



DUNCAN CREEK GOLDDUSTERS LTD.

A SEISMIC REFRACTION SURVEY
OF PORTIONS OF LOWER DUNCAN CREEK,
ELSA AREA, CENTRAL YUKON

120153

Michael Power M.Sc.

Placer Claims and Leases

PL8722, PL8794, PL8793, PL8800, PL8792, P2167

Location: 135° 30' W 63° 48' N
NTS: 105 M14/M13
Territory/Province: Yukon Territory
Mining District: Mayo
Work Performed: May 1, 1992 - May 8, 1992

120153

This report has been examined by
the Geological Evaluation Unit under
Section 41 Yukon Placer Mining Act
and is recommended as allowable
representation work in the amount
of \$ 6,719.40.

Robert Deblak

for Chief Geologist, Exploration and
Geological Services Division, Northern
Affairs Program for Commissioner of
Yukon Territory.

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Summary

A seismic refraction survey was performed on placer leases and claims owned by Duncan Creek Goldbusters Ltd. on the lower end of Duncan Creek in the Mayo area from May 1 to May 8, 1992. The survey mapped three velocity layers corresponding to low velocity silt and sand, moderate velocity glacial till and gravels and high velocity bedrock. Depths to bedrock are quite deep in the central portion of the valley and shallower near the valley walls where creeks have eroded some of the overburden. The survey located a depression in bedrock on the west side of the valley beneath shallow overburden which appears to be a buried periglacial stream channel.

A. Introduction

This report describes a seismic refraction survey performed on placer claims and leases owned by Duncan Creek Goldusters Ltd. on the lower end of Duncan Creek. The survey was conducted from May 1, 1992 to May 8, 1992 in order to determine the depth to bedrock and to map the bedrock topography before conducting further testing.

B. Property

The Duncan Creek Placer Property owned by Duncan Creek Goldusters Ltd. is located on the lower end of Duncan Creek, above its confluence with the Mayo River in the central Yukon Territory (Figure 1). The property is 40 km from Mayo along the Duncan Creek Road and Silver Trail.

The geophysical survey was performed on the following placer leases and claims:

<u>Name</u>	<u>Claim/Lease Number</u>
4th Tier, 3 mile	PL8800
3rd Tier, 3 mile	PL8793
2nd Tier, 2 mile	PL8792
2nd Tier, 1 mile	PL8794
1st Tier, 4 mile	PL8722
Jimbo 2	P2167

The property and geophysical grid lines are shown in Figure 2. A detailed breakdown of the work performed on each claim and lease is contained in the survey log (Appendix B).

C. Geology

The Duncan Creek Property is underlain by PreCambrian rocks of the Hyland Group (Roots and Murphy 1992) (Figure 3). On Van Cleaves Hill, west of the property, and in the creek bed on the property, grey weathering fine to coarse grain quartzite and phyllite are found in outcrop. Rocks north of the property are cut by north to northeast verging shallow-dipping thrust faults which in turn are cut by steeply-dipping to vertical northeast-trending strike slip faults of minor displacement and complementary northwest-trending offset faults. These structures host the silver-lead-zinc deposits in the Elsa/Keno area. Outcrop is scarce near the placer property and no structures are mapped on it.

The surficial geology of the lower end of Duncan Creek is

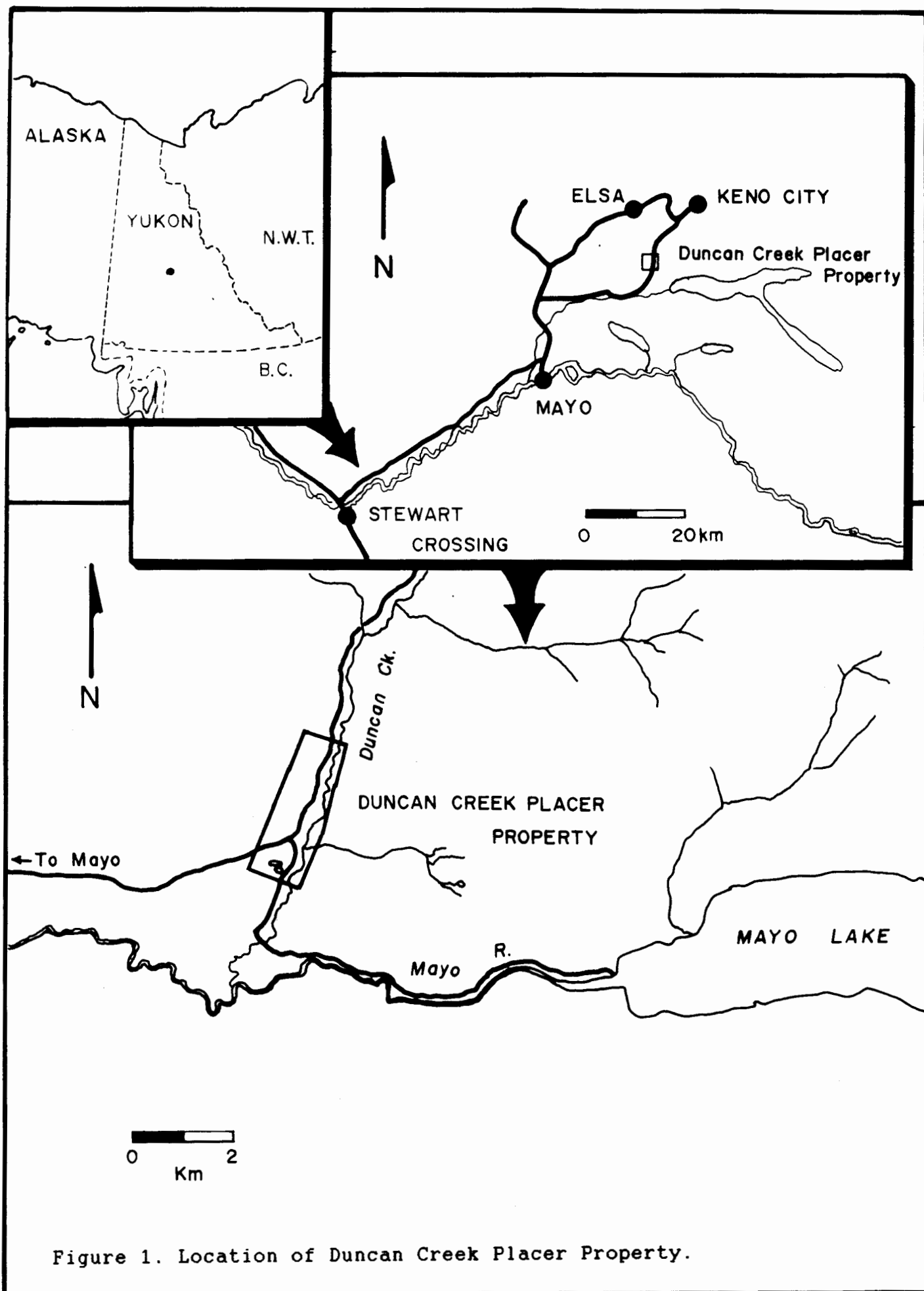


Figure 1. Location of Duncan Creek Placer Property.

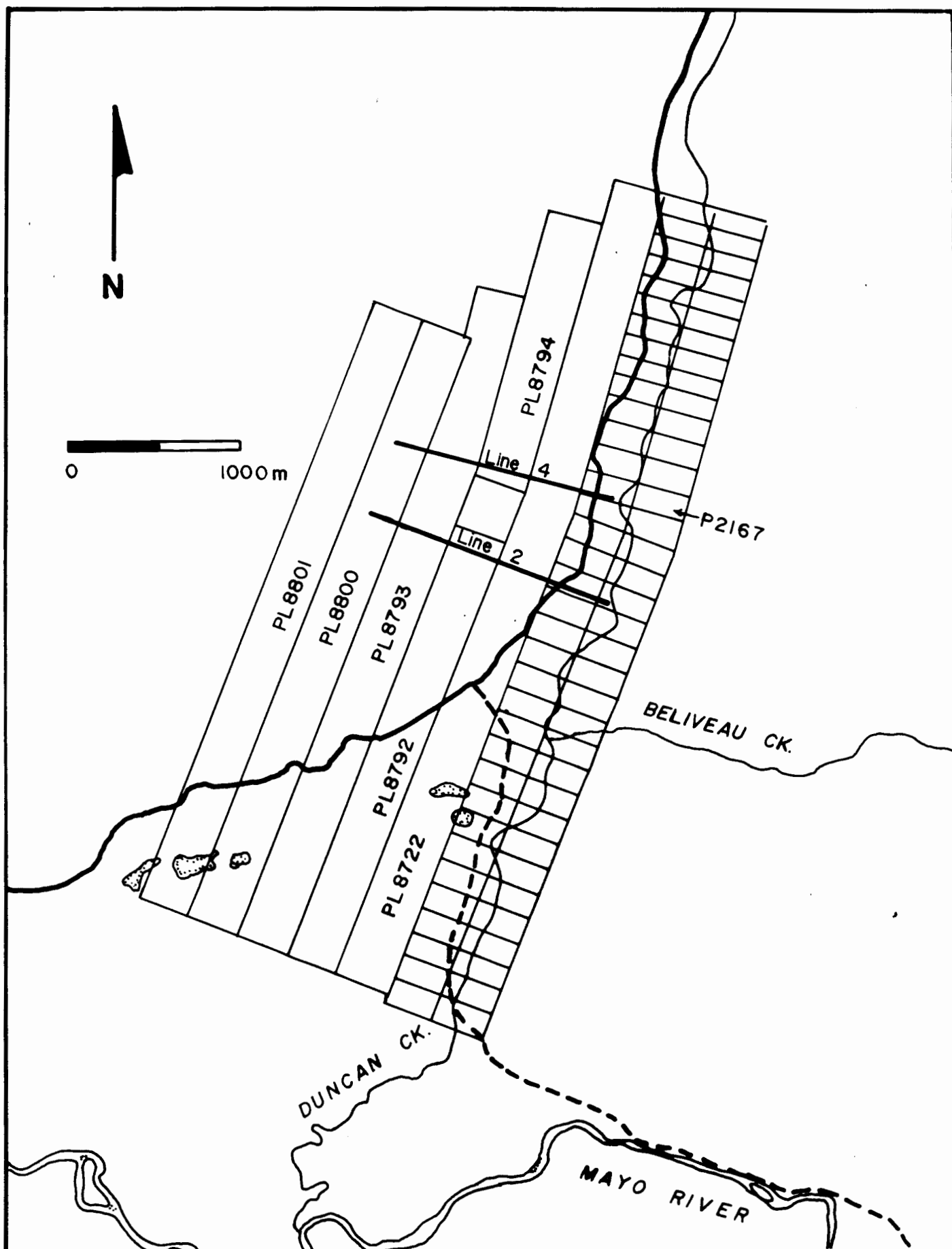


Figure 2. Duncan Creek Placer Property showing location of survey lines and claim and lease boundaries.

dominated by glacial landforms and deposits and has been mapped by Hughes (1982). The overall U-shaped profile of the creek valley and the smoothing and plucking of bedrock outcrops below 4500 feet in the valley appear to predate the dominant effects of the McConnell glaciation and may be evidence of the Reid Glaciation in the area. During the McConnell Glaciation, a lobe of a large glacier in the Mayo River valley appears to have pushed up Duncan Creek as far as the north end of the Duncan Creek Property, leaving a blanket of glacial till and what appears to be a lateral moraine (LM in Figures 3 and 4a). Hughes mapped extensive blankets and complex deposits of pebble through boulder till in the area (Mb and Mx in Figure 3). It is doubtful that older deposits lie beneath the glacial till given that the ice movement was parallel to the drainage. Duncan Creek re-established a channel on the east side of the valley following the retreat of the ice, depositing a sequence of glaciofluvial deposits (Gp and Gx in Figure 3). Figure 4b illustrates the stratigraphy of the glaciofluvial sediments at the present mine workings in Duncan Creek. At the base of the sequence 7 to 10 m of massive to crudely stratified poorly sorted gravel lie on weathered bedrock (Taylor 1990) (3 in Figure 4b). This is overlain by gravel with interbedded laminated sand layers (2 in Figure 4b) and 8 to 12 m of predominantly sand and silt (1 in Figure 4b). These sediments are thought to be derived from the glacial till and, in the area of the mine workings, they completely replace glacial deposits. While they are younger than the glacial deposits, it is unlikely that the glaciofluvial sediments would overly them since the fluvial environment in which they were deposited would quickly remove any glacial sediments in the stream bed.

There are significant differences between flow regimes in the current stream and in the older postglacial stream. The post glacial stream formed a large deltaic lobe and the glaciofluvial sediments in section display bedforms associated with braided stream environments (Taylor 1990). The recent stream is confined to a single high gradient channel within the older alluvial plain. In some areas the recent stream has cut into bedrock while in others it has not yet cut down to the basal gravel unit. At the lower end of Duncan Creek, it has deposited a complex bed of alluvium (Unit Ax in Figure 3). The overall gradient of the recent stream is significantly steeper than the older drainage; near its confluence with the Mayo River, the present channel is 100 to 200 feet lower than the older glacial channel deposits. The recent stream is also cutting back upstream, dissecting the older alluvial plain and forming a steep-sided channel which now extends to near the limit of the McConnell Glaciation. This change in gradient between the older and recent drainage suggests that the area is currently undergoing uplift, perhaps caused by postglacial isostatic rebound.

Placer gold is mined from the lowermost gravels in the

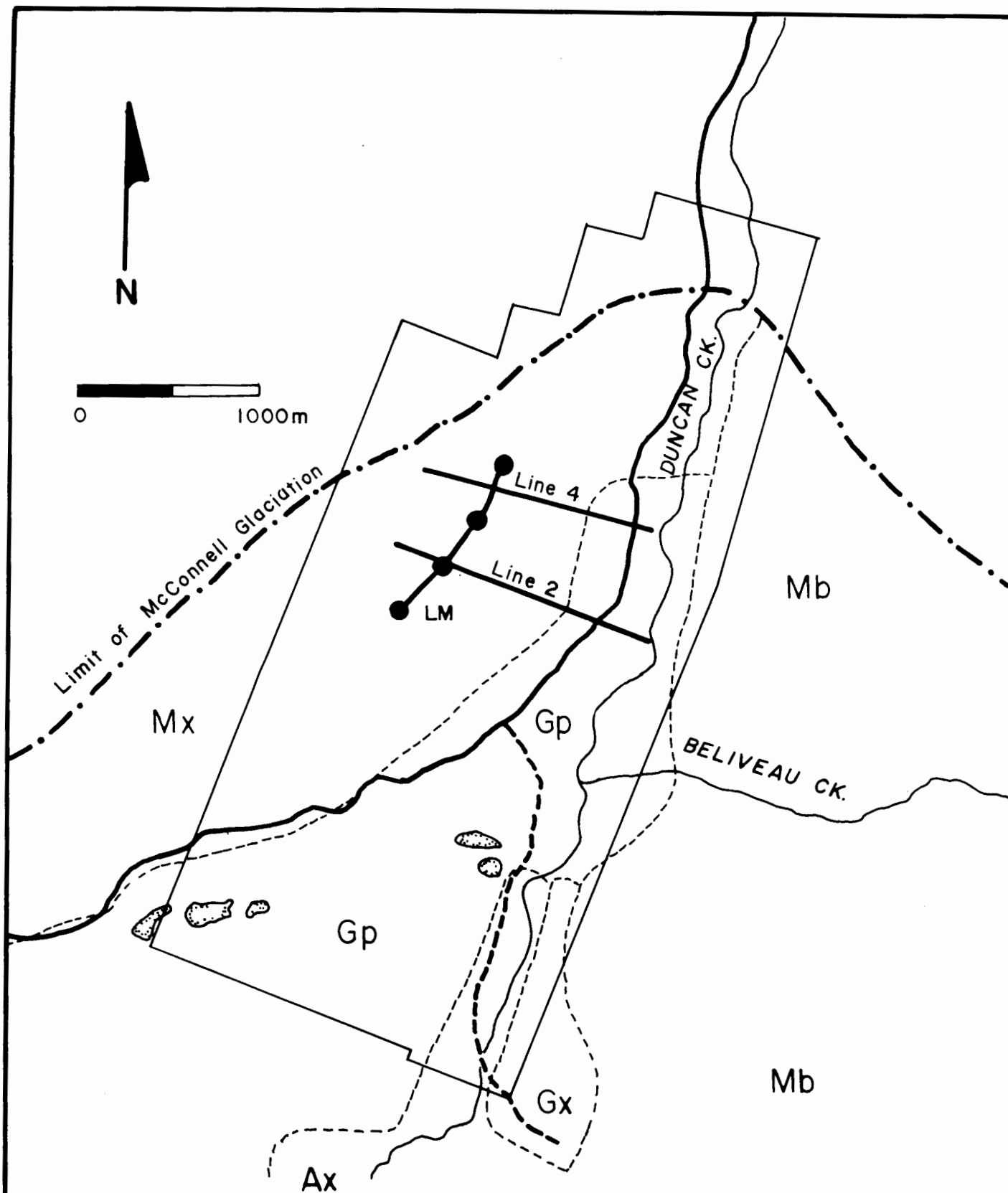
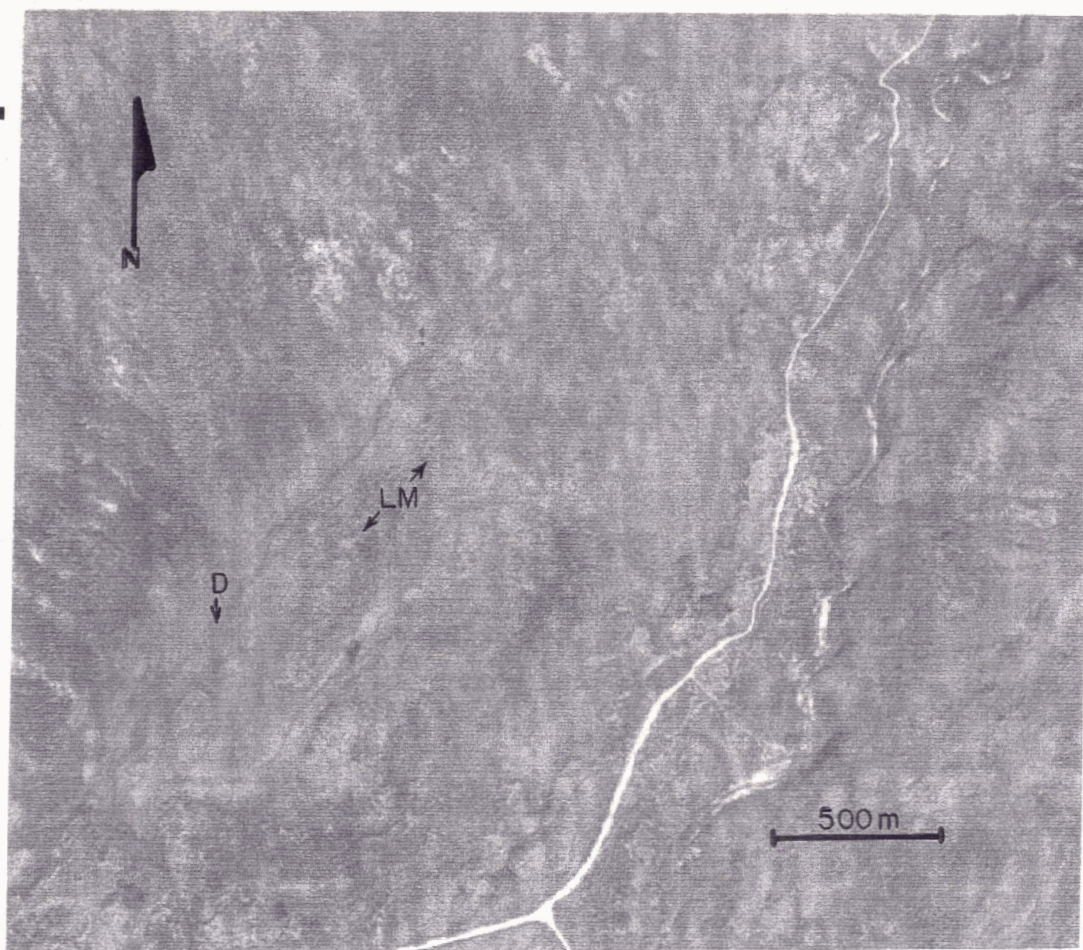


Figure 3. Surficial geology in the vicinity of the Duncan Creek Property after Hughes (1982). Mx - complex moraine. Mb - blanket moraine. Gp - glaciofluvial plain, Gx - glaciofluvial complex, Ax - recent alluvial complex, LM - lateral moraine.

a.



b.



Figure 4. Surficial geology. (a) Enlargement of airphoto A19604-60 showing Duncan Creek Placer Property. LM - lateral moraine, D - older drainage. (b) Glaciofluvial deposits in the present mine workings at Duncan Creek at the east end of Line 4. 1 - Predominantly sand and silt with minor gravel. 2 - gravel with interbedded laminated sand. 3 - Auriferous, poorly sorted, crudely stratified to massive gravels.

glaciofluvial sediments (Units Gp and Gx) where exposed in the recent channel of Duncan Creek. This is interesting in that these gravels are derived from glacial deposits and not from degradation of nearby bedrock (Taylor 1990). Normally, glacial processes tend to disrupt and disperse placer deposits. Sims (1982) points out, however, that under conditions where terminal ice positions remain relatively constant, rich bedrock or placers can be moved to the terminus, reworked and reconcentrated. In the Westland District of New Zealand, economic placers occur in kame and esker complexes and at Valdez Creek in Alaska, rich placer ground is found in deep glacial outwash channels. Sims states that placer gold in glacial deposits is generally fine, rounded or flattened and fairly evenly dispersed. The placer gold found in Duncan Creek fits this description (F. Taylor, 1992, personal communication). The ultimate bedrock source of the placer gold in Duncan Creek is probably upstream in silver-lead-zinc veins on Galena Hill and arsenopyrite-gold veins near Mount Hinton.

D. Seismic Refraction Theory

Seismic refraction techniques can be used to determine the depth to bedrock and, if conducted with a topographic survey, to map bedrock topography. Basic principles, interpretation methods and survey practice are described below. Comprehensive treatments can be found in standard texts such as Telford *et al.* (1984).

A point energy source such as a hammer, explosive charge or shotgun blast generates an acoustic compressional wave (P-wave) in any medium which radiates from the source in a spherical pattern. In cross-section (Figure 5a), near the source, a direct wave travelling just below the surface is the first energy to arrive at a measurement point. Energy radiated down into the earth will reflect and refract the interface between layers with contrasting velocities. The angle of refraction is governed by Snell's Law:

$$\sin\theta_1 / \sin\theta_2 = V_1 / V_2 \quad (1)$$

where θ_1 and θ_2 are the angles of incidence and refraction. For media where the velocity below the interface is greater than the velocity above ($V_2 > V_1$), the refracted ray path will flatten as shown in Figure 5a; otherwise, the raypath will steepen. If the velocity of the lower medium is greater than the velocity of the upper medium, at some critical distance (x_c), the incident wave will refract along the interface producing a head wave which

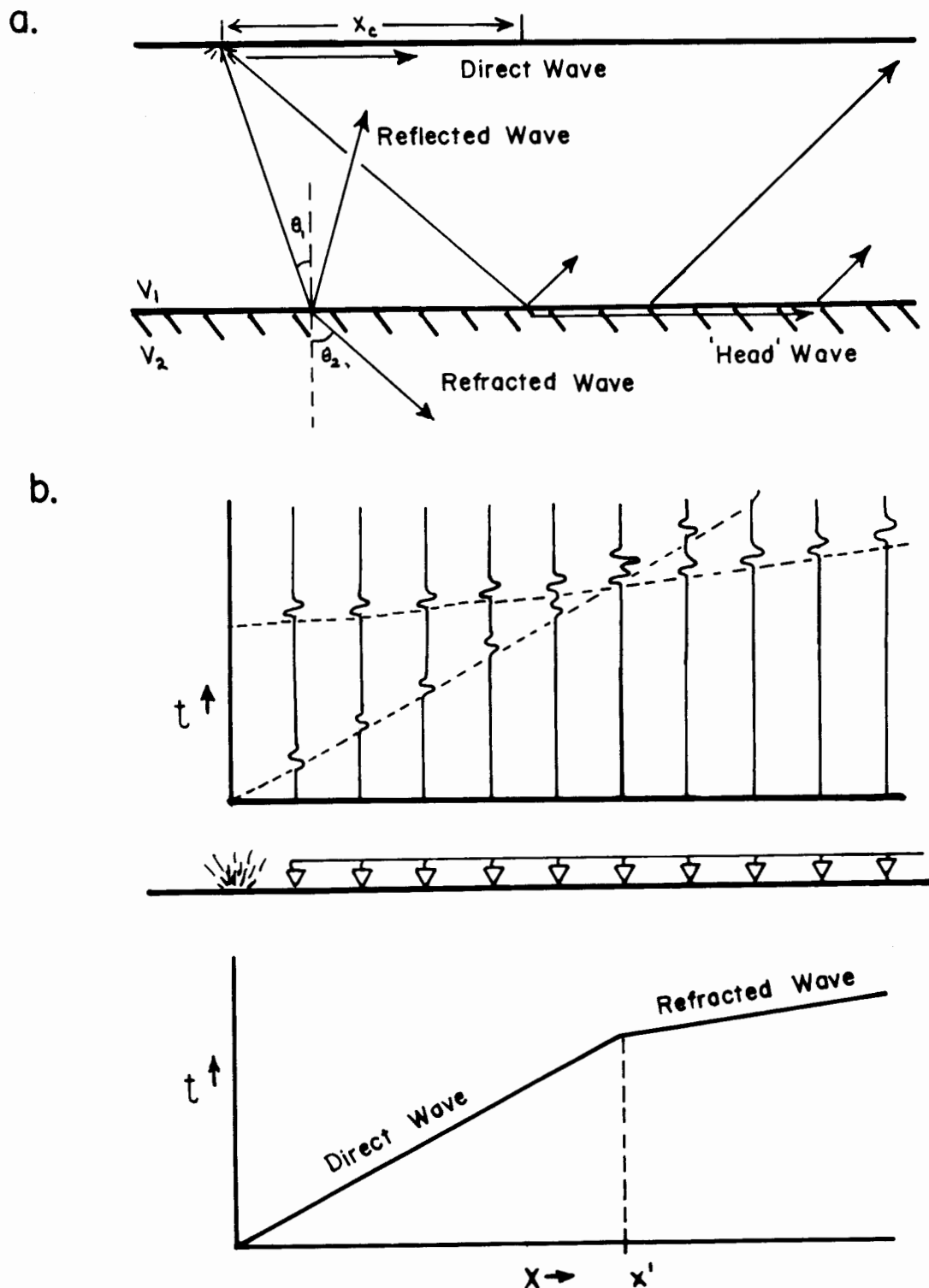


Figure 5. Geometry of seismic waves. (a) Refracted, reflected and direct waves. (b) Pattern of reflected and refracted wave arrivals from a single flat refractor/reflector. Synthetic seismogram is above the model and the corresponding T-X plot below it.

travels at the faster velocity of the lower medium. The critical angle of incidence necessary to produce a head wave is:

$$\theta_c = \sin(V_1/V_2) \quad (2)$$

Place a string of geophones along a line from a shot, trigger the recorder with the shot (at $t=0$) and you will get a record similar to that shown in Figure 5b. In the records you can see a parabolic reflection which turns into a refraction near the critical distance as well as the direct wave travelling through the upper medium. The distance where the refracted wave is the first arrival (first break) in the shot record is termed the crossover distance; it is always greater than the critical distance. First arrivals are normally plotted in time-distance (T-X) plots such as the one shown in Figure 5b.

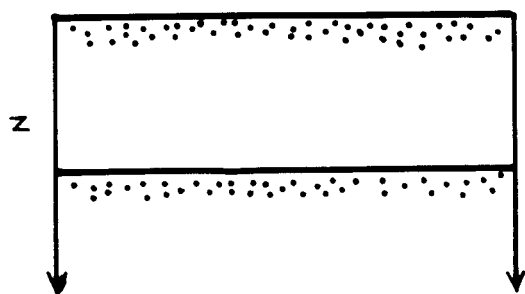
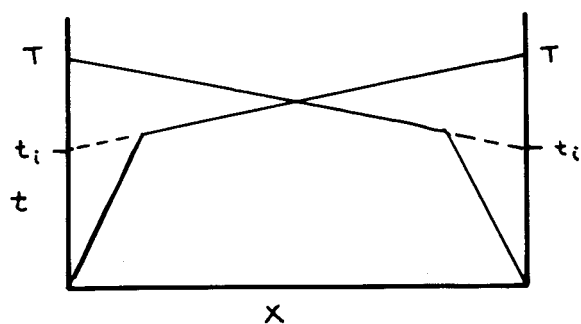
T-X plots for planar horizontal, planar dipping, multiple planar and irregular refractors are shown in Figure 6a-d. The steep portions of the arrival times curves near the x-axis are slow direct wave arrivals. The shallower portions of the arrival time curves are faster refracted wave arrivals. The inverse slope of the curve segment can be used to calculate apparent layer velocities. Normally, shots are fired at either ends of a geophone spread to produce a reversed profile. Common sense and the Law of Reciprocity dictates that the travel time from the shot on the left to the geophone on the right is the same as for the shot on the right to the geophone on the left (T in Figure 6a).

A number of older methods for interpreting refraction data are based on graphical and numerical techniques which use the T-X plots directly. More advanced automated techniques involve setting a starting model, calculating the predicted response using ray tracing algorithms, computing the error between modelled results and observations, correcting the model and rerunning.

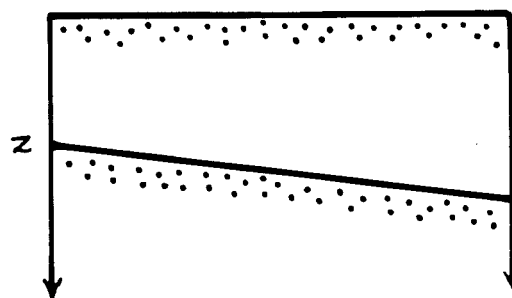
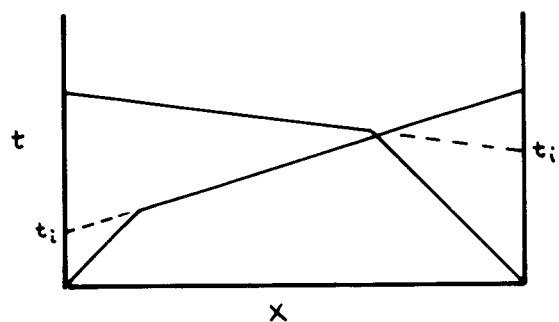
The simplest of the graphical techniques involves fitting the data to a model consisting of planar interfaces. Intercept times (t_i in Figure 6a) are measured and mean refractor velocities calculated from the inverse slope of the arrival time curves by fitting lines to those segments of the curves which are refracted arrivals. If the refractor has no relief, this approach can yield acceptable depth estimates. Such calculations are easily performed and are useful as order of magnitude checks on results from more complicated methods. A complete discussion of this approach including rigorous derivation of the equations used in the calculations can be found in Telford *et al.* (1984).

If the refractor is irregular, graphical interpretation is usually performed using a delay time method. The delay time is

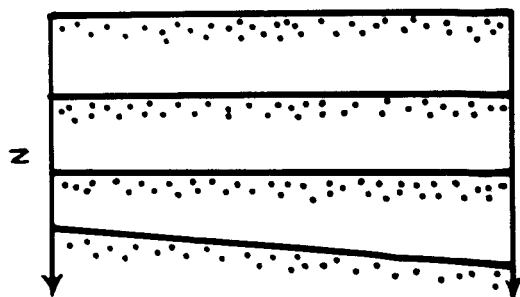
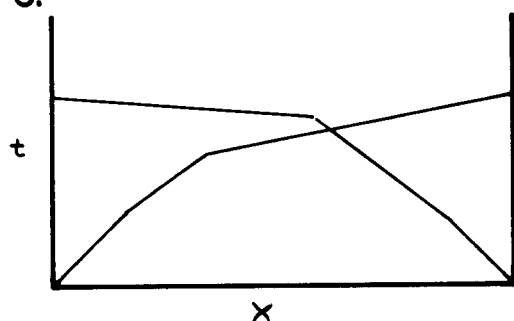
a.



b.



c.



d.

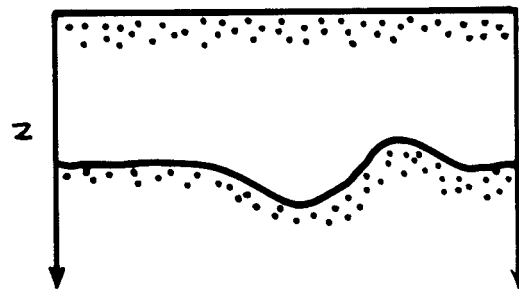
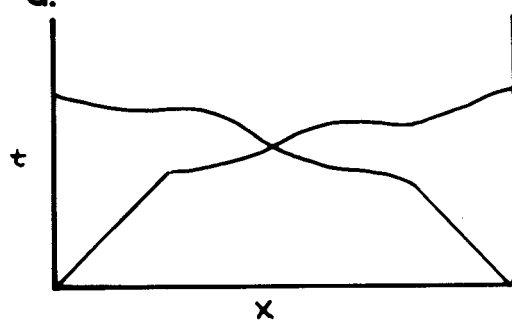


Figure 6. T-X plots for various types of refractors. (a) Flat planar refractor. (b) Dipping planar refractor. (c) Multiple planar refractors. (d) Irregular refractor. T indicates reciprocal time and t_i is the intercept time.

the difference between the observed arrival time of a refracted wave less the time required for the wave to travel along the horizontal projection of the refractor beneath the shot and geophone (Figure 7a). The delay time is made up of a shot delay time (SDT) and geophone delay time (GDT). When the refracting surface has a relatively shallow overall dip, the delay time can be calculated quite easily to acceptable accuracy using the shot-to-geophone spacing and the direct and refracted wave velocities derived from the slopes in the T-X curves.

