Tutorial: Converted wave (2D PS) processing

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ABSTRACT

This tutorial represents an initial attempt at documenting conventional converted wave (PS) processing as practiced at CREWES. It is intended for people who, while already familiar with ProMAX, have never processed a converted-wave data set. The Blackfoot 1997 3C-2D dataset is used as an example, and a series of ProMAX processing flows sufficient to generate a time-migrated radial stack from raw shot gathers are presented.

INTRODUCTION

In these notes, we describe the conventional converted-wave (PS) processing of the 1997 Blackfoot 3C-2D seismic line in ProMAX.

Several assumptions are made:

1. Familiarity with ProMAX, and an understanding of the basic concepts of converted-wave processing.
2. All assumptions required for standard vertical processing are also required for radial processing.
3. One vertical and two horizontal geophones were carefully planted at each station on the seismic line, one of the horizontals parallel to the seismic line (inline), the other perpendicular (crossline). So, all three components have the same field geometry.
4. The vertical component (PP) data are already fully processed, so the final PP root mean square (RMS) and interval velocities are already known.
5. Only converted waves with a down going P wave, a conversion point at a reflector, and an up going S wave are considered to be signal. Multi-mode converted waves are considered to be noise.

PROCESSING

1. Create a new line:

In the same ProMAX area used for processing the vertical component (PP) data, create a new line directory for processing the radial component (PS) data.

2. View shot gathers:

Before beginning, it is a good idea to have a look at the raw shot gathers in order to get an initial impression of data quality (Flow 1). We recommend that you name your flows with a number followed by a descriptive name. For example, “(01) View shot gathers.” Descriptive names are also recommended for data sets, tables, and lists.

SEG-Y Input
Type of storage to use...Disk Image
Enter DISK file path name ..../disk/datadirectory/radial_shots.sgy
Automatic Gain Control
Trace Display

Flow 1. View raw shot gathers.

3. Geometry:

Use Flow 2 to transfer existing geometry information from the radial trace headers to the database. Complete the "2D Land Geometry Spreadsheet*" exactly the same way as for vertical data, including CDP binning. Then use Flow 3 to synchronize the database with the trace headers. Under LINE->datasets, click on "shots with geom" with the middle mouse button. If all has gone well, it should say that your geometry and trace numbers match the database.

SEG-Y Input ....same as Flow 1
Extract Database Files
Source index method...FFID
Receiver index method... STATIONS

Flow 2. Copy existing geometry information from radial trace headers to database.

SEG-Y Input ....same as Flow 1
Inline Geom Header Load
Primary header to match database..FFID
Disk Data Output
Output dataset filename.. shots with geom

Flow 3. Load geometry from database to radial trace headers.

An easier way to do the same thing (recommended) is to copy the database from the vertical line to the radial line using, then execute Flow 3. This avoids the need to complete the geometry spreadsheet twice.

4. Trace edits:

Run Flow 1, then from the pull-down menus in 'Trace Display' use 'Picking->Kill Traces…' to flag bad traces in the shot gathers. Use 'Picking->Reverse Traces…' to fix any polarity reversals. In this example we are saving our results in lists called 'trace kill for radial' and 'reverse traces for radial' (used in Flow 5).

5. PS binning:

While many methods exist for binning PS data, we only discuss asymptotic binning here. Execute Flow 4, then plot common depth point (CDP) fold from the CDP database to check the results. You will find that the PP CDP fold has been replaced with the PS ACP (asymptotic conversion point) fold which depends on the average *Vp/Vs* ratio, and will look different than the CDP fold.

We use the same bin size for CDP as for ACP binning; however, the natural bin size for ACP binning is smaller than for CDP binning. This can cause extreme variations of fold from one bin to the next if an integer *Vp/Vs* ratio is used (Figures 3, 4, and 8. Lawton (1994) has some good 3D examples). For land data, *Vp/Vs*=2 is usually a good initial guess, but it is better to use 1.9 or 2.1 in Flow 4 (Figures 1, 2, and 3).

P-S Asymptotic Binning*

Select input database	shots with geom
Overwrite input dataset headers	No
Select output dataset	shots with psbin
Trace sample format	16 bit
Skip primary disk storage?	No
Vp/Vs value for binning	2.1
Pad ACP range?	Yes
Number of bins to pad ends by	10

Flow 4. PS asymptotic binning.

6. Initial guess of PS RMS velocity:

Copy the final PP RMS velocity file from the vertical line to the radial line, and execute Flow 5. This will provide an initial guess of the PS RMS velocity for use in Flow 7. Parameters for this step can be obtained by inspection of the PP and PS shot gathers. If the same events can be identified on both components, then time-varying *Vp/Vs* values can be estimated.

7. Prestack processing:

Prestack processing (Flow 6) is identical to PP processing, with one major exception: traces on one side of the source location in a PS shot gather will have the opposite polarity to traces on the other side (Figure 4). The third “Trace Kill/Reverse” in Flow 6 takes care of this of reversing the polarity of all traces with a negative source-receiver offset (Figure 5).

8. Refraction statics (shot and receiver):

Refraction statics are crucial for converted wave processing, especially since the receiver statics can be as large as 100-200 ms. As mentioned before, converted waves are P-wave down and S-wave up. Practically, this means that shot statics calculated during PP processing (Typically with Hampson-Russell GLI3D at CREWES) can be reused for PS processing. However, shear velocities vary more laterally in the shallow section than compressional velocities, so PS receiver statics are more difficult to compute.

