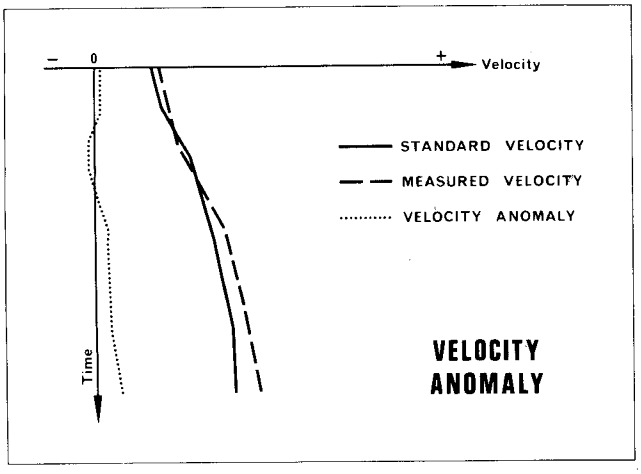
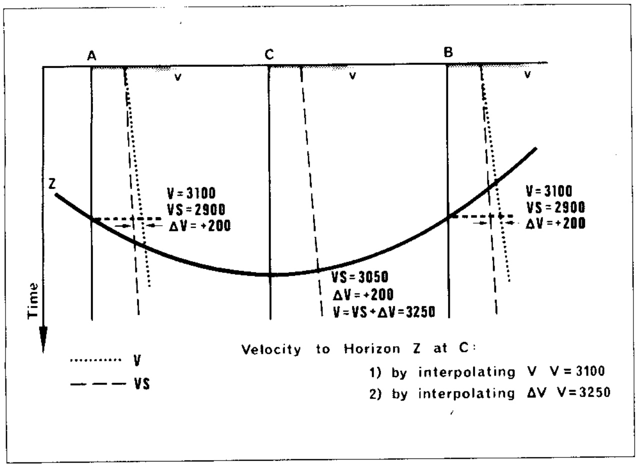
curve of moveout velocity against time at a specific location on a line. From this moveout velocity it is possible to calculate the average velocity to any reflection, subject to a number of assumptions.

Unfortunately, there are a number of sources of error in velocity analyses, only some of which can be corrected for, so that the random error in the velocities is always much greater than that in the reflection times. However, there are real velocity variations which must be allowed for. Separating these real variations from the random variations can be done by assuming that the rapid or high frequency variations are noise, and the slow or low frequency variations are real.

If this is done simply by smoothing or averaging the velocity analyses, the results are acceptable, unless there is also significant structure on the reflections. If this is the case the velocity varies with depth of burial which may change rapidly, for example at a fault.





An alternative method is to adopt a standard curve of change in velocity with reflection time, and to smooth the difference between the velocity and the standard velocity, referred to as velocity anomaly. The concept of velocity anomaly can be illustrated with a plot (Figure 1) showing the curves for standard velocity, measured velocity (from analyses) and velocity anomaly plotted against time. This concept may be applied to either moveout velocity or average velocity.

Figure-2 shows the difference in results compared to using average velocity for smoothing. In this case a cross-section in reflection time is shown, with a seismic horizon Z. Velocity data is from analyses at points A and B. If the velocities are averaged the velocity at C is 3100, whereas if the velocity anomaly, ΔV, is averaged the velocity is 3250. This is closer to the real value provided only that the slope of the standard curve is closer to the slope of the real time/velocity curve than the assumption of no variation with depth. In general this requirement can be easily met, using either well data or the analyses themselves.

In practice it is necessary in marine data to correct the standard curve for water depth at each point, as it has been found that the increase in velocity with depth depends on depth of burial below sea floor, not depth below sea level.

In the area of Kingfish Field in Gippsland this method gave a standard deviation of 17 m in the random variation of depth ties with 45 wells. This is equivalent to 0.75% of depth. Most of the variation is due to velocity variation although some, in fact, may be due to errors in well depths. By comparison, the real variation in velocity, from both well and seismic data is about 10%.

SHOULD WE INVEST IN TELEMETRY SYSTEMS?

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Introduction

Over the years we have experienced increasing numbers of recording channels in reflection seismic data acquisition systems, from 24 through 120 for technical and economic reasons. Perhaps maximum feasible achievable spread lengths have been attained, however, trends to high resolution techniques demand more channels at lesser station intervals for a given spread length. Also, trends to a real (3-D) techniques demand more channels although not necessarily at lesser station intervals.

Conventional seismic cables become increasingly heavier, more expensive and fragile with increase in number of pairs and contribute alarmingly to crew down-time despite increased maintenance effort.

In practice, conventional cables would seem to be limited to 120 pairs while an increase in the number of recording channels in conventional systems beyond 96 are accompanied by an unacceptable reduction in sampling rate. Beyond 100 channels telemetry techniques offer the only practicable solution.