Barry (1967) devised a delay time interpretation method which is well suited for reversed profiles shot over irregular refractors. For multiple layers, Barry's Method must be repeated and the effect of the upper layers must be removed (layer stripping). To do this, first calculate the influence of the first layer and map the first refractor, then remove the effect of the first layer and repeat the process for the second layer. In effect this involves moving the shot and geophones to the top of the next layer down by removing the travel time through the layer above and by shifting the shot and geophone locations to compensate for the inclined travel path through the layer above the refractor. Finally, upon completion of the depth determinations for all layers, it is necessary to calculate depths from the true topographic surface rather than a presumed flat surface to reveal true refractor topographies.

The data collected during the seismic survey was interpreted using a generalized version of Barry's Method to accommodate multiple irregular refractors and irregular topography. In detail the procedure is as follows:

a. Compute T-X curves and calculate upper layer velocities and apparent refractor velocities.

b. Identify segments of arrival times curve caused by first refractor.

c. Calculate total delay time DT from observed arrival time T and shot to geophone spacing X:

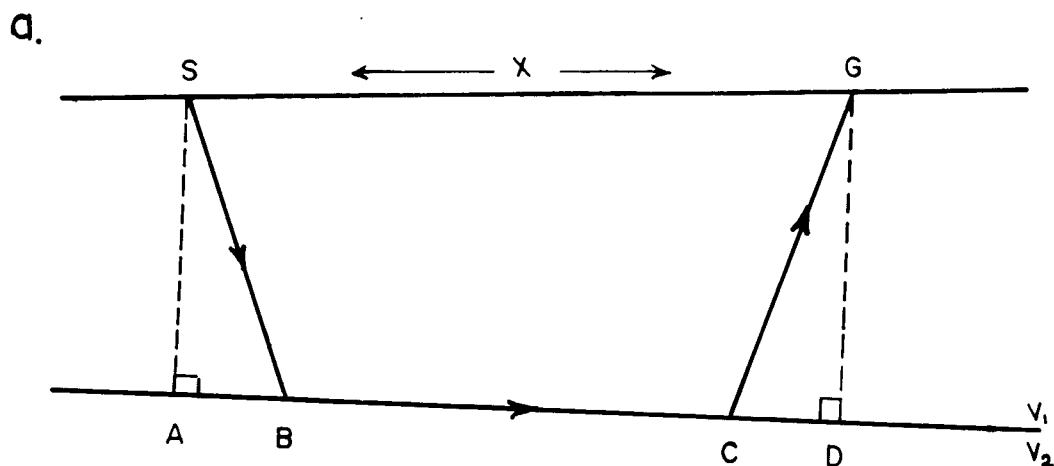
$$DT = T - X/V_2 \quad (3)$$

where V_2 is the refractor velocity (ie. velocity of medium below).

d. Calculate shot delay time:

$$SDT = t_1 / 2 \quad (4)$$

where t_1 is the intercept time for the shot.



$$DT = t_{SBCG} - t_{AD} \approx t_{SG} - X/V_2$$

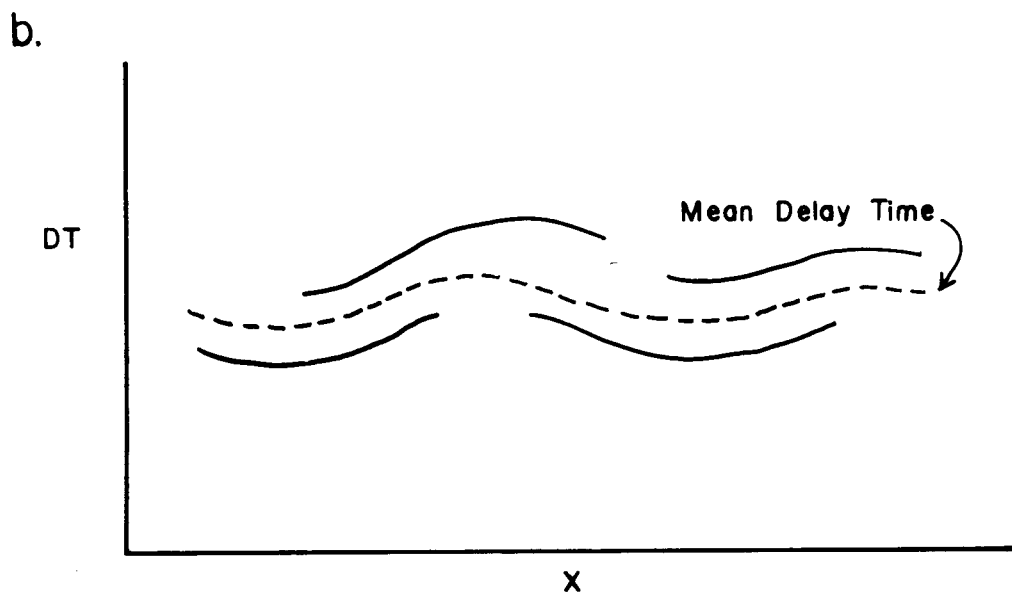


Figure 7. Delay time methods. (a) Definition of delay time: the difference between the observed travel time less the time required for the wave to travel along the projection of the refractor. (b) Picking mean delay time curve from delay time segments as part of Barry's Method.

e. Calculate geophone delay time:

$$GDT = DT - SDT \quad (5)$$

f. Calculate geophone offset distance DX:

$$DX = V2 * GDT * (\tan(\theta_c))^2 \quad (6)$$

and shift geophone locations towards shot by this amount to compensate for inclined path through the upper medium.

g. Plot geophone delay times and corrected geophone locations in a T-X plot. Delay time curves for different shots should be parallel, indicating a correct choice of V1 and V2 and correct identification of refractions in the T-X plots. Pick a mean geophone delay time curve that is an average of the curves as shown in Figure 7b.

h. Convert the mean geophone delay times to depth to the refractor:

$$z = V1 * GDT_{mean} / \cos\theta_c \quad (7)$$

i. If there is more than one refractor apparent in the T-X plot, strip the effect of the top layer from the data:

- * Delete all direct wave arrivals.

- * Shift the shot location to the spot where the critical ray strikes the refractor (shot location shift SLS):

$$SLS = z * \cos(90 - y - \theta_{c1}) * \cos\theta_{c1} / \cos y \quad (8)$$

where θ_{c1} is the angle of incidence from the surface to the medium immediately below which refracts again to produce a critical in the next layer down and y is the dip of the refractor near the shot.

- * Subtract the travel time in the upper layer from the observed travel time. The correction (ST) is:

$$ST = z * \cos(\theta_{c1}) / (V1 * \cos y) \quad (9)$$

Then replace the original travel times by the corrected travel times.

Upon completion of layer stripping, return to step a. and replot T-X curves and repeat the process for the next layer down.

j. After stripping down to the next to last layer and calculating the depth to the last refractor, calculate the elevation of the refractors relative to the topography. If Z is the ground elevation and $d_1, d_2, \dots, d_n$ are the depths to n refractors, the elevation of refractor n is:

$$z_n = Z - d_1 - d_2 - \dots - d_n \quad (10)$$

This can be applied to interpret the data from multiple irregular refractors and is consequently the most general of the graphical techniques available. The procedure was automated in a computer program which allows the operator to determine velocities, process shots and pick mean delay times interactively.

Two physical situations can render the results of a seismic refraction survey invalid and several other factors affect the overall accuracy of the method. If a seismic refraction survey is conducted over an area where a low velocity zone is sandwiched between two higher velocity zones, the incident ray will steepen instead of flatten as it enters the zone. No evidence of the zone will be found in the first arrival times and the interpreted depths will be too great. This is termed the Blind Zone or Low Velocity Layer problem. A second problem can result if a thin, high velocity layer is sandwiched between a slower overlying layer and a faster underlying layer. The wave will refract but there will be no evidence of the extra layer in the first arrivals. Once again, the interpreted depth will be in error. Depending upon the velocity contrast, the lower refractor will appear to have a depth greater or smaller than it truly is. This problem is termed the Hidden Zone or Hidden Layer problem. Several practical problems can also affect the data quality and indirectly affect depth determinations. Commonly, the head wave may change phase (ie. change shape) at successive geophones and this can fool the interpreter into picking the wrong arrival time. Sometimes, the noise level is quite high and first arrivals are disrupted by spurious signals; wrong arrival times can be easily picked in this situation.

Bedrock topography can be mapped using seismic refraction methods if a velocity contrast exists between the bedrock and overburden. Typical velocities for various types of bedrock and overburden are listed in Table I. Under optimum conditions with relatively simple velocity structures and good velocity contrasts, shallow refraction seismic surveys can determine the depth to bedrock to within $\pm 10\%$. If ground conditions are poor, the velocity structure complex or if hidden layers or blind zones are present, the error can be much worse. Even relatively large errors may be acceptable if the object of a survey is to get a rough idea of depths to bedrock and bedrock topography.

Table I. Seismic Velocities of Rock and Overburden

<u>Material</u>	<u>Velocity (m/s)</u>
Air	330
Water	1400-1500
Ice	4000(+)
Gravel - thawed	1800-2800
Gravel - frozen	4000-4600
Glacial till - thawed	1500-2800
Glacial till - frozen	3000-4300
Sand & Silt - thawed	600-1500
Sand & Silt - frozen	1500-3000
Metamorphic and igneous rock	4000-6000
Limestone and dolomites	3000-5500
Shale and sandstones	2000-3500
Weathered granite	450-3200

Sources: Birch (1966)
 Johnston (1981)
 Coates (1965)

E. Survey Procedure

The seismic refraction survey was conducted on lines cut and flagged prior to the geophysical survey. The survey lines are approximately 1.5 m wide and flagged at 10 m intervals. No tie lines were cut. The seismic survey was conducted only on selected portions of the survey lines due to time restrictions. It was conducted with an ABEM Terraloc Mark III 24 channel signal enhancement seismograph using a spread of 24 geophones at 10 m intervals. Technical specifications for the seismograph are contained in Appendix C. Explosive charges of 2 to 4 sticks of 40% Forcite were electrically fired at either end of the spread and at 60 m intervals along it. The seismograph was triggered by a geophone placed near the charge and wired into the seismograph. Following each shot the data (shot records) were inspected and filtered, first arrival times picked and the results printed on a thermal printer in the field. Filtering consisted of a 150 Hz high cut filter to remove microseisms and electrical noise and, on occasion, an 80 Hz low cut filter to remove noise caused by wind and moving trees. The effect of the filter on the location of first breaks can be to create a false early break in the signal and this effect was considered in picking first arrivals from filtered data.

Following the seismic survey, geophone locations and elevations were surveyed using a Wild T-1 transit and Geodimeter electronic distance measuring device (EDM). This data is required to adjust the depths to refractors in order to produce a true picture of bedrock topography. Topography along the survey lines outside of the areas in which the seismic survey was conducted was also surveyed. Elevations along each line were corrected to an arbitrary datum near the lowest elevation of bedrock. Consequently, the elevations shown in the depth sections are relative and not tied to any surveyed datum.

The author conducted the survey described in this report and was ably assisted by T. Taylor and J. Kirby with occasional assistance by F. Taylor.

F. Results

Copies of the shot records and the first arrival picks are contained in Appendix D. The records are collated in the order in which they were shot: Line 4 from 0W to 1320W followed by Line 2 from 0E to 1020E. Stations on Line 2 were recharged after the seismic survey and consequently arbitrary local coordinates were assigned during recording and corrected after the topographic survey. The timing marks on shot records correspond to the arrival times listed below the records.

The data is of variable quality. Recordings on Line 4 from 0W to 230W and on Line 2 from 570E to 800E were poor due to soft ground conditions and wind. Channel gains had to be lowered for some shots and consequently the returns at geophones distant from the shot are occasionally very weak or not visible above the noise.

T-X diagrams for each spread are in Appendix E. Uppermost layer and refractor velocities were picked interactively using a computer program. Upper layer velocities were often quite variable and this was taken into account during data processing; shots were processed with the local upper layer velocity rather than an average value. Average refractor velocities were used in processing lower layers because it is difficult to separate real velocity variations from those caused by dip. The data was interpreted using the method described earlier in this report and selected depth determinations near shot points were checked against calculations made using simple dipping layer assumptions. Where possible, depth determinations were also correlated with depth determinations from nearby drill holes and excavations.

Figures 8 and 9 are depth sections prepared from the seismic and topographic survey data for lines 2 and 4. In general, three different layers are present in the sections. Layer A is a relatively low velocity layer (450 m/s to 1500 m/s) up to 10 m thick found on Line 4. The velocities range from the speed of sound in air to the speed of sound in water, suggesting that this layer consists of loose overburden. On the eastern end of Line 4, this layer corresponds closely with an observed bed of predominantly sand and silt in the face of the mining cut (Layer 1 in Figure 4b).

Layer B has velocities ranging from 1500 to 3400 m/s and is the most wide spread unit on the property. Layer B1 occurs on both lines 2 and 4 and has velocities ranging from 1500 m/s to 2800 m/s. Gravel, coarse glacial till, weathered bedrock and frozen overburden have velocities in this range and consequently it is difficult to conclusively correlate any given material with this layer. The lower boundary of the layer generally follows topography with considerable local irregularities and consequently might be the bedrock-overburden interface in most circumstances. Layer B2 is found on the western end of Line 4 and has a slightly higher velocity (3200-3400 m/s). It follows topography and occurs under a B1 layer; consequently it is probably weathered bedrock, low velocity bedrock or completely frozen overburden.

Layer C has velocities ranging from 4500 to 6000 m/s. This velocity range is that expected for fresh, unbroken bedrock. The velocity of this layer varies from Line 4 (Layer C1: 5600-6100 m/s) to Line 2 (Layer C2: 4500 m/s), possibly reflecting a change in bedrock lithology. With the exception of from 770W to

910W on Line 4, the top of layer C appears to be the top of bedrock. From 770W to 910W on Line 4, the top of layer B2 appears to be the top of bedrock. Depressions in bedrock indicated by dips in layer C may be old stream channels or localized glacial scours. Apparent depressions in bedrock may also be caused by variations in the depth of bedrock weathering. On the eastern end of Line 4, bedrock depths are known in the mine workings and were surveyed into the line profile. The observed depth to bedrock appears to be shallower than the depth calculated for layer C near the mining cut. Undetected low velocity layers in overburden or deep weathering of bedrock could cause this overestimation of bedrock depth.

It is impossible to isolate the effects of frozen and thawed ground upon seismic velocity from those caused by variations in overburden composition. It was the author's impression that extensive, deep permafrost is not found in the Duncan Creek valley and that permafrost is not significantly affecting the lateral variation in upper layer velocities (layers A and B). The overall slope of the Duncan Creek valley is to the south, mature stands of poplar occur on the property and shallow excavations on the property have encountered only 2 to 3 metres of frozen ground beneath the active layer (F. Taylor, 1992, personal communication).

The stratigraphy apparent in the seismic sections appears to fit the mapped surficial geology. Loose, fine grain glaciofluvial material is mapped only in the eastern portion of the property (Unit Gp) and layer A which appears to correspond to this lithology, is found only on the eastern end of Line 4. Overburden velocities on the western portion of the property are higher than on the eastern side, suggesting that the overburden here contains more coarse material in the uppermost layers. This layer would correspond to the moraine blanket mapped in this area. If older gravels occur below this layer, they too would have a velocity corresponding to that of layer B. The seismic survey can neither confirm nor rule out the presence of older creek gravels in the valley because the velocities of glacial deposits and gravels fall in the same range.

A significant depression in layer C and presumably in bedrock on the western end of Line 2 at 180E is coincident with an old drainage channel west of the lateral moraine in airphotographs (D in Figure 4a). This channel was apparently connected to the old postglacial drainage north of the lateral moraine (top right of Figure 4a) and is at roughly the same elevation as the glaciofluvial sediments. It appears to have been cut off when the recent channel began to incise the older alluvial deposits. This channel may contain older glaciofluvial gravels and is of economic interest.

G. Conclusions

- a. The seismic survey detected three velocity layers. Seismic velocity layer A appears to correspond to a layer of sand and silt, layer B appears to be deposits of glacial till, heavily weathered bedrock or gravel and layer C appears to be unweathered bedrock. Velocity layer A corresponds to the uppermost sediments in unit Gp as mapped by Hughes (1982) and layer B appears to correspond with glaciofluvial gravels lower in unit Gp and with glacial till in unit Mx.
- b. The top of layer C appears to be the bedrock surface except between 770W and 910W on Line 4 where bedrock may have been deeply weathered.
- c. Bedrock depths indicated by the seismic survey when correlated with inferred bedrock depths in the mine workings suggest that the bedrock surface indicated by the seismic survey is probably too low by approximately 5 to 10 m. This effect could be caused by low velocity layers in the overburden, by a hidden zone problem, by weathering of the bedrock or by a combination of these effects.
- d. Shallow depths to bedrock are found on the flanks of the valley where existing (east) and older (west) drainages have eroded the overburden.
- e. Apparent dips in bedrock may be caused by old stream channels, by glacial scours or by variations in the depth of weathering. Several profiles across the valley may be necessary before it is possible to determine which if any of the bedrock depressions in the middle of the valley might be old stream channels.
- f. The seismic survey cannot establish whether old stream gravels might exist beneath glacial till in the centre of the valley. This is because glacial till and stream gravels have roughly the same seismic velocity.
- g. The bedrock depression located by the seismic survey at 180E on Line 2 appears to be coincident with an older stream channel visible in airphotographs. This channel is higher than the recent channel, lies beneath relatively thin overburden and may contain older, auriferous glaciofluvial gravels.

H. Recommendations

a. The indicated bedrock depression on Line 2 near 180E should be tested by excavation or drilling.

b. Further exploration should be conducted to test glaciofluvial sediments south of Line 2. Here, the older gravels appear to have been deposited over a significantly larger area and overburden could be thinner since this is closer to the toe of the postglacial deltaic complex.

c. If resources permit, one hole should be drilled to completely test the deepest indicated bedrock depression on either Line 2 or Line 4 in the area underlain by glacial till. The hole should be logged by a placer geologist familiar with the drilling equipment being used. I believe that it is essential to determine whether ANY undisturbed gravels exist below the glacial deposits before conducting any further work on this part of the property. It is possible that glacial action removed all older pay gravels, especially given the fact that the ice movement was parallel to the drainage. The deepest spot on either line is suggested as the most likely point where significant deposits of older gravel might be located.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read 'M. Power'.

Michael A. Power M.Sc.
Geophysicist

May 19, 1992

References Cited

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Appendix A. Statement of Qualifications

I, Michael Allan Power of Whitehorse, Yukon Territory, certify that:

1. I obtained a Bachelor of Science degree with First Class Honours in Geology from the University of Alberta in 1986 and a Masters degree in Geophysics from the University of Alberta in 1988.

2. I have worked in the mining exploration industry and in geophysical research since 1984.

3. I conducted the geophysical survey described in this report and prepared this report for submission.

4. I have not received nor expect to receive, directly or indirectly, any interest in the property of Duncan Creek Goldbusters Ltd.

A handwritten signature in black ink, appearing to read 'M. Power'.

Michael A. Power M.Sc.

Whitehorse, Yukon Territory
May 19, 1992

Appendix B. Survey Log



AMEROK GEOPHYSICS

SURVEY LOG

Job: 92-5 Duncan Creek Seismic Survey
Period covered: May 1, 1992 - May 9, 1992

Date: May 1, 1992

Production: 0

Other: Drove from Whitehorse to Duncan Creek

Set up line 4: 0W-230W

(all work on P2167/PL8722)

Date: May 2, 1992

Production: 230m

Other: Shot line 4: 0W-230W. Moved to 480W-710W.

(1/2 day on P2167/PL8722 and 1/2 day on PL8794)

Snow and rain

Date: May 3, 1992

Production: 230m

Other: Set up 480W-710W and fired. Moved to 710W-940W.

(1/2 day on PL8794 and 1/2 day on PL8793/8794)

Snow flurries

Date: May 4, 1992

Production: 230m

Other: Set up 710W-940W (Line 4) and fired. Moved to

line 4: 1080W-1320W. A lot of snow.

(1/2 day on PL8794/8793 and 1/2 day on PL8800)

Date: May 5, 1992

Production: 230m

Other: Fired line 4: 1080W-1320W and moved gear to line 2:

0E-230E. (1 day on PL8800). Flurries

Date: May 6, 1992

Production: 230m

Other: Fired line 2: 0E-230E. Moved to line 2: 570E-800E

(1/2 day on PL8800 + 1/2 day on PL8792)

Date: May 7, 1992

Production: 460m

Other: Fired line 2: 570E-800E and moved to line 2: 800E-

1030E. Fired and shot.

(All day on PL8792)

Date: May 8, 1992
Production: 0 m
Other: Spent 1/2 day moving off PL8792. Set up in mining cut.
Damaged seismograph with firing 3rd shot.
(1/2 day on PL8792)

Date:
Production:
Other:

Date:
Production:
Other:

Date:
Production:
Other:

Date:
Production:
Other:

Date:
Production:
Other:

Date:
Production:
Other:

Date:
Production:
Other:

Appendix C. Instrument Specifications

TECHNICAL SPECIFICATIONS

—more than enough for the toughest assignments

TERRALOC FIELD UNIT

Sampling rates	24, 48, 100, 200 and 500 μ s 1, 2 and 5 ms
Record length	1000 samples per trace
Record time	24 to 5000 ms
Delay time	0 to 9999 ms
Amplifier gain	6 to 126 dB in steps of 6 dB
Gain accuracy	$\pm 3\%$
Frequency range	1 to 2000 Hz
Analog filters	Low-cut, 18 dB/octave, Bessel type
Filter frequencies	50, 100, 150, 200, 250, 300, 350 or 400 Hz
Max input signal	± 4 V
Noise level	Less than 0.7 μ V RMS over bandpass
A/D converter	8 bits (256 levels)
A/D range	± 8 V
Step size	62 mV at A/D converter input 30 nV at system input (max gain)
Input transformer	600 ohms input impedance, eliminates line noise
Memory	1000 16-bit words for each trace stack
Storage	Two standard 3.5" floppy disk drives and slots for two optional RAMdisks
Disk format	Standard MS-DOS, can be read by IBM and compatible PCs with 3.5" disk drives
Disk capacity	713 Kbytes per disk, equal to 14 24-channel records or 28 12-channel records
Time and date	Internal quartz clock, backed up by board mounted lithium battery and 9 V standard battery
Hours in use	Monitored and displayed
Battery protection	Low-voltage switch-off function
Digital I/O	RS-232-C serial interface, 75 to 19200 baud. IEEE-488 parallel talk/listen interface
Interface functions	10, including SEG-1 communication protocol
CRT screen	9" daylight visible, 512x512 pixels
Video connector	Standard BNC 75-ohm coaxial connector
Power	12 V external battery or 110/220 V, 50/60 Hz (in office)
Power consumption	Less than 48 W
Weight	22 kg (24 channels)
Dimensions	25x53x57 cm
Temperature range	-10 to +70°C (RAM disk can be used at extreme temperatures)
PROCESSING	
Signal stacking	16-bit stack width (255 shots)
Display processing	Enhanced, signal-averaged or normalized (1 to 99 % of display range). Normalized window (with or without amplitude limiter function). Digital AGC
Trace modes	Variable area (pos or neg) Wiggle trace Dotted trace
Gain adjustment	Automatic gain adjustment to optimum setting based on test shot

Signal level warning	System warns against excessively high or low input signals
Collection modes	PREVIEW for operator-controlled stacking AUTOSTACK FAST STACK STACK ONCE
Noise gate	Selectable from 1 to 99 % of A/D converter range
Polarity	Additive or subtractive stacking for all traces or individual traces
Locking	Any trace can be protected from modification
Trace selection	Individual traces can be displayed or hidden
Notebook	Six areas available for record keeping. Notes are automatically stored with record
Record number	Automatic or operator-set identification number
Programmable memory	User can enter 10 sets of gain profiles into CMOS-backed memory for easy retrieval. 10 sets of trace/channel/display assignments can also be entered by the user
Digital filters	99 high-cut and 99 low-cut filters for post-recording filtering
Digital filter slope	12 dB/octave
Digital filter phase shift	None for stationary signals
Time line	Moveable time cursor (with associated time display)
First arrivals	Automatically picked on all channels, before or after filtering (manual editing)
Signal voltage readout	Actual input voltage for user-specified sample of any trace calculated and displayed on screen
Trace scroll	Time-enlarged traces can be scrolled up and down on screen
Self-check	Circuitry and battery are checked at every power-up. Service menu displays internal voltages. Error messages alert operator if fault is found.

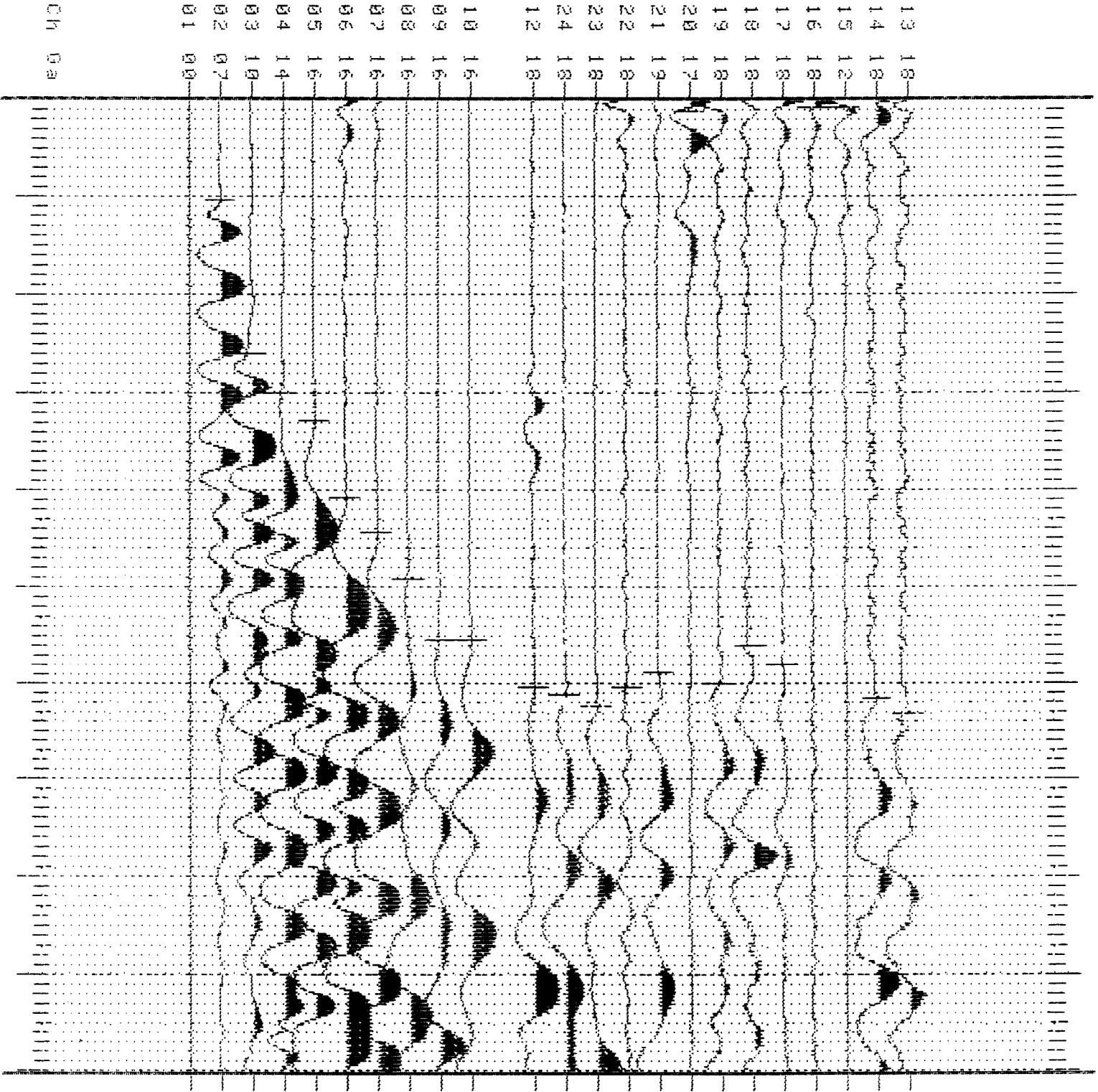
TERRALOC PRINTER

Type	Thermal printer, ASCII and graphic
Line width	560 dots or 80 ASCII characters
Print width	128 mm
Paper size	214 mmx30 m
Record length	405 mm (full size)
Print time	35 s per record
Copy time	9 s
Power	12 V
Current drain	0.7 A (idle), 1.5 to 4 A (printing)
Weight	6 kg
Dimensions	12x33x63 cm

IBM is a registered trademark of International Business Machines Corp.
MS-DOS is a registered trade mark of Microsoft Corp.

