9229-N9-2E

REPORT ON THE REFLECTION SEISMOGRAPH SURVEY ON THE ARROWHEAD AREA, N.W.T.

60°20'N to 60°40'N, 122°45'W to 123°15'W

For

N.S.M. RESOURCES LTD.

By

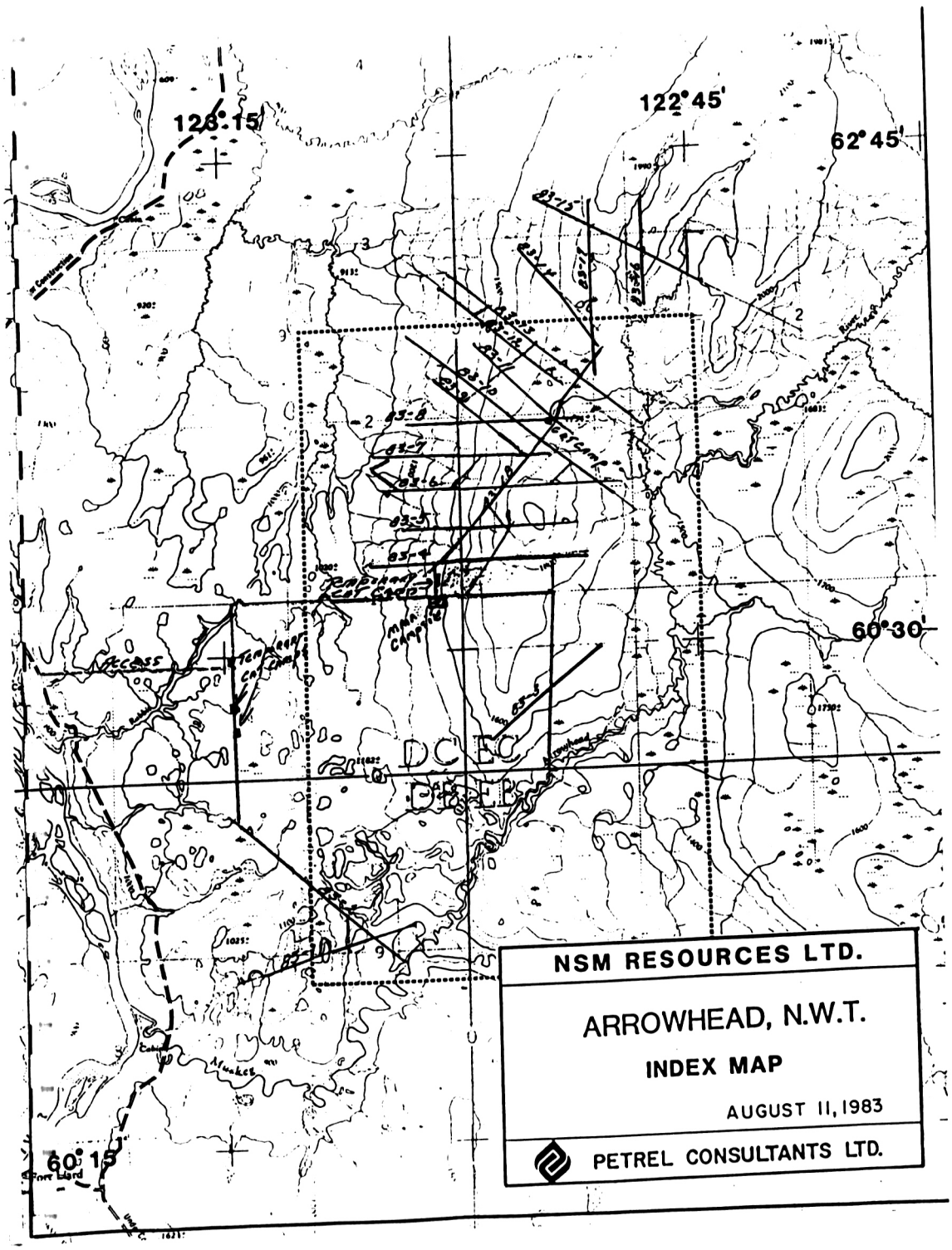
PETREL CONSULTANTS LTD.

Exploratory Licence Number 382
Land Use Permit Number N82-B830
C.O.G.L.A. Project Number 9229-N9-2E
August 1983

P. Viney

J.D.T. Crane, P. Geoph.

TABLE OF CONTENTS


128°15'
122°45'
62°45'
60°30'
60°15'
NSM RESOURCES LTD.
ARROWHEAD, N.W.T.
INDEX MAP
AUGUST 11, 1983
PETREL CONSULTANTS LTD.

INTRODUCTION

The Arrowhead prospect consists of four grid areas located between 60°20'N and 60°40'N, 122°45'W and 123°15'W in the N.W.T., immediately northeast of Fort Liard.

Under the terms of a farmout agreement from Texaco, N.S.M. Resources Ltd. undertook active exploration of the area. Existing Texaco seismic data and data from both 1982 and 1983 seismic programs are incorporated in this report. Field work was shot by Enertec Geophysical Services Ltd. while Petrel Consultants Ltd. planned and supervised the field work, processed and interpreted the data.

Surface Conditions

The area lies east of the Liard River and is drained by the Arrowhead and Muskeg Rivers. A prominent topographic high exists on the block with elevations up to 650 meters A.S.L. while flanking this, lower muskeg flats (320 m A.S.L.) are present. Some good stands of spruce and poplar are present throughout the area but in the flats, scrub spruce is found.

Data Base

The Texaco data consisted of 73 km of 600% CDP seismic which was utilized in conjunction with 200 km of 1200% data shot in 1982 for N.S.M. Resources and 183 km of 1200% data shot in 1983. Previously shot 100% data belonging to Texaco was not used in the study.

