Making Seismic Data Easier To Handle

Jill Lewis, CEO Troika International Ltd.,
Committee Member SEG Technical Standards Liaison, EarthIQ, OGP Geomatics Committee, Energistics Format Enthusiast

Troika International

20 Years Old
Pool c++ objects
Data Management Products
- Transcription
- Format QC
- Database, TraceStore, Data Management Systems
- Workstation Loading Preparation
- Encapsulation and Unencapsulation
- Disk Crawling

QC and Consultancy Services

Jill Lewis

DPTS Transcription Operator, Manager QC, Sales

Tape Technology – 11 Transcription centres worldwide, MD

Troika International – Tunbridge Wells, Aberdeen, Houston

SEG Technical Standards Committee

- SEGY1.0
- SEGD2.2
- SEGD3
- SEGY2 (under review)

EZ_Seismic Data

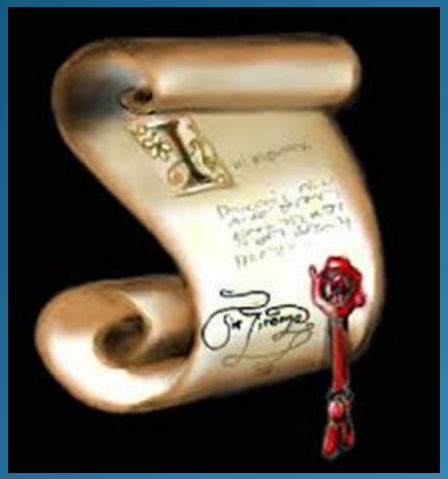
- Making sure newly received seismic data is ready for processing and interpretation - without the need to convert it into a different format
- Easier methods to check data quality and completeness
- Developing a natural data flow for how you handle seismic data
- Benefits of the recently ratified SEGD 3.0 field tape standard
- Benefits of the latest draft of SEGY2 standard for storing geophysical data

Shopping

A VERY EXPENSIVE SHOP

A VERY EXPENSIVE ITEM FROM A CONTRACT

What is it?



It's in the contract

Seismic Field Data Management

What is in the packages

?

Formats

DFS III

In February 1968 Texas Instruments started to advertise the DFS III. If the original DFS with 9000 amplifiers was the first generation Digital Field System, and the DFS-10000 was the second generation Digital Field System, then the new system was the third generation Digital Field System or DFS III. A dynamic range of 174 dB was optimistically claimed, with dynamic resolution of 84 dB. It was the first TI seismic system to use integrated analog and digital circuits ("chips") on a large scale, and was still in widespread use 10 years later.

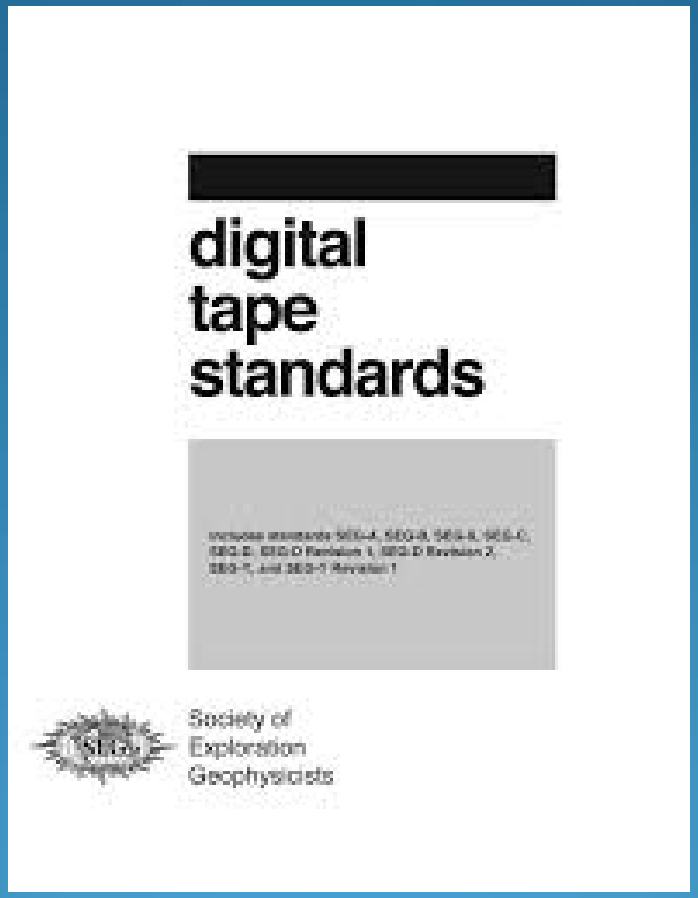
DFS IV

The DFS IV was announced in late 1970, with the big innovation of instantaneous floating point gain: the gain was changed for each sample so that the amplitude of the signal input to the converter was nearly at full scale.