Appendix D. Shot Records

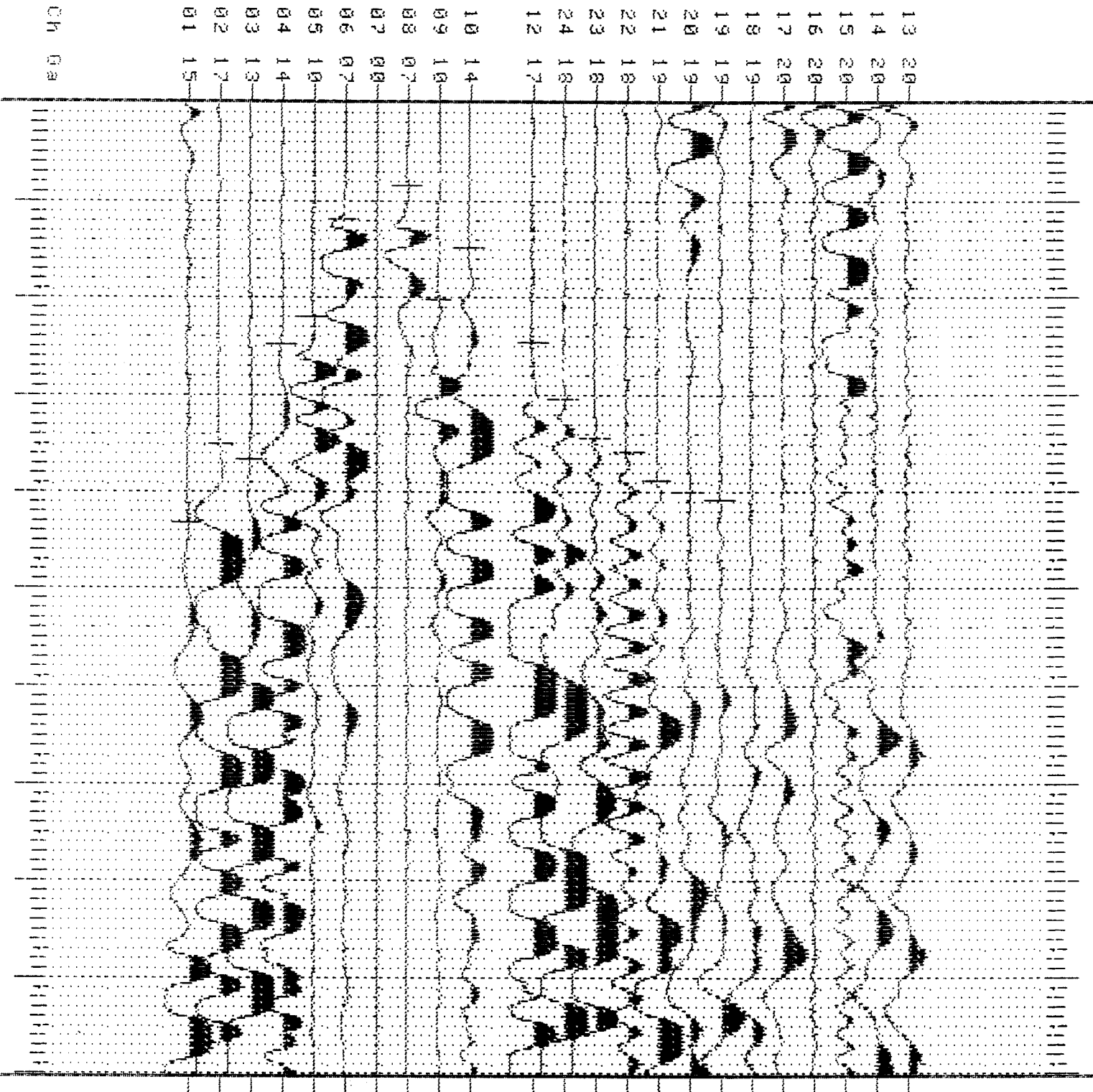
ABEM Terraloc Seismic System Record-000615 Date-920502 Time-12:02
Shot pos.: 0000.0 Layout start: 0000.0 Layout end: 0230.0
Profile No.: 000001 Note: 000000000001 Operator: 00001
Record time: 200 ms Delay time: 0000 ms Analog filter: 100
Display mode: Normal, Low-cut: Off Hz High-cut: 100Hz Shots: 001



Listing of markers: Record-000615 Date-920502 Time-12:02

Trace No	Marker time (ms)	Field notes
1	0000.0	Record time: 200 ms
2	0000.0	Delay time: 0000 ms
3	0000.0	Shot pos.: 0000.0
4	0000.0	Layout start: 0000.0
5	0000.0	Layout end: 0230.0
6	0000.0	Profile No.: 000001
7	0000.0	Note: 000000000001
8	0000.0	Operator: 00001
9	0000.0	
10	0000.0	
11	0000.0	
12	0000.0	
13	0000.0	
14	0000.0	
15	0000.0	

ABEM Terraloc Seismic System Record-000615 Date-920502 Time-12:54
Shot pos.: 0000.0 Layout start: 0000.0 Layout end: 0230.0
Profile No.: 000001 Note: 0000000000001 Operator: 00001
Record time: 200 ms Delay time: 0000 ms Analog filter: 100
Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920502 Time-12:54

Trace No	Marker time (ms)	Field notes
10	0000.0	Record time: 200 ms
02	0000.0	Delay time: 0000 ms
03	0000.0	Shot pos.: 0000.0
04	0000.0	Layout start: 0000.0
05	0000.0	Layout end: 0230.0
06	0000.0	Profile No.: 000002
07	0000.0	Note: 0000000000001
08	0000.0	Operator: 00001
09	0000.0	
10	0000.0	
12	0000.0	
24	0000.0	
23	0000.0	
22	0000.0	
21	0000.0	
20	0000.0	
16	0000.0	
18	0000.0	
17	0000.0	
19	0000.0	
15	0000.0	
14	0000.0	
13	0000.0	

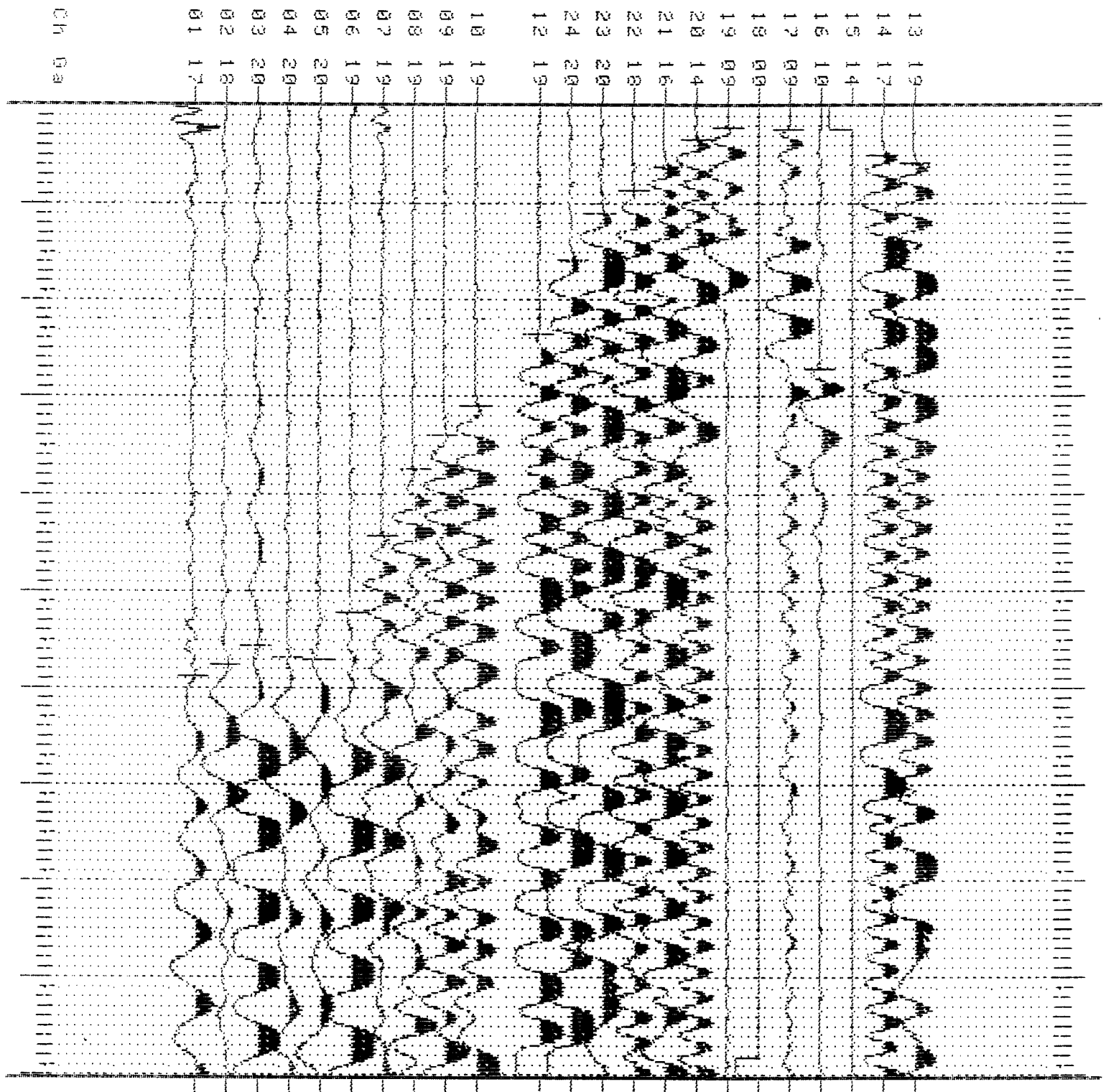
ABEM Terraloc Seismic System Record-000615 Date-920502 Time-13:53

Shot pos.: 0100.0 Layout start: 0000.0 Layout end: 0230.0

Profile No.: 000004 Note: 000000000001 Operator: 00001

Record time: 200 ms Delay time: 0000 ms Analog filter: 100

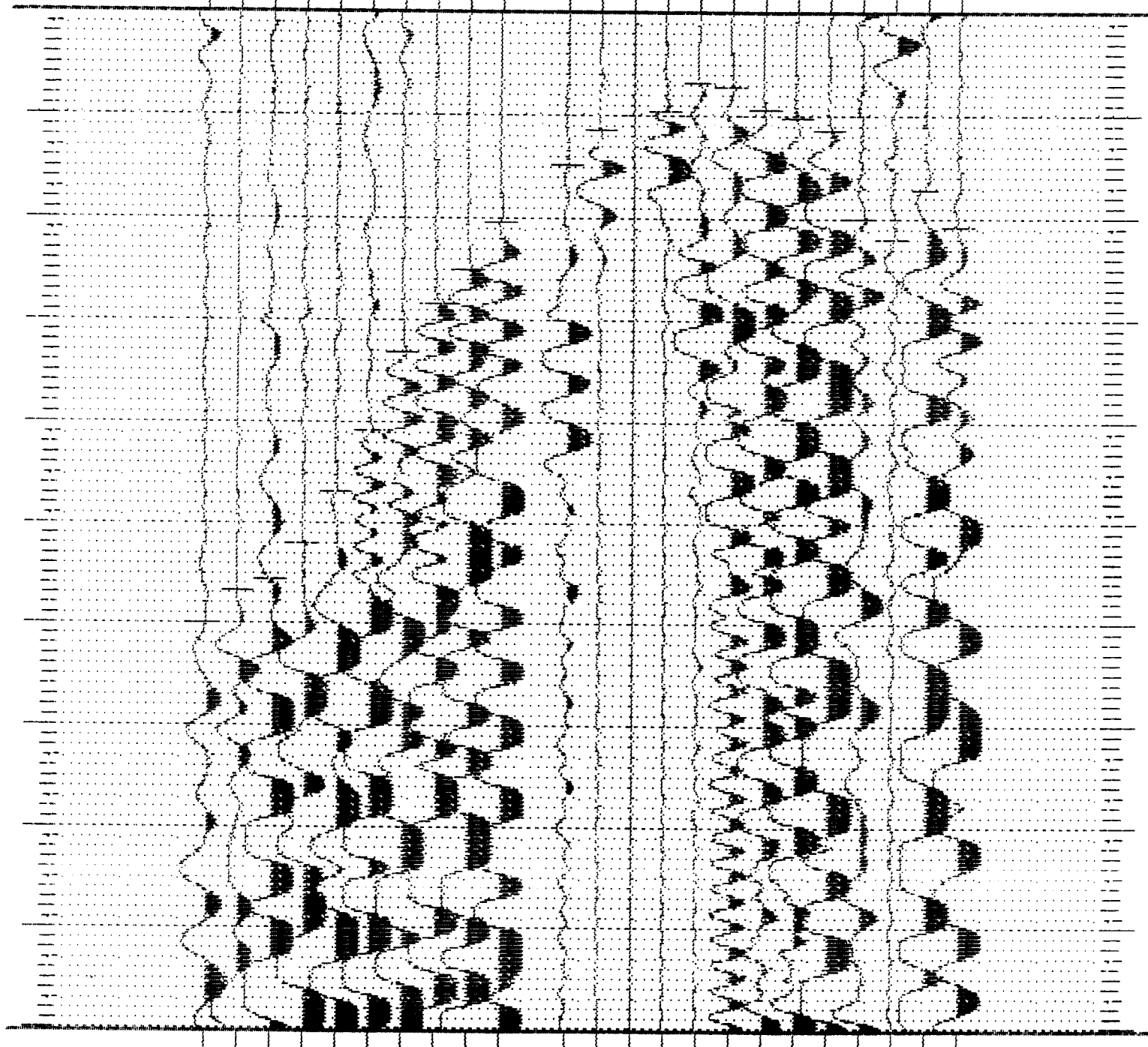
Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920502 Time-13:53

Trace No	Marker time (ms)	Field notes
1	11	Record time: 200 ms
2	11	Delay time: 0000 ms
3	11	Shot pos.: 0100.0
4	11	Layout start: 0000.0
5	11	Layout end: 0230.0
6	11	Profile No.: 000004
7	11	Note: 000000000001
8	11	Operator: 00001
9	11	
10	11	
11	11	
12	11	
13	11	
14	11	
15	11	
16	11	
17	11	
18	11	
19	11	
20	11	
21	11	
22	11	
23	11	
24	11	
25	11	
26	11	
27	11	
28	11	
29	11	
30	11	
31	11	
32	11	
33	11	
34	11	
35	11	
36	11	
37	11	
38	11	
39	11	
40	11	
41	11	
42	11	
43	11	
44	11	
45	11	
46	11	
47	11	
48	11	
49	11	
50	11	
51	11	
52	11	
53	11	
54	11	
55	11	
56	11	
57	11	
58	11	
59	11	
60	11	
61	11	
62	11	
63	11	
64	11	
65	11	
66	11	
67	11	
68	11	
69	11	
70	11	
71	11	
72	11	
73	11	
74	11	
75	11	
76	11	
77	11	
78	11	
79	11	
80	11	
81	11	
82	11	
83	11	
84	11	
85	11	
86	11	
87	11	
88	11	
89	11	
90	11	
91	11	
92	11	
93	11	
94	11	
95	11	
96	11	
97	11	
98	11	
99	11	
100	11	

13	20	13	20
14	20	14	20
15	20	15	20
16	20	16	20
17	20	17	20
18	18	18	18
19	18	19	18
20	18	20	18
21	18	21	18
22	07	22	07
23	00	23	00
24	07	24	07
12	10	12	10
10	16	10	16
09	16	09	16
08	19	08	19
07	19	07	19
06	20	06	20
05	20	05	20
04	20	04	20
03	20	03	20
02	18	02	18
01	17	01	17



Trace No	Marker	time (ms)
1	Start	0
2	End	1000

```
Record time: 200 ms
Delay time: 0000 ms
Shot pos.: 0130.0
Layout start: 0000.0
Layout end: 0230.0
Profile No.: 0000003
Note: 00000000000001
Operator: 00001
```

ABEM Terraloc Seismic System

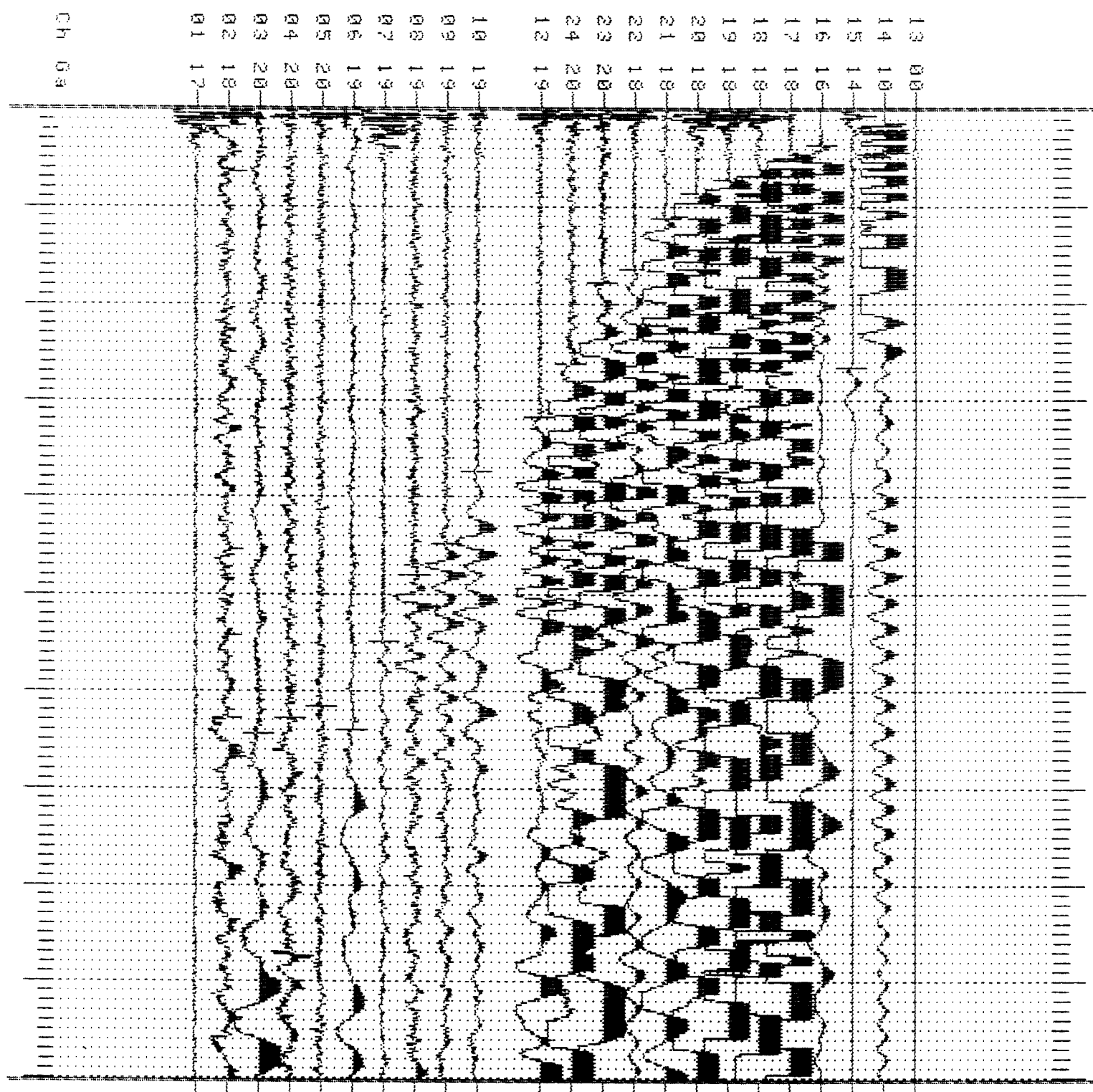
ABEM Terraloc Seismic System Record-000615 Date-920502 Time-14:35

Shot pos.: 0230.0 Layout start: 0000.0 Layout end: 0230.0

Profile No.: 000005 Note: 000000000001 Operator: 00001

Record time: 200 ms Delay time: 0000 ms Analog filter: 100

Display mode: Normal, Low-cut: Off Hz High-cut: Off Hz Shots: 001



Listing of markers: Record-000615 Date-920502 Time-14:35

Trace No	Marker time (ms)	Field notes
01	0000.0	Record time: 200 ms
02	0000.0	Delay time: 0000 ms
03	0000.0	Shot pos.: 0230.0
04	0000.0	Layout start: 0000.0
05	0000.0	Layout end: 0230.0
06	0000.0	Profile No.: 000005
07	0000.0	Note: 000000000001
08	0000.0	Operator: 00001
09	0000.0	
10	0000.0	
11	0000.0	
12	0000.0	
13	0000.0	
14	0000.0	
15	0000.0	
16	0000.0	
17	0000.0	
18	0000.0	
19	0000.0	

ABEM Terraloc Seismic System Record-000615 Date-920502 Time-15:16

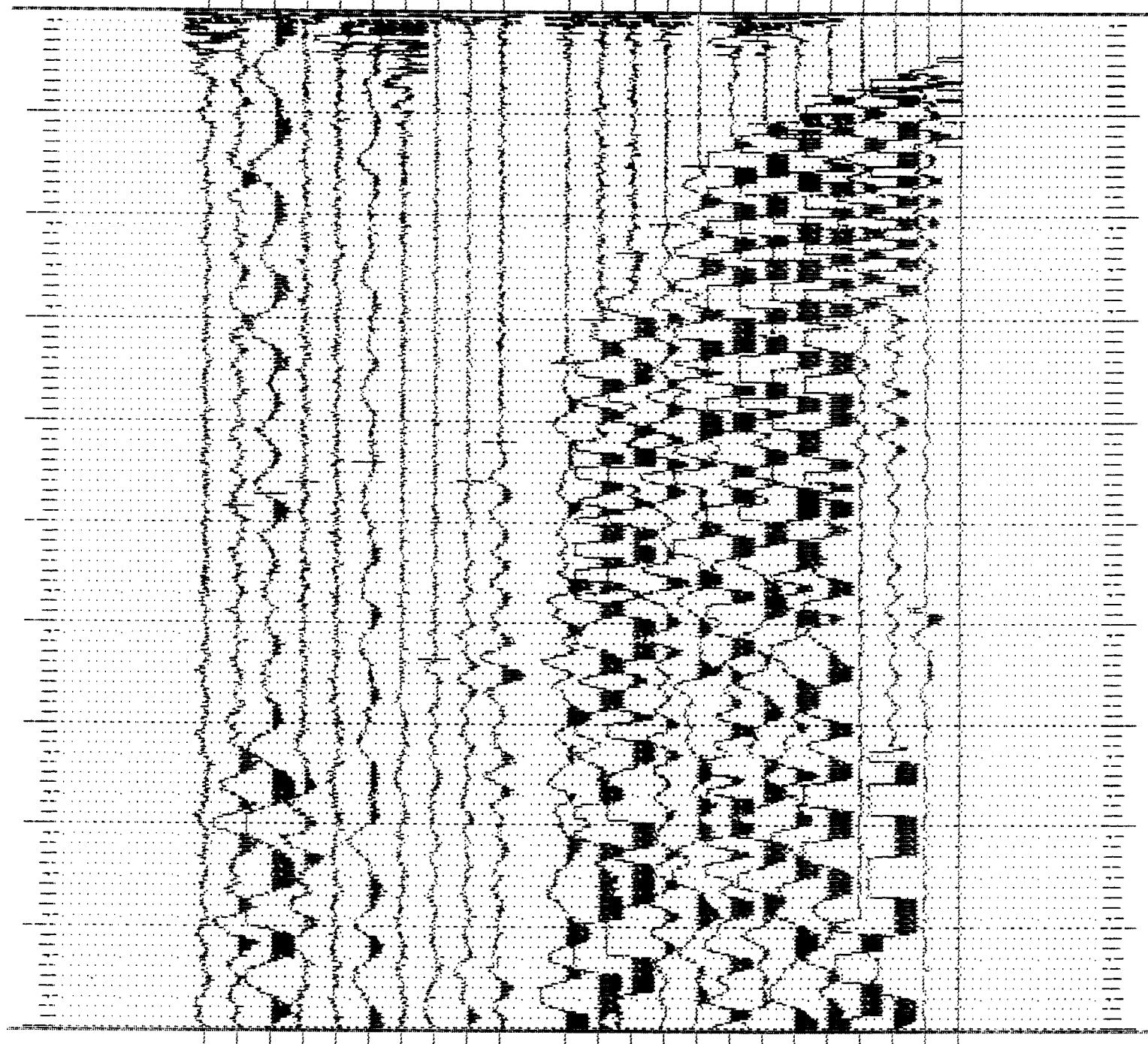
Shot pos.: 0290.0 Layout start: 0000.0 Layout end: 0230.0

Profile No.: 000006 Note: 000000000001 Operator: 00001

Record time: 200 ms Delay time: 0000 ms Analog filter: 100

Display mode: Normal, Low-cut: Off Hz High-cut: Off Hz Shots: 001

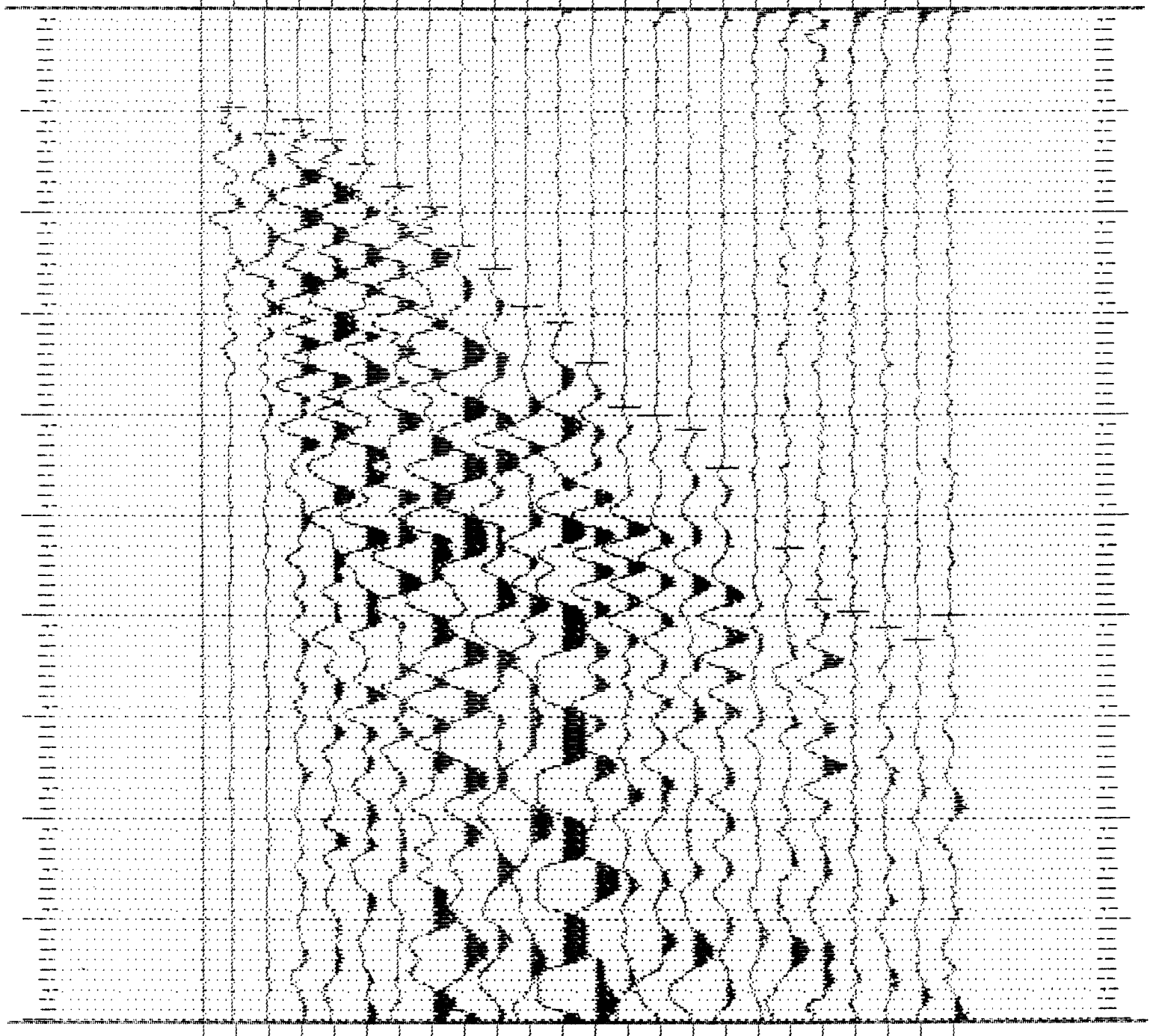
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21



Listing of markers: Record-000615 Date-920502 Time-15:16

Trace No	Marker time (ms)	Field notes
10	0000.0	Record time: 200 ms
20	0000.0	Delay time: 0000 ms
30	0000.0	Shot pos.: 0290.0
40	0000.0	Layout start: 0000.0
50	0000.0	Layout end: 0230.0
60	0000.0	Profile No.: 000006
70	0000.0	Note: 000000000001
80	0000.0	Operator: 00001

13	20
14	20
15	20
16	20
17	20
18	20
19	20
20	19
21	19
22	19
23	19
24	19
12	20
11	19
10	19
09	19
08	19
07	18
06	18
05	18
04	17
03	14
02	10
01	00



```
Record time: 200 ms
Delay time: 0000 ms
Shot pos.: 0420.0
Layout start: 0400.0
Layout end: 0710.0
Profile No.: 000000
Note: 4000000000002
Operator: 00001
```

ABEM Terraloc Seismic System

ABEM Terraloc Seismic System

Record-000615

Date-920503

Time-09:50

Shot pos.: 0480.0

Layout start: 0480.0

Layout end: 0710.0

Profile No.: 000007

Note: 400000000002

Operator: 00001

Record time: 200 ms

Delay time: 0000 ms

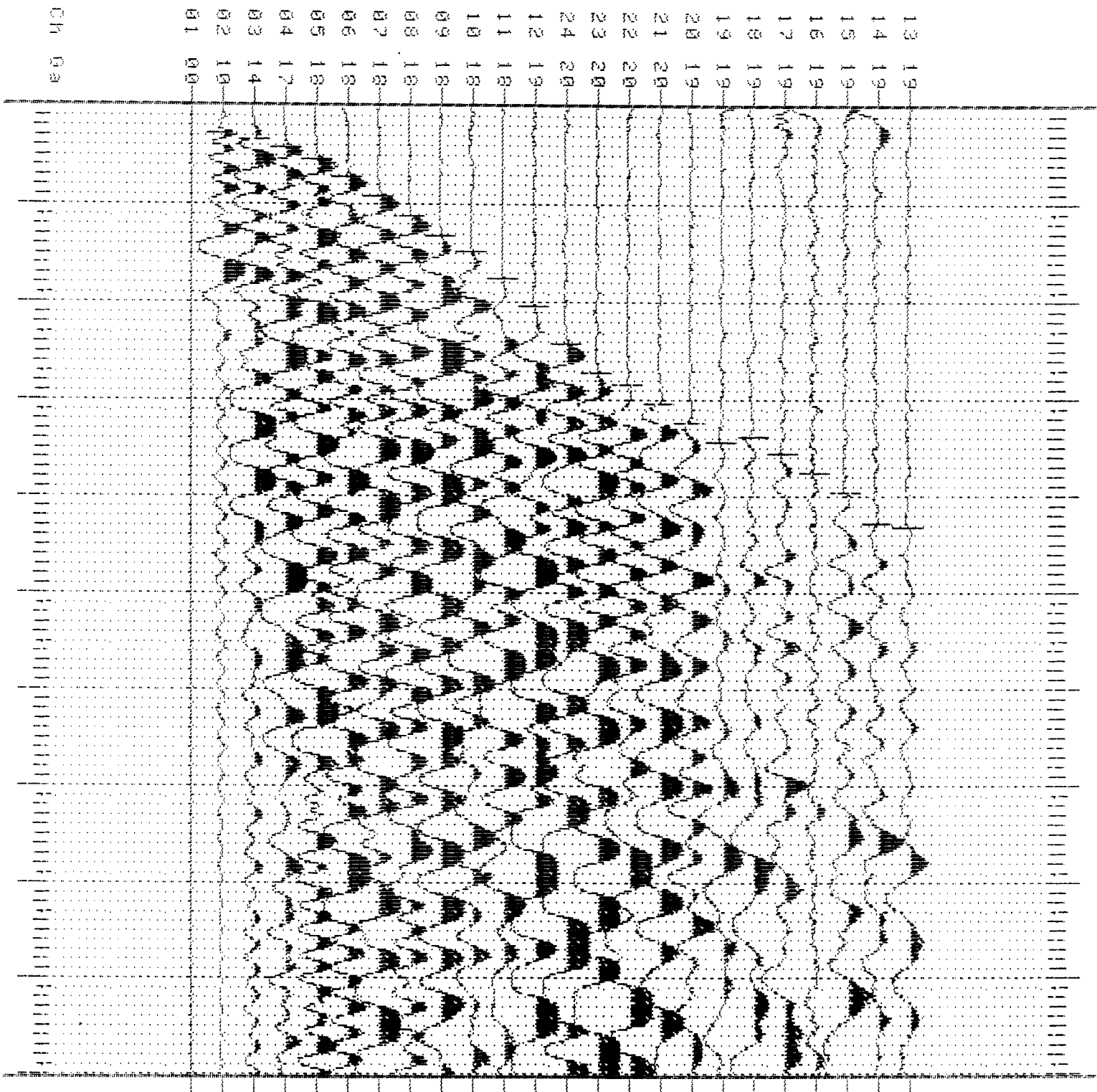
Analog filter: 100

Display mode: Normal,

Low-cut: Off Hz

High-cut: 150Hz

Shots: 001



Listing of markers:

Record-000615

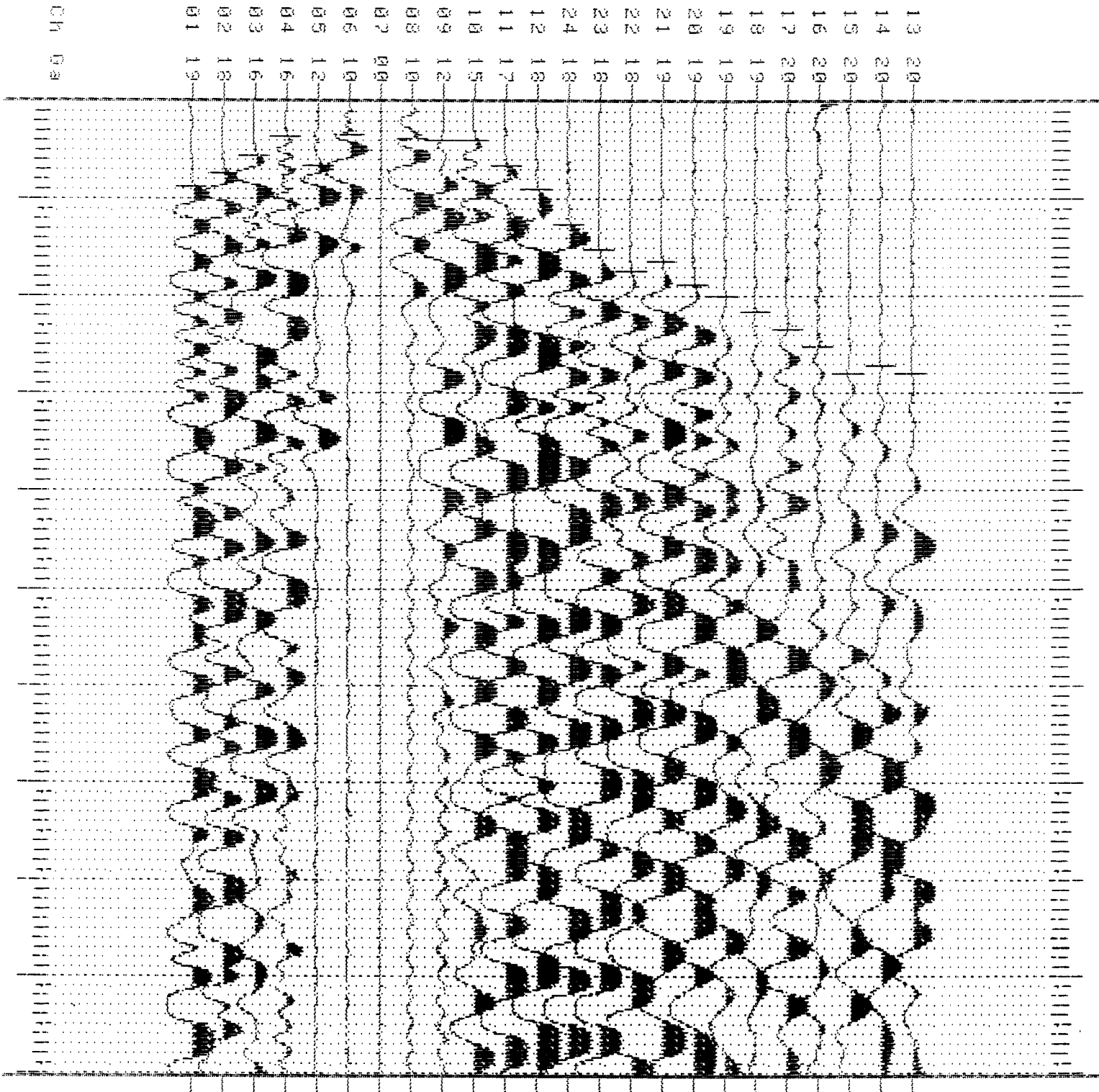
Date-920503

Time-09:50

Trace No	Marker time (ms)	Field notes
10	00	Record time: 200 ms
20	01	Delay time: 0000 ms
30	04	Shot pos.: 0480.0
40	07	Layout start: 0480.0
50	10	Layout end: 0710.0
60	13	Profile No.: 000007
70	16	Note: 400000000002
80	19	Operator: 00001