There are two ways to do receiver refraction statics for the radial component: 1) Identify the S-wave refraction in the shot gathers and use the results to calculate the receiver static, and 2) hand statics (easiest). Four steps are necessary to apply hand statics: 1) Generate a receiver stack (Flow 7), 2) Interpret a horizon (Flow 8), 3) transfer the horizon to the database (Flow 9), 4) apply the hand statics and evaluate the results (Flow 10).

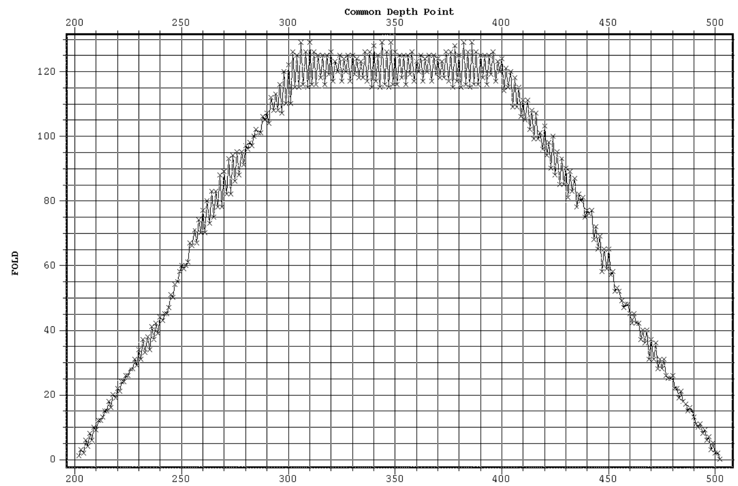

FIG. 1. Asymptotic conversion point (ACP) fold for *Vp/Vs* = 1.9

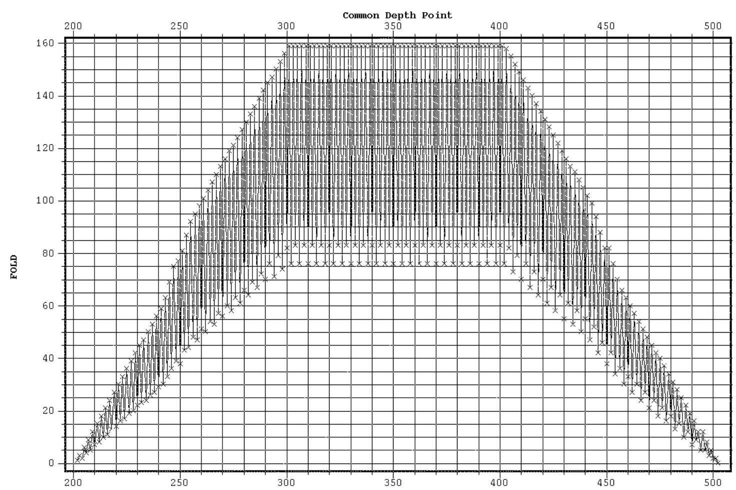

FIG. 2. Asymptotic conversion point (ACP) fold for *Vp/Vs* = 2.0

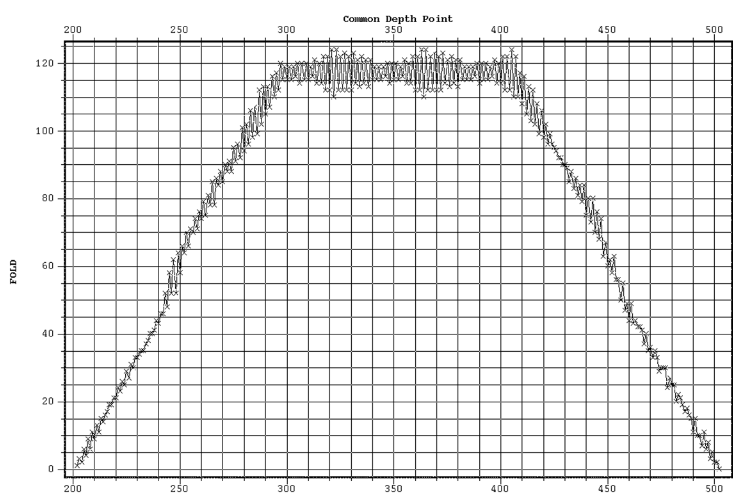

FIG. 3. Asymptotic conversion point (ACP) fold for *Vp/Vs* = 2.1

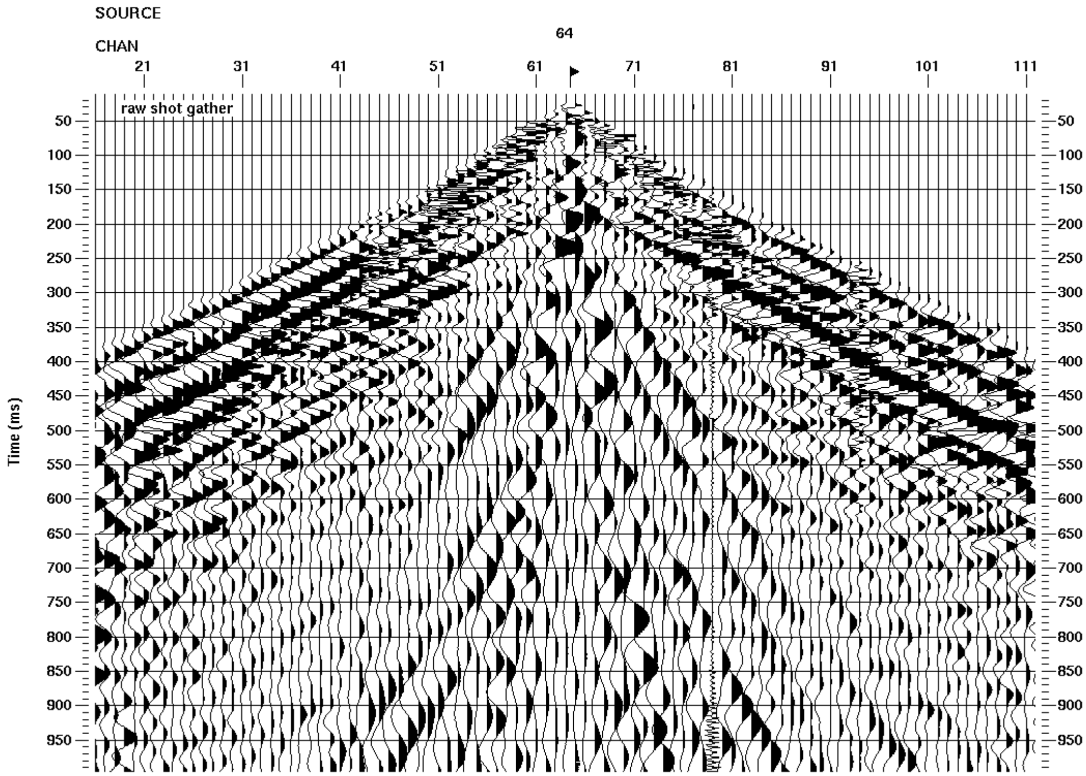

FIG. 4. Example of an unprocessed radial shot gather, after Flow 3.

