charge at 6 m depth. The caps gave a very low SNR, whereas the 250 g charges caused relatively much source generated noise. These results are in agreement with the conlusions of van der Hoff et al. (1996) recommending a shot hole depth of 1/3 λ below the groundwater

table (at 1 to 2 m) to suppress reverberating guided waves. A comparison of the dynamite data and the vibroseis data at identical positions is shown in Figure 2.

Data Processing

Processing upto a brute stack (velocity model derived from a sonic log) is done in the field shortly after the acquisition (next morning) as part of the Quality Control procedure.

Anomaleous noise event

A particular linear noise event, cut off at a fixed location, has been observed in several shot records and is probably due to a bending pipeline. A further evaluation will follow during the presentation.

Conclusions

- Basic processing ("next morning brute stack results") in the field enables direct feedback to the acquisition parameters resulting in an improved final product.
- For the shallow target (100 - 400 m) both the vibroseis and the dynamite source give good results. However, dynamite gives a higher penetration than vibroseis data leading to a better imaging of the deeper subsurface (depths greater than 500 m).
- Acquisition with dynamite requires a larger field crew than with vibroseis due to the drilling of the shot-holes. This is compensated by a higher and more stable production rate with dynamite (about 1.5 times higher than with vibroseis due to shorter registration times (no sweep)).
- The "clay-pots" offer a unique solution for seismic data acquisition in urban zones with hard pavements only. No significant differences have been observed between traces registered with geophones in these "clay-pots" or directly in soft soil.

Acknowledgements

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References

G.J. van der Hoff, J.A.C. Meekes, K. Roy-Chowdhury and B.C. Scheffers, 1996. Source-depth optimisation in high resolution seismics. Presented at the 2nd Conference of the European Section of the EEGS, Nantes.

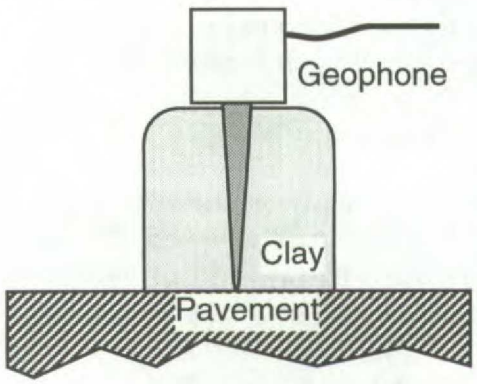

Figure 1: Scheme of newly designed "clay-pots" to use geophones on hard pavements.

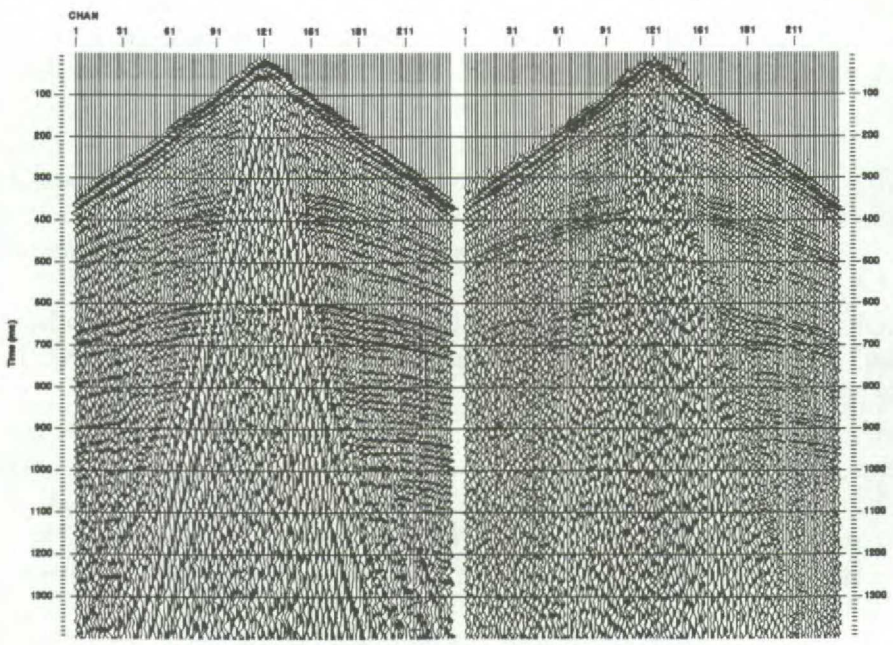

Figure 2: Shot record obtained with 125 g dynamite (left) and with vibroseis (right).