ABEM Terraloc Seismic System

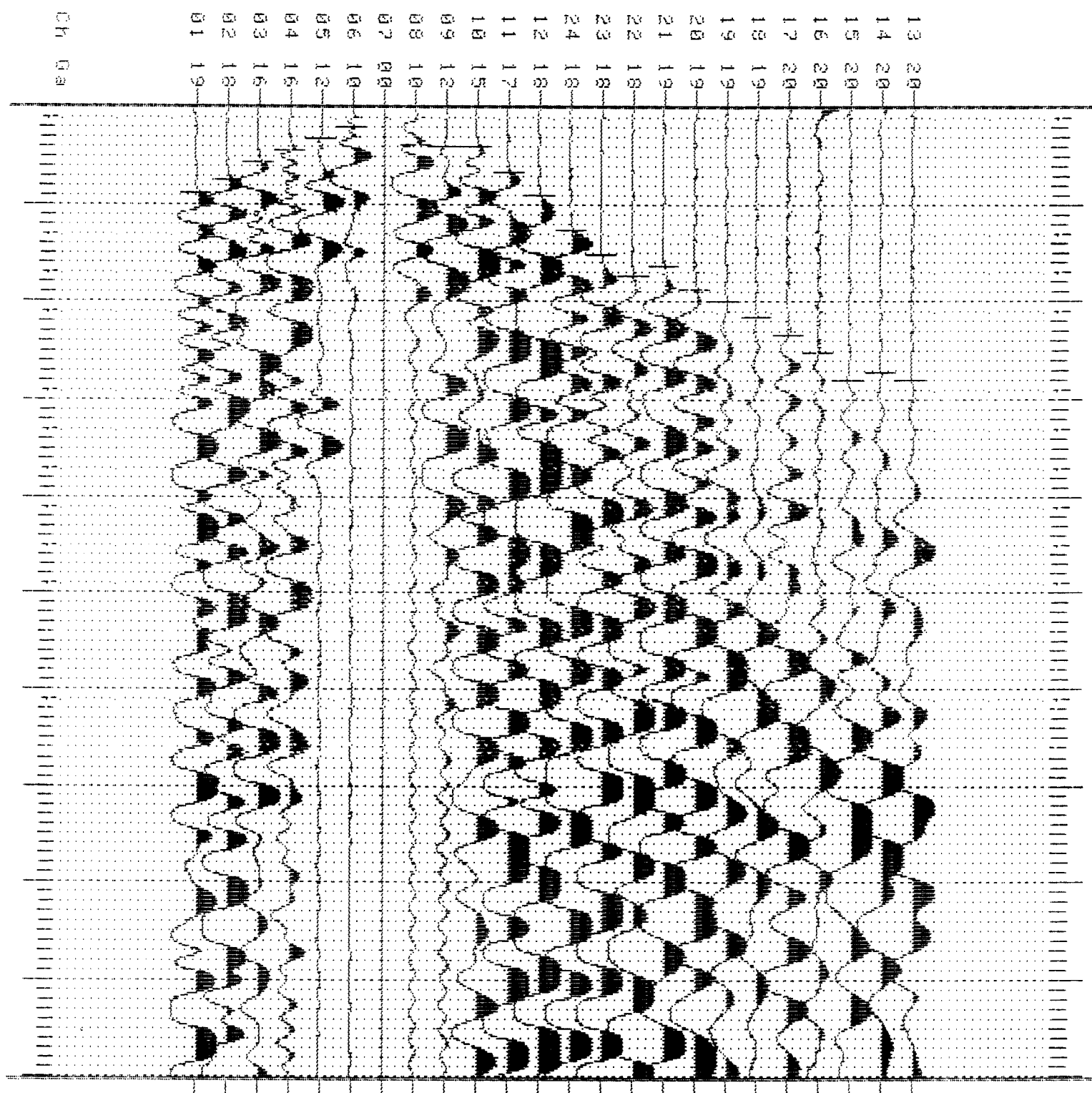
ABEM Terraloc Seismic System Record-000615 Date-920503 Time-10:54
Shot pos.: 0420.0 Layout start: 0400.0 Layout end: 0710.0
Profile No.: 000000 Note: 4000000000002 Operator: 00001
Record time: 200 ms Delay time: 0000 ms Analog filter: 100
Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920503 Time-10:54

Trace No	Marker time (ms)	Field notes
1	1.0	Record time: 200 ms
2	2.0	Delay time: 0000 ms
3	3.0	Shot pos.: 0420.0
4	4.0	Layout start: 0400.0
5	5.0	Layout end: 0710.0
6	6.0	Profile No.: 000000
7	7.0	Note: 4000000000002
8	8.0	Operator: 00001

```
Shot pos.:      0540,0      Layout start:    0480,0      Layout end:      0710,0
Profile No.:    000000      Note:         4000000000002      Operator:        00001
Record time:    200 ms      Delay time:     0000 ms      Analog filter:   100
Display mode:   Normal      Low-cut: Off Hz      High-cut: 150Hz      Shots: 001
```

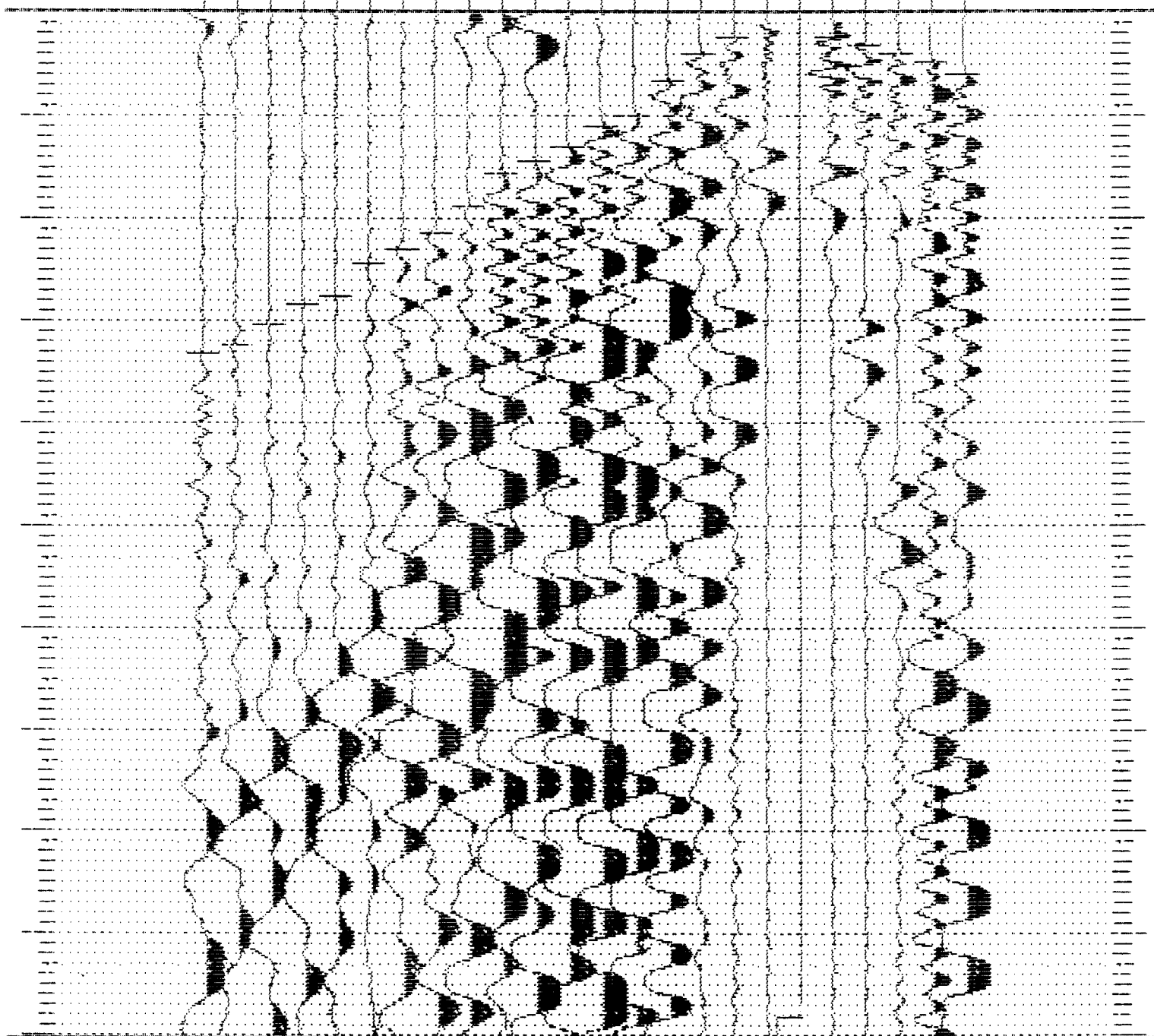


Trace No	Marker	time (ms)
----------	--------	-----------

Field notes.

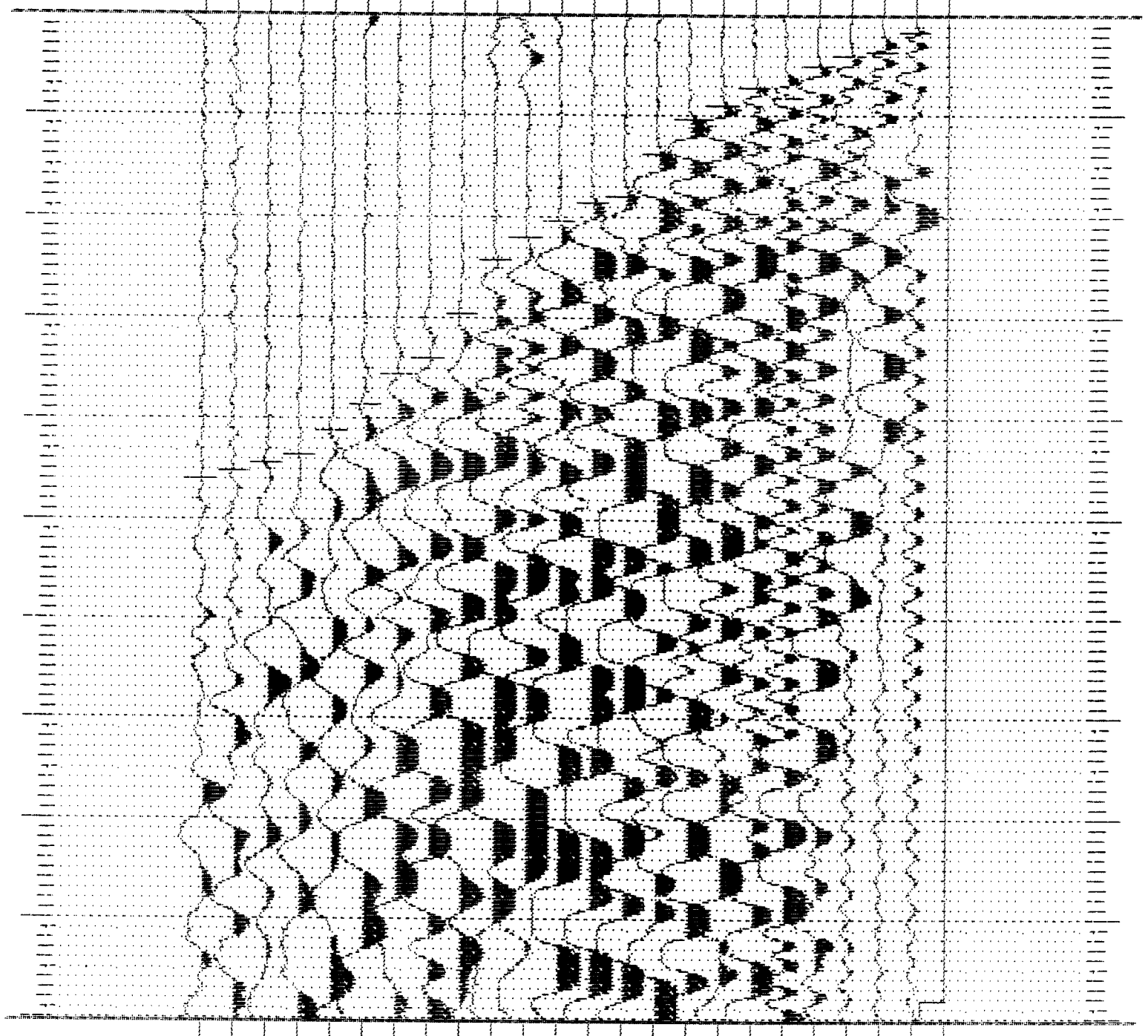
```
Record time: 230 ms
Delay time: 0000 ms
Shot pos.: 0540.0
Layout start: 0400.0
Layout end: 0710.0
Profile No.: 000000
Note: 4000000000002
Operator: 00001
```


13	18
14	16
15	14
16	12
17	10
18	09
19	10
20	12
21	14
22	16
23	18
24	20
12	20
11	20
10	20
09	20
08	20
07	20
06	19
05	20
04	20
03	20
02	20
01	20



Trace No	Marker	time (ms)	Field notes
1	1	0.0000	Record time: 200 ms
2	2	0.0000	Delay time: 0000 ms
3	3	0.0000	Shot pos.: 0660.0
4	4	0.0000	Layout start: 0400.0
5	5	0.0000	Layout end: 0710.0
6	6	0.0000	Profile No.: 000009
7	7	0.0000	Note: 4000000000002
8	8	0.0000	Operator: 00001

13	00
14	10
15	14
16	16
17	18
18	19
19	19
20	19
21	20
22	20
23	20
24	20
12	20
11	20
10	20
09	20
08	20
07	20
06	20
05	20
04	20
03	20
02	20
01	20



Trace No	Marker	Time (ms)
----------	--------	-----------

```
Record time: 200 ms
Delay time: 0000 ms
Shot pos.: 0710.0
Layout start: 0480.0
Layout end: 0710.0
Profile No.: 000010
Note: 4000000000002
Operator: 00001
```

ABEM Terraloc Seismic System

ABEM Terraloc Seismic System Record-000615 Date-920503 Time-15:37

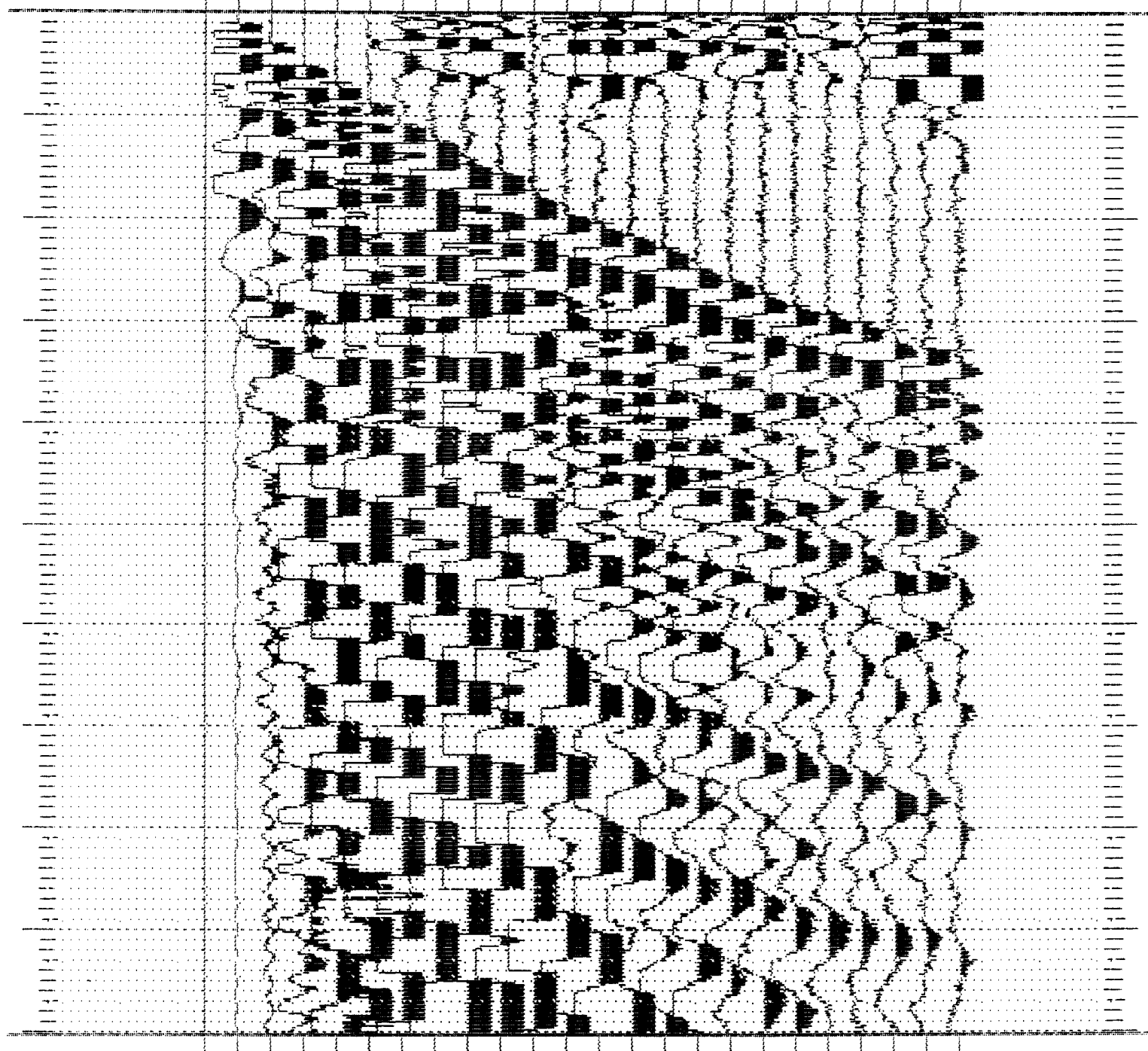
Shot pos.: 0710.0 Layout start: 0710.0 Layout end: 0940.0

Profile No.: 000011 Note: 4000000000003 Operator: 00001

Record time: 200 ms Delay time: 0000 ms Analog filter: 100

Display mode: Normal, Low-cut: Off Hz High-cut: Off Hz Shots: 001

Ch	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19

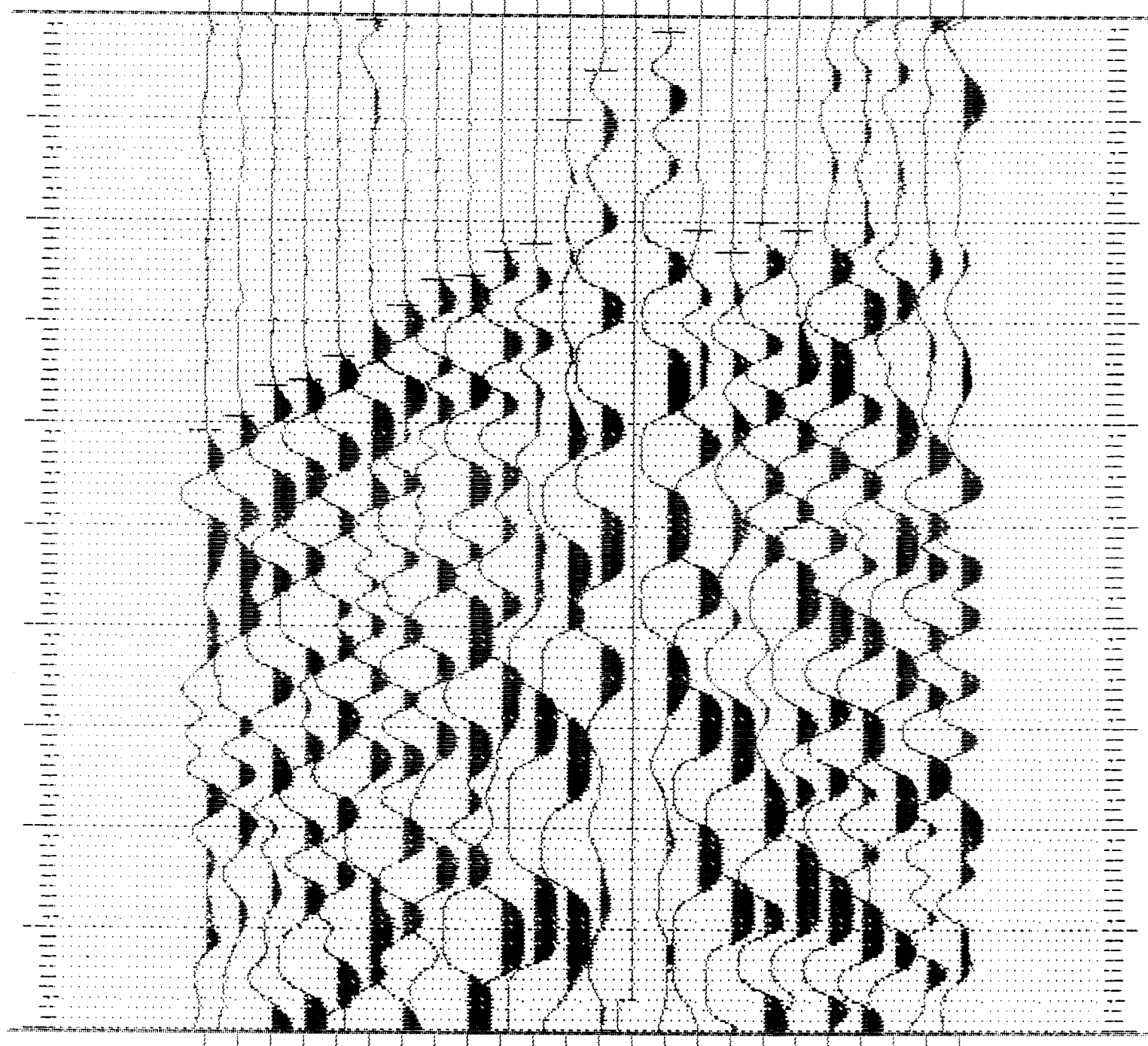


Listing of markers: Record-000615 Date-920503 Time-15:37

Trace No	Marker time (ms)	Field notes
1	0000	Record time: 200 ms
2	0000	Delay time: 0000 ms
3	0000	Shot pos.: 0710.0
4	0000	Layout start: 0710.0
5	0000	Layout end: 0940.0
6	0000	Profile No.: 000011
7	0000	Note: 4000000000003
8	0000	Operator: 00001

Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001

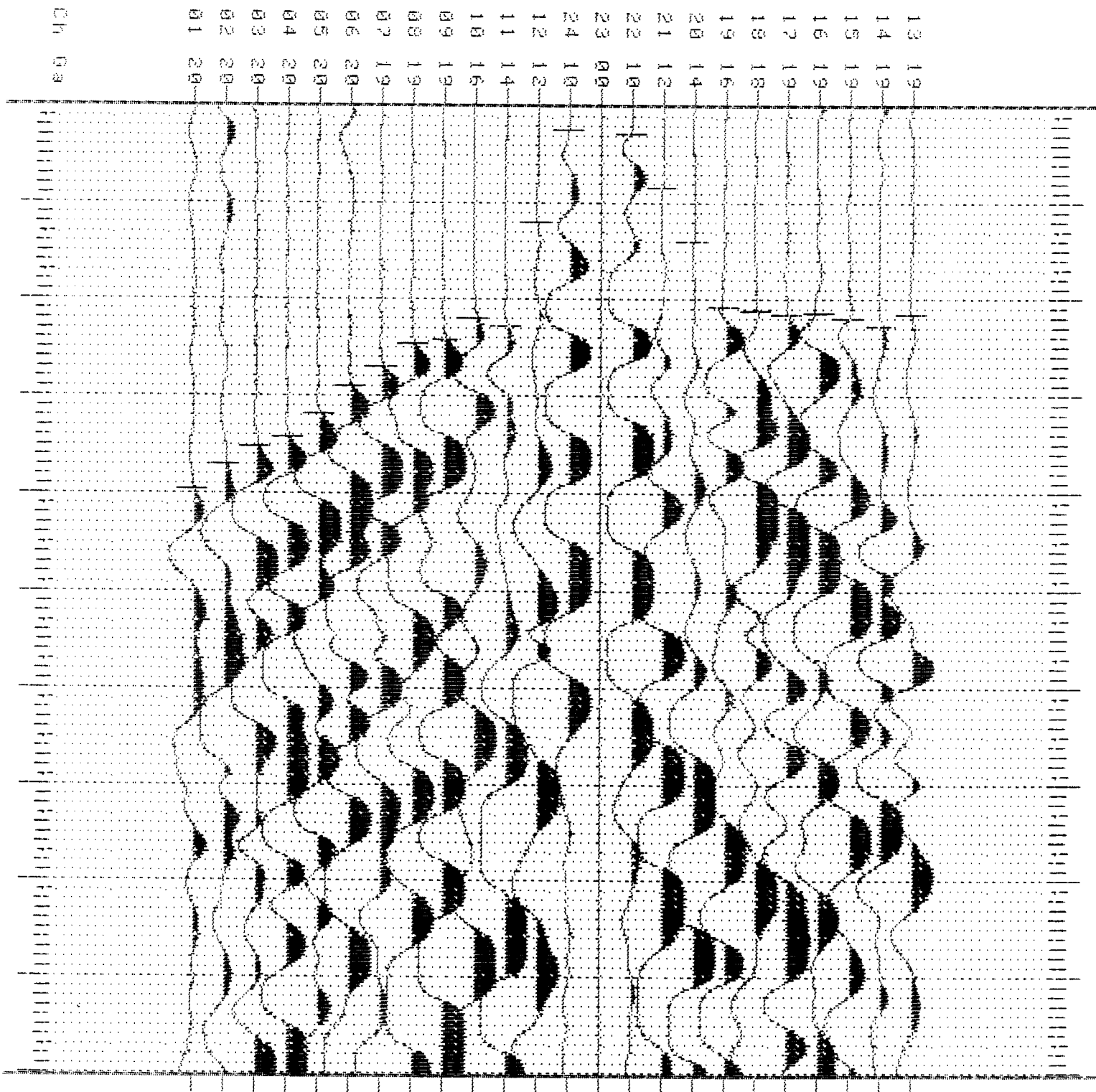
13	13	13
14	13	
15	13	
16	13	
17	13	
18	13	
19	16	
20	14	
21	12	
22	10	
23	00	
24	10	
12	12	
11	14	
10	16	
09	13	
08	13	
07	13	
06	20	
05	20	
04	20	
03	20	
02	20	
01	20	



Operator: 00001

ABEM Terraloc Seismic System

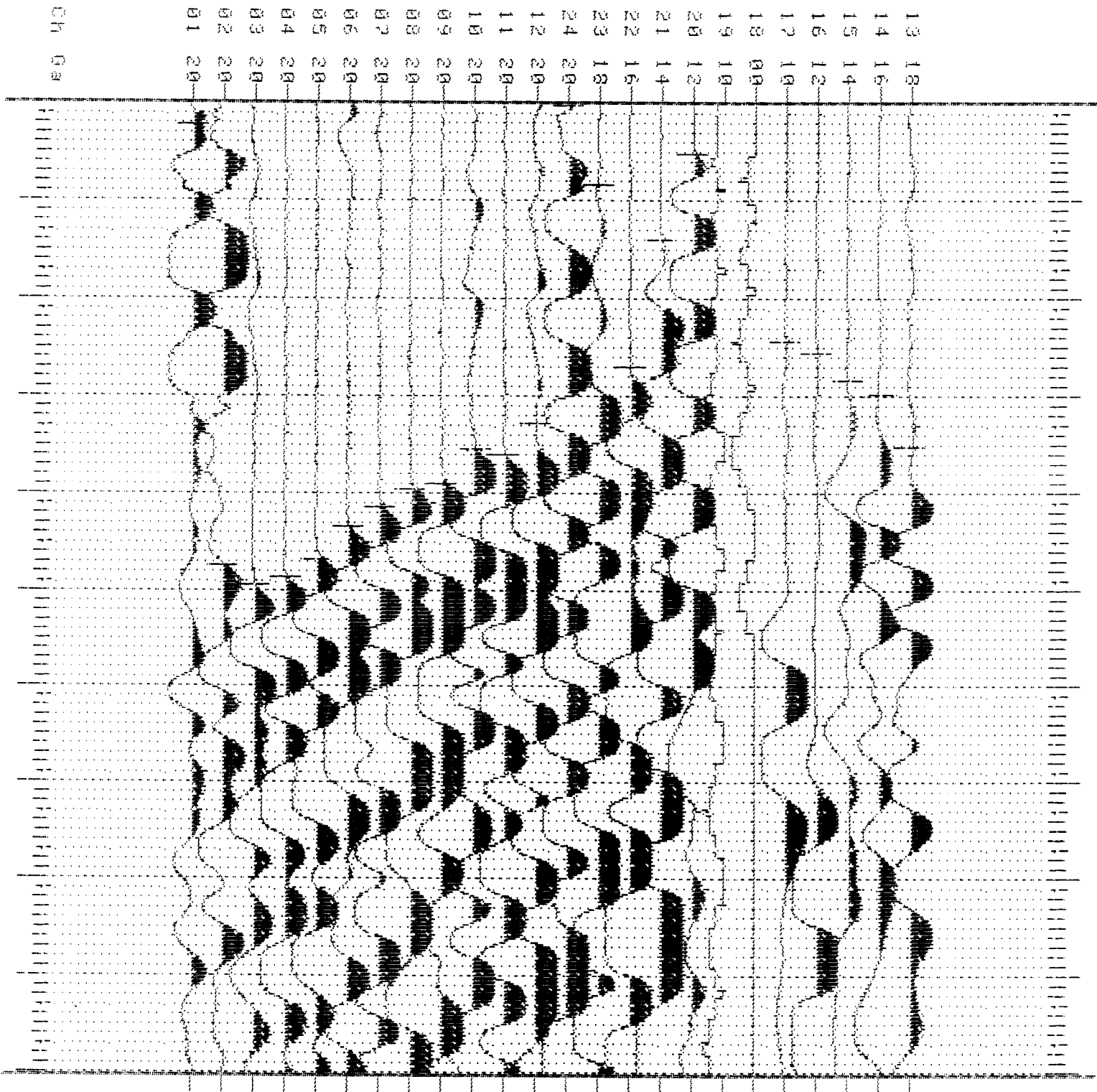
ABEM Terraloc Seismic System Record-000615 Date-920504 Time-09:34
Shot pos.: 0840.0 Layout start: 0710.0 Layout end: 0940.0
Profile No.: 000013 Note: 4000000000003 Operator: 00001
Record time: 100 ms Delay time: 0000 ms Analog filter: 100
Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920504 Time-09:34

Trace No	Marker time (ms)	Field notes
10	0.0	Record time: 100 ms
20	0.2	Delay time: 0000 ms
30	0.4	Shot pos.: 0840.0
40	0.6	Layout start: 0710.0
50	0.8	Layout end: 0940.0
60	1.0	Profile No.: 000013
70	1.2	Note: 4000000000003
80	1.4	Operator: 00001
90	1.6	
100	1.8	
110	2.0	
120	2.2	
130	2.4	
140	2.6	
150	2.8	
160	3.0	
170	3.2	
180	3.4	
190	3.6	
200	3.8	

ABEM Terraloc Seismic System Record-000615 Date-920504 Time-10:01
Shot pos.: 0000.0 Layout start: 0710.0 Layout end: 0940.0
Profile No.: 000014 Note: 4000000000003 Operator: 00001
Record time: 100 ms Delay time: 0000 ms Analog filter: 100
Display mode: Normal, Low-cut: Off Hz High-cut: 200Hz Shots: 001



Listing of markers: Record-000615 Date-920504 Time-10:01		
Trace No	Marker time (ms)	Field notes
1	0000.0	Record time: 100 ms
2	0000.0	Delay time: 0000 ms
3	0000.0	Shot pos.: 0000.0
4	0000.0	Layout start: 0710.0
5	0000.0	Layout end: 0940.0
6	0000.0	Profile No.: 000014
7	0000.0	Note: 4000000000003
8	0000.0	Operator: 00001
9	0000.0	
10	0000.0	
11	0000.0	
12	0000.0	
13	0000.0	
14	0000.0	
15	0000.0	
16	0000.0	
17	0000.0	
18	0000.0	
19	0000.0	
20	0000.0	

ABEM Terraloc Seismic System

DUPLICATE

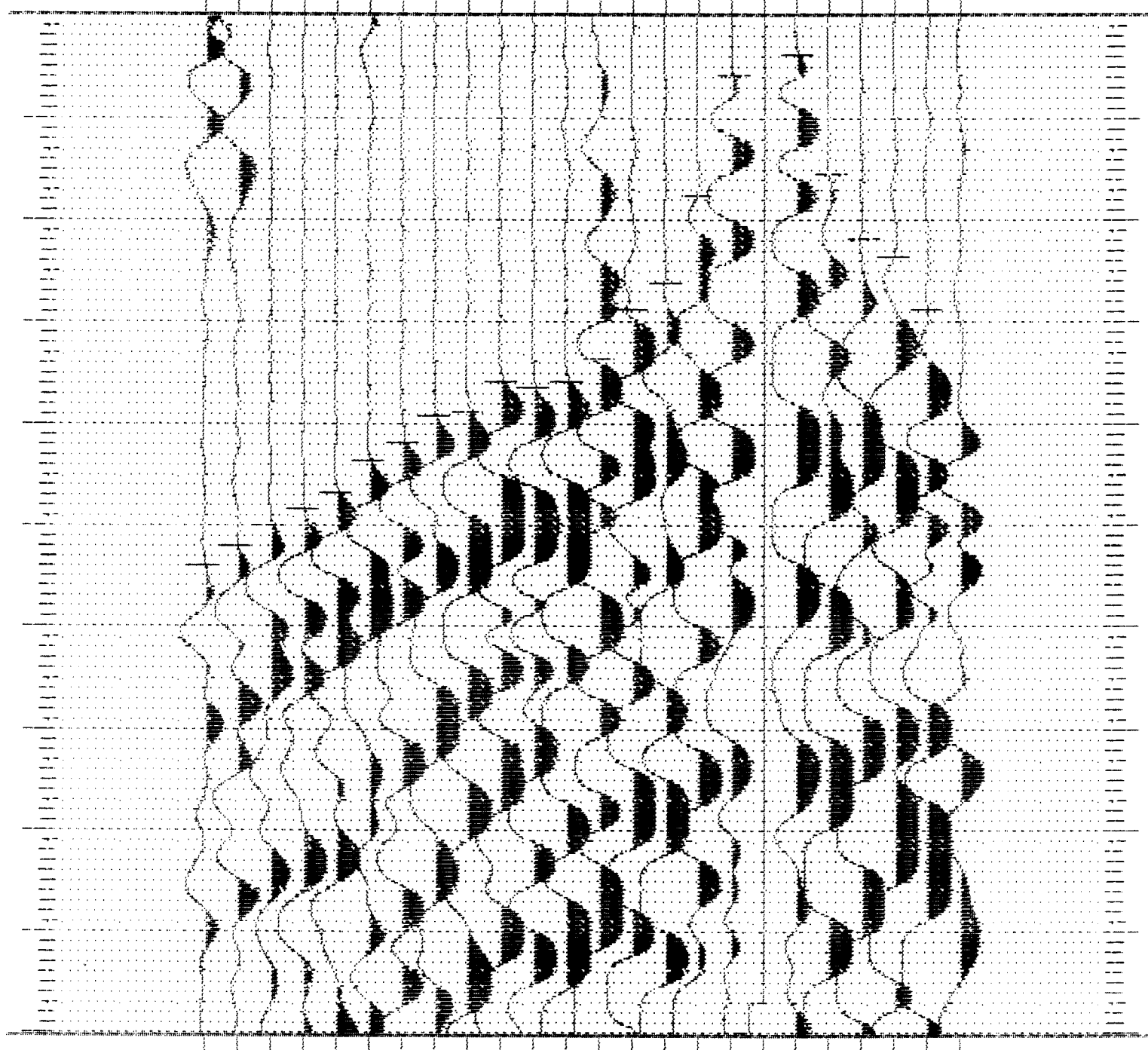
Record-000615 Date-920504 Time-10:14

Profile No.: 000014 Note: 4000000000003 Operator: 00001

Record time: 100 ms Delay time: 0000 ms Analog filter: 100

Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001

13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
122	122
11	11
10	10
09	09
08	08
07	07
06	06
05	05
04	04
03	03
02	02
01	01
CH	