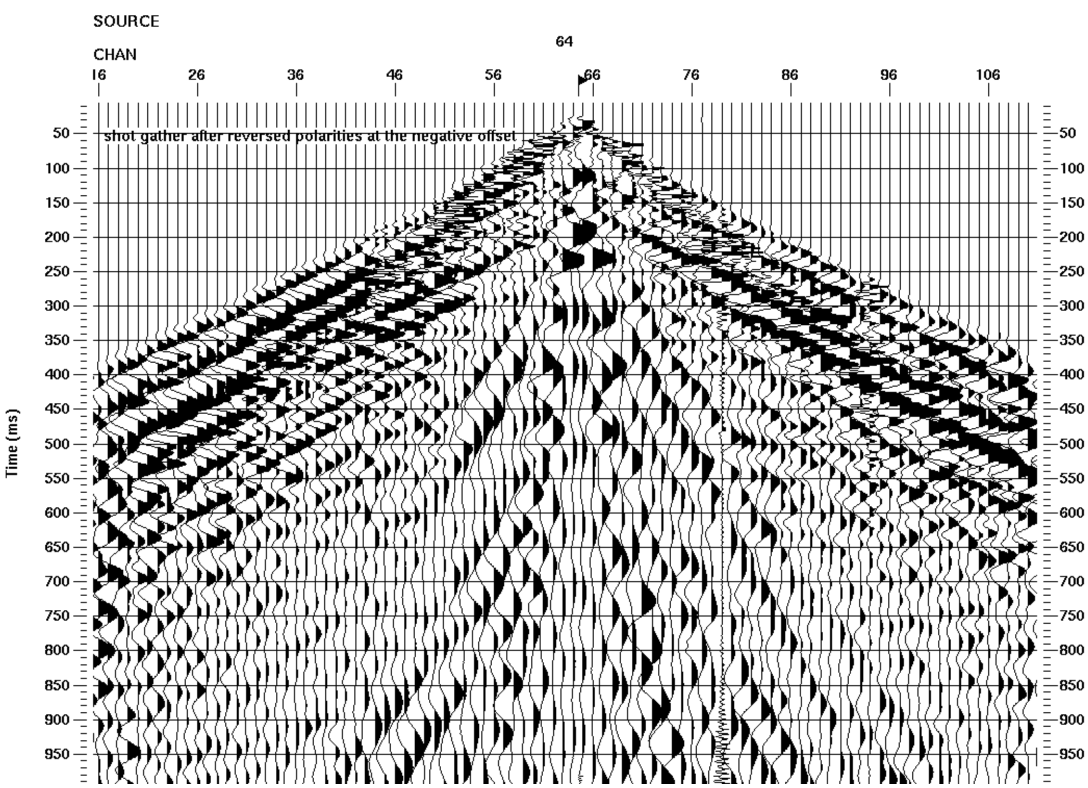

FIG. 5. Shot gather shown in Figure 1 after reversing the polarity of traces with a negative source-receiver offset (right side, Flow 6).

Construct P-S Velocities* <= P-P final velocities
Input P-P Velocity Field
Type of P-P velocity field .... stacking (RMS) velocity
Get P-P velocities from the database?.. Yes
SELECT P-P input RMS velocity file .... P-P final velocities
Input P-S Velocity Field
Get Vp/Vs ratios from database? ....No
Vp/Vs values vs. P-P time...1: 0-2.1,1000-2.1,3000-2.1
Output Velocity field
Type of output velocity field...NMO velocities
Output RMS or INTERVAL velocities?....................................Stacking (RMS) Velocity
SELEECT output RMS velocity file .... P-S initial
Time step size for the output table .... 50.

Flow 5. Initial guess of PS RMS velocity field.