Well logs from all surrounding wells were utilized, one of which, Texaco Arrowhead B-76, was used to prepare a synthetic seismogram for identification and modeling as reported in Appendix D.

Regional Geology

No new drilling has taken place in the area and the geologic discussion is as presented in the 1982 report:

The Arrowhead acreage overlies a segment of the Slave Point reef edge which is well known and tested extensively to the southeast through Celibeta, Petitot and well into British Columbia. This reef also extends northeast and east of Arrowhead through the Horn River area where fewer wells with lesser success have been drilled. Underlying the Slave Point a carbonate sequence of Middle Devonian formations is present while below this an untested Siluro-Ordovician section is indicated.

The Upper Devonian, Fort Simpson clastic section and Tetcho and Kotcho carbonates are about 1200 meters thick and are generally unprospective. Above this a Mississippian section with erosional subcrops of the Banff, Flett and Mattson members is present, thickening extensively to the southwest.

The regional dip of most horizons within the project area is to the southwest. This dip is modified across the area due to the presence of several features that have existed or been activated since Precambrian time.

The area lies on a northern extension of the Bovie Lake fault system which coupled with the Laramide Orogeny might explain the large increase in dip to the west, in the western part of the project area.

The Liard high and the Celibeta high are approximately 25 kilometers north and 25 kilometers southeast of the project area respectively. These features, either present or reactivated since Precambrian time, modify regional dip to the north and to the southeast.

The main target for hydrocarbon accumulation is considered to be the Slave Point reef edge and its associated porosity. The back reef facies is generally tight however this carbonate and the underlying Keg River carbonates may be prospective near fault zones where secondary dolomitization is anticipated. The third target is the erosional Mississippian top and the Mattson in particular.

Interpretation

Seismic events were as identified from synthetic seismograms and sonic logs from the Texaco Arrowhead B-76 and N-2 wells (See Appendix E). The following seismic events were carried and interpreted over the project area:

Paleozoic surface	-	blue
Tetcho	-	orange
Slave Point	-	yellow
Chinchaga	-	green

The following maps were prepared from the interpreted data:

Slave Point Structure in Time
Tetcho Structure in Time
Tetcho - Slave Point Isochron
Paleozoic - Tetcho Isochron

The Slave Point Structure map indicates three main geologic features:

1) The band of steep west dips that traverse the project area from north to south, just west of 123°00 West longitude.
2) The western limit of Slave Point reef edge development which traverses the project from south-southwest to north-northeast diagonally across the farmin block.

3) The fault zone which extends in a north-northwest south-southeast direction across the project area.

The steep west dip is coincident with the limit of the Slave Point reef edge only in the middle of the project area from 60°29'N to 60°35'N latitude.

Southward the steep west dip is believed controlled by an extension of the Bovie fault system. To the north the fault zone (3), which extends to the north-northwest, becomes the controlling factor for this Slave Point dip.

The Tetcho structure map indicates features quite different from the Slave Point:

1) The band of steep west dip on the Slave Point is broken into two distinct bands; in the south half of the project the dips correspond; in the north half of the project, the steep dip on the Tetcho strikes northwest to west-northwest at the northern end of the block.
2) The western limit of the Slave Point reef edge has little or no expression on the Tetcho surface.
3) The major fault zone has created a complex fault sequence on the Tetcho horizon. The faults at the Tetcho surface are release or drag faults resulting from the uplift of the Slave Point. As such

the faults at the Tetcho level generally: a) are not vertically coincident with faults at the Slave Point level, b) have opposite throw of the Slave Point fault.

The main objective of the present evaluation is the Slave Point reef edge that traverses the area. Highs along this reef edge have been productive traps to the south and east of the project area. The Slave Point reef edge is indicated on the three maps: Tetcho and Slave Point structure maps and on the Tetcho-Slave Point isochron. In the extreme southwest part of the project area the reef edge is tentative due to poor record quality caused by severe weathering and surface problems existing in this area.

Features of Interest

Three Middle Devonian features are recommended:

1) K-69, 60°40'N 122°45'W:

Seismic Line 82-2, SP 337

This previously recommended feature is structurally high, with approximately 20 ms of closure; and is located on the Slave Point reef edge as shown by thinning in the interval Tetcho-Slave Point. The location is supported by Slave Point character changes in the seismic events which are believed indicative of porosity.

Secondary possibilities exist in the Mississippian and Lower Cretaceous.

2) Unit 76, Block 60°40'N, 122°45'W

Line 83-7, SP 245

New shooting over this area, Lines 83-6 seismic, 83-7, confirms the coincidence of the Slave Point reef edge and the major fault that crosses the northern portion of the project specifically in Units 76 and 77. This additional control makes this a most prospective feature. Possible dolomitization associated with both the reef front and the major fault pattern to the southeast also makes Unit 65 a prospective unit.

3) Unit 49, Block 60°30'N, 122°45'W

Seismic Line 82-10, SP 489

The additional control obtained has modified previous fault patterns, decreasing the prospective nature of this feature.

In addition to the above locations, two features of interest were interpreted from the geophysical data as follows:

A strong seismic amplitude immediately above the Mississippian reflector in Units 13 and 23 on Line 83-4 may be related to a Mattson play. The Mattson is present in the Texaco Arrowhead N-2 well and is considered prospective to the west. Three additional seismic lines are recommended for acquisition in the western part of the block as shown on the enclosed program map.

The Slave Point reef edge is well controlled by seismic except in the southwest corner of the area. Well control to the south indicates that a major change in direction exists and a good potential area is present along 60°20'N at the south edge of the option block. Three seismic lines are also recommended to delineate this area.

