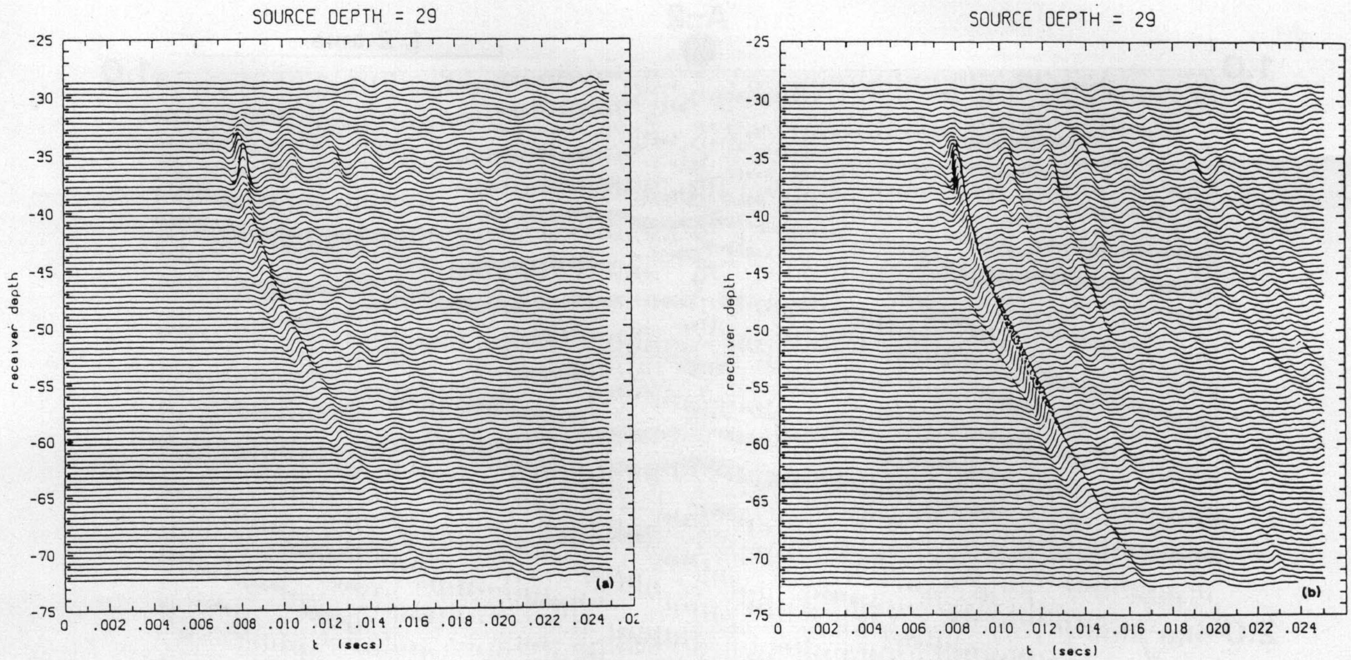

FIGURE 5.
Cross-hole seismic shot gather (a) without coherency enhancement, (b) with coherency enhancement.

"High Tech" Exploration Without High Cost

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Summary

An example of inversion modelling and interpretation which can be done on a personal computer, and three examples of significant seismic data improvement achieved by simple application of oft-overlooked basic procedures, are presented.

Acoustic impedance traces containing only those frequencies recorded in the field can be easily generated from zero-phase seismic data. Forward modelling of these traces using a personal computer can determine lithology and porosity. A short case history of modelling a Miocene reef is presented.

Shallow anamolies of limited areal extent can sometimes distort raypaths to the degree that desired reflections are not received. Designing field setups to avoid such a problem is common on land. An example of successful application of this technique offshore is presented.

Another problem more common onshore than offshore is statics. An example of a marine statics problem is presented.

Finally, the most neglected process of all, display, has been addressed. I intend to show, that contrary to the beliefs of many, this is not a totally subjective topic.

High tech seismic modelling on a low tech computer

Once the feasibility of seismically detecting the desired anomaly (in this case reef porosity) has been established for the available data, detailed modelling can be accomplished by using only a simple synthetic trace generation program.

Figure 1 shows a line across a reef on Salawati Island, off the western tip of New Guinea. A portion of synthetic trace from the discovery well is superimposed. The strong "U" marker reflection is from a relatively constant velocity argillaceous limestone which can be used to calibrate the events below it in the modelling process. Forward modelling using a synthetic generation program led to the results of Figure 2. Modelling provided the velocities from which the