Disk Data Input <- shots with psbin
Trace Kill/Reverse <= trace kill for radial
Trace editing MODE.. Kill
Get edits from the DATABASE?.. Yes
SELECT trace kill parameter file...trace kill for radial
Trace Kill/Reverse <= reverse trace for radial
Trace editing MODE...Reverse
Get edits from the DATABASE?.. Yes
SELECT trace Reverse parameter file ....reverse trace for radial
Trace Kill/Reverse
Trace editing MODE...Reverse
Get edits from DATABASE?..No
Trace selection mode... Kill/Reverse traces in select list
PRIMARY edit list header word...FFID
SECONDARY edit list header word.. OFFSET
TERTIARY edit list header word .... No trace header entry selected
SPECIFY traces to be edited.../* : -9999.0-0.0/
Apply Elevation Statics
Final datum elevation..same as used for vertical component
Replacement velocity ....same as used for vertical component
Database math method ....Shot Holes Ignoring Uphole Times
Specify Weathering velocity .... /120:610./
NMO static method...Elevations
Length of smoother 51
Processing DATUM...NMO DATUM
True Amplitude Recovery <= P-S tar velocity
Apply spherical divergence corrections?.. Yes
Basis for spherical spreading..1/dist
Apply inelastic attenuation corrections? ....No
Get TAR velocity function from database?... Yes
Select velocity parameter file...P-S tar velocity
Apply dB/sec corrections?... Yes
dB/sec correction constant .... 4.
Apply time related to a power corrections?..No
APPLY function to data or REMOVE effect of amplitude corrections? .... Apply
Maximum application TIME.. 4000.

Flow 6a. Prestack data processing.

Surface Consistent Decon
Choose version .... Memory Version (small datasets)
Display spectra and autocorrelations? .... No
Start CDP 202
End CDP 501
Get decon gates from the DATABASE? .... No
SELECT Primary decon gate header word .... SIN
SELECT Secondary decon gate header word .... AOFFSET
SPECIFY decon gate parameters 1:10:445-2830/1:2990:1750-2970/
TYPE of deconvolution .... Spiking
Components of spectral decomposition: .... SHOT RCVR OFFSET CDP
Spectral decompositions used in Application: .... SHOT RCVR
Limit offsets in decomposition? .... No
Decon operation length (ms) 140
Operator 'white noise' level 0.1
Window rejection factor .... 3.
Apply a bandpass filter after decon? .... No
Number of Gauss-Siedel iterations 5
Re-apply trace mute after decon? .... Yes
TV Spectral Whitening
Type of filter .... Time-Invariant Parameters
Spectral balancing length .... 700.
Percent zero padding for FFT's .... 25.
Automatic filter panel design? .... Yes
Number of frequency panels 9
SPECIFY spectral balancing frequencies 1,6,70,80
Mode for amplitude restoration .... Log Average
Re-apply trace mute after spectral whitening? .... Yes
Disk Data Output -> shots preprocessed

Flow 6b. Flow 6a continued.

Figure 6 shows a receiver stack generated by Flow 7 and displayed with Flow 8. Locate a reflection that will be easy to pick, for example at 2200 ms. Go to "Picking -> Pick Other Horizons" and set a new table name "horizon at 2200ms" for this example. Pick the horizon, and be sure to "File -> Save Picks," before exiting "Trace Display."

Execute Flow 9, then go to "Database" and find the horizon ***** under SRF. Click on the name of the horizon, go to "math," "scalar," "shift," and shift your horizon by -2200 (ms, this example only). Go to "Database," save the edited horizon and exit the database.

Flow 10 makes a new receiver stack which includes the new hand statics. If the statics are good, you should see a flat event at around 2200ms (Figure 7). If not, you should repeat the procedure for picking a horizon until you are satisfied with your results.

Disk Data Input <- shots preprocessed .... sort by REC_SLOC
Database/Header Transfer
  Direction of transfer .... Load TO trace header FROM database
  Number of parameters 2
  First database parameter .... SIN STATICS GLISTAT
  First header entry .... s_ref
  Second database parameter .... SRF STATICS GLISTAT
  Second header entry .... r_ref
Trace Header Math .... r_ref=r_ref*2.1
Header Statics
  Bulk shift static .... 0.
  What about previous statics? .... Remove previous statics
  Apply how many statics header entries? 2
  First header word to apply .... s_ref
  Second header word to apply .... r_ref
  HOW to apply header statics .... Add
Normal Moveout Correction <= P-S initial
  Direction for NMO application .... FORWARD
    Stretch mute percentage .... 30.
    Apply any remaining statics during NMO? .... Yes
  Apply partial NMO? .... No
  Get velocities from database? .... Yes
  Select Velocity parameter file .... P-S initial
Trace Muting
  Re-apply previous mutes .... No
  Mute time reference .... Time 0
  TYPE of mute .... top
    Starting ramp 30
    EXTRAPOLATE mute times? .... Yes
  Get mute file from the database? .... No
    SELECT Primary mute header word .... receiver index number
    SELECT Secondary mute header word .... AOFFSET
    SPECIFY mute parameters 12:300:0/12:360:300/12:660:600/
    12:1500:1080/12:2500:1250/12:3240:1440/
CDP/Ensemble Stack
  Sort order of input ensembles .... RECEIVER
  Method for trace summing .... Mean
  Root power scalar for stack normalization 0.5
  Has NMO been applied? .... Yes
Resample/Desample
Disk Data Output -> receiver stack

Flow 7. Make a receiver stack.

Disk Dataset Input <- receiver stack .... sort by REC_SLOC
Bandpass Filter 5-8-40-50
Automatic Gain Control
Trace Display

Flow 8. Display the receiver stack for horizon picking.

Database/Horizon Transfer*	
Direction of transfer	Horizon To Database
Horizon tables	horizon at 2200ms

Flow 9. Transfer horizon to database.

Disk Data Input <- shots preprocessed	sort by REC_SLOC
Database/Header Transfer	same as Flow 7
Header Statics	same as Flow 7
Trace Header Math	same as Flow 7
Database/Header Transfer	
Direction of transfer	Load To trace header FROM database
Number of parameters	1
First database parameter	SRF horizon ****
First header entry	r_hand1
Header Statics	
Bulk shift static	0.
What about previous statics?	Add to previous statics
Apply how many statics header entries?	1
First header word to apply	r_hand1
How to apply header statics	Subtract
Normal Moveout Correction	same as Flow 7
Trace Muting	same as Flow 7
CDP/Ensemble Stack	same as Flow 7
Trace Display	

Flow 10. Make and display a new receiver stack with hand statics.