The deeper section, of Ordovician-Silurian, shows high relief features largely peneplaned by later erosion. However, many features in the Middle Devonian Chinchaga to Red Beds may be present as illustrated on Line 83-15 where underlying scarps influence their deposition. Mapping of events below the Devonian was not undertaken at this time but could be undertaken if geologic prospects develop.

Conclusions and Recommendations

It is recommended that a well be located at K-69, 60°40, 122°45' on SP 337, Line 82-2, to test the Slave Point reef front. This is an elongated feature showing dip closure to the west and south. The Tetcho-Slave Point isochron indicates surge channels providing closure updip along the reef front. Seismic character changes associated with this feature indicate porosity development within the Slave Point (See Appendix D Modeling).

A second Middle Devonian test should be considered along the same reef front at the intersection of the front with the major fault trend, i.e. at SP 245, Line 83-07, Unit 76, Block 60°40'N, 122°45'W. Secondary dolomitization of the carbonate section is anticipated.

Additional seismic control should be obtained to complete the delineation of the Slave Point reef edge to the southwest and to evaluate the potential for a Mattson play in the northwest quadrant of the map area. The proposed program is outlined on the attached map.

250

Appendix A
Identification

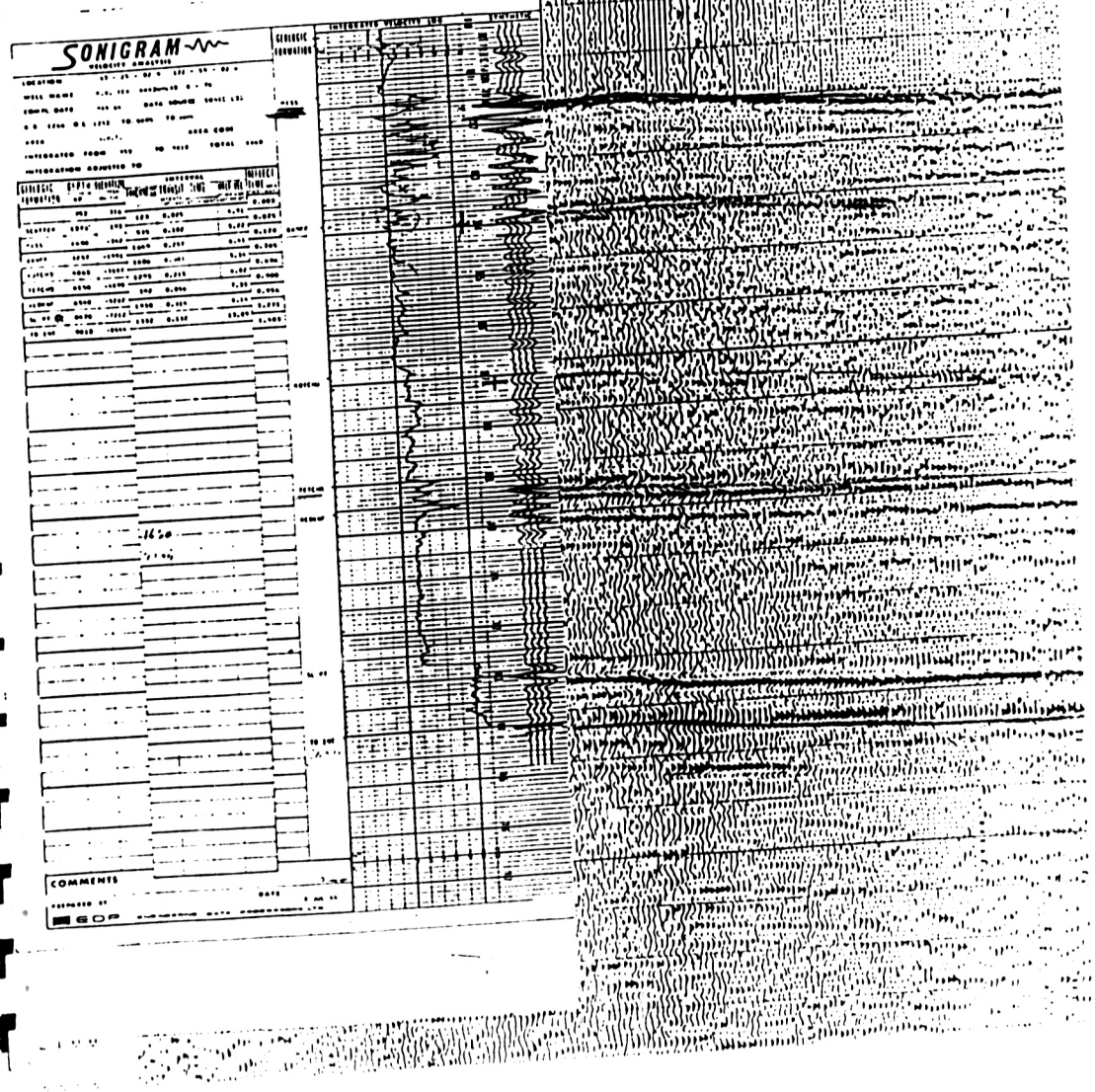
LINE 11
SP 254

LINE C
SP 523

487 485 481 477 473 469 465 461 457 453 449 445 441 433 429 425 421 417 409

NW

200



APPENDIX B

FIELD PARAMETERS

Recording — Arrowhead 1983

Sample Rate	2 ms
Record Length	5 sec.
Recording Filter	Lowcut 8 Highcut 128
Sub-surface Coverage	1200%
Number of Groups	96
Group Interval	33.5 m
Geophone Array	3.75 m spacing
Seismometers per Group	9
Shot Point Location	On station - every fourth station
Spread	1608-33.5-0-33.5-1608
Holes per Location	1
Hole Depth	18.3 m
Dynamite Charge	2.2 kg