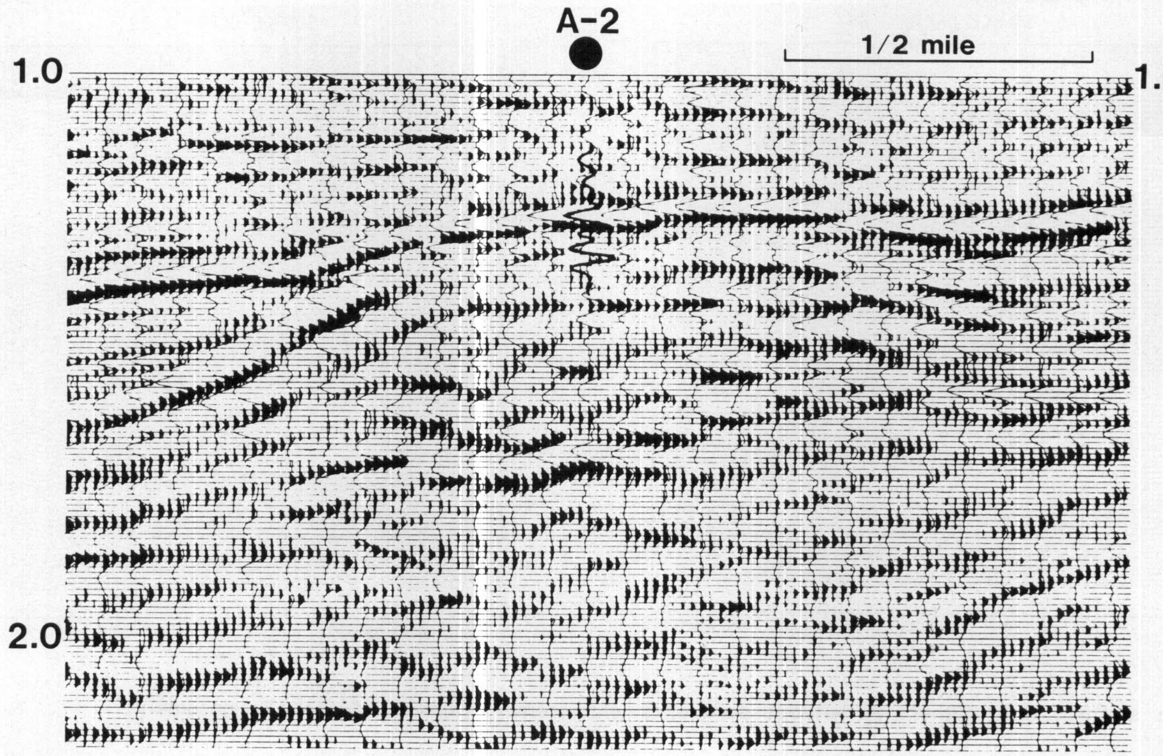

FIGURE 1
Seismic Line 136 Across Miocene Reef.

geology was interpreted. Subsequent drilling confirmed the results.

This type of interpretation can be accomplished if zero-phase seismic traces are available and 2-D effects are not significant.

Undershooting

It is well known that continuous sampling of the subsurface can be achieved under a river, for example, without having to set geophones or fire shots in the river. The same principles apply offshore, and they apply to anamalous bodies within the earth as well as to surface features. Figure 3 shows a salt intrusive. The base/salt objective is impossible to map because of velocity pull up and spurious raypaths associated with normal offsets where either one or both legs of a reflection path travel through the salt intrusion. It can be seen that with long offsets, the base/salt can be sampled by raypaths which have only travelled through relatively thin salt. Successful application of this methodology has replaced a totally NR segment below the salt intrusion with a strong, continuous reflection.

Display

Industry has failed to heed both Kim's (1965) and Feagin's (1981) advice to us that the seismic displays we use (variable area and variable area-wiggle) are not ideal for providing the most correct interpretations most of the time.

Given that we persist in using these less than ideal displays, playback parameters are critical. Signal to noise, bandwidth, and dynamic range all depend on these parameters. These choices are often (wrongly) thought to be subjective and a matter of personal preference.

Trace spacing which is too tight has the same effect as a fast-acting AGC, loss of dynamic range. Noise which has been attenuated to low amplitude by stacking or other processes can suddenly become almost the same amplitude as reflectors which have been enhanced by those same processes. "Doublets" and other examples of "character" which can help correlating reflections can be similarly lost by trace spacing which is too close.

Acquisition of traces very close together may be necessary either to successfully remove noise with steep apparent dip, or to preserve steeply dipping reflections without aliasing, or both. In the case of only needing to attenuate noise, the final display need not contain all those traces. When steeply dipping reflectors are involved, the traces are still needed on the stacked section in order to correlate events without fear of aliasing. In the latter case, dynamic range can only be preserved by making wider displays or reverting to variable density as prescribed by both Kim and Feagin.

Offshore statics

Near-seabed features can affect record quality and even dip direction on deeper reflections. This potentially serious problem is usually indicated on the stacked section, but examination of the shot records provides definite proof. Correction can usually be accomplished with automatic statics.