DFS V

In August 1975 Texas Instruments started advertising the DFS V. It was a dramatically more compact and lower power system, offering up to 120 channels in only four "man portable" modules. By the time the seismic industry collapsed at the end of 1981, TI had delivered over 1000 systems, which will probably remain an all time record for number manufactured of any one design of seismic recording system.

Standards



FREE

seg.org/ts

Step 1 - Contracts

Standard Clauses in the Contract +

e.g. Transcription

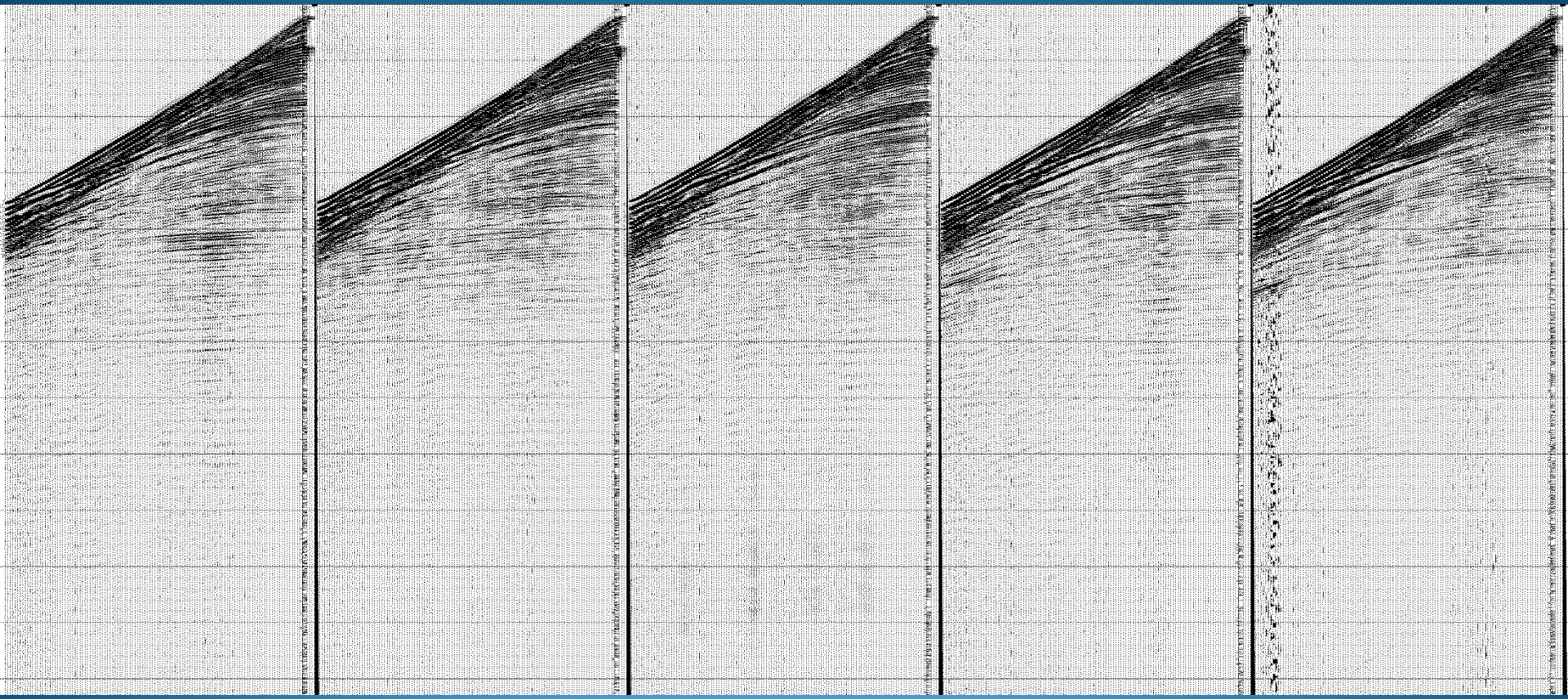
- SEG format AND REVISION NUMBER
- Level of QC
- Recovery Methods
- Header Data Population
- Meta-Data Collection and Provision
- Listings
- Plots