APPENDIX C

STATISTICAL DATA

Dates

Mobilization Date	February 7, 1983
Start of Recording	February 18, 1983
Completion of Recording	March 3, 1983
Demobilization Date	March 5, 1983

PRODUCTION

Recording

Total operating days	15
Total recording days	15
Total moving days	0
Total weather days	0
Total testing days	0
Total down days	0
Production profiles shot	1361
Kilometers shot	182.98
Profiles per day	97
Kilometers per production day	13.07
Total days moving mob/demob	4

Technical

Amplifiers	DFS V
Tape Systems	DFS V Seg. B 1600 BPI
Oscillograph	SIE - ERC - 10
Remote Firing System	I.O. Firing System
Cables	Mark Universal - 1410' - 58' T.O.
Geophone Strings	250 Mark - 14 Hz

Vehicles

1 Party Manager's Unit
1 Recorder
1 Shooting Unit
4 Cable Trucks
1 First Aid Man and Vehicle
3 Survey Trucks
4 Drilling Rigs
2 Drill Water Trucks
1 Supply Truck

Camp - Drilling and Recording

1 Kitchen - Diner
1 Utility

1 Office - Sleeper

1 Recording Trailer

5 Sleepers

1 Power Plant

1 Standby Power Plant

1 Powder Magazine

1 Incinerator

2 Fuel Trailers

2 1000 g Propane Tanks

Dozer Crews

2 D7 Cats

3 D6 Cats

1 Cat Push Truck

1 Camp

APPENDIX D

Processing

Processing of seismic data was undertaken by Petrel Consultants Ltd.

Sequence

1. Demultiplex
2. Trace Gather
3. Amplitude Recovery
4. Deconvolution
   - spiking
   - Gate: 500 - 2500 ms
   - operator length: 80 ms
   - pre-whitening: 3%
5. N.M.O. - Well TDT
6. Static Corrections - Elev/Tuh/Drift
7. Brute Stack
8. Common Offset Stack
9. R.N.M.O.
10. Automatic Residual Statics
11. First Break Mute
12. Stack 1200%
13. Filter 12/16 - 85/100
14. Trace Equalization
15. Film - 24 tr/~~in~~ mm 10 in/sec

APPENDIX E

MODELING

ARROWHEAD MODELING

The purpose of this modeling was to establish the polarity of the data and to test the assumption that character anomalies observed at the Slave Point level are caused by porosity development.

The modeling consisted of first digitizing the sonic log from B.A. - Texaco Arrowhead B-76 between 9000 and 9800 feet and generating synthetic seismic traces for this interval. Two modifications were then made:

- insertion of about 300 feet of porosity corresponding to a fully dolomitized Slave Point section (Figures 1 & 2) and,
- insertion of 50 feet of porosity, 60 feet below the top of the Slave Point (Figures 3 & 4).

Synthetic traces for the well were generated using 28 ms, 32 ms and 35 ms zero phase Ricker wavelets. These correspond to dominant frequencies of 36 hz, 31 hz and 28 hz. The normal polarity 32 ms wavelet gives the best match with the actual data in normal polarity (our convention is that an acoustic impedance increase causes a deflection to the right, or peak on the seismic trace). Figure 6 illustrates this match in log reverse polarity.

Synthetic traces for the modified wells were generated using 28 and 32 ms wavelets. A comparison of the original well with the two modifications is shown in Figure 5.

Modification 2, the insertion of 50 feet of porosity 60 feet below the top of the Slave Point most clearly resembles the anomaly observed in the actual seismic data (Figure 7). The salient feature on the lines is the diminishing of the amplitude of the trough below the dominant peak caused by the top of the Slave Point on the normal polarity sections. This trough is caused by the side lobes of the wavelet. When some porosity is present within the Slave Point, as in modification 2, the reflection resulting from the base of the porosity destructively interferes with the trough caused by the side lobe from the Slave Point reflection. This effect is best observed in the reverse polarity sections.

Modification 1, the insertion of 300 feet of porosity in the Slave Point creates an anomaly which does not have an analogy on the seismic lines.

From this relatively straightforward modeling exercise, it can be concluded that the anomaly observed on the seismic line is consistent with there being a porous interval within the Slave Point Formation. This porous zone would lie 50 to 100 feet below the Slave Point top and would not be expected to be greater than 200 feet thick. In order to obtain a more precise estimate of the position and the amount of porosity in the Slave Point, more sophisticated modeling techniques such as interactive trace matching between synthetic and actual data, wavelet processing, and inversion, would be necessary.

LOG EDITING MENU

A ZOOM LOG
  A,START DEPTH,END DEPTH (A,1000,2000)
B RUB ZOOM
C REDIGITIZE A PORTION OF LOG FROM TABLET
D REDIGITIZE A PORTION OF LOG FROM X-HAIRS
E EXTRAPOLATE ENDS OF LOG
  E,FRONT,NEW START (E,FRONT,1000)
  E,BACK,NEW END (E,BACK,10000)
F BULK SHIFT LOG
  F,DEPTH TO ADD (F,207)
G DELETE ENDS OF LOG
  G,FRONT,NEW START (G,FRONT,2000)
  G,BACK,NEW END (G,BACK,10000)
H RUB MODIFICATIONS
I CHANGE RATE OF DEPTH SAMPLING
  I,NEW RATE (I,0.5)
J DISPLAY LOG
K LIST LOG ON LINE PRINTER
L CHANGE UNITS OF MEASUREMENTS
M EXIT LOG EDITOR