[illegible]

Record-000615 Date-920504 Time-10:14

Trace No.	Marker	Time (ms)
1	Start	0.00
2	End	1.00
3	Peak	0.50
4	Baseline	0.25
5	End	1.00

Field notes

[illegible]

```
Record time: 100 ms
Delay time: 0000 ms
Shot pos.: 0000.0
Layout start: 0710.0
Layout ends: 0940.0
Profile No.: 000014
Note: 40000000000003
Operator: 00001
```

ABEM Terraloc Seismic System

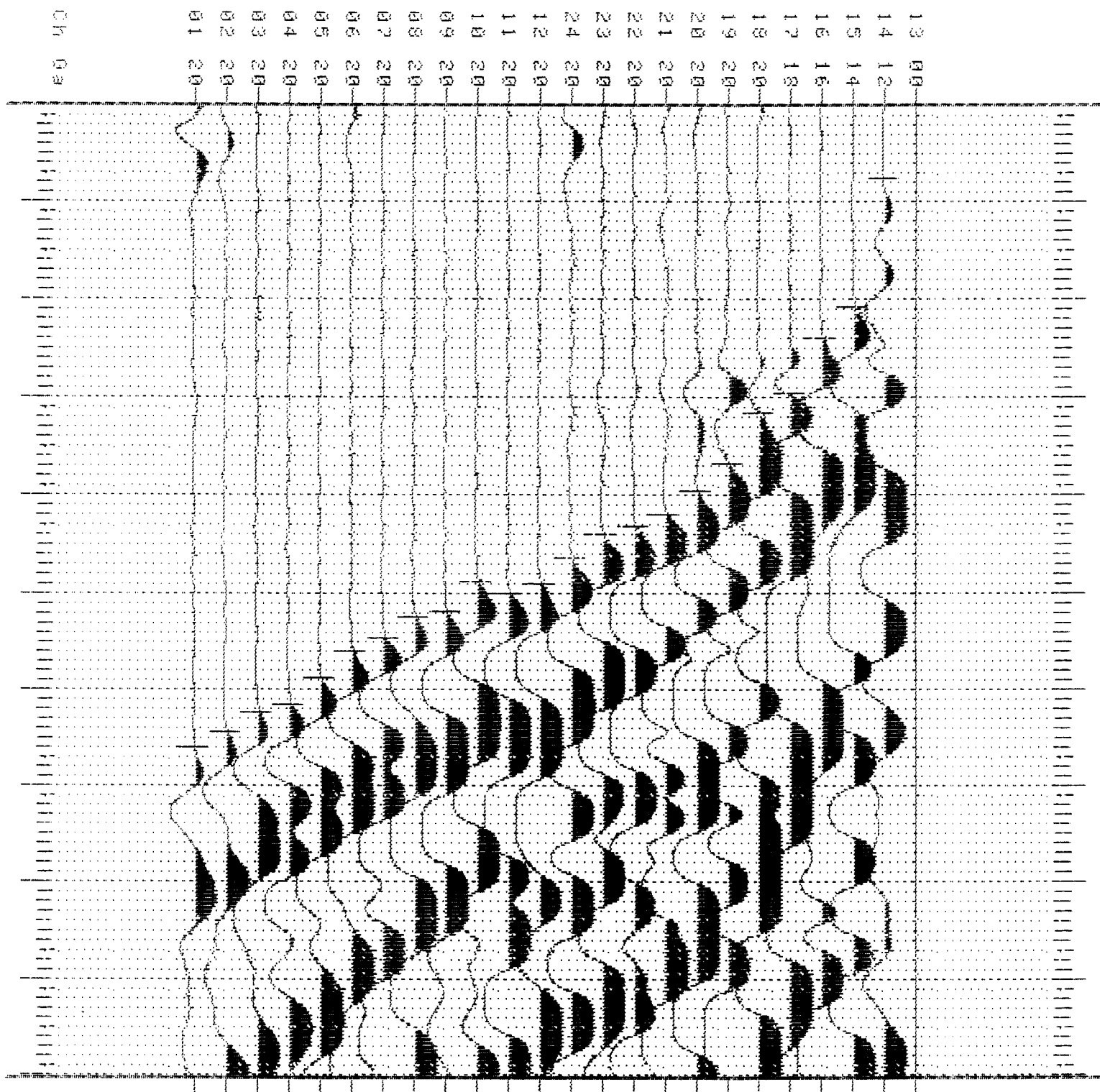
ABEM Terraloc Seismic System Record-000615 Date-920504 Time-10:49

Shot pos.: 0940.0 Layout start: 0710.0 Layout end: 0940.0

Profile No.: 100015 Note: 4000000000003 Operator: 00001

Record time: 100 ms Delay time: 0000 ms Analog filter: 100

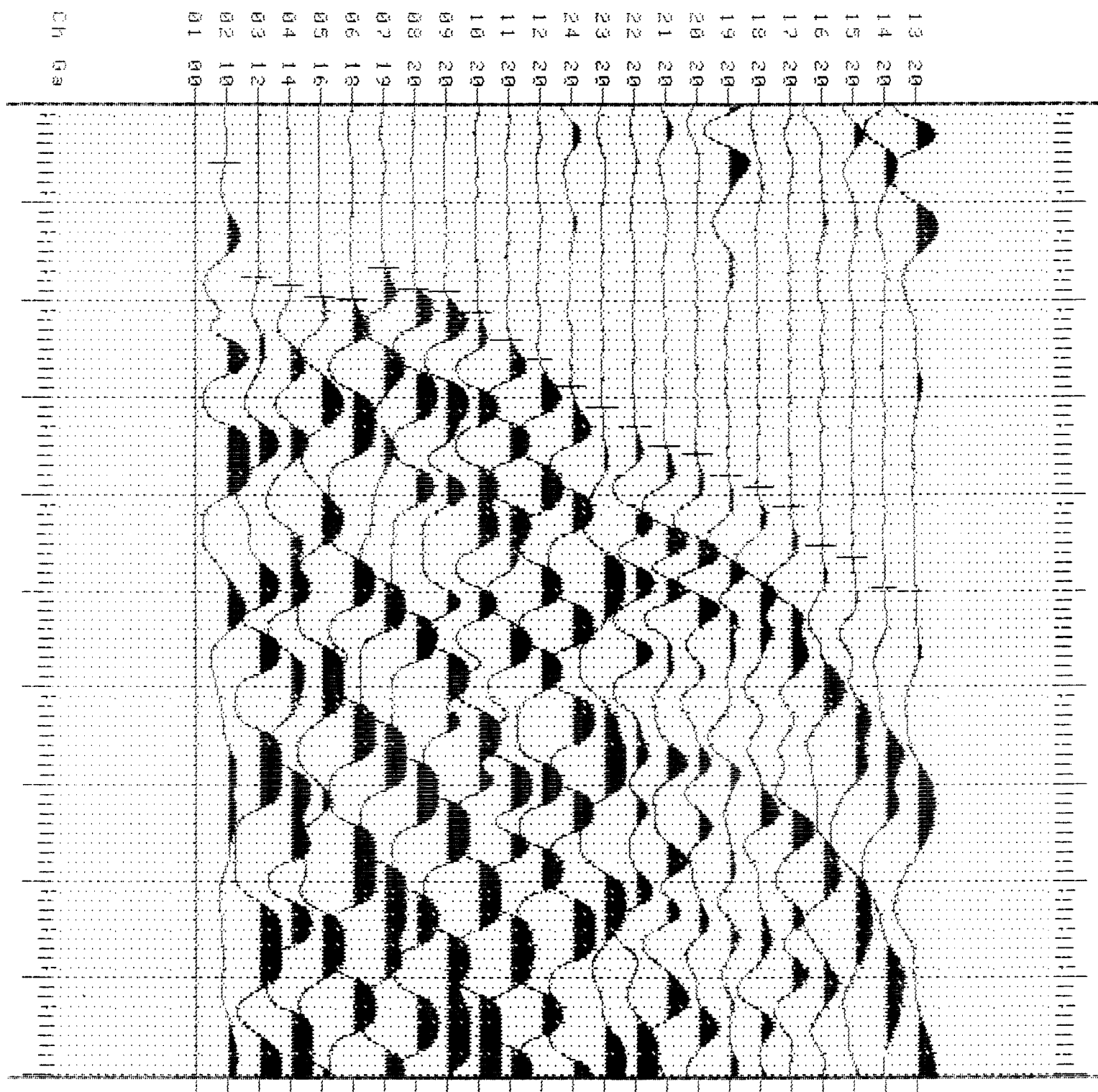
Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920504 Time-10:49

Trace No	Marker time (ms)	Field notes
1	0.0	Record time: 100 ms
2	0.0	Delay time: 0000 ms
3	0.0	Shot pos.: 0940.0
4	0.0	Layout start: 0710.0
5	0.0	Layout end: 0940.0
6	0.0	Profile No.: 100015
7	0.0	Note: 4000000000003
8	0.0	Operator: 00001

Shot pos.: 1000.0 Layout start: 1000.0 Layout end: 1310.0
 Profile No.: 100016 Note: 4000000000004 Operator: 00001
 Record time: 100 ms Delay time: 0000 ms Analog filter: 100
 Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001

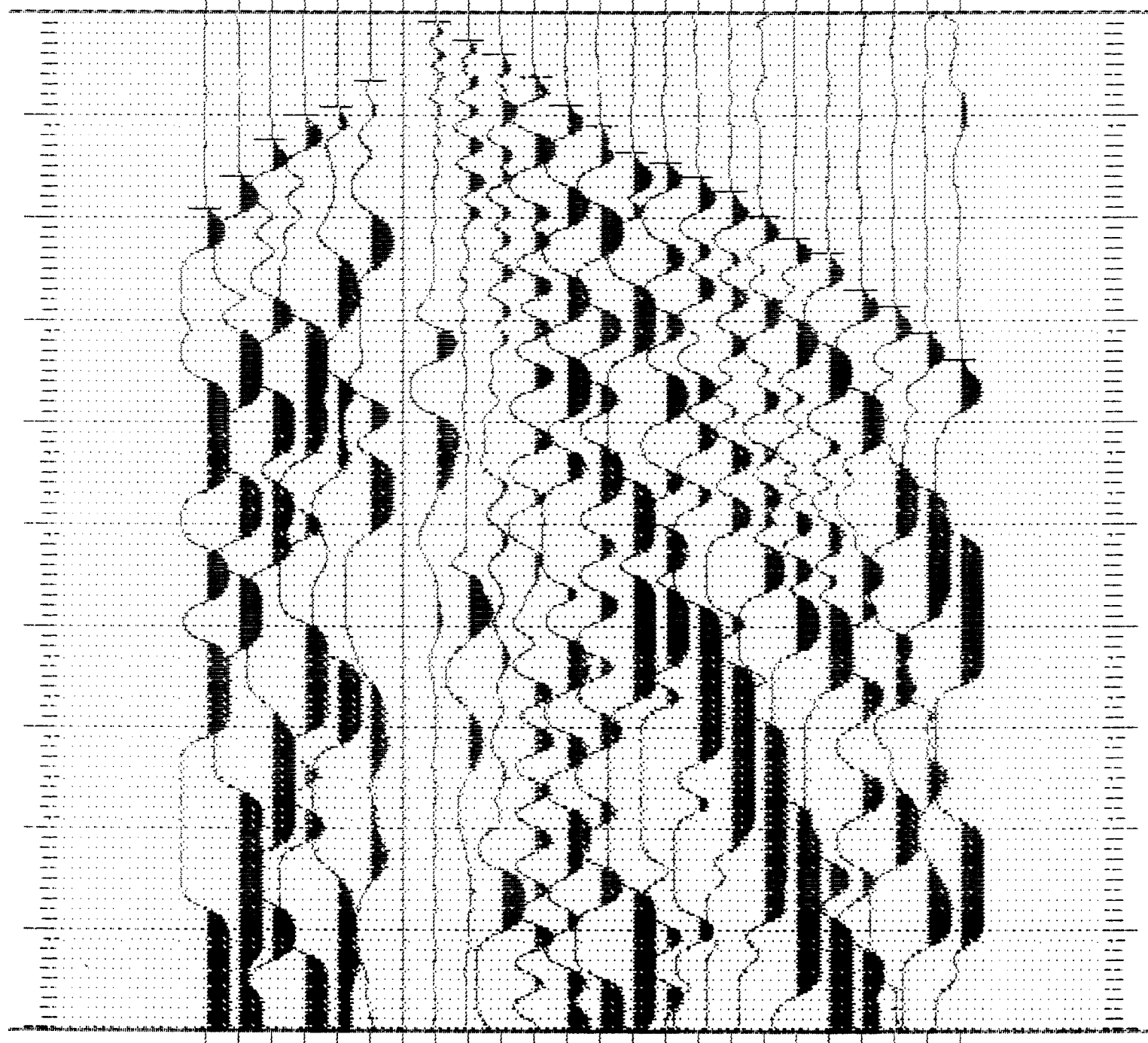


Listing of markers: Record-000615 Date-920504 Time-15:31

Trace No	Marker time (ms)	Field notes
1	0.0	Record time: 100 ms
2	0.0	Delay time: 0000 ms
3	0.0	Shot pos.: 1000.0
4	0.0	Layout start: 1000.0
5	0.0	Layout end: 1310.0
6	0.0	Profile No.: 100016
7	0.0	Note: 4000000000004
8	0.0	Operator: 00001

Shot pos.: 1140.0 Layout start: 1000.0 Layout end: 1310.0
 Profile No.: 100017 Note: 4000000000004 Operator: 00001
 Record time: 100 ms Delay time: 0000 ms Analog filter: Off
 Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001

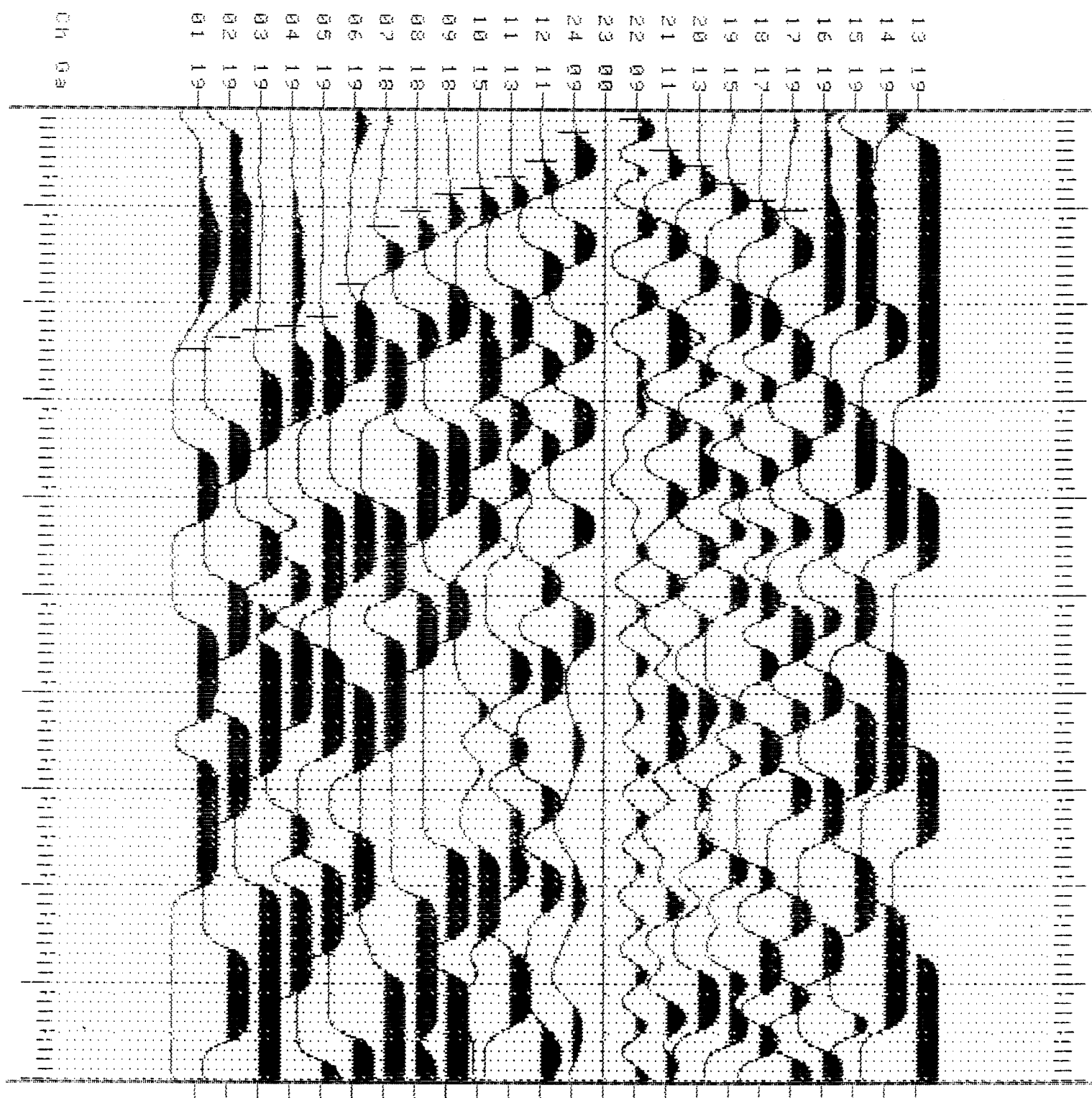
40	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
00	01	01	01	01	01	01	00	01	01	01	01	01	01	01	02	02	02	02	02	02



Listing of markers: Record-000615 Date-920504 Time-15:47

Trace No	Marker time (ms)	Field notes
1	1000.0	Record time: 100 ms
2	1000.0	Delay time: 0000 ms
3	1000.0	Shot pos.: 1140.0
4	1000.0	Layout start: 1000.0
5	1000.0	Layout end: 1310.0
6	1000.0	Profile No.: 100017
7	1000.0	Note: 4000000000004
8	1000.0	Operator: 00001

ABEM Terraloc Seismic System Record-000615 Date-920504 Time-16:26
 Shot pos.: 1210.0 Layout start: 1000.0 Layout end: 1310.0
 Profile No.: 200018 Note: 400000000004 Operator: 00001
 Record time: 100 ms Delay time: 0000 ms Analog filter: Off
 Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920504 Time-16:26

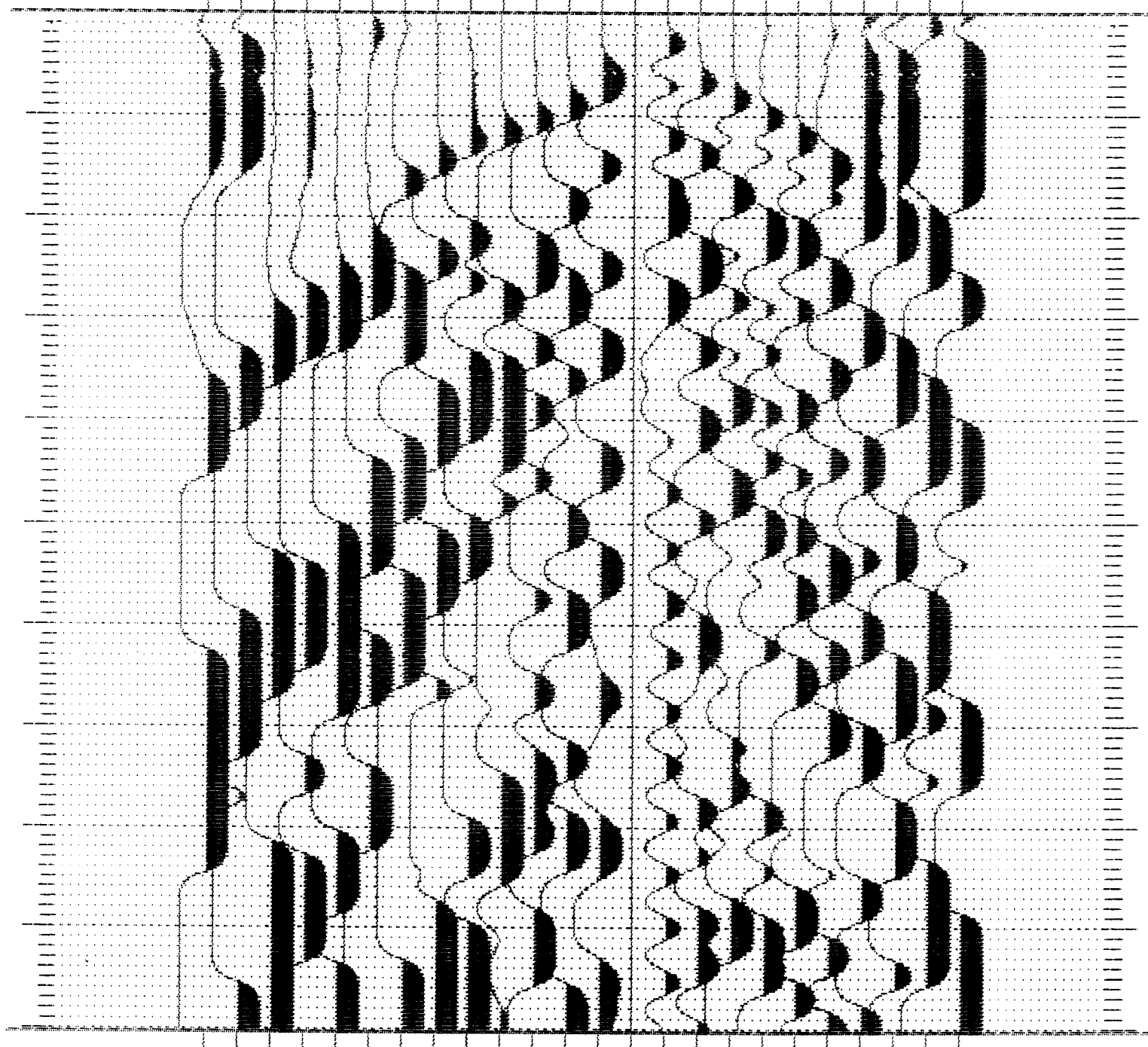
Trace No	Marker time (ms)	Field notes
1	1000.0	Record time: 100 ms
2	1000.0	Delay time: 0000 ms
3	1000.0	Shot pos.: 1210.0
4	1000.0	Layout start: 1000.0
5	1000.0	Layout end: 1310.0
6	1000.0	Profile No.: 200018
7	1000.0	Note: 400000000004
8	1000.0	Operator: 00001

```

ABEM Terraloc Seismic System      Record-000615   Date-920504   Time-16:16
Shot pos.:      1210.0      Layout start:  1000.0      Layout end:    1310.0
Profile No.:    100010      Note:      4000000000004      Operator:      00001
Record time:    100 ms      Delay time:    0000 ms      Analog filter: Off
Display mode: Normal,      Low-cut: Off Hz      High-cut: 150Hz      Shots: 001

```

0	1	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	2	1	1	1	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0



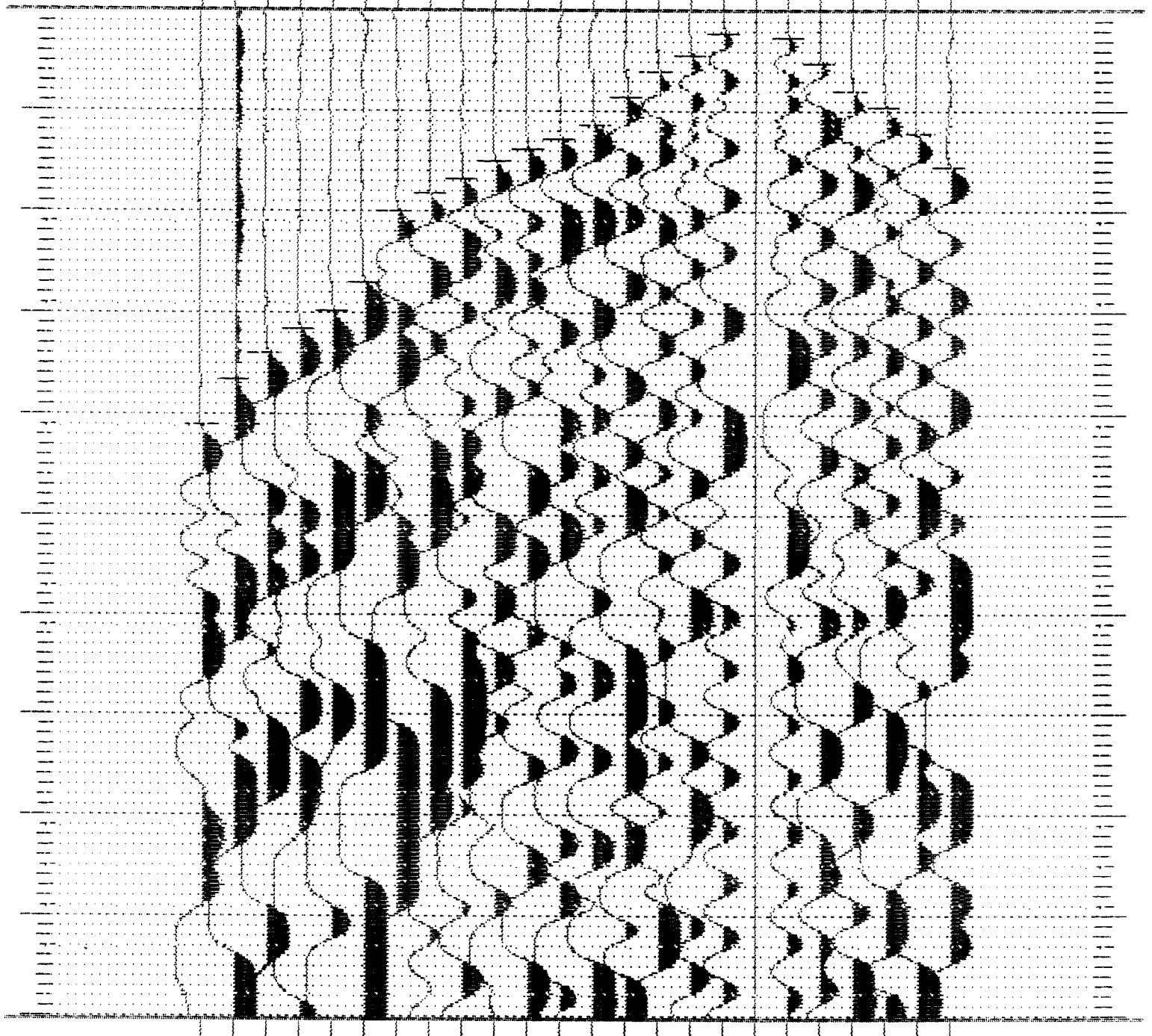
```

Listing of markers:      Record-000615   Date-920504   Time-16:16

```

Trace No	Marker time (ms)	Field notes
1	1000.0	Record time: 100 ms
2	1000.0	Delay time: 0000 ms
3	1000.0	Shot pos.: 1210.0
4	1000.0	Layout start: 1000.0
5	1000.0	Layout end: 1310.0
6	1000.0	Profile No.: 100010
7	1000.0	Note: 4000000000004
8	1000.0	Operator: 00001

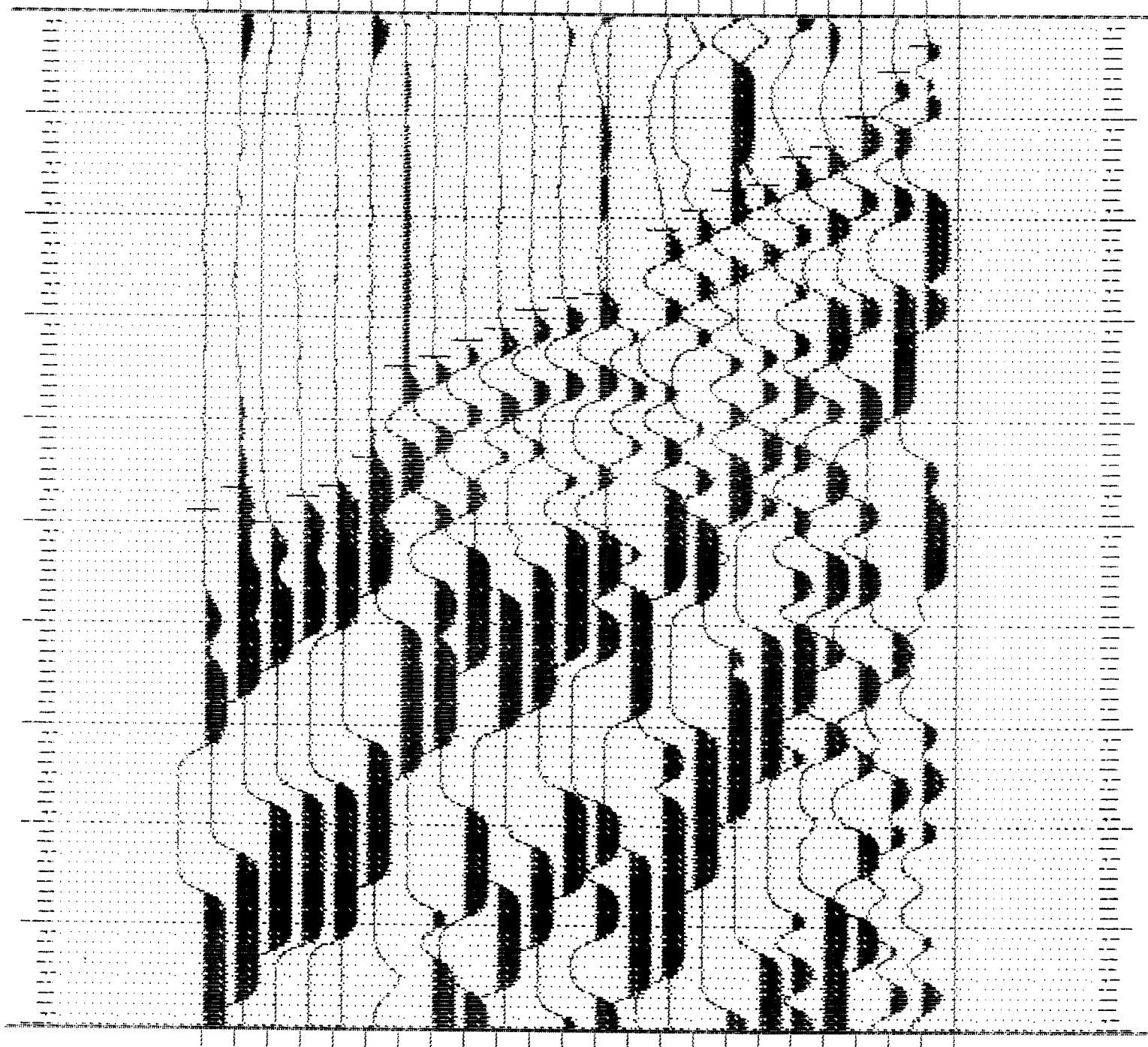
13	18	Ch
14	18	
15	18	
16	16	
17	14	
18	12	
19	00	
20	12	
21	14	
22	16	
23	18	
24	20	
12	20	
11	20	
10	20	
09	20	
08	20	
07	20	
06	20	
05	20	
04	20	
03	20	
02	20	
01	20	



Listing of markers: Record-000615 Date-920505 Time-09:20

Trace No	Marker time (ms)	Field notes
1	100	Record time: 100 ms
2	8000	Delay time: 8000 ms
3	1250.0	Shot pos.: 1250.0
4	1000.0	Layout start: 1000.0
5	1310.0	Layout end: 1310.0
6	100019	Profile No.: 100019
7	4000000000004	Note: 4000000000004
8	00001	Operator: 00001

CH	Gas	CH	Gas
13	00	13	00
14	12	14	12
15	14	15	14
16	16	16	16
17	18	17	18
18	20	18	20
19	20	19	20
20	20	20	20
21	20	21	20
22	20	22	20
23	20	23	20
24	20	24	20
12	20	12	20
11	20	11	20
10	20	10	20
09	20	09	20
08	20	08	20
07	20	07	20
06	20	06	20
05	20	05	20
04	20	04	20
03	20	03	20
02	20	02	20
01	20	01	20