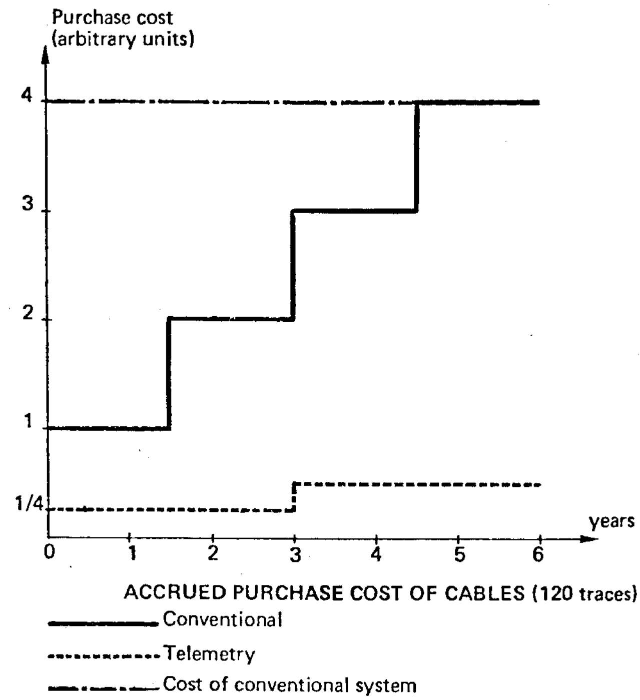
Before replacing existing conventional equipment a company may ask: "Should we invest in Telemetry?"

Purchase Cost Considerations

The cost of a conventional seismic data acquisition system is less than that for a telemetry system operating with the same number of channels in that the former has one or two gain ranging amplifiers and digitizers while the latter utilises one set per channel along with transmission electronics in a relatively harsh environment.

The cost of these expensive station modules multiplied by the number of channels is offset by the relatively low telemetry cable cost. This is illustrated in the figure which was prepared on the assumption that the cost of a set of 120 pair cables is approx. 25% of the cost of a 100 channel conventional system with a service life of 6 years and that these cables for a given spread length are fourfold the cost at half the service life cables typically employed with the Sercel model SN 348 telemetry system.

The economics afforded by the telemetry technique together with vastly simpler cable maintenance contributes profitwise but, unfortunately, the capital cost of the instruments is conspicuous.



Operations and Logistics

The weight of each station module is of the order of a single geophone array, however, the difference in weight between 100 m of 120 pair conventional cable is of the order of 20kg. or 5 station modules over that of the same length of telemetry cable. It can be seen that by way of the telemetry technique the total weight of cables, geophones and station modules per geophone station is less than that for conventional techniques.

Less weight carried can perhaps be translated into profits whether this be by way of an increased production rate or low operating cost.

Technical Advantages – Cable Noise

Noise pick-up in multi-pair cables is experienced to a greater or lesser extent depending upon environmental conditions and the condition of the cables and geophone arrays being employed apart from relatively static conditions such as geophone array impedance and cable capacitance, etc. The effects are readily recognised when the spectra of the interfering source is of a different nature to that of the seismic signal spectra, for example, the 50 Hz. pick-up associated with overhead power lines.

A series of tests were run including those utilising a Sercel model SN 348 telemetry system to record the 50 Hz pick-up from a spread crossing under a power line whereby a standard set-up of telemetry cables and station units were modified by the addition of a multipair cable through which the geophone arrays at their original station locations were connected to a ground series of station units interconnected with the same telemetry cables.

A comparison of the records made with the standard telemetry spread and the alternative spread with introduced multi-pair cable, all other things being essentially equal, indicated a considerable advantage in eliminating the multi-pair cable to the extent that in practice a survey can be run with a telemetry system without the need for notch filters. There is no need to stress the advantage of recording without notch filters.

The 50 Hz. contamination of the far traces inthe multi-pair spread cable configuration was particularly noticeable and it can be assumed that seismic signal cross-feed on a production record would be as intense. However, the cross-feed in the telemetry mode is negligible.

Conclusion

Telemetry systems were developed to meet requirements for large numbers of recording channels and the initial high cost would seem to restrict useage to application not readily accommodated by conventional systems, despite other apparent advantages. A closer examination of the overall costs reveals at least a breakeven cost situation occurring within the service life of a conventional systems and that of a telemetry system, cable maintenance and replacement costs taken into account. Consideration should also be given to the less recognised economics afforded by more reliable cables in reducing field down-time. In concluding, the difficulty to access cost advantage of elminating cable pick-up and cross-feed can be significant, and in poor areas this can mean the difference between success and failure.

EXPLORATION FOR UNDERGROUND GAS STORAGE TARGETS IN SOUTH AUSTRALIA

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Exploration in South Australia for underground structures suitable for storing natural gas was initiated in 1964, following the proposed utilisation of natural gas from the Moomba-Gidgealpa gasfields via a pipeline to Adelaide.