9. Brute stack:

The next step is to create an ACP brute stack so we have something to compare the results of poststack processing to (Flow 11). The initial guess at the PS velocity function from Flow 6 is used for NMO corrections.

10. Velocity analysis:

Velocity analysis is a critical aspect of any seismic processing. Flow 12 will generate and display data for semblance-based velocity picking. Save your picks, and use them in Flow 11 to generate a new version of the brute stack (brute stack1, this example). As you refine your velocity function, the brute stack should improve.

11. Residual statics:

ProMAX provides several residual statics modules. Here, we only describe the procedure for use of the “EMC Autostat: Xcor Sum” module, which requires an external model. First, an enhanced stack must be created for use as the model using any of the signal enhancement techniques available in ProMAX. In addition to normal pre-processing, unwanted high- and low-frequency noise should be removed by band-limiting the input data. An AGC should also be applied to all input traces (Flow 13). Data preparation for input to the residual statics module includes correlation with the external model (Flow 14).

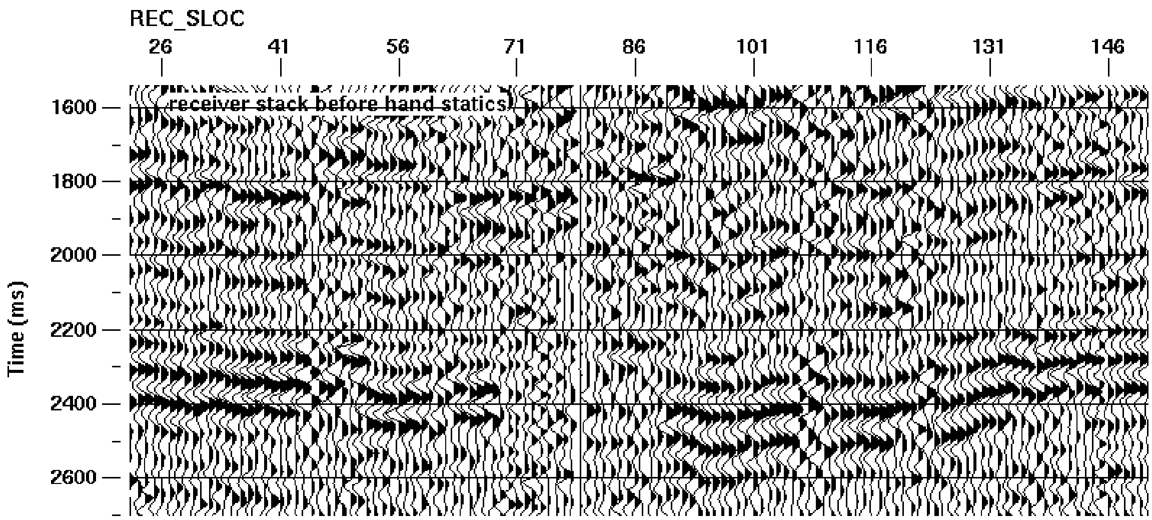

FIG. 6. Portion of initial receiver stack generated by Flow 7.

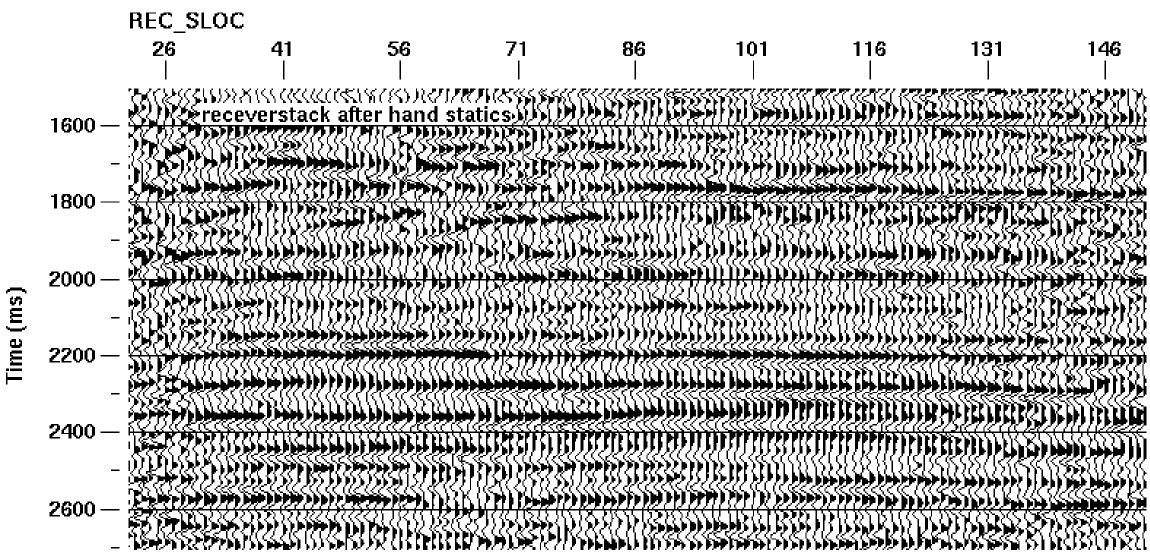

FIG. 7. Receiver stack with hand statics (Flow 10).