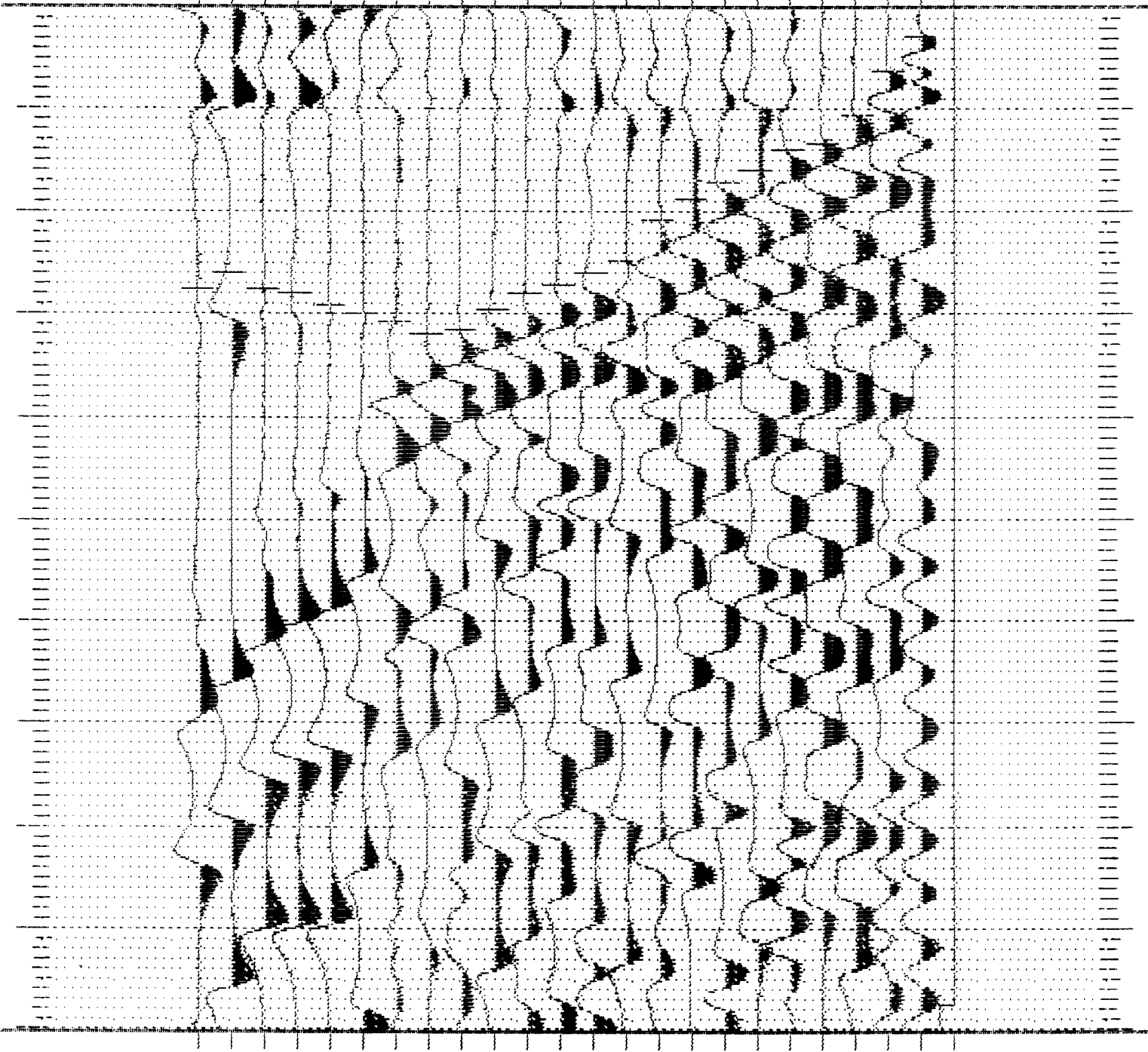
Trace No	Marker	time (ms)
----------	--------	-----------

```
Record time:      100 ms
Delay time:      0000 ms
Shot pos.:       1310.0
Layout start:    1000.0
Layout end:      1310.0
Profile No.:     100020
Note:           4000000000004
Operator:        00001
```

ABEM Terraloc Seismic System

ABEM Terraloc Seismic System Record-000615 Date-920505 Time-10:32
Shot pos.: 1310.0 Layout start: 1000.0 Layout end: 1310.0
Profile No.: 200020 Note: 4000000000004 Operator: 00001
Record time: 100 ms Delay time: 0000 ms Analog filter: Off
Display mode: Normal, Low-cut: 50Hz High-cut: 200Hz Shots: 001

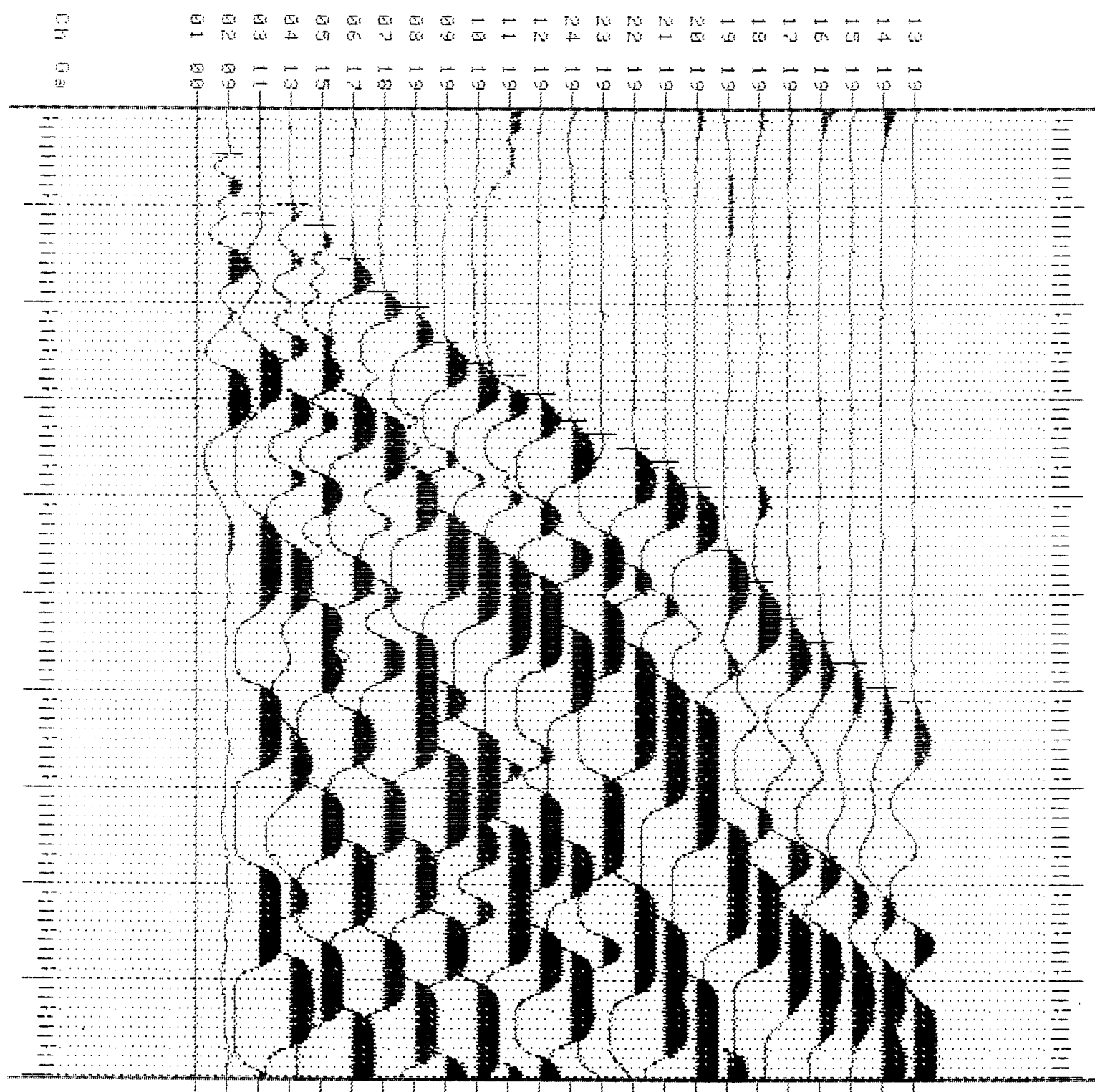
40	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	00



Listing of markers: Record-000615 Date-920505 Time-10:32

Trace No	Marker time (ms)	Field notes
1	1000.0	Record time: 100 ms
2	1000.0	Delay time: 0000 ms
3	1000.0	Shot pos.: 1310.0
4	1000.0	Layout start: 1000.0
5	1000.0	Layout end: 1310.0
6	1000.0	Profile No.: 200020
7	1000.0	Note: 4000000000004
8	1000.0	Operator: 00001

Shot pos.:	0000,0	Layout start:	0000,0	Layout end:	0230,0
Profile No.:	100021	Note:	100000000002	Operator:	00001
Record time:	100 ms	Delay time:	0000 ms	Analog filter:	Off
Display mode:	Normal,	Low-cut:	Off Hz	High-cut:	150Hz
				Shots:	001



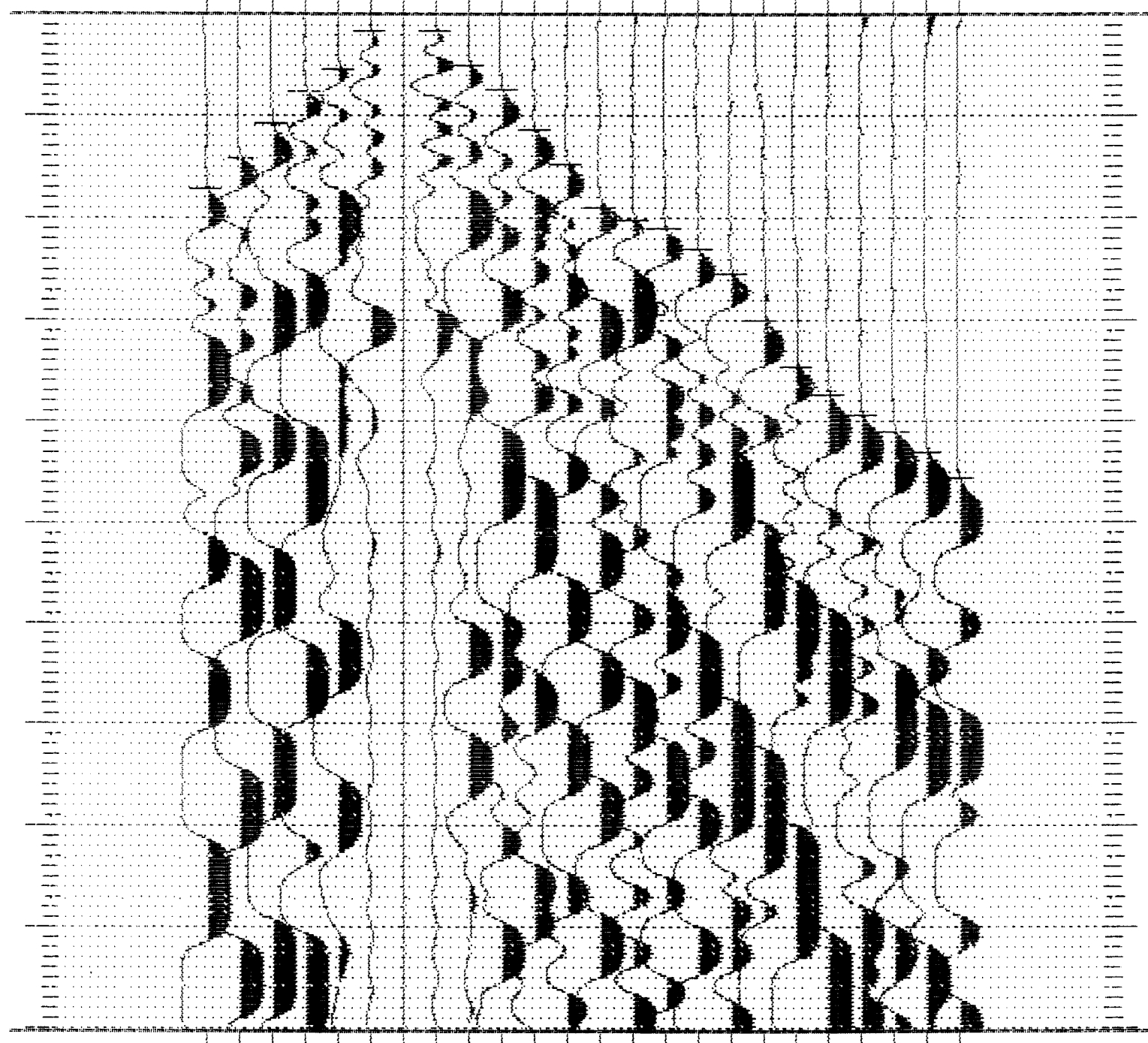
Trace No	Marker	time (ms)
----------	--------	-----------

Field notes.

```
Record time: 100 ms
Delay time: 0000 ms
Shot pos.: 0000.0
Layout start: 0000.0
Layout end: 0230.0
Profile No.: 100021
Note: 100000000002
Operator: 00001
```

ABEM Terraloc Seismic System

Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



```
Listing of markers:      Record-000615   Date-320505   Time-15:37
```

Trace No	Marker	time (ms)
----------	--------	-----------

Field notes

$$+109674700 \cdot 66785 + 109674700 \cdot 66785 + 109674700$$

$$\cdot 66785 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 109674700$$
[illegible]

```
Record time: 100 ms
Delay time: 0000 ms
Shot pos.: 0060.0
Layout start: 0000.0
Layout end: 0230.0
Profile No.: 100022
Note: 1000000000002
Operator: 00001
```

~~-----page two-----~~

```

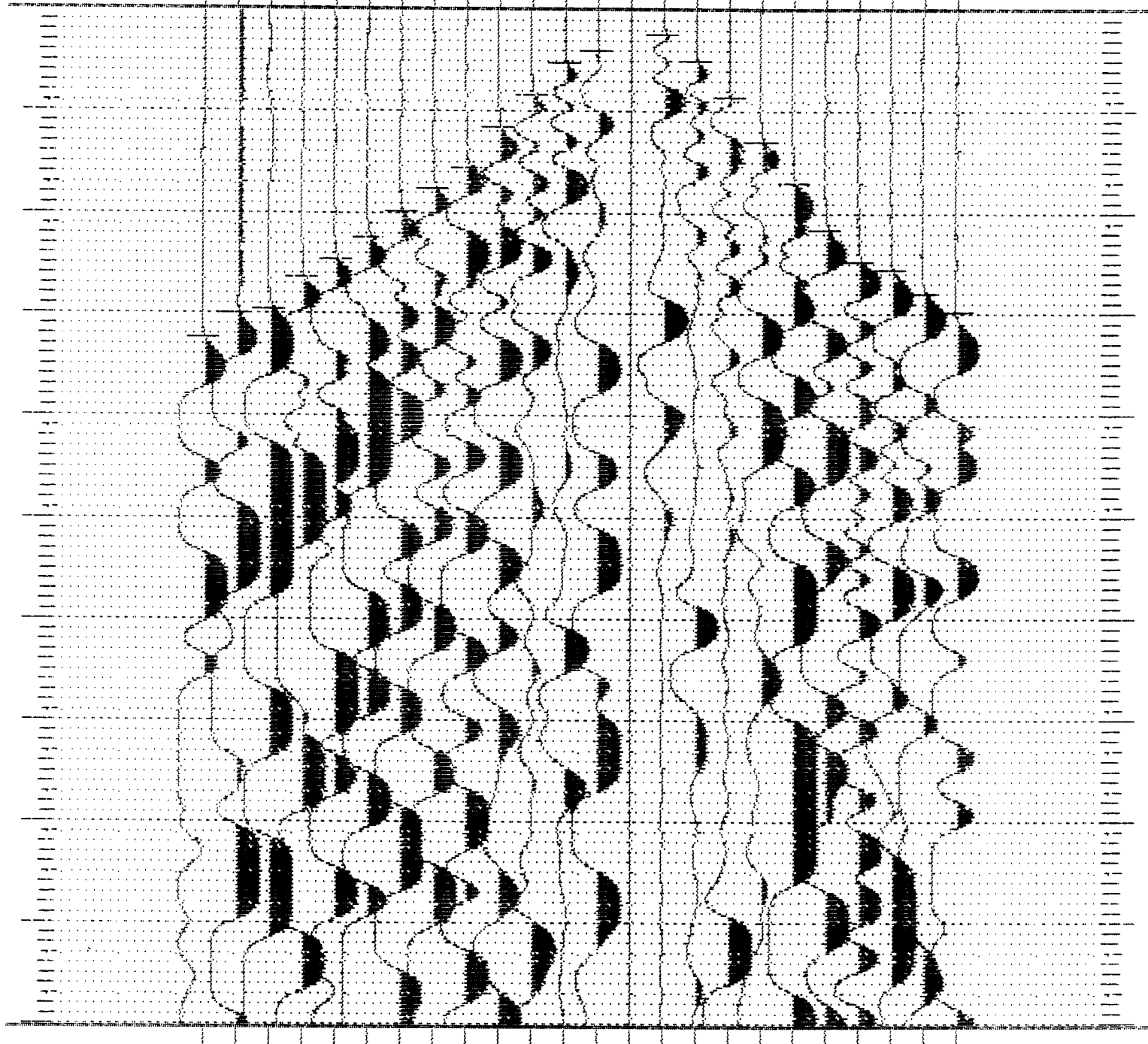
ABEM Terraloc Seismic System      Record-000615   Date-920506   Time-09:36
Shot pos.:      0130.0      Layout start:      0000.0      Layout end:      0230.0
Profile No.:    100023      Note:      1000000000002      Operator:      00001
Record time:    100 ms      Delay time:      0000 ms      Analog filter: Off
Display mode: Normal,      Low-cut: Off Hz      High-cut: 150Hz      Shots: 001

```

```

40      10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
20      01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01

```



```

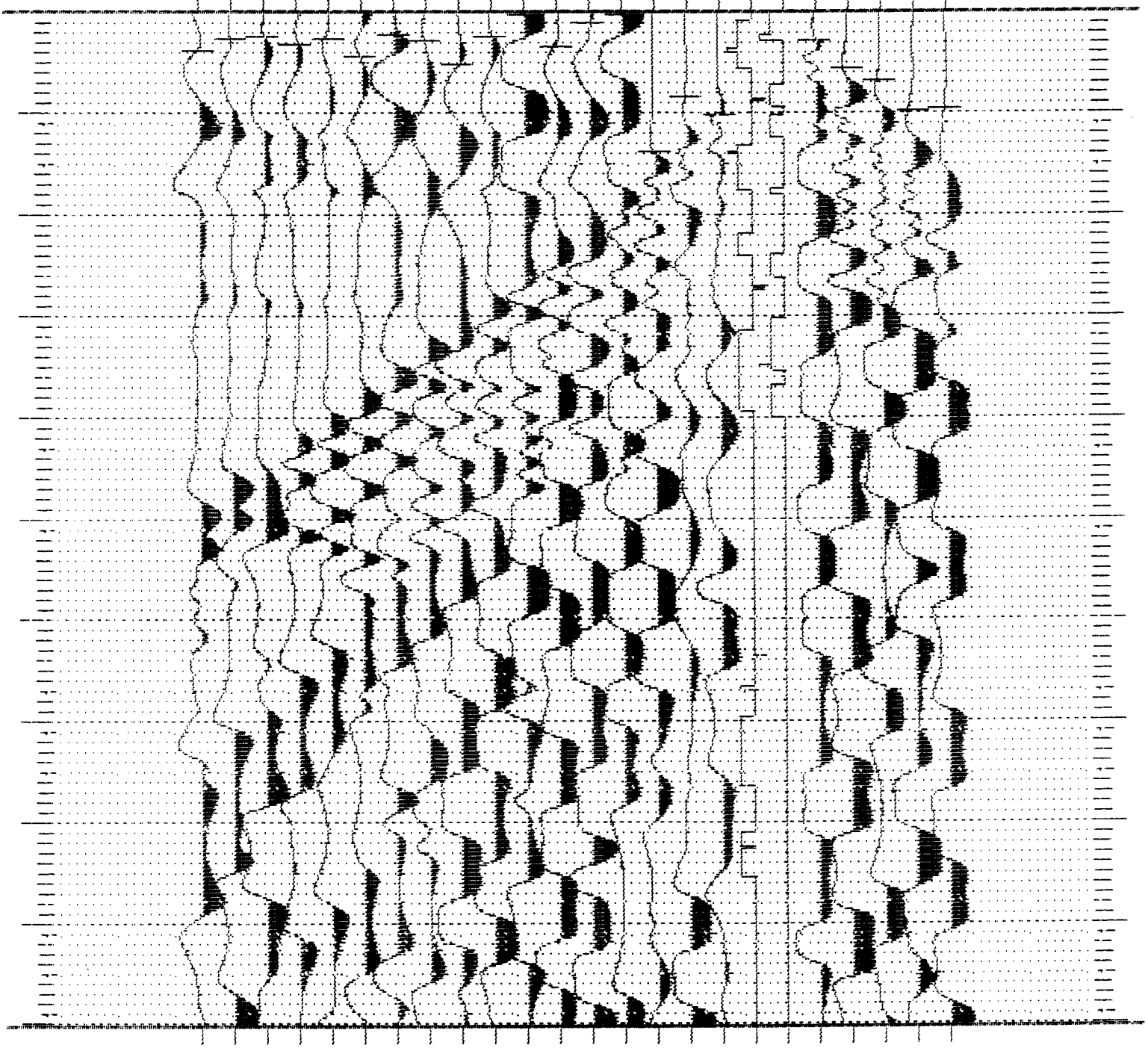
Listing of markers:      Record-000615   Date-920506   Time-09:36

```

Trace No	Marker time (ms)	Field notes
10	0000.0	Record time: 100 ms
20	0000.0	Delay time: 0000 ms
30	0000.0	Shot pos.: 0130.0
40	0000.0	Layout start: 0000.0
50	0000.0	Layout end: 0230.0
60	0000.0	Profile No.: 100023
70	0000.0	Note: 1000000000002
80	0000.0	Operator: 00001

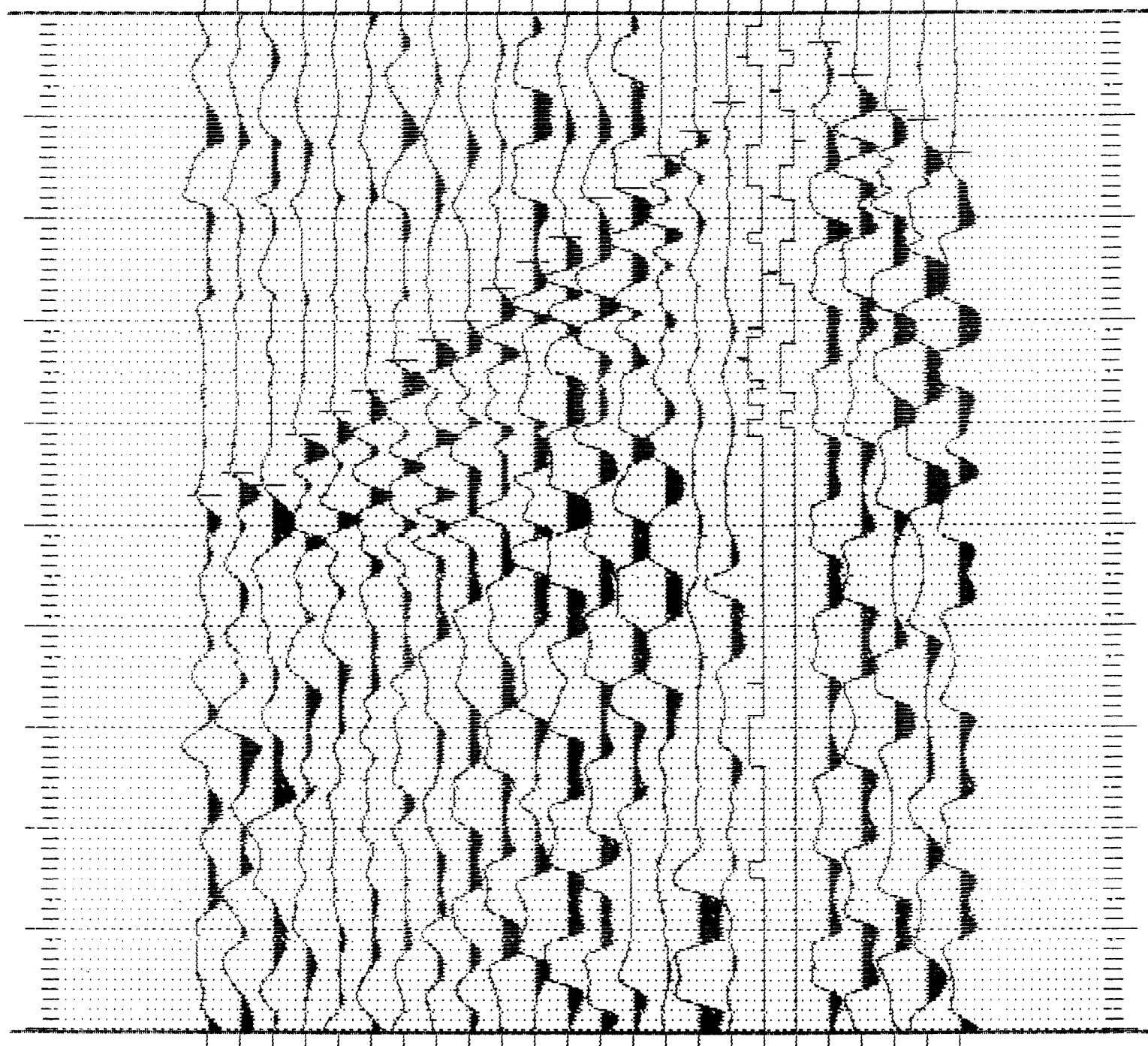
ABEM Terraloc Seismic System Record-000615 Date-920506 Time-09:56
Shot pos.: 0100.0 Layout start: 0000.0 Layout end: 0230.0
Profile No.: 100024 Note: 100000000002 Operator: 00001
Record time: 100 ms Delay time: 0000 ms Analog filter: Off
Display mode: Normal, Low-cut: 50Hz High-cut: 150Hz Shots: 001

1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



ABEM Terraloc Seismic System

13	16	16
14	16	16
15	16	16
16	14	14
17	12	12
18	10	10
19	00	00
20	10	10
21	12	12
22	14	14
23	16	16
24	18	18
12	18	18
11	18	18
10	18	18
09	18	18
08	18	18
07	18	18
06	18	18
05	18	18
04	18	18
03	18	18
02	18	18
01	18	18

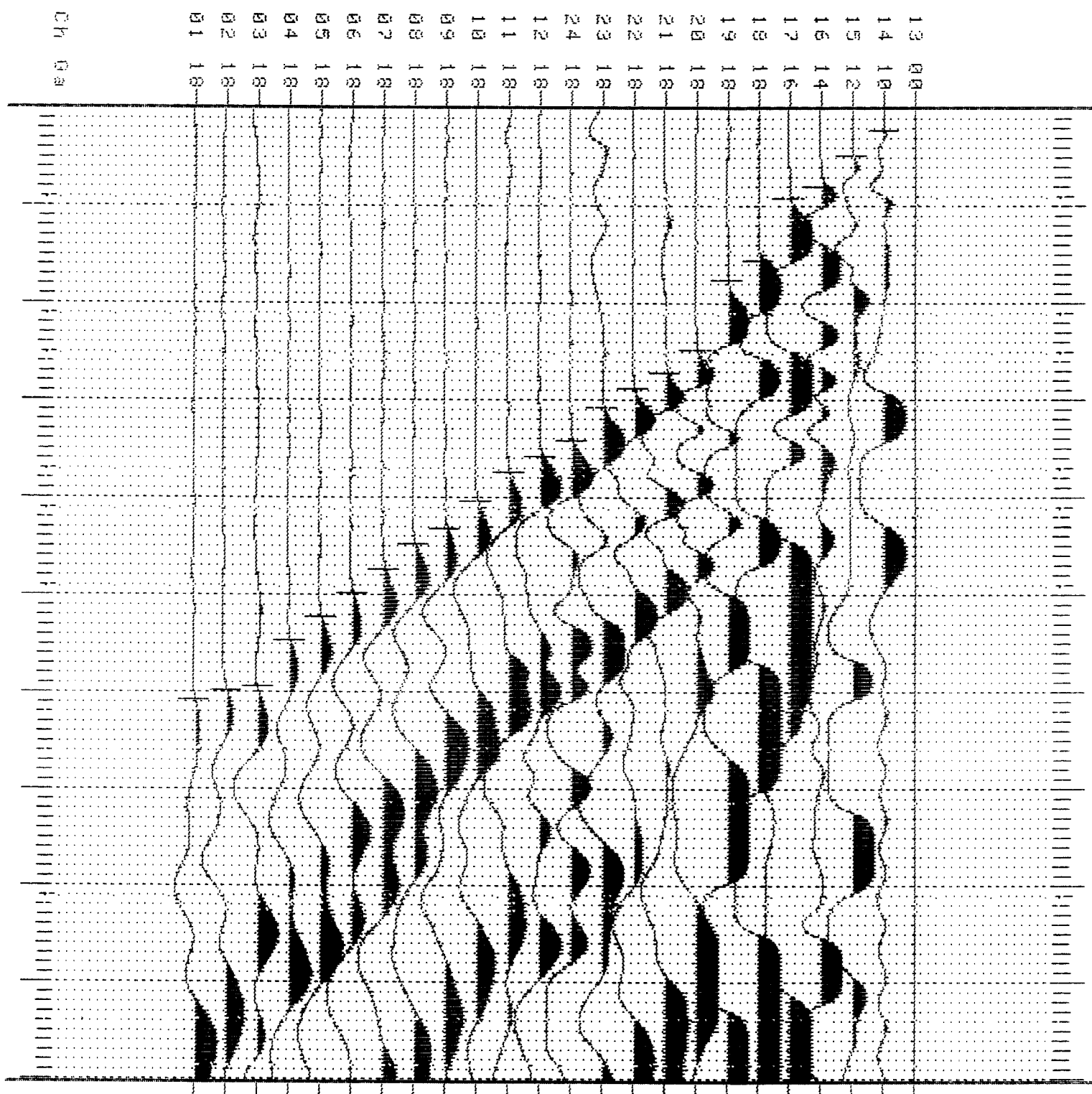


Trace No	Marker	time (ms)
----------	--------	-----------

```
Record time: 100 ms
Delay time: 0000 ms
Shot pos.: 0100.0
Layout start: 0000.0
Layout end: 0230.0
Profile No.: 100024
Note: 1000000000002
Operator: 00001
```

ABEN Terraloc Seismic System

```
Shot pos.: 0230,0      Layout start: 0000,0      Layout end: 0230,0
Profile No.: 100025     Note: 1000000000002      Operator: 00001
Record time: 100 ms     Delay time: 0000 ms      Analog filter: Off
Display mode: Normal,    Low-cut: Off Hz    High-cut: 150Hz    Shots: 001
```



Trace No	Marker	time (ms)
----------	--------	-----------

Field notes

[illegible]

```
Record time: 100 ms
Delay time: 0000 ms
Shot pos.: 0230.0
Layout start: 0000.0
Layout end: 0230.0
Profile No.: 100025
Note: 100000000002
Operator: 00001
```

Record-000615 Date-920506 Time-15:00

Shot pos.: 0230,0 Layout start: 0230,0 Layout end: 0460,0

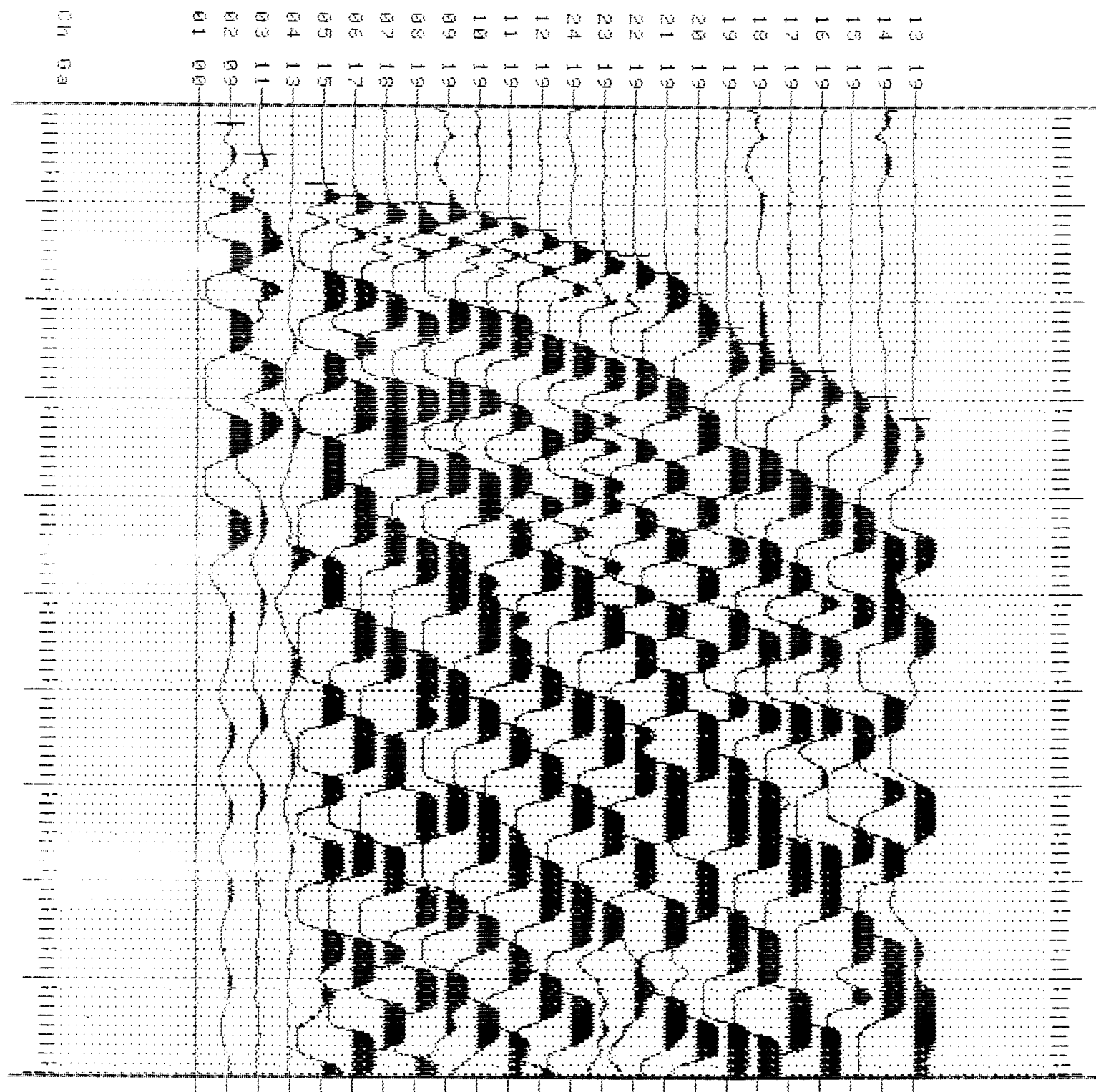
```

100026      Note:      2000000000002      Operator:      00001

```

Record time: 200 ms Delay time: 0000 ms Analog filter: Off

Filter: mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920506 Time-15:00

Trace No	Marker	time (ms)
----------	--------	-----------

Field notes.

