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REPORT ON DIGITAL PROCESSING

ON SEISMIC DATA FROM

BONAPARTE GULF, NORTHERN TERRITORY

AUSTRALIA

FOR

AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD.

SYDNEY, AUSTRALIA

BY

DIGICON

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SINGAPORE 2057

JULY 1982

digicon
SINGAPORE.

INTRODUCTION

The data processing system can be considered to consist of 4 phases.

PHASE I - PRE-PROCESSING

1. Demultiplex, correlation and True Amplitude Recovery.
2. Edit and common depth point gather.
3. Datum Statics application.
4. Initial Stack.

PHASE II - PARAMETER ANALYSIS

1. Constant Velocity Stack before autostatics.
2. Autostatics, design gate and dips determined from initial stack. Autostatics stack produced for Q.C.
3. Constant Velocity Stack after autostatics.
4. Front-end mute test to determine ramp for final stack.
5. Filter Analysis.

PHASE III - FINAL STACK

Optimum parameters from Phase II are applied to the gathers to produce the final stack.

PHASE IV - SPECIAL PROCESSING

1. Wave Equation Migration

ABSTRACT

Digital processing of the data from the Bonaparte Gulf was performed by Digicon in the Singapore Center. A total of 12 lines were shot, utilizing a 48 trace split spread cable with 24 fold coverage.

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CHAPTER 2

DESCRIPTION OF METHOD

DEMULTIPLEX

The Vibroseis multiplex data from the field tape were correlated and converted to Digicon's internal 9-track format in the sequential demultiplexed form for subsequent processing. Each output record has a header with location available for writing offset, distances, velocity functions and coordinates for each trace.

TRUE AMPLITUDE RECOVERY

True Amplitude Recovery phase of seismic data processing consists of the following steps :

i) Removal of binary gain (non-linear) which is applied to the data during recording.

ii) Correction for amplitude loss due to spherical spreading of the wave-front as it propagates downwards through the earth and reflected back to the surface. To correct for this, each trace is multiplied by VT, where V is the seismic wave velocity and T is the two-way record time.

iii) Correction for the absorption of energy due to inelastic attenuation of the earth which is experimentally shown to be linear and frequency dependent i.e. increasingly greater losses of higher frequencies with record time.

To correct for these effects each trace is multiplied by an exponential gain function (normally expressed in decibels per second) which usually remain constant for the prospect and brings the record to a readable level. An exponential gain function of 3 db/sec. from 0.0 - 3.0 sec. was applied to the data.

EDIT

This option is used on some records to zero noisy or wild traces which would not make a useful contribution to the stack.

DATUM STATICS

A separate weathering survey was performed and datum statics supplied from this crew were used in data processing.

COMMON DEPTH POINT GATHER (CDP)

The seismic traces along a line are arranged in a sequence on the basis of common reflection point. The offset, surface and sub-surface coordinates are annotated in the trace header for use in the subsequent processing.

TIME VARIANT DECONVOLUTION

Deconvolution is the process of designing and applying an inverse filter to remove the earth's filtering effects on the recorded data. The deconvolution is accomplished by the application of one or more whitening or non-whitening filters designed from the auto-correlation of the data trace of the input record. For optimum design of deconvolution filters, the length of the auto-correlation gate must be at least ten times the filter length. The filter is designed to whiten or broaden the frequency spectrum within a band pass having an allowable S/N ratio.

The gate is moved down the trace one sample and the process is repeated. The position of the first gate is adjusted to account for an initial muting. The points in the first and last gates are scaled by the scalar determined for their respective center points.

If a point of the output trace exceeds 2^{31} the value will be adjusted to 2^{31} and the correct sign maintained.

CONSTANT VELOCITY STACKS

These are run over 24 or 48 depth points as required, both before and after autostatics. Typically 12 to 15 different constant velocities are used within a range of 2300 to 5700 m/sec.

NORMAL MOVEOUT (NMO)

The normal moveout is performed assuming that the energy travels in a straight ray path and utilizing following equation :

$$T^2 \text{ recorded} = T^2 \text{ corrected} + \left(\frac{X \times 1000}{\text{VRMS}} \right)^2$$

A space varying velocity function is utilized and the program computes a new space-varying function for each trace by making floating point linear interpolation between input control points to produce a high fidelity NMO output. The velocity function referenced to sea level as datum.

RESIDUAL STATICS

The routine assumes that the static variations from trace to trace are caused by velocity and thickness variations in the low-velocity weathering layer. It further assumes that the initial datum statics applied to the data are not very precise and that the refined corrections based on statisticscomputed from the reflection data itself are desirable.

The automated statics analysis routine is conducted on NMO corrected gather records by utilizing all possible cross correlations between traces within and from adjacent depth points.
An iterative method is used to determine the statics.

The estimates of the residual statics are written on an output tape. This tape can then be used in a separate run to apply the residual statics:

a) Static limits (usually ± 20 msec.)

BANDPASS DIGITAL FILTERING

The stacked data of all lines were filtered using digital filter with passbands of:-

BANDPASS/db/cycle	TIME (secs)
12/3 - 60/1	0 secs.
12/3 - 45/1	2.0 secs.
15/3 - 45/1	3.0 secs.
15/3 - 30/1	4.0 secs.

CHAPTER 3

SPECIAL PROCESSING

WAVE EQUATION MIGRATION

In this process events in the stacked seismic section are migrated to the proper position using modified RMS velocities provided. The program uses an improved version of the finite difference wave equation technique developed by John Claerbout of Stanford University. The input parameters to the migration program, consist of stacking velocity, subsurface trace interval and layer thickness which is a function of interval velocity and dip. The fundamental effects of migration stack are :-

1. Lateral displacement of dipping events.
2. Collapsing of diffraction patterns.
3. Uncovering buried foci.
4. More distinct fault resolution.
5. Signal to noise ratio improvement for coherent events in areas where most of the noise consists of diffraction arrivals.

There are, of course, some limitations to the migration - process and these should be considered during interpretation.

1. The migration is done in two dimensions only. Therefore, some apparently attractive structures may correspond to reflections from out of the plane of the section. This also explains why some events may not tie exactly on two cross lines which have been migrated.

2. If lines are not shot along the true dip or true strike, the migration routine can only migrate data in relationship to the apparent dip or apparent strike.

3. The selection of layer thickness parameter is controlled by the maximum amount of dip suspected in the section and the ability to define the velocity adequently.

DATA DISPLAY

The final sections were displayed on film with the following plotting parameters.

1) Variable area wiggle trace.

2) Horizontal scales 22 traces /inch.

3) Vertical scale 3.75 inches/sec.

4) Full timing lines every 50 ms.

5) Normal Polarity.

Respectfully submitted
On behalf of
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