traction batteries designed specifically for deep discharge. Cost in dollars per cycle is about 3 to 1 in favour of traction batteries, initial cost is 3 to 1 in favour of starting batteries. Traction batteries have no problems in handling starting duties.

In terms of performance and longevity lead-acid rates abysmally against nicad. For portable applications the smaller nicads are hard to beat. It is a scientific fact that lead-acids cannot compete with nicads for performance, energy/weight ratio, longevity, etc. Many nicad types are very cost effective and we have enjoyed many successes with power packs and battery belts utilising this technology. Table 1 compares the characteristics of three types of battery used for the lighting of trains.

Finally, a few general rules. Alkaline cells are superior to acidic cells. Sealed batteries usually have a shorter life than open batteries. Try to compare like with like, e.g. avoid comparing a 10 AH acid type with a 10 AH alkaline, they are rated on different scales. The most common cause of dissatisfaction with nicad cells is lack of understanding of their principles, charge and use them as alkaline cells and not as a substitute for acid cells and you will experience few problems.

If this paper has served to increase your insight into the battery industry or has given you a key you can use to open new doors it has performed its function.

NEAR SURFACE MODELLING BY INTERACTIVE REFRACTION ANALYSIS

R. Beattie and J. Wardell

Introduction

An accurate estimate of the shallow near surface structure, and the static corrections for its compensation, has become more important as seismic exploration objectives become more difficult to attain. The static correction profile must be 'broadband' in the sense of containing good estimates of short, medium, and long wavelength components. In most modern seismic surveying, the short wavelength components (up to one spreadlength), which affect the signal-to-noise ratio of the stacked section, are usually determined by an automatic residual static analysis of the refraction data; while the long wavelengths (greater than about five spreadlengths), which affect structures and velocity estimates, are estimated from uphole survey information. This leaves the medium wavelengths, which also affect structures and velocity estimates: these cannot be reliably estimated from the reflection data, and would require an uphole survey spacing of half a spreadlength for complete resolution—an expensive proposition.

An alternative source of information on the medium wavelengths are the refraction events, or 'first breaks'. Ideally this data would be collected by a specialised refraction crew, but again this is relatively expensive, and so in recent times attention has turned more and more to the use of first breaks on the 'production' reflection records. While these first breaks may not be of optimum quality, at least with modern multi-channel high fold recording they are available in abundance. This large volume of data makes an automatic picking and interpretation system essential, but at the same time the inherent ambiguities in the data require an efficient means of manual intervention in the process: in other words, an interactive system.

The Interactive Modelling Method

The system discussed here runs on a Texas Instruments desktop computer, with colour graphics, and preferably linked to the mainframe computer. The procedure begins on the mainframe, where trace data from a time gate over the first breaks is selected and transferred to the desktop computer, along with the data collection geometry files. First breaks are picked semi-automatically, and the trace data with superimposed picks displayed on the screen for quality control and editing; the latter function being controlled by a 'mouse'. Adequate display resolution within the confines of the video screen can be aided by the application of linear moveout correction, based on an estimated refractor velocity (Fig. 1).

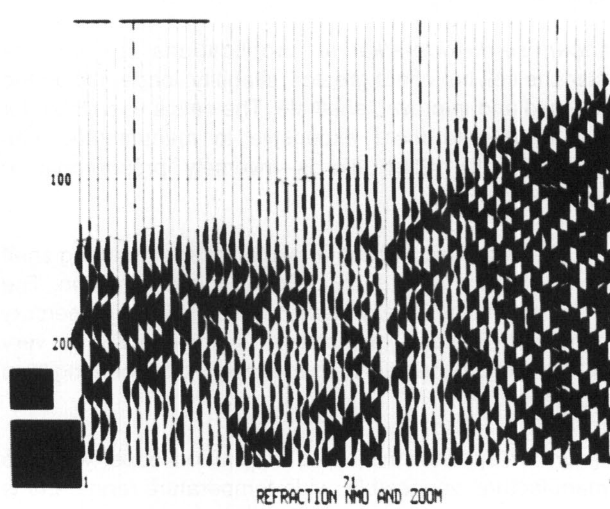

FIGURE 1
Video screen display of first break data, after linear moveout correction, showing first break picks. Original display is two colour dual variable area.

From the pick times, short wavelength residual statics are computed using a 'beamsteer' algorithm of the type described by Hileman *et al.* (1968), and bandlimited by a spatial low cut filter, normally to wavelengths less than about one to two spreadlengths. (If desired, the automatic first break picking and short wavelength static computation can be done on the mainframe, then transferred to the desktop computer for editing.) These short wavelength statics can be separated into left and right statics for a split spread.