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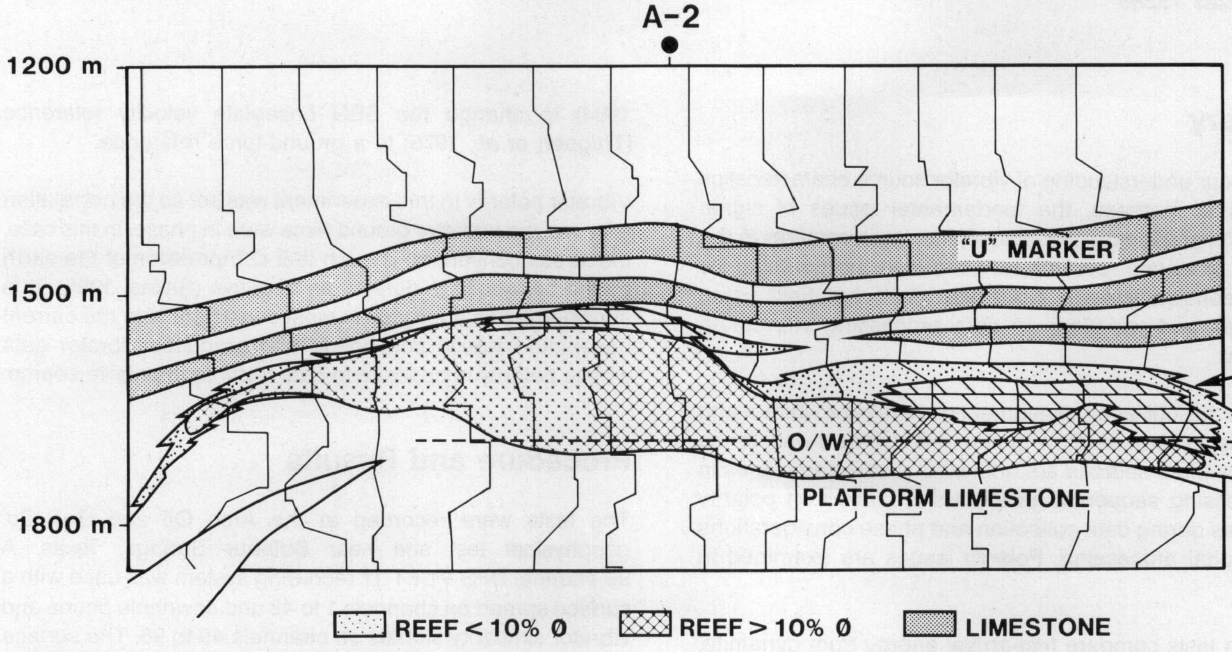

FIGURE 2
Lith/Porosity Model — Line 136.

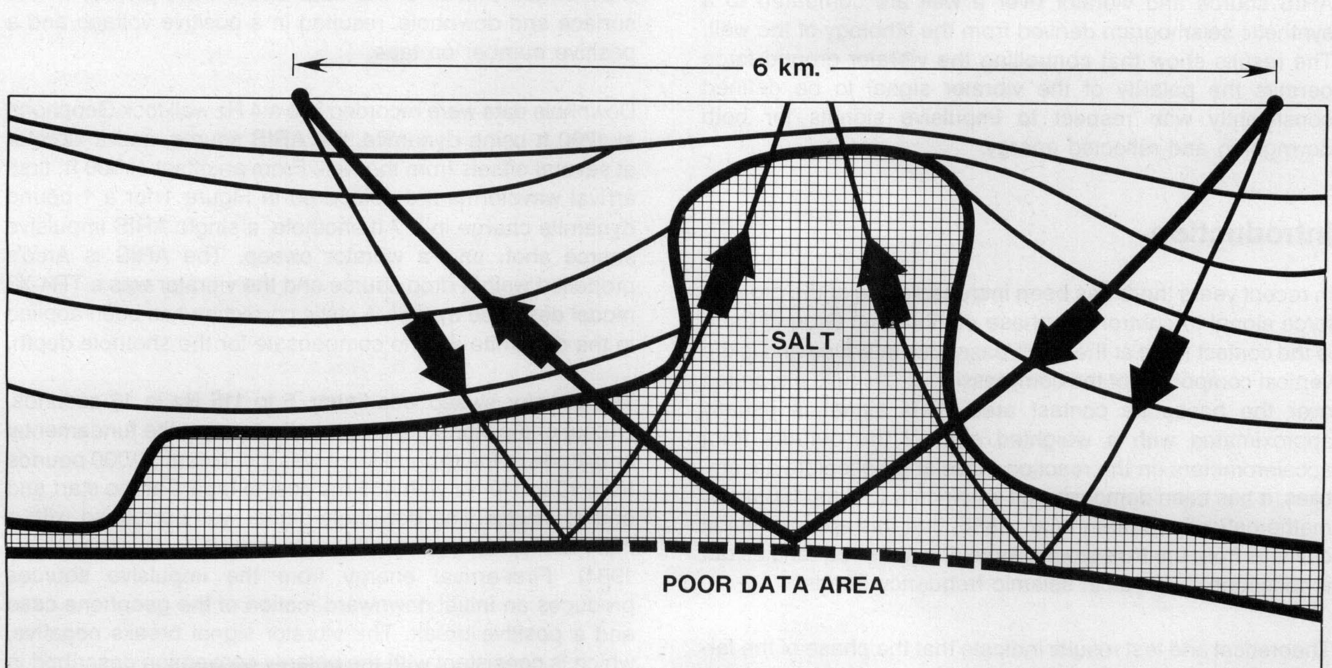

FIGURE 3
Salt intrusive with raypaths having one or no legs through the salt.