Disk Data Input <- shots preprocessed .... sort by CDP
Database/Header Transfer .... same as Flow 7
Trace Header Math .... same as Flow 7
Header Statics .... same as Flow 7
Database/Header Transfer .... same as Flow 10
Header Statics .... same as Flow 10
Normal Moveout Correction <= P-S initial .... same as Flow 7
Trace Muting
  Re-apply previous mutes .... No
  Mute time reference .... time 0
  TYPE of mute .... top
    Starting ramp 30
    EXTRAPOLATE mute times? .... Yes
  Get mute file from the DATABASE? .... No
    SELECT primary mute header word .... CDP
    SELECT second mute header word .... AOFFSET
    SELECT mute parameters 212:300:0/212:360:300/212:660:600/
212:1500:1080/212:2500:1250/212:3240:1440/
CDP/Ensemble Stack
  Sort order of input ensembles .... CDP
  Method for trace summing .... Mean
  Root power scalar for stack normalization 0.5
  Has NMO applied? .... Yes
Trace Display
Disk Data Output -> brute stack

Flow 11. Make a brute stack.

Execute Flow 15 to compute the residual statics. Note that the ID number and maximum source or receiver static must match those specified in Flow 14. Actually, these statics are decomposed into source, receiver, and structure (CDP) statics. The newly computed residual source and receiver statics should now be in the database. Source: SIN STATICS SPEM0001, Receiver: SRF STATICS SPEM0001.

A. Repeat the velocity analysis (Flow 12), but apply residual statics and generate a new velocity function, ‘PS vel2.’

B. Make a new ACP stack (Flow 11), but apply residual statics and use the new velocity function. This stack should be an improvement over the original brute stack.

C. Repeat the steps for calculating residual statics (Flows 13-15), but apply the residual statics from the first round, and use the new velocity function. Also, change the maximum source and receiver static from 36 to 24, and change the ID number from 0001 to 0002.

You should now have new residual source and receiver statics in the database. Source: SIN STATICS SPEM0002, Receiver: SRF STATICS SPEM0002.

Disk Data Input <- shots preprocessed ....sort by CDP and OFFSET
Database/Header Transfer ....same as Flow 7
Trace Header Math ....same as Flow 7
Header Statics ....same as Flow 7
Database/Header Transfer ....same as Flow 10
Header Statics ....same as Flow 10
Normal Moveout Correction <= P-S initial
Direction for NMO application ....FORWARD
Stretch mute percentage .... 10.
Apply any remaining statics during NMO? .... Yes
Apply partial NMO?...No
Get velocities from database?.. Yes
Select Velocity parameter file .... P-S initial
Trace Muting ....same as Flow 11
Automatic Gain Control
Bandpass Filter 10-14-70-90
Resample/Desample.. 4.
Disk Data Output -> temp for vel analysis
Supergather Formation*
Read data from other lines/surveys?..No
Select dataset .... temp for vel analysis
Maximum CDP fold ....from database
Minimum center cdp number ....from database
Maximum center cdp number..from database
Cdp increment 25
Cdps to combine.. 15
Velocity Analysis <= P-S_vel_1
Select display DEVICE ....This Screen
Table to store velocity picks...P-S_vel_1
Is the incoming data Precomputed?...No
Number of CDPs to sum into gather 15
Apply partial NMO-to-binning ....No
Apply differential CDP mean statics? ....No
Absolute offset of first bin center .... 5.
Bin size for vertically summing offsets.. 10.
Maximum offset .... 3400.
Use absolute value of offset for stacking? .... Yes
Number of stack velocity functions 11
Method of computing velocity functions ....Top/base range
Velocity variation at time 0.. 200.
Velocity variation at maximum time... 1000.
Interact with other processes using PD?...No
Get guide function from an existing parameter table?.. Yes
Velocity guide function table name .... P-S initial
Maximum stretch percentage for NMO .... 0.
Interval velocity below last knee .... 0.
Set horizon parameters? ....No
Copy picks to next location .... Yes

Flow 12. Semblance based velocity analysis on supergathers.

Disk Data Input <- brute stack 1
Time-Variant Scaling
Trace Equalization
F-X Decon
TYPE of filter...Wiener Levinson
Percentage of white noise...0.1
Horizontal window length...31
Number of filter samples...13
Time window length...150.
Time window overlap...75.
F-X filter start frequency...1.
F-X filter end frequency...70.
Re-apply trace mute after filter?...Yes
Automatic Gain Control
Bandpass Filter...5-8-40-50
Disk Data Output -> FX model

Flow 13. External model as pioneer traces.

Disk Data Input <- shots preprocessed..............................sort by CDP and OFFSET
Database/Header Transfer..same as Flow 7
Trace Header Math..same as Flow 7
Header Statics..same as Flow 7
Database/Header Transfer..same as Flow 10
Header Statics..same as Flow 10
Normal Moveout Correction
Direction of NMO application..Forward
Stretch mute percentage..0
Apply any remaining statics during NMO?..Yes
Get velocities from the database?..Yes
SELECT Velocity parameter file..P-S vel1
Time-Variant Scaling
Trace Muting..same as Flow 11
Automatic Gain Control
Bandpass Filter..5-8-40-50
External Model Correlation
Select model trace dataset..FX model
Use autostatics horizon or gate file?..GATE
Get autostatics gate from the DATABASE?..No
SPECIFY autostatics gate parameters..301:400-2900/
Minimum live samples in a gate (percentage)..50.
Maximum static shift..36.
Write correlation pick TIMES to the database?..Yes
Write correlation pick AMPLITUDES to the database?..Yes
Write quality control estimates to the database?..Yes
Database mode..Overwrite/New
Enter 4 digit ID number..0001
Disk Data Output -> data input for calculate residual statics

Flow 14. Input data for residual statics computation.