The next stage of the process is to apply these short wavelength static corrections to the first break trace data, and pick times. This helps to linearise and clarify the various refractor segments on the first breaks, and aids interactive picking of the offset ranges over which refractor velocities and intercept times are to be determined. These parameters are computed by a least mean squares straight line fit over the appropriate range of picks, or optionally by a straight line fit between specified end points, and displayed on a time versus offset plot of the pick times for quality control and editing (Fig. 2).

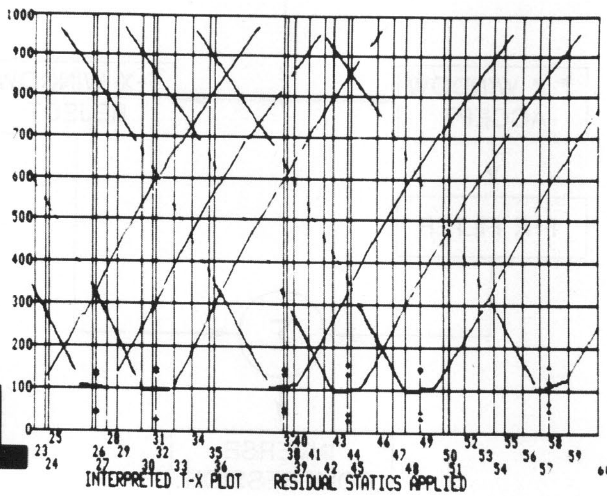

FIGURE 2
Time versus offset video plot of interpreted first breaks, showing two refractors, after short wavelength static correction. Small tick marks show intercept times.

From the velocities and intercept times, a near surface model is constructed. The method used is based on the work of Johnson (1976), and consists of the thickness of the interval velocities of the near surface layers at the selected shot points. This initial model contains only the medium and long wavelength effects. To produce a full bandwidth model, the short wavelength statics are incorporated into the model as either velocity or thickness variations in the shallowest layer (Fig. 3). The full bandwidth refraction statics can then be tied to uphole statics if necessary, before being applied to the seismic data.

Medium wavelength static determination is often the main reason for using interactive statics. The short wavelengths, determined at the start of the processing sequence in this way, benefit certain processes (such as velocity filtering, initial velocity analysis, and 'brute' stacks), which are normally used before such statics can be obtained from an automatic residual statics process.

Limitations

While this type of refraction analysis can be useful in many situations, two significant limitations must be recognised. Firstly, the source and receiver arrays normally used for production recording degrade the sharpness of the first

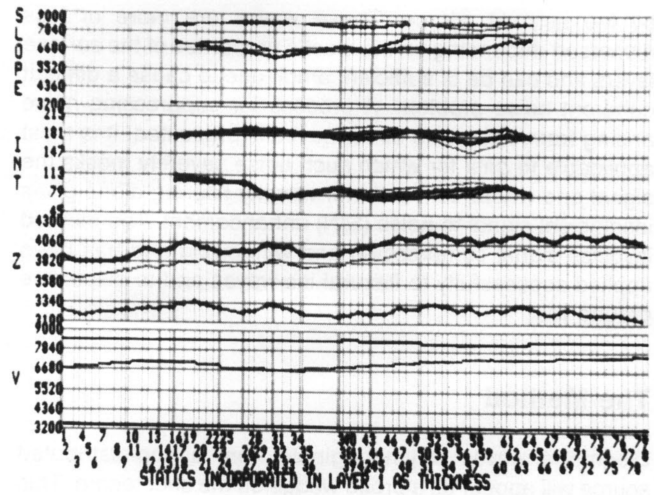

FIGURE 3
Final near surface model video display, showing refractor slope, intercept time, surface and layer elevations (Z), and velocities (V).

breaks, making accurate picking of the break difficult; although band pass filtering and possibly deconvolution can sometimes improve this situation. The second problem is that the first break information may be incapable of defining the near surface correctly. For instance, hidden layers or velocity inversions can result in an incorrect model, while thin shallow high velocity 'stringers', common in many areas of Australia, may totally obscure the main refraction events.

Conclusions

Where the refraction data on production seismic records is capable of defining the near surface layers, interactive refraction analysis offers an efficient method of fully exploiting that large volume of data, while allowing a high degree of quality control and editing by the geophysicist.

References

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Johnson, S. H. (1976)—'Interpretation of split spread refraction data in terms of plane dipping layers', *Geophysics* **41**, 418–424.

WINDOWING OF DISPERSIVE NOISE IN TWO DOMAINS

Greg Beresford-Smith

Introduction

During the collection of seismic data on land, various types of near-surface horizontally propagating waves are generated