ENTER MENU SELECTION
GO A/M

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SONIC LOG

BA-TEX ARROWHEAD B-76

START OF LOG 8699 FEET

END OF LOG 9880 FEET

DEPTH SAMPLING RATE = 500 (X 1000) FEET

EDIT MENU SELECTION PRODUCING DIAGRAM=C

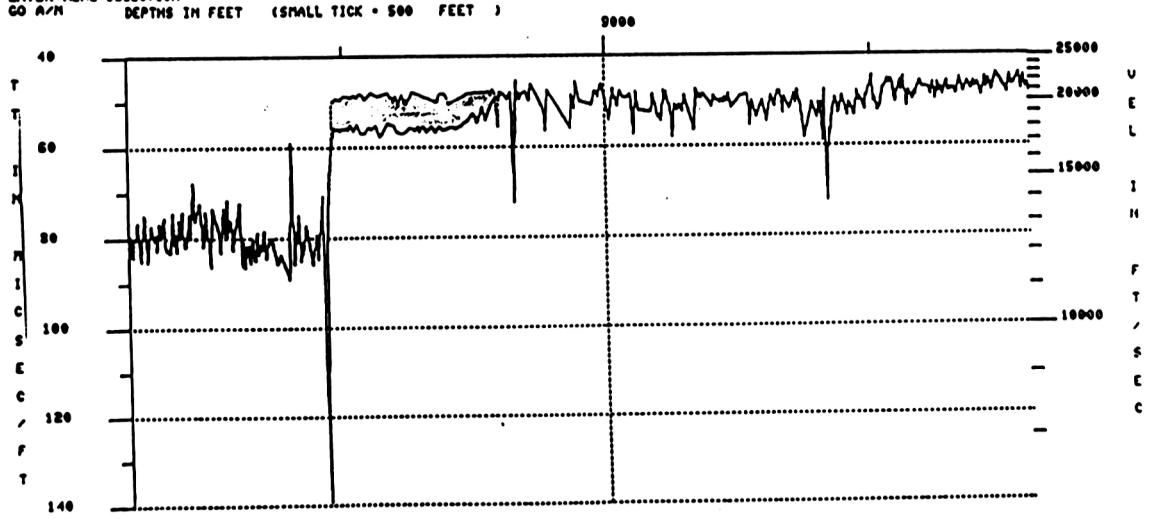

Figure 1. Original well (dotted) and first modification, in which approximately 300 feet of porous dolomite with an average transit time of 56 usec./ft. is substituted for a tight limestone with an average transit time of 49 usec./ft.

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LOG EDITING MENU
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A ZOOM LOG
  A,START DEPTH,END DEPTH (A,1000,2000)
B RUB ZOOM
C REDIGITIZE A PORTION OF LOG FROM TABLET
D REDIGITIZE A PORTION OF LOG FROM X-HAIRS
E EXTRAPOLATE ENDS OF LOG
  E,FRONT,NEW START (E,FRONT,1000)
  E,BACK,NEW END (E,BACK,10000)
F BULK SHIFT LOG
  F,DEPTH TO ADD (F,207)
G DELETE ENDS OF LOG
  G,FRONT,NEW START (G,FRONT,2000)
  G,BACK,NEW END    (G,BACK,10000)
H RUB MODIFICATIONS
I CHANGE RATE OF DEPTH SAMPLING
  I,NEW RATE (I,0.5)
J DISPLAY LOG
K LIST LOG ON LINE PRINTER
L CHANGE UNITS OF MEASUREMENTS
M EXIT LOG EDITOR

ENTER MENU SELECTION
GO A/M
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CGG  13.51.28. 20/07/83  P 3

SONIC   LOG

BA-TEX ARROWHEAD B-76

START OF LOG  8999   FEET

END OF LOG    9800   FEET

DEPTH SAMPLING RATE =  500       (X 1000) FEET

ZOOMED FROM   8400  TO 9000  FEET

EDIT MENU SELECTION PRODUCING DIAGRAM-A
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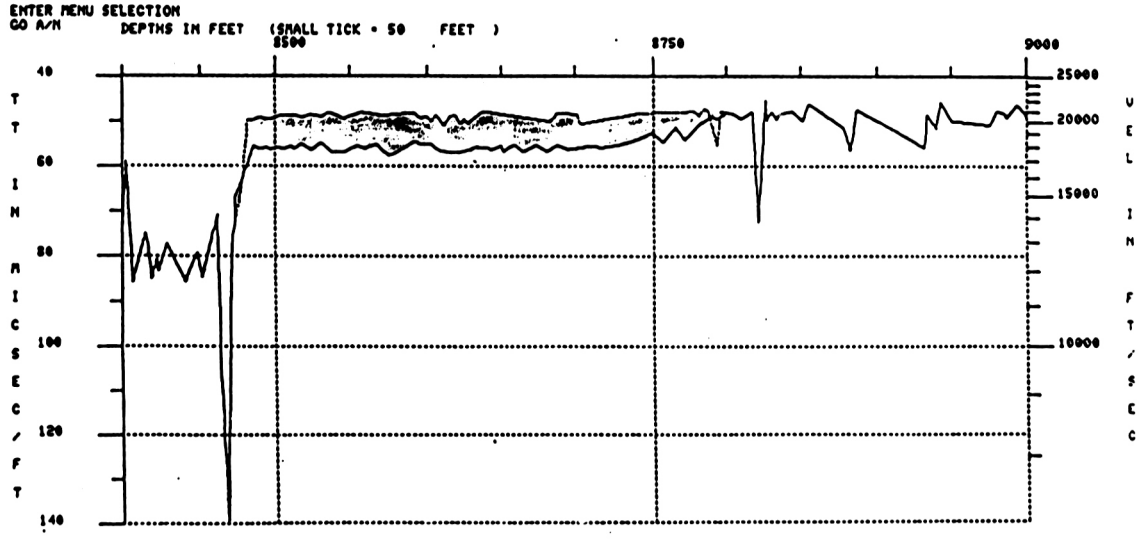

Figure 2. Enlarged view of modification 1.