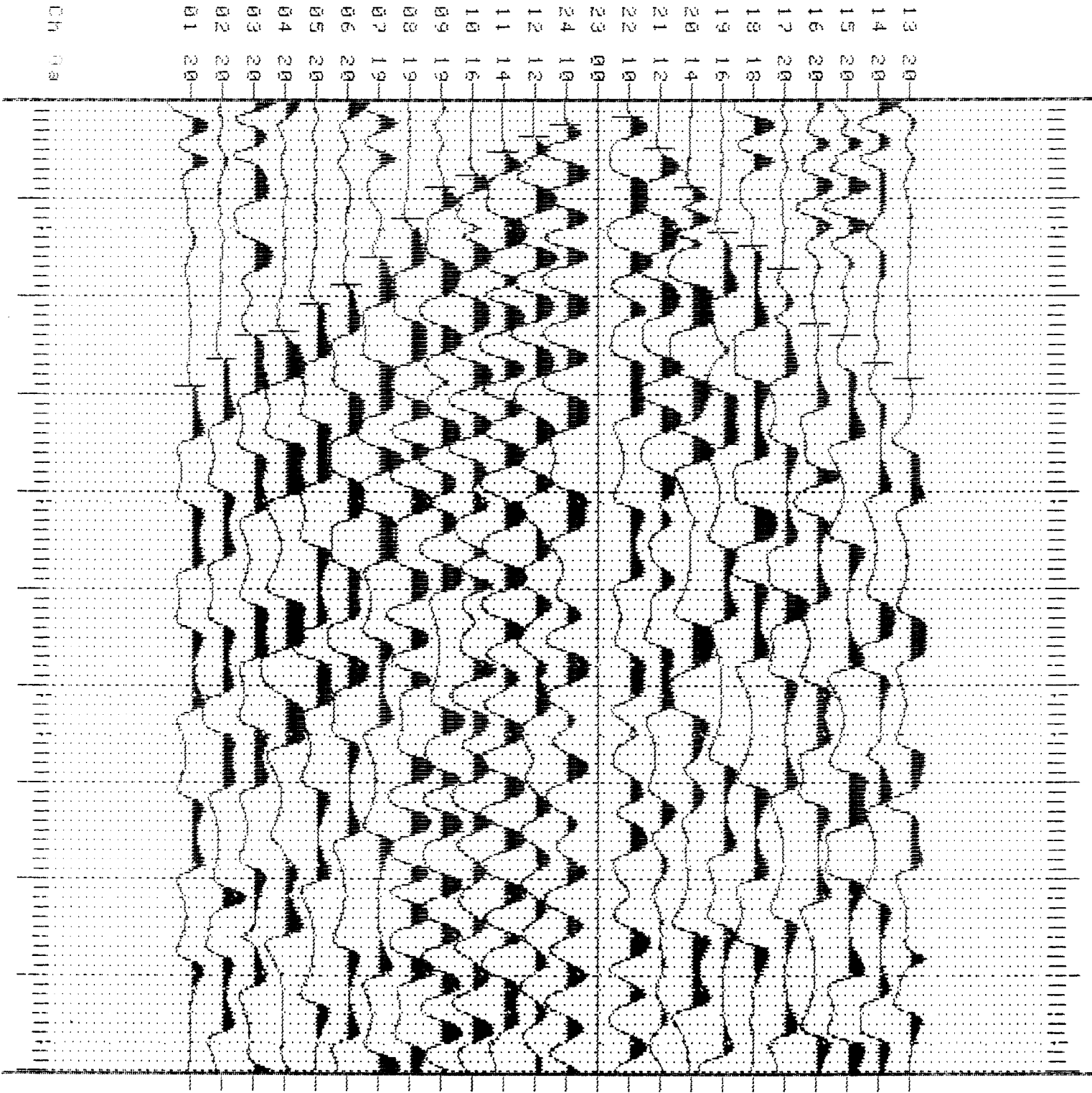
[illegible]

```
Record time: 200 ms
Delay time: 0000 ms
Shot pos.: 0230.0
Layout start: 0230.0
Layout end: 0460.0
Profile No.: 100026
Note: 2000000000002
Operator: 00001
```

GEOTECHNICAL TeraLoc Seismic System

ABEM Terraloc Seismic System

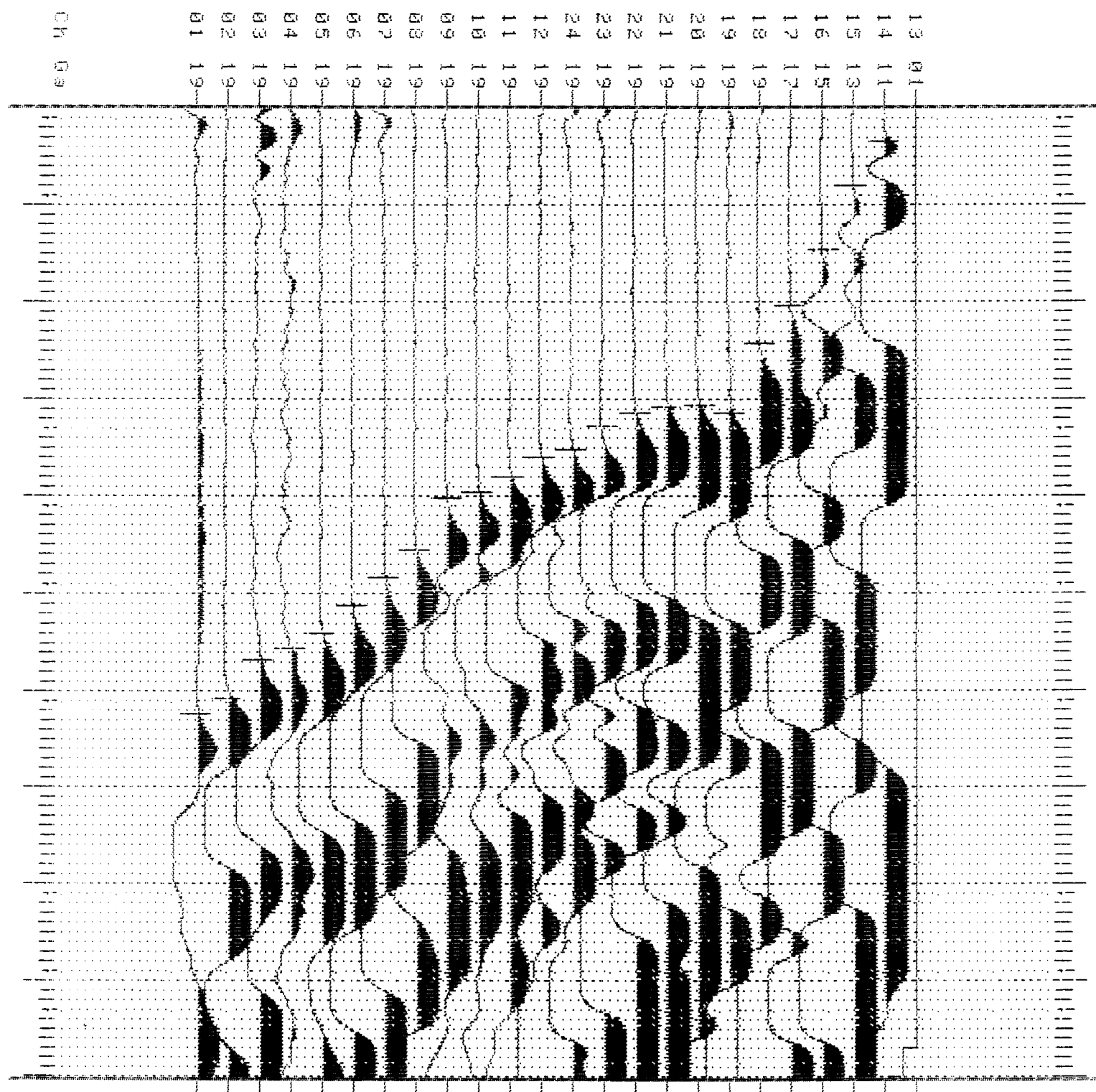
ABEM Terraloc Seismic System Record-000615 Date-920506 Time-15:36
Shot pos.: 0360.0 Layout start: 0230.0 Layout end: 0460.0
Profile No.: 100028 Note: 200000000002 Operator: 00001
Record time: 100 ms Delay time: 0000 ms Analog filter: Off
Display mode: Normal, Low-cut: 80Hz High-cut: 150Hz Shots: 001



Listing of markers: Record-000615 Date-920506 Time-15:36		
Trace No	Marker time (ms)	Field notes
01	0000	Record time: 100 ms
02	0000	Delay time: 0000 ms
03	0000	Shot pos.: 0360.0
04	0000	Layout start: 0230.0
05	0000	Layout end: 0460.0
06	0000	Profile No.: 100028
07	0000	Note: 200000000002
08	0000	Operator: 00001
09	0000	
10	0000	
11	0000	
12	0000	
13	0000	
14	0000	
15	0000	
16	0000	
17	0000	
18	0000	
19	0000	
20	0000	
21	0000	
22	0000	
23	0000	
24	0000	
25	0000	
26	0000	
27	0000	
28	0000	
29	0000	
30	0000	
31	0000	
32	0000	

ABEM Terraloc Seismic System

Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 001



Operator: 00001

ABEM Terraloc Seismic System Record-000615 Date-920506 Time-15:51

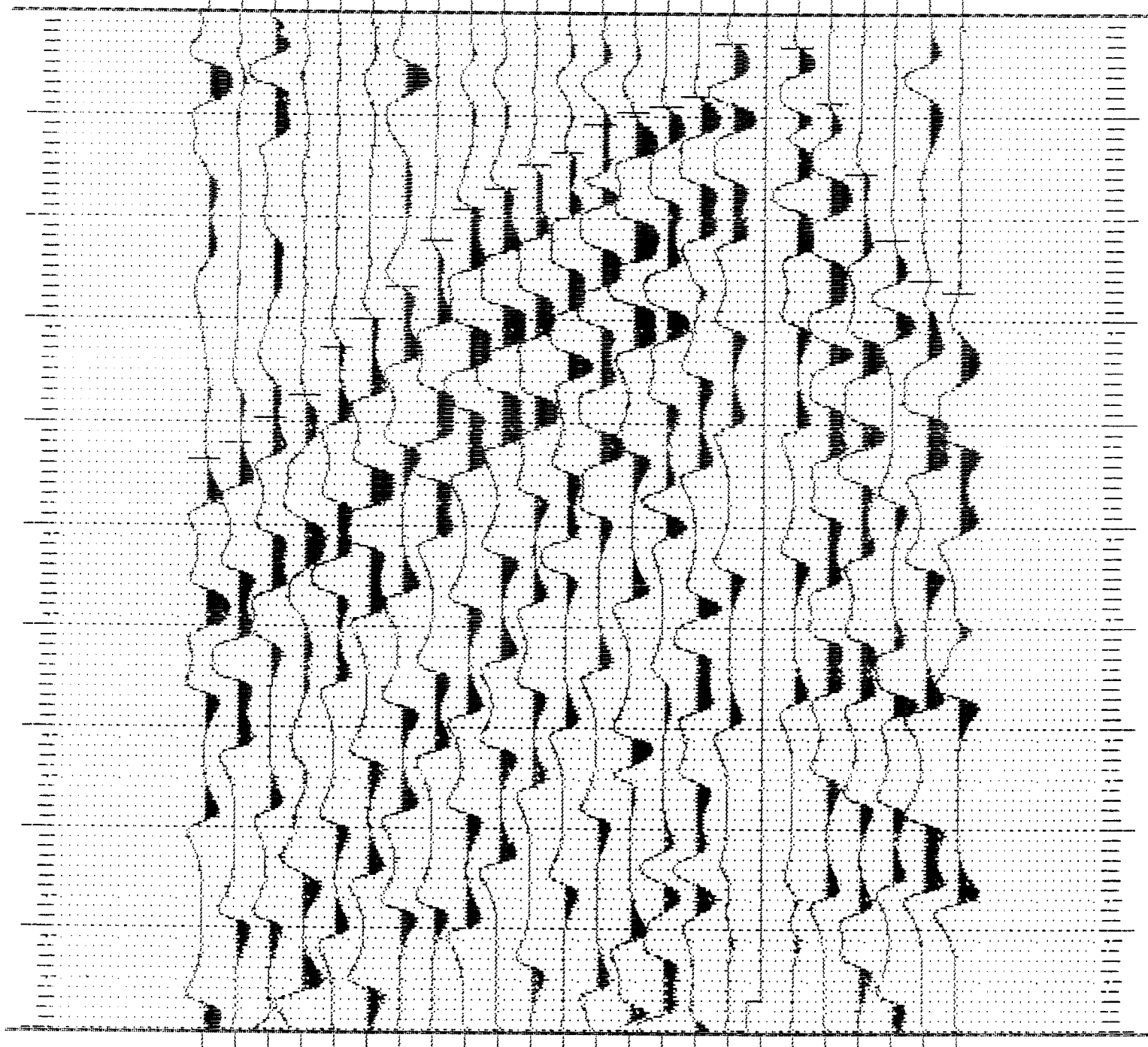
Shot pos.: 0400.0 Layout start: 0230.0 Layout end: 0460.0

Profile No.: 100029 Note: 200000000002 Operator: 00001

Record time: 100 ms Delay time: 0000 ms Analog filter: Off

Display mode: Normal, Low-cut: 60Hz High-cut: 150Hz Shots: 001

0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
g	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19



Listing of markers: Record-000615 Date-920506 Time-15:51

Trace No	Marker time (ms)	Field notes
0	4	Record time: 100 ms
1	4	Delay time: 0000 ms
2	4	Shot pos.: 0400.0
3	4	Layout start: 0230.0
4	4	Layout end: 0460.0
5	4	Profile No.: 100029
6	4	Note: 200000000002
7	4	Operator: 00001

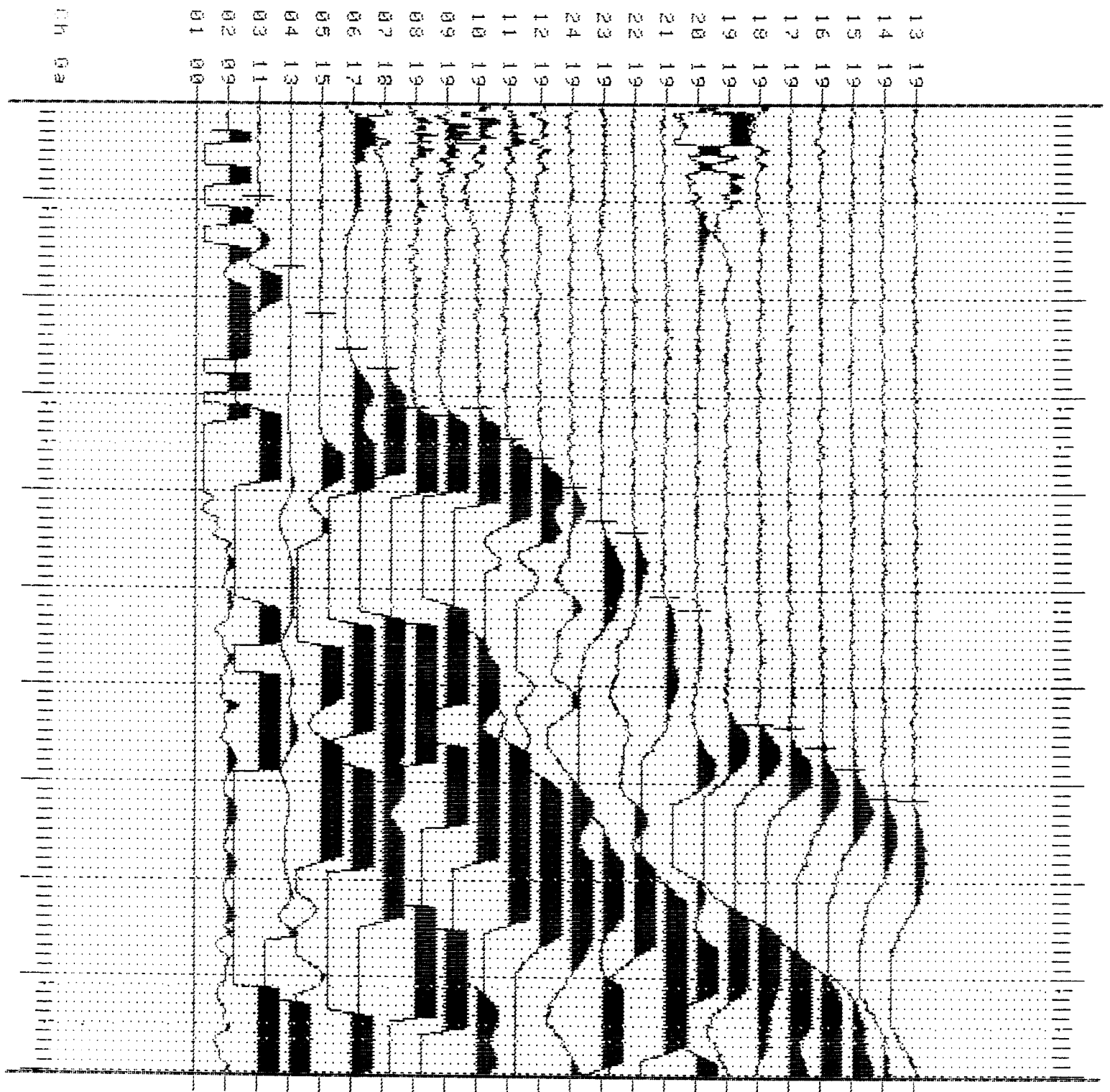
ABEM Terraloc Seismic System Record-000615 Date-920507 Time-11:27

Shot pos.: 0460.0 Layout start: 0460.0 Layout end: 0690.0

Profile No.: 100031 Note: 3000000000002 Operator: 00001

Record time: 100 ms Delay time: 0000 ms Analog filter: Off

Display mode: Normal, Low-cut: Off Hz High-cut: Off Hz Shots: 001

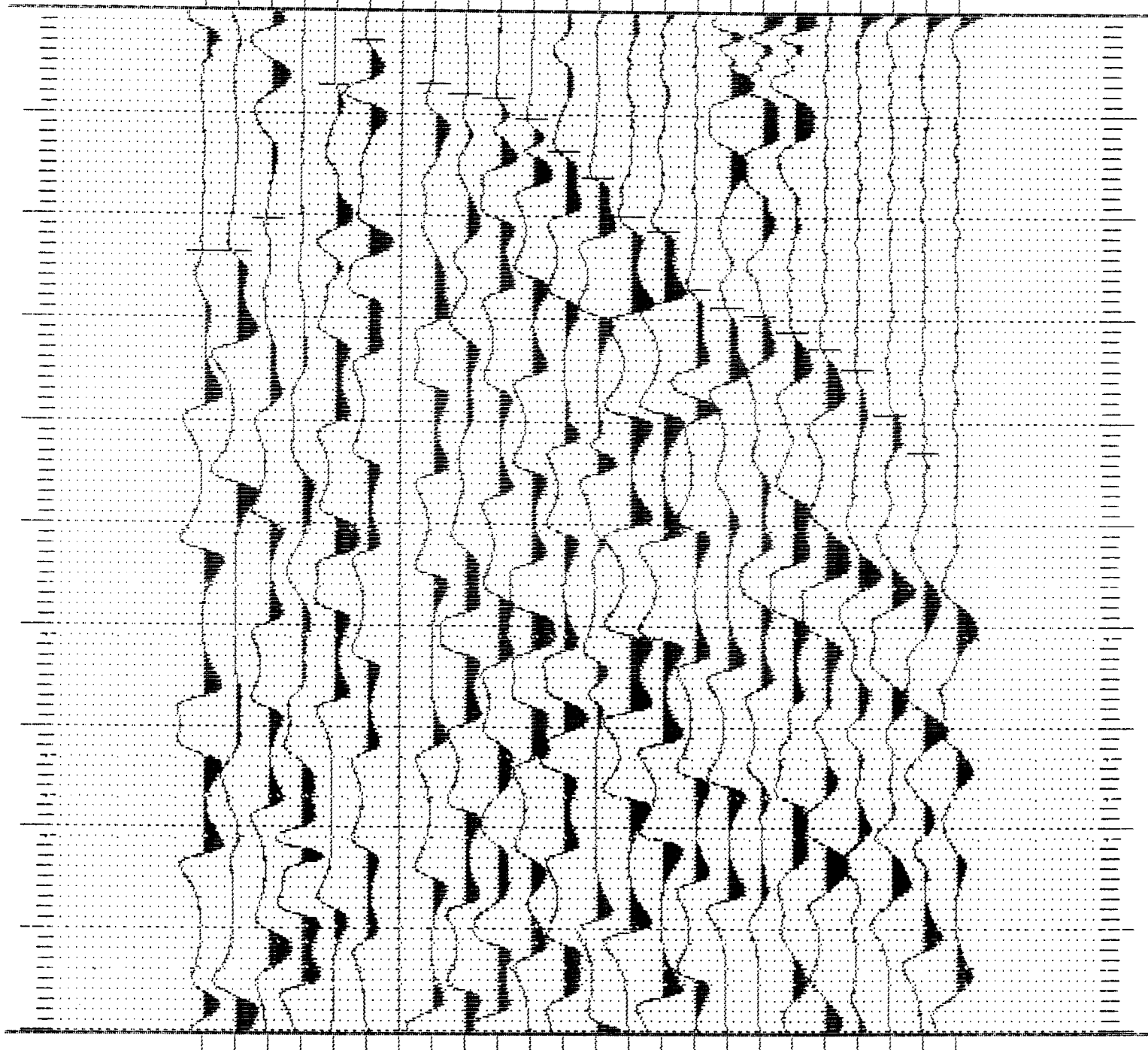


Listing of markers: Record-000615 Date-920507 Time-11:27

Trace No	Marker time (ms)	Field notes
1	0.0	Record time: 100 ms
2	0.0	Delay time: 0000 ms
3	0.0	Shot pos.: 0460.0
4	0.0	Layout start: 0460.0
5	0.0	Layout end: 0690.0
6	0.0	Profile No.: 100031
7	0.0	Note: 3000000000002
8	0.0	Operator: 00001
9	0.0	
10	0.0	
11	0.0	
12	0.0	
13	0.0	
14	0.0	
15	0.0	
16	0.0	
17	0.0	
18	0.0	
19	0.0	

ABEM Terraloc Seismic System Record-000615 Date-920507 Time-13:01
Shot pos.: 0520.0 Layout start: 0460.0 Layout end: 0690.0
Profile No.: 200032 Note: 3000000000002 Operator: 000001
Record time: 100 ms Delay time: 0000 ms Analog filter: Off
Display mode: Normal, Low-cut: 60Hz High-cut: 150Hz Shots: 001

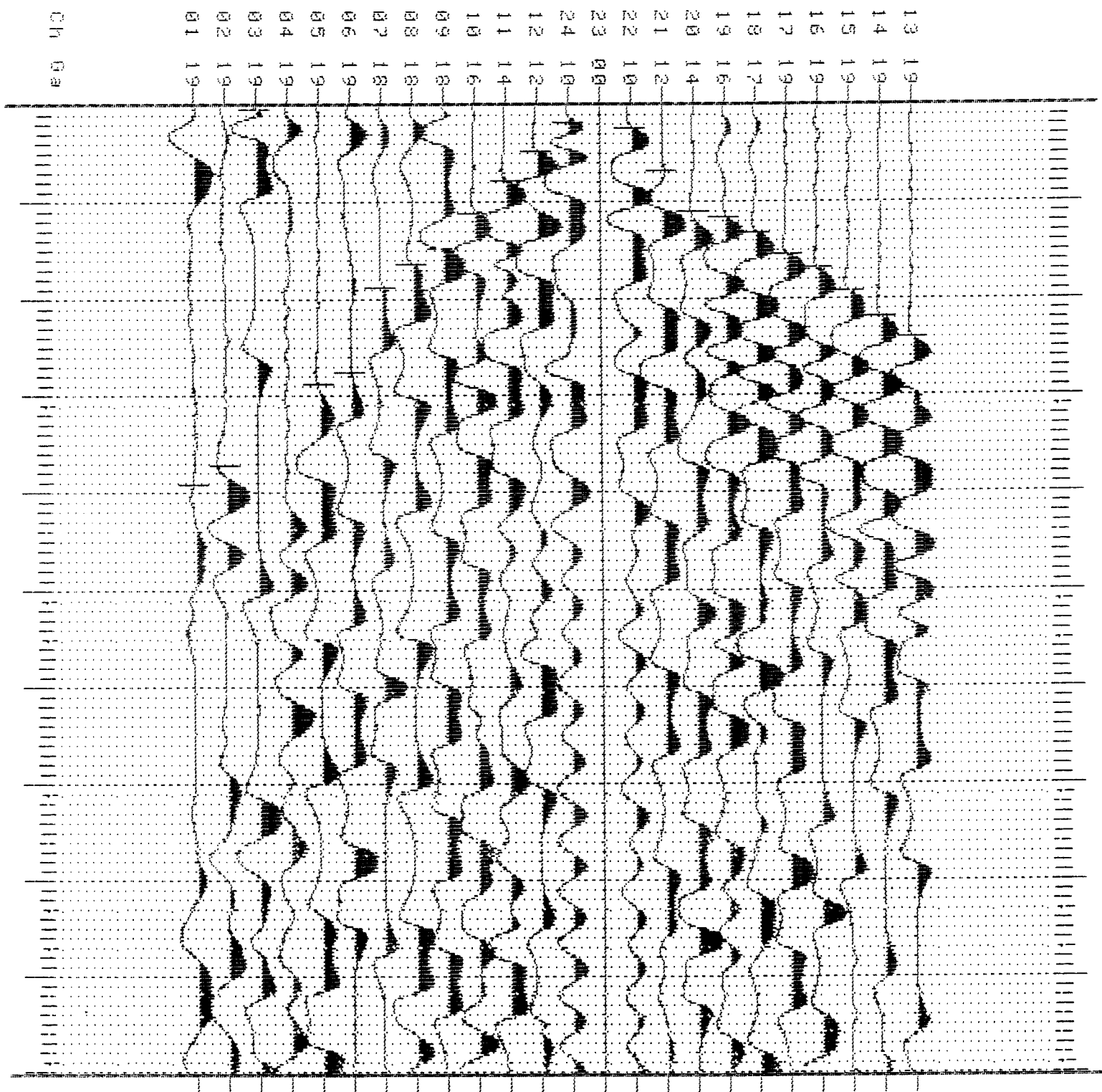
Ch	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Gain	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



Listing of markers: Record-000615 Date-920507 Time-13:01

Trace No	Marker time (ms)	Field notes
1	0.000000	Record time: 100 ms
2	0.000000	Delay time: 0000 ms
3	0.000000	Shot pos.: 0520.0
4	0.000000	Layout start: 0460.0
5	0.000000	Layout end: 0690.0
6	0.000000	Profile No.: 200032
7	0.000000	Note: 3000000000002
8	0.000000	Operator: 000001

ABEM Terraloc Seismic System Record-000615 Date-920507 Time-13:21
Shot pos.: 0590.0 Layout start: 0460.0 Layout end: 0690.0
Profile No.: 100033 Note: 300000000002 Operator: 000001
Record time: 100 ms Delay time: 0000 ms Analog filter: Off
Display mode: Normal, Low-cut: 80Hz High-cut: 150Hz Shots: 001

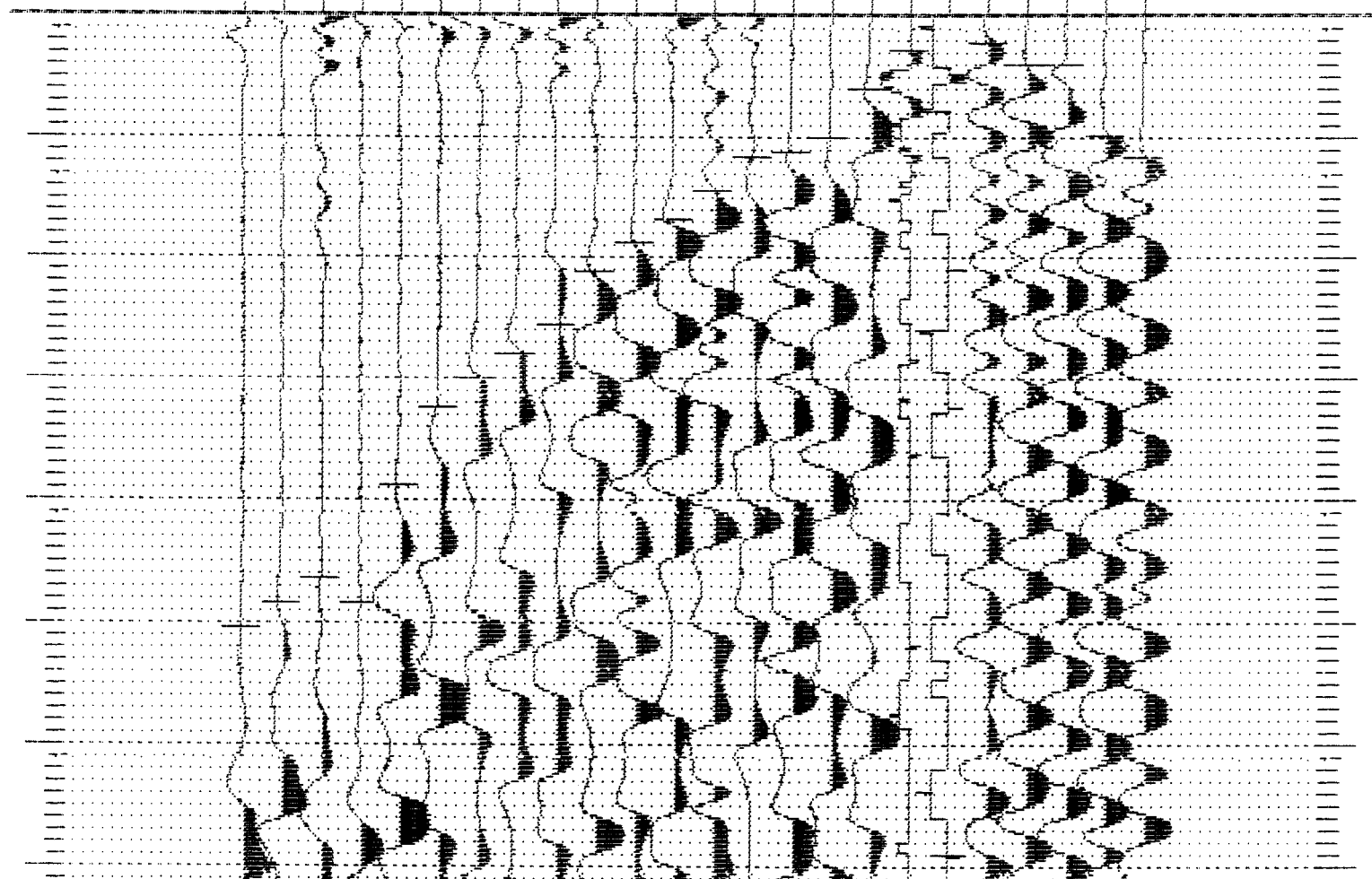


Listing of markers:			Record-000615	Date-920507	Time-13:21
Trace No	Marker time (ms)	Field notes			
1	000	Record time: 100 ms			
2	000	Delay time: 0000 ms			
3	000	Shot pos.: 0590.0			
4	000	Layout start: 0460.0			
5	000	Layout end: 0690.0			
6	000	Profile No.: 100033			
7	000	Note: 300000000002			
8	000	Operator: 000001			

ABEM Terraloc Seismic System

Display mode: Normal, Low-cut: 60Hz High-cut: 150Hz Shots: 001

13	17
14	17
15	17
16	16
17	14
18	13
19	60
20	12
21	14
22	16
23	16
24	19
12	19
11	19
10	19
09	19
08	19
07	19
06	16
05	19
04	16
03	16
02	16
01	16