EMC Autostat: Xcor Sum*
Input correlations from Tape or Disk .... Disk
Select input correlation file .... data input for calculate residual statics
First statics computation domain .... CDP
Second statics computation domain .... Source
Third statics computation domain .... Receiver
Fourth statics computation domain .... NONE
Adjust correlations by a previous SOURCE static? .... No
Adjust correlations by a previous RECEIVER static? .... No
Adjust correlations by a previous CDP RESIDUAL STRUCTURE? .... No
Method for correlation summing .... Alpha-trimmed Mean
Percentage of samples to exclude .... 15.
Maximum source or receiver static .... 36.
Create a NEW database entry for each run? .... Yes
Enter 4 digit ID number 0001

Flow 15. Compute residual statics.

EMC autostat: Xcor Sum*
Input correlations from Tape or Disk .... Disk
Select input correlation file .... data input for calculate residual statics
First statics computation domain .... Channel
Second statics computation domain .... NONE
Adjust correlations by a previous SOURCE static? .... No
Adjust correlations by a previous RECEIVER static? .... No
Adjust correlations by a previous CDP RESIDUAL STRUCTURE? .... No
Method for correlation summing .... Alpha-trimmed Mean
Percentage of samples to exclude .... 15.
Maximum source or receiver static .... 12.
Create a NEW database entry for each run? .... Yes
Enter 4 digit ID number 0003

Flow 16. Compute trim statics.

Repeat steps A and B, but change the maximum source and receiver static from 24 to 12, and change the ID number from 0002 to 0003. Now run Flow 16 instead of Flow 15 for step C. You will now find trim statics in the database: TRC STATICS TRIM0003.

12. ACP stack:

Repeat step A to generate an improved PS velocity function (P-S vel3), and repeat step B with the new velocity function and trim statics to make the final ACP stack section.

13. Poststack time migration:

If the final ACP stacked section is satisfactory, you can perform a poststack migration on it. After stacking, the stacked section is at the final datum, but your PS velocity function is at a floating datum (NMO datum). Before Kirchoff time migration, ‘P-S vel3’ must be adjusted to the final datum using velocity manipulation (Flow 17). The adjusted velocity function is then used in Flow 18 to produce a migrated section (Figure 7).

Velocity Manipulation* <= P-S vel3
Type of velocity table to input ....Stacking (RMS) Velocity
Get velocity table from database? .... Yes
Select input velocity database entry ....P-S vel3
Combine a second velocity table with the first?...No
Resample the input velocity table(s)?...No
Shift or stretch the input velocity table?...No
Adjust velocities to the final datum?.. Yes
Type of parameter table to output ....Stacking (RMS) Velocity
Select output velocity database entry .... P-S for kirmig
Spatially resample the velocity table?...No
Output a single average velocity table?...No
Smooth velocity field? .... Yes
Half height of triangular smoother .... 200.
Time step sizes for the output velocity table .... 60.
Adjust output velocities by percentages? ....No
Clip output velocities?...No

Flow 17. Adjust PS velocity function for use with Kirchoff migration.

14. Depth variant stack:

As mentioned above (section 5), the average *Vp/Vs* ratio is used when we do asymptotic binning. This is a very rough estimate, especially for the shallow section, where *Vp/Vs* is typically much higher than the average. Now that have migrated CDP and ACP stacks for the vertical and radial components, we can estimate the *Vp/Vs* ratio in different time windows, and at different locations along the line. The first step is to interpret the same horizons on both stacks, possibly with the aid of synthetic seismograms. Once this has been done *Vp/Vs* can be estimated from the picked travel times using $\frac{V_p}{V_s} = \frac{2\Delta T_{PS}}{\Delta T_{PP}} - 1$, where T_{PP} is the traveltime to a horizon on the migrated PP section, and T_{PS} is the traveltime to the same horizon on the PS section. Now Flow 19 can be used to make a depth-variant stack.

15. Migrate final stack:

Run Flow 18 again to produce the final migrated stack.

Disk Data Input <- final stack
TV Spectral Whitening
TYPE of filter....................Time-Invariant Parameters
Spectral balance scalar LENGTH .... 500.
Percentage zero padding for FFT's .... 25.
Automatic filter panel design? .... Yes
Number of frequency panels 9
SPECIFY spectral balancing frequencies....................1,6,70,80
Mode for amplitude restoration....................Log Average
Re-apply trace mute after spectral whitening? .... Yes
Trace Equalization
Trace Equalization
Time-Variant Scaling
F-X Decon
Type of filter ....Wiener Levinson
Percentage of white noise.................... 0.1
Horizontal window length.................... 21
Number of filter samples.................... 3
Time window length.................... 150.
Time window overlap.................... 75.
F-X filter start frequency.................... 1.
F-X filter end frequency.................... 70.
Re-apply trace mute after filter?.................... Yes
Bandpass Filter....................4-7-60-70
Kirchhoff Time Mig.
CDP interval (feet or meters) .... 10.
Maximum frequency to migrate (in Hz).................... 70
Migration aperture (feet or meters) .... 0.
Maximum dip to migrate.................... 180.
Avoid spatial aliasing? .... Yes
Get RMS velocity from database?.................... Yes
Select RMS vs. time velocity file.................... P-S for kirmig
Change maximum memory usage? ....No
Change the default tapering?....................No
Re-apply trace mutes.................... Yes
Re-kill dead traces?.................... Yes
Disk Data Output -> mig_stacked

Flow 18. Poststack Kirchoff time migration.