LOG EDITING MENU

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B RUB ZOOM
C REDIGITIZE A PORTION OF LOG FROM TABLET
D REDIGITIZE A PORTION OF LOG FROM X-HAIRS
E EXTRAPOLATE ENDS OF LOG
  E,FRONT,NEW START (E,FRONT,1000)
  E,BACK,NEW END (E,BACK,10000)
F BULK SHIFT LOG
  F,DEPTH TO ADD (F,207)
G DELETE ENDS OF LOG
  G,FRONT,NEW START (G,FRONT,2000)
  G,BACK,NEW END (G,BACK,10000)
H RUB MODIFICATIONS
I CHANGE RATE OF DEPTH SAMPLING
  I,NEW RATE (I,0.5)
J DISPLAY LOG
K LIST LOG ON LINE PRINTER
L CHANGE UNITS OF MEASUREMENTS
M EXIT LOG EDITOR

ENTER MENU SELECTION
GO A/M

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SONIC LOG

BA-TEX ARROWHEAD B-76

START OF LOG 8899 FEET

END OF LOG 9800 FEET

DEPTH SAMPLING RATE = 500 (X 1000) FEET

EDIT MENU SELECTION PRODUCING DIAGRAM=C

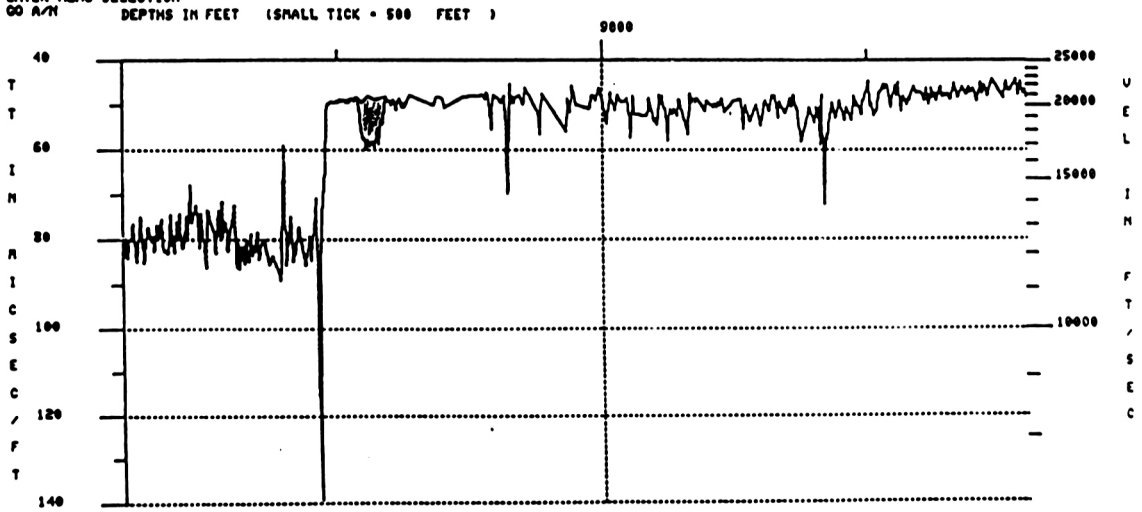

Figure 3. Second modification (solid) and original well (dotted). Fifty feet of porosity with an average transit time of 59 usec./ft. were substituted for tight limestone 60 feet below the top of the Slave Point.

LOG EDITING MENU

A ZOOM LOG
  A,START DEPTH,END DEPTH (A,1000,2000)
B RUB ZOOM
C REDIGITIZE A PORTION OF LOG FROM TABLET
D REDIGITIZE A PORTION OF LOG FROM X-HAIRS
E EXTRAPOLATE ENDS OF LOG
  E,FRONT,NEW START (E,FRONT,1000)
  E,BACK,NEW END (E,BACK,10000)
F BULK SHIFT LOG
  F,DEPTH TO ADD (F,287)
G DELETE ENDS OF LOG
  G,FRONT,NEW START (G,FRONT,2000)
  G,BACK,NEW END (G,BACK,10000)
H RUB MODIFICATIONS
I CHANGE RATE OF DEPTH SAMPLING
  I,NEW RATE (I,0.5)
J DISPLAY LOG
K LIST LOG ON LINE PRINTER
L CHANGE UNITS OF MEASUREMENTS
M EXIT LOG EDITOR