ABEM Terraloc Seismic System Record-000615 Date-920507 Time-13:51

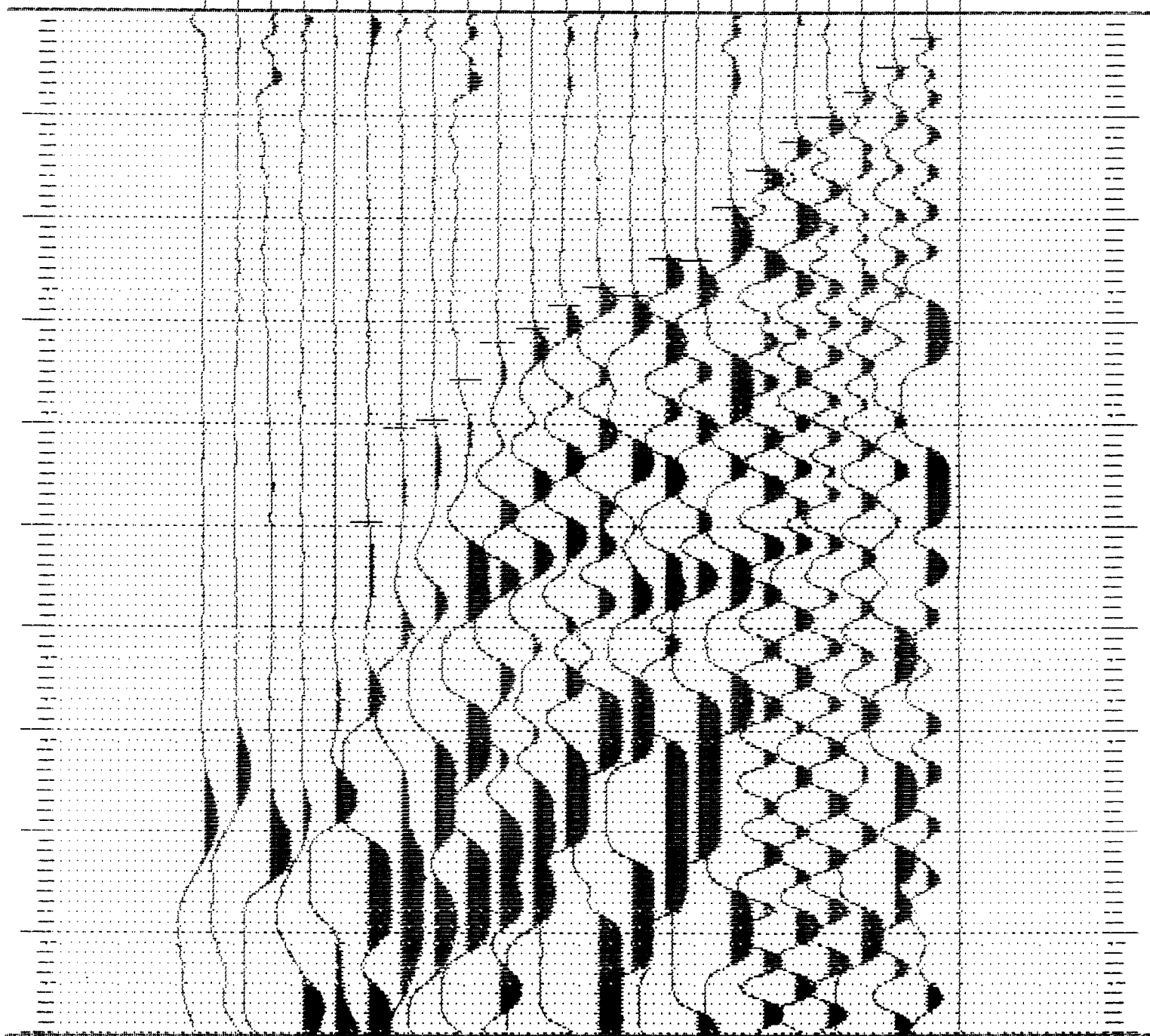
Shot pos.: 0690.0 Layout start: 0460.0 Layout end: 0690.0

Profile No.: 100034 Note: 3000000000002 Operator: 000001

Record time: 100 ms Delay time: 0000 ms Analog filter: Off

Display mode: Normal, Low-cut: Off Hz High-cut: 150Hz Shots: 002

NO	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



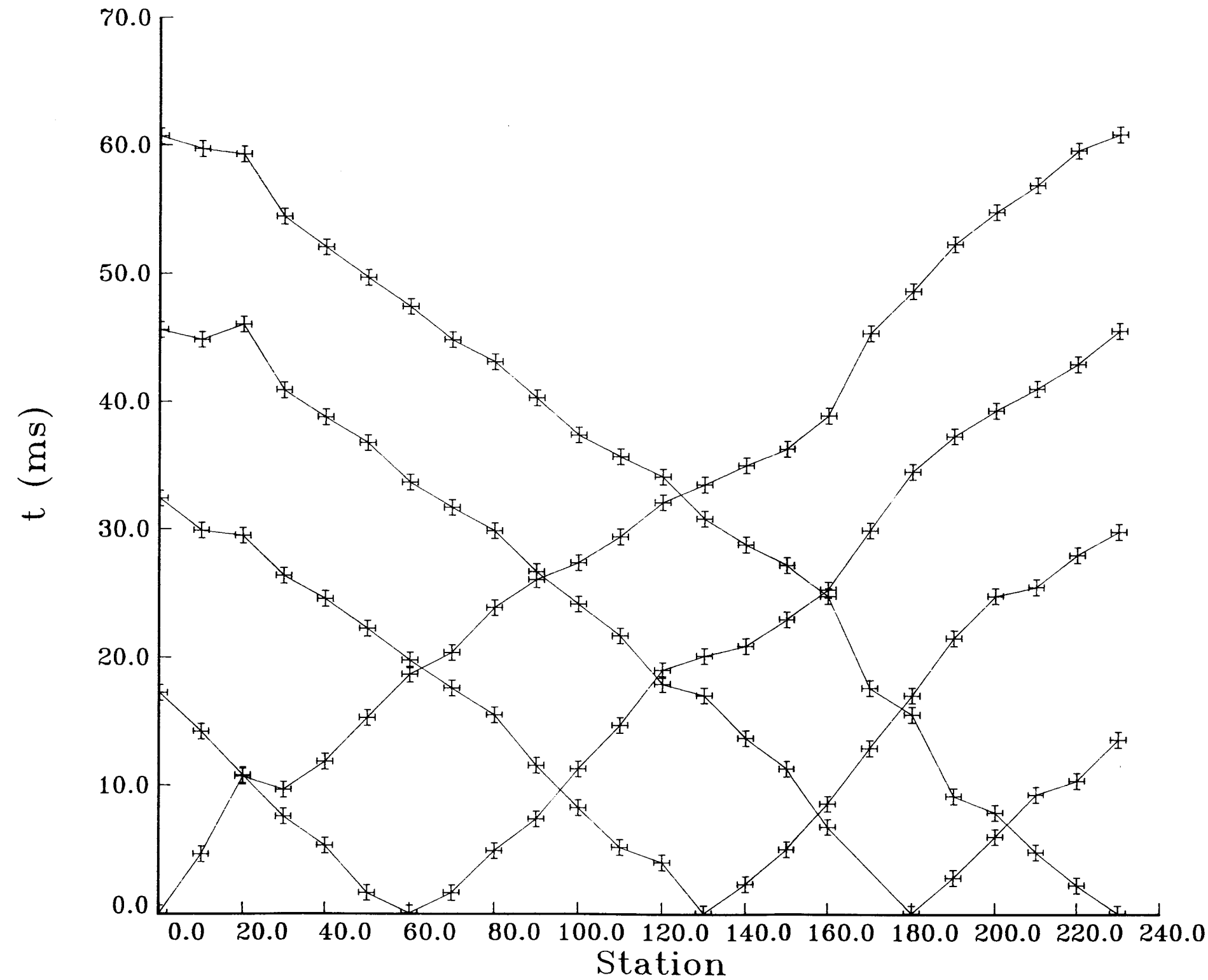
Listing of markers: Record-000615 Date-920507 Time-13:51

Trace No	Marker time (ms)	Field notes
100034	0460.0	Record time: 100 ms
100034	0460.0	Delay time: 0000 ms
100034	0460.0	Shot pos.: 0690.0
100034	0460.0	Layout start: 0460.0
100034	0460.0	Layout end: 0690.0
100034	0460.0	Profile No.: 100034
100034	0460.0	Note: 3000000000002
100034	0460.0	Operator: 000001

ABEM Terraloc Seismic System

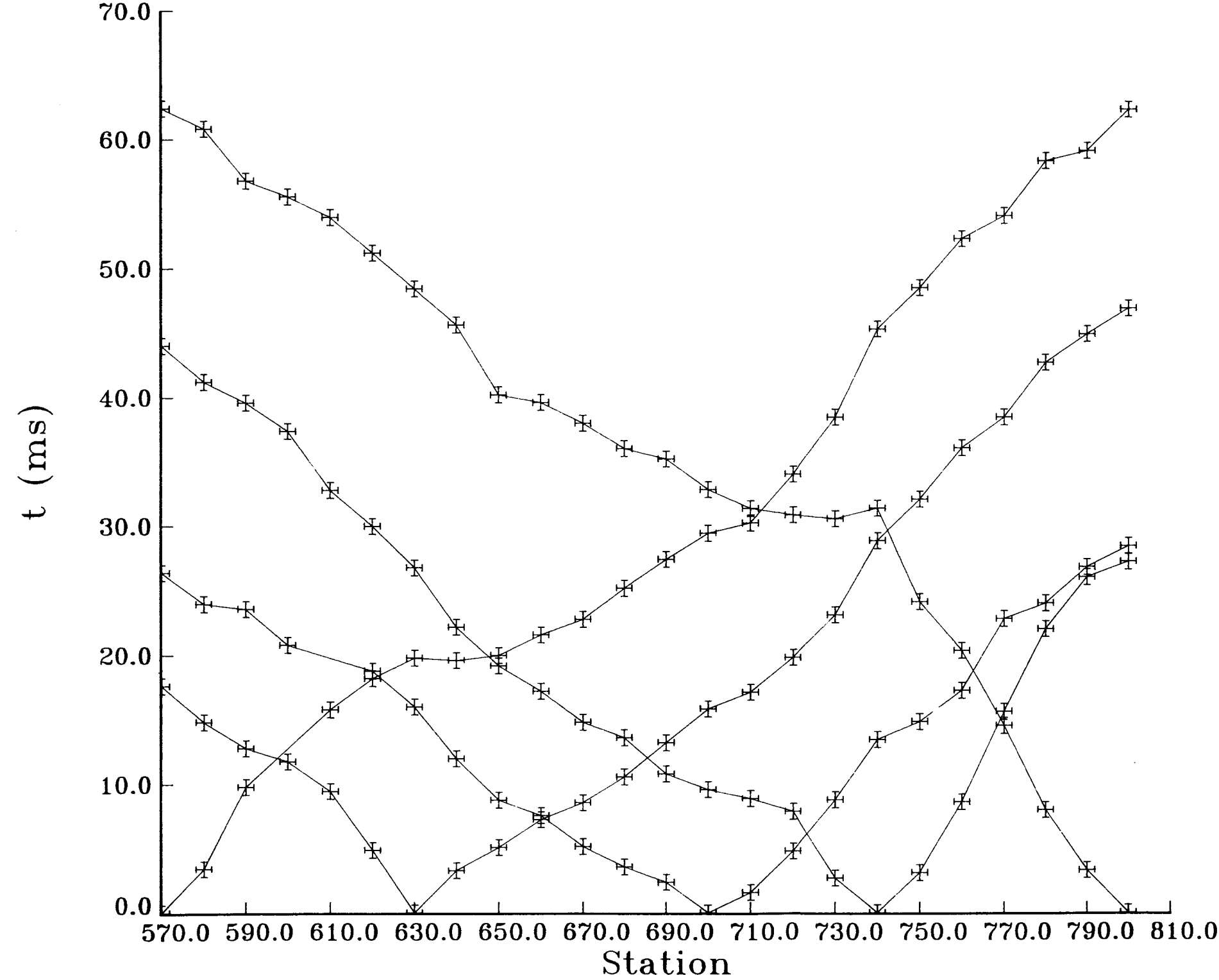
Appendix E. T-X Plots

T-X Plot



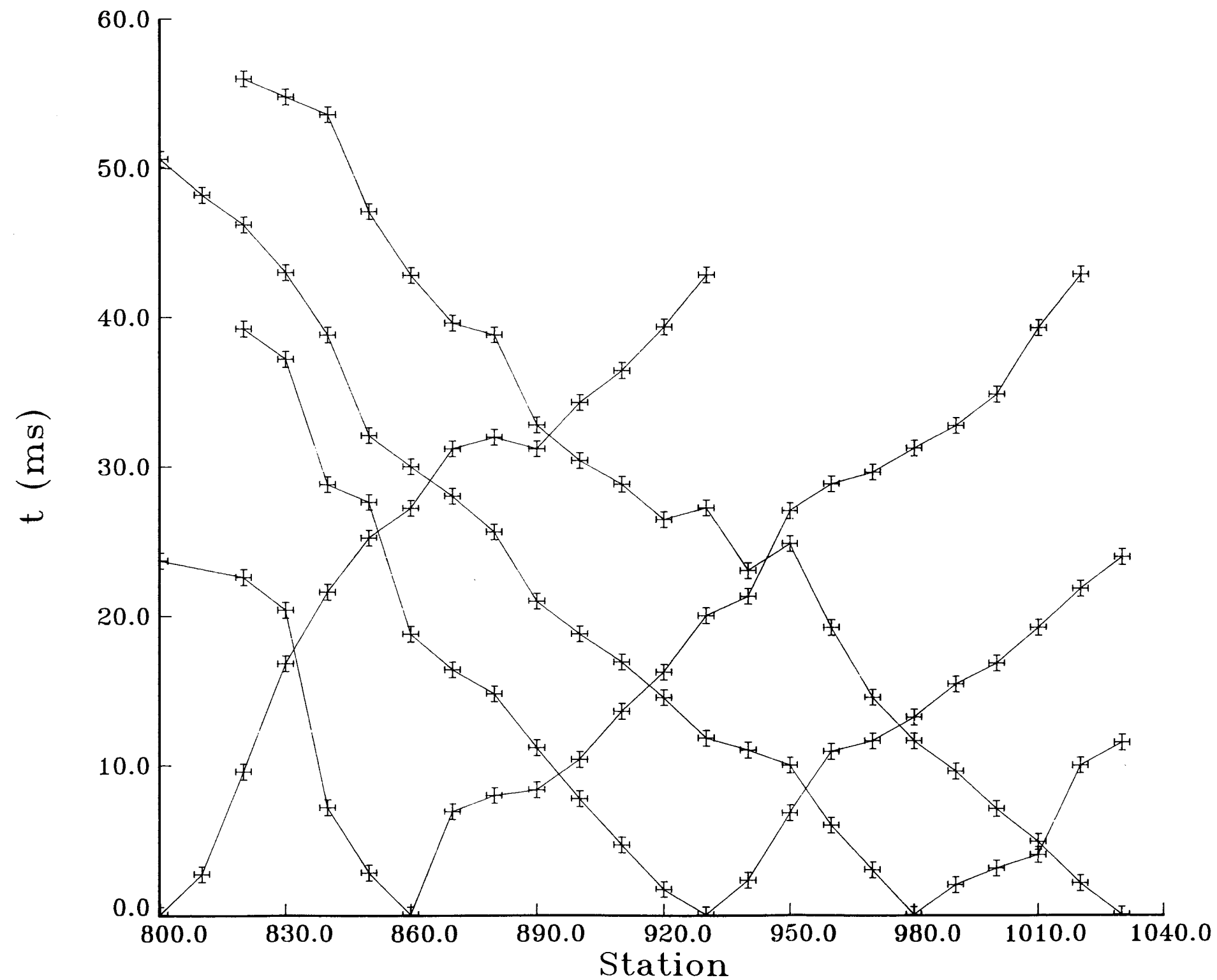
Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 2: OE-230E	AMEROK GEOPHYSICS	

T-X Plot



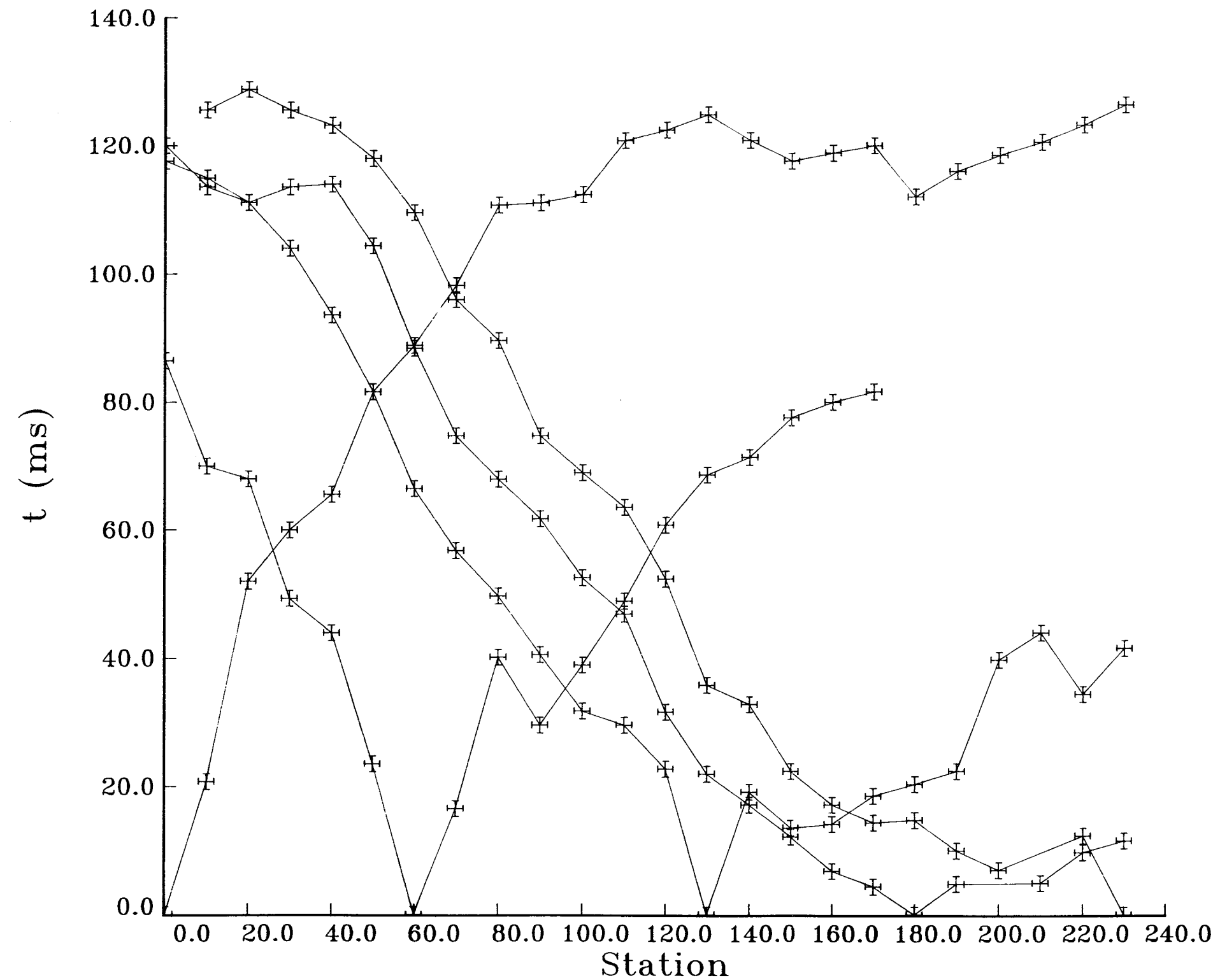
Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 2: 570E-800E	AMEROK GEOPHYSICS	

T-X Plot



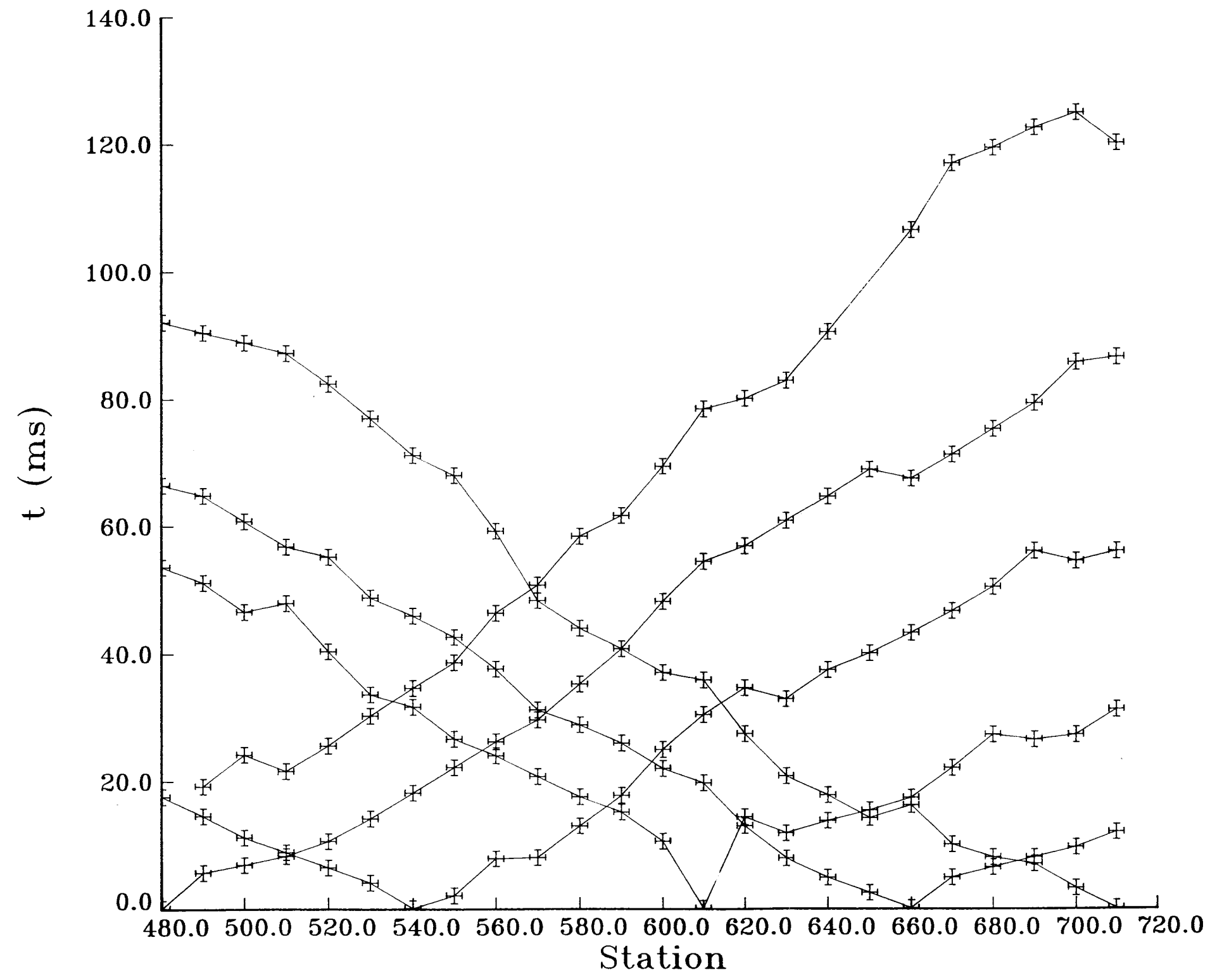
Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 2: 800E-1040E	AMEROK GEOPHYSICS	

T-X Plot



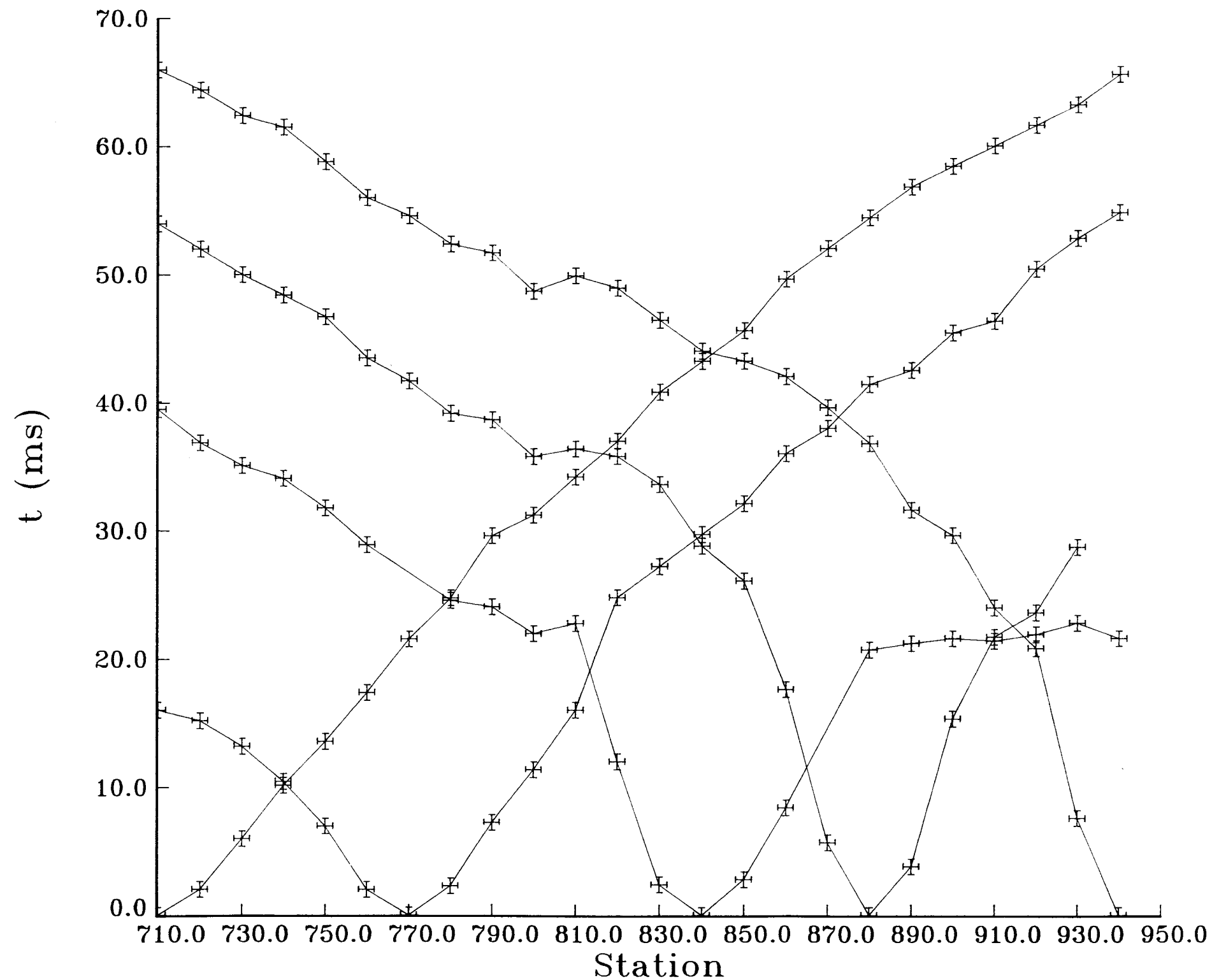
Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 4: OW-230W	AMEROK	GEOPHYSICS

T-X Plot



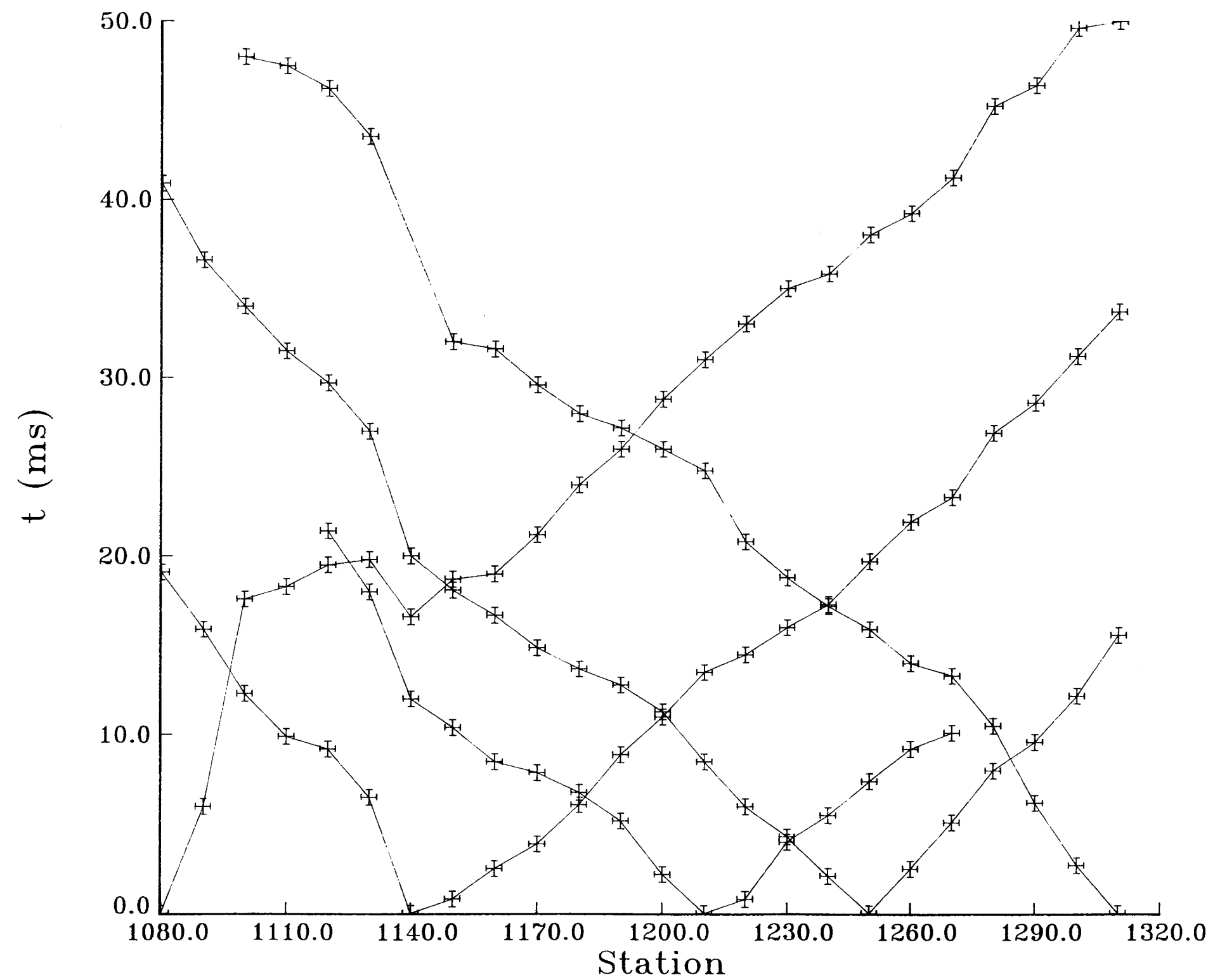
Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 4: 480W-710W	AMEROK GEOPHYSICS	

T-X Plot



Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 4: 710W-940W	AMEROK GEOPHYSICS	

T-X Plot



Duncan Ck. Golddusters	Scale 1: 1100	May 12/92
First Arrival Times	NTS: 105M	M.D.: Mayo
Line 4: 1080W-1310W	AMEROK GEOPHYSICS	

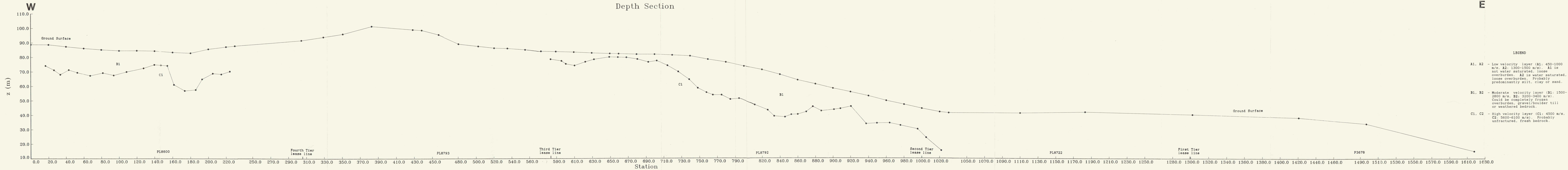


Figure 8. Interpreted depth section for Line 2. Vertical exaggeration is 2.3

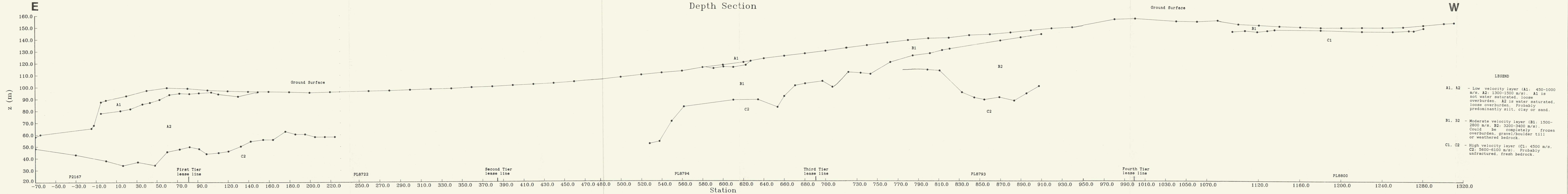


Figure 9. Interpreted depth section for Line 4. Vertical exaggeration is 1.2