Disk Data Input <- shots preprocessed .... sort by CDP
Database/Header Transfer .... same as Flow 7
Header Statics .... same as Flow 7
Database/Header Transfer .... same as Flow 10
Header Statics .... same as Flow 10
Database/Header Transfer
Direction of transfer .... Load TO trace header FROM database
Number of parameters 4
First database parameter .... SIN STATICA SPEM0001
First header word entry .... s_resi_1
Second database parameter .... SRF STATICS SPEM0001
Second header word entry .... r_resi_1
Third database parameter .... SIN STATICS SPEM0002
Third header word entry .... s_redi_2
Forth database parameter .... SRF STATICS SPEM0002
Forth header word entry .... r_resi_2
Header Statics
Bulk shift static .... 0.
Apply how many statics header entries? 4
First header word to apply .... s_resi_1
Second header word to apply .... r_resi_1
Third header word to apply .... s_resi_2
Forth header word to apply .... r_resi_2
HOW to apply header statics? .... Add
Apply Trim Statics
Normal Moveout Correction <= P-S final
Direction for NMO application .... Forward
Stretch mute percentage 0
Apply any remaining static during NMO? .... Yes
Apply partial NMO? .... No
Get velocities from database? .... Yes
Select Velocity parameter file .... P-S final
Trace Muting .... final top mutes
Converted wave stack <= P-S final
Maximum offset to stack .... 3240.
Create multiple offset planes? .... No
Shift data to final datum? .... Yes
Stack by common transmission point? .... No
Get P-P RMS velocities from database? .... Yes
SELECT P-P RMS velocity file .... P-S final
Get Vp/Vs ratios from database? .... No
Vp/Vs ratios for stacking .... Vp/Vs from correlation
Trace Display
Disk Data Output -> depth variant stack

Flow 19. Depth variant stack.

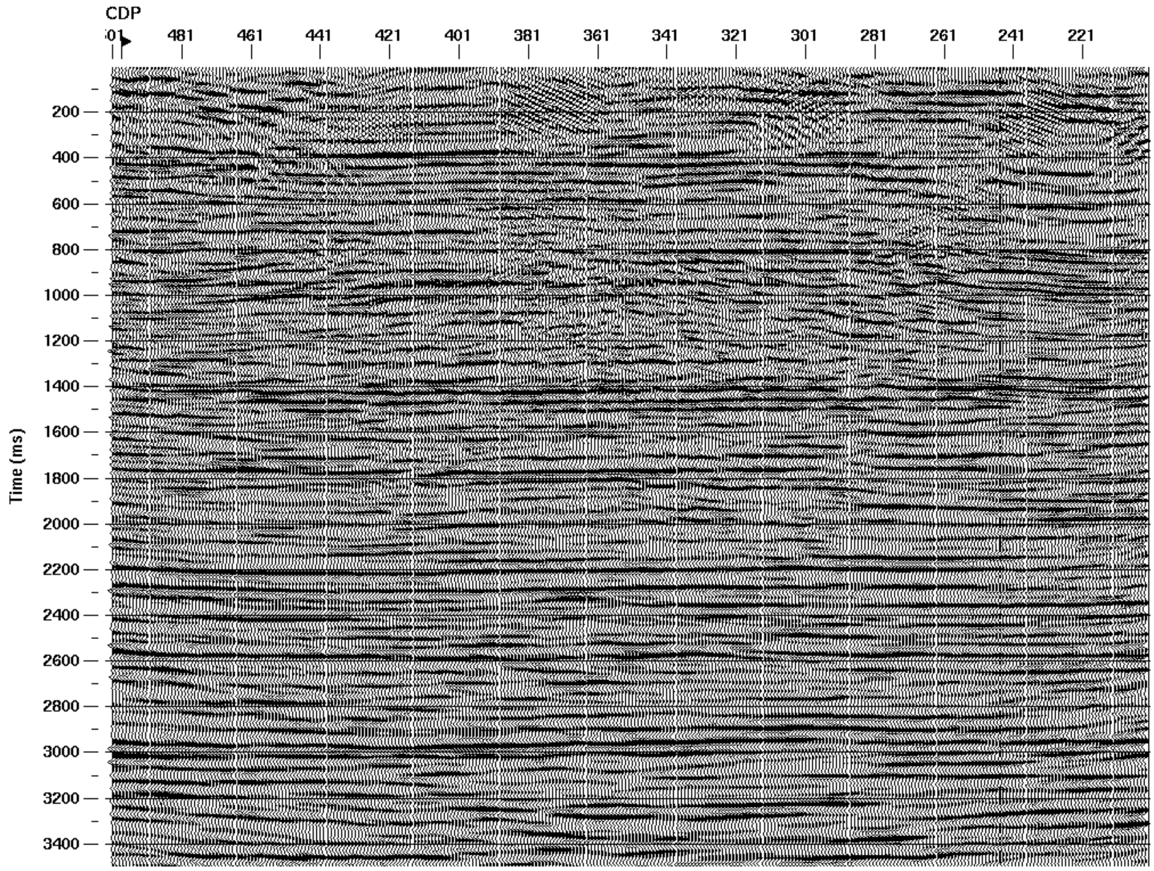

FIG. 7. Poststack Kirchoff time-migrated depth-variant stack created by Flow 18.

SUMMARY

The Blackfoot 1997 3C-2D data set has been used to demonstrate basic converted-wave processing in ProMAX. The reader should be able to use the example processing flows to successfully process their own 2D data sets.

FUTURE WORK

This tutorial needs to be checked for consistency with ProMAX version 2003.3.2, the version in use at CREWES at the time of writing. A discussion of max-power geometric data rotation would be useful and ProMAX modules written at CREWES should be added to the tutorial. The authors welcome any comments or criticism of this document.

REFERENCES

Lawton, D. C., 1994, Acquisition design for 3-D converted waves; CREWES Research Report, **6**.

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