ENTER MENU SELECTION
GO A/M

CGG 14.40.17. 20/07/83 P 3

SONIC LOG

BA-TEX ARROWHEAD B-76

START OF LOG 8093 FEET

END OF LOG 9800 FEET

DEPTH SAMPLING RATE = 500 (X 1000) FEET

ZOOMED FROM 8400 TO 9000 FEET

EDIT MENU SELECTION PRODUCING DIAGRAM=A

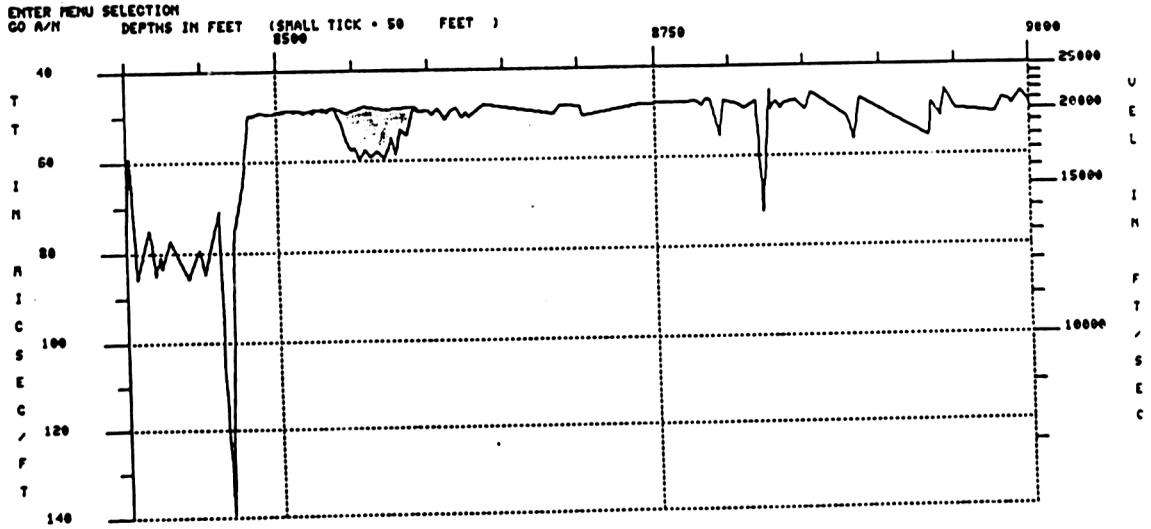

Figure 4. Enlarged view of modification 2.

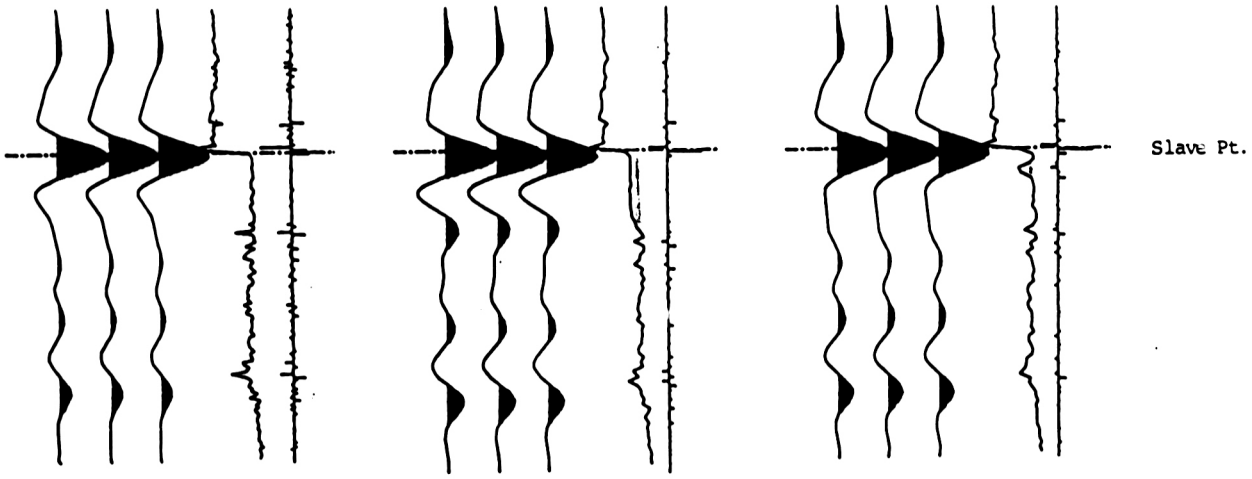

Figure 5. Comparison of synthetic traces for BA Texaco Arrowhead B76 and the two modifications. Synthetics generated with a zero phase Ricker 32ms. (31 hz.) wavelet.

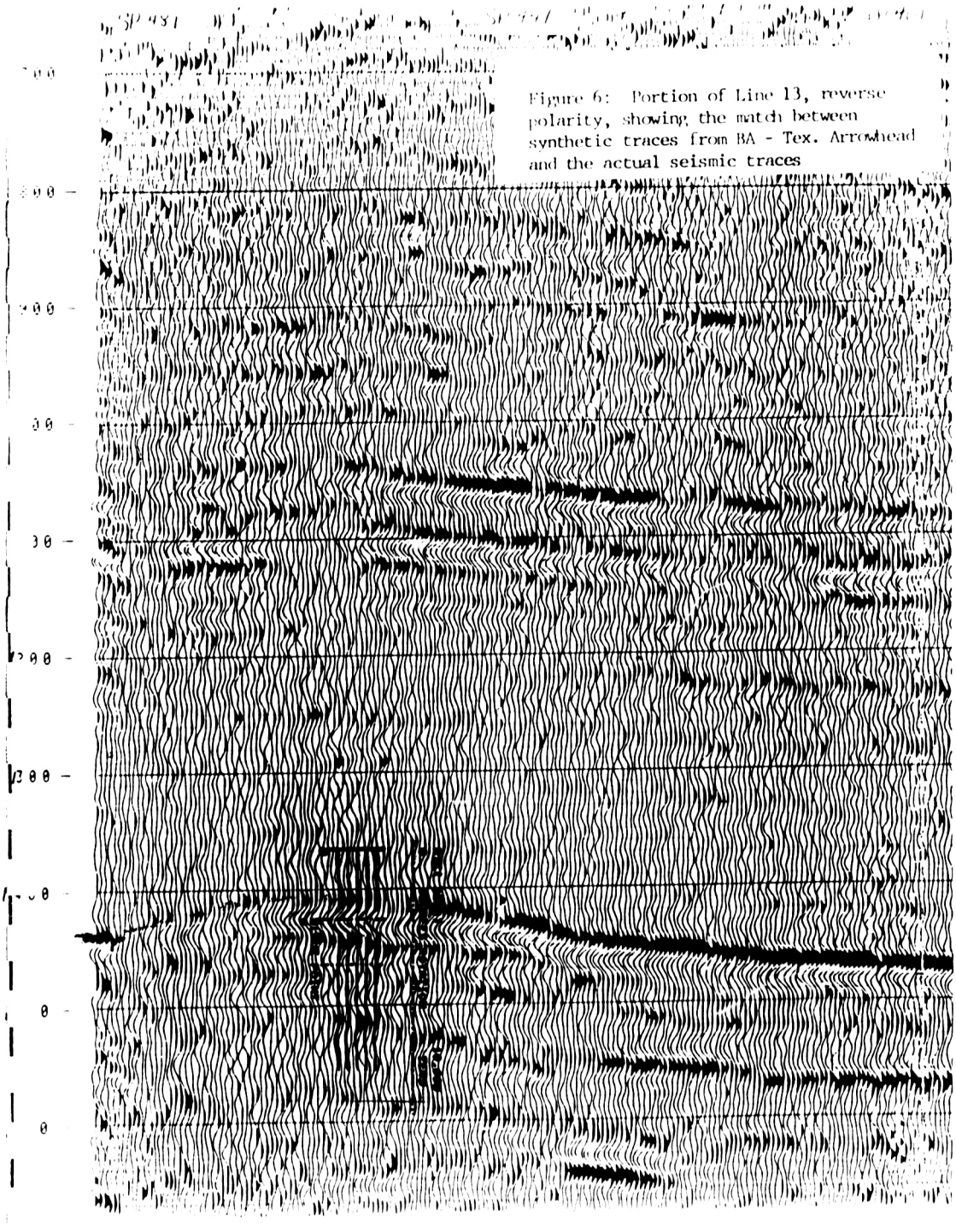

Figure 6: Portion of Line 13, reverse polarity, showing the match between synthetic traces from BA - Tex. Arrowhead and the actual seismic traces

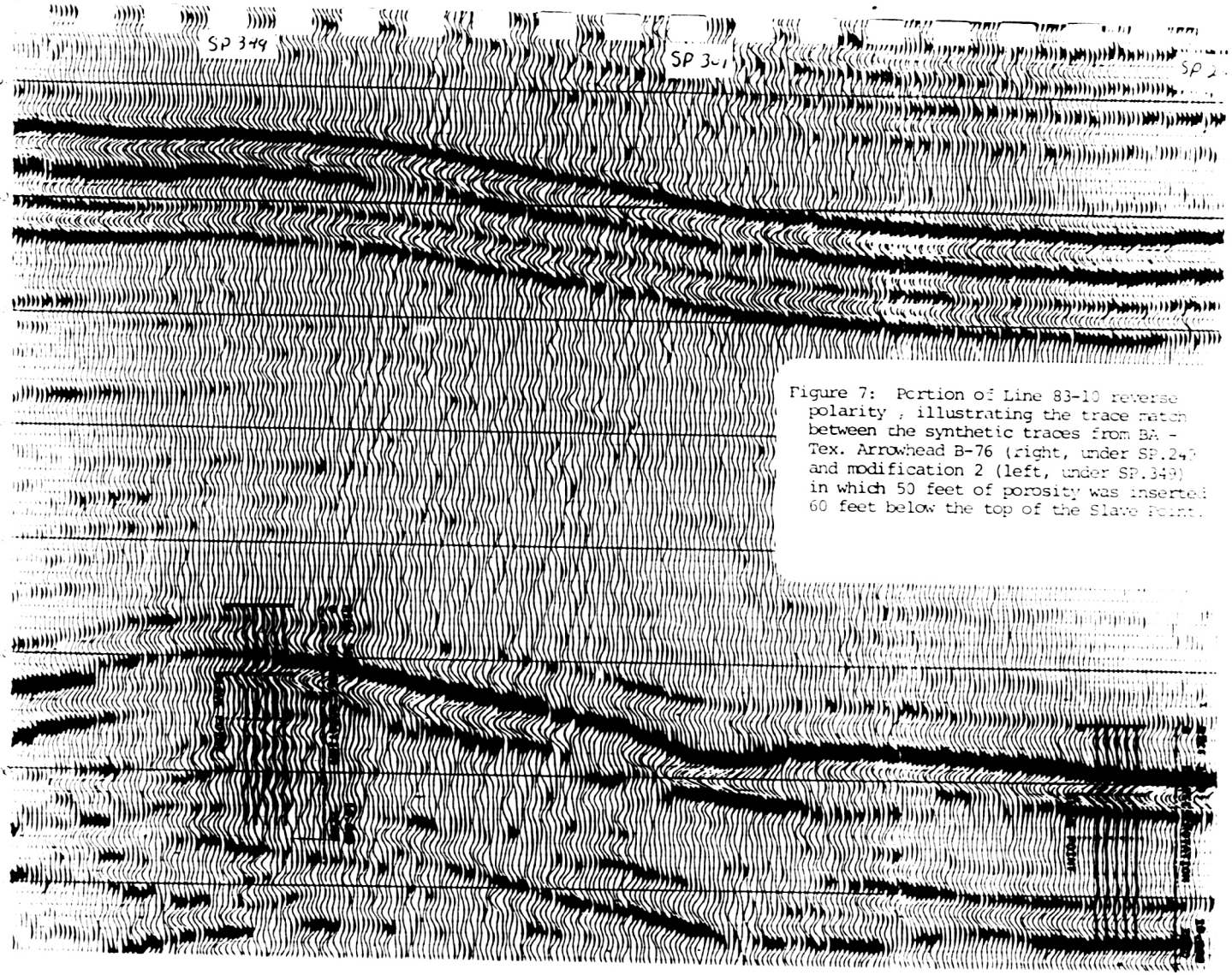

Figure 7: Portion of Line 83-10 reverse polarity , illustrating the trace match between the synthetic traces from BA - Tex. Arrowhead B-76 (right, under SP.249 and modification 2 (left, under SP.349) in which 50 feet of porosity was inserted 60 feet below the top of the Slave Point.