Step 2 – QA Reports

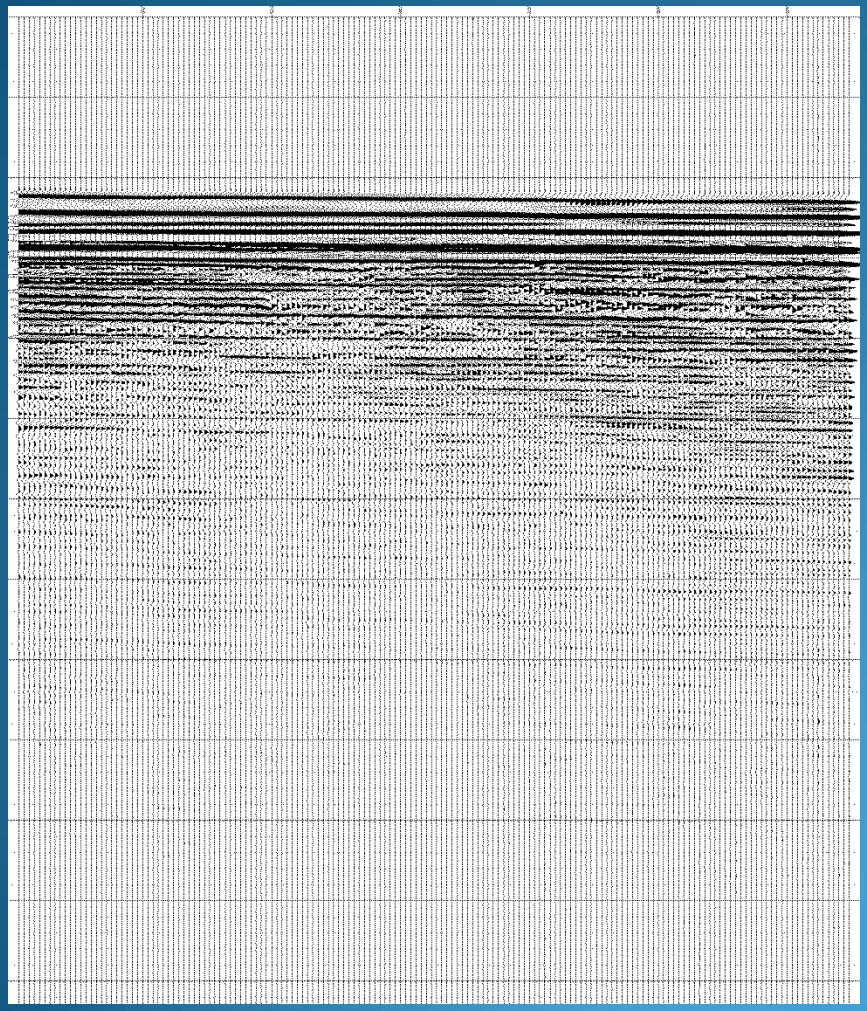
*TAPE=13702.tap
FORMAT=SEGD_DMX
BYTES=173046340
LINEID=M92-4560
RECLEN=5632
DT=2
DATATYPE=FIELD
NSEIS=960
NAUX=27
ENSEMB=FFID
RANGE=9995,9998
RANGE=101,127

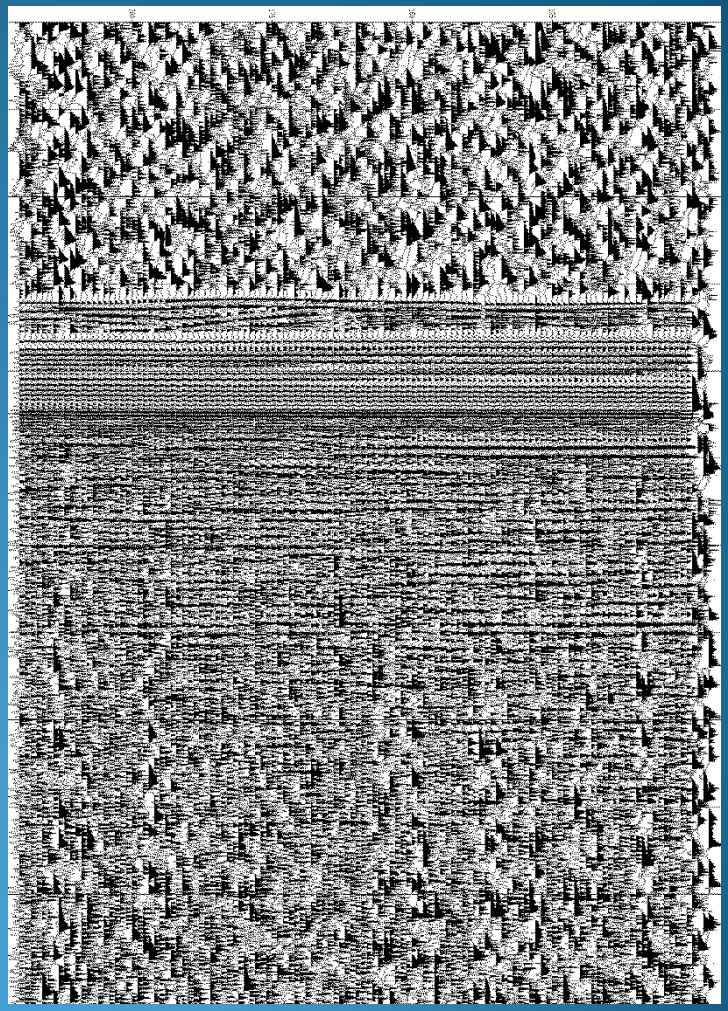
*TAPE=N85-24.sgy
TAPEFILE=1
FORMAT=SEGY
BYTES=16482256
LINEID=N85-24
RECLEN=6064
DT=4
DATATYPE=POSTSTACK
FOLD=1
UNITS=METRES
ENSEMB=cdp
RANGE=1001,3614

Step 3 – QC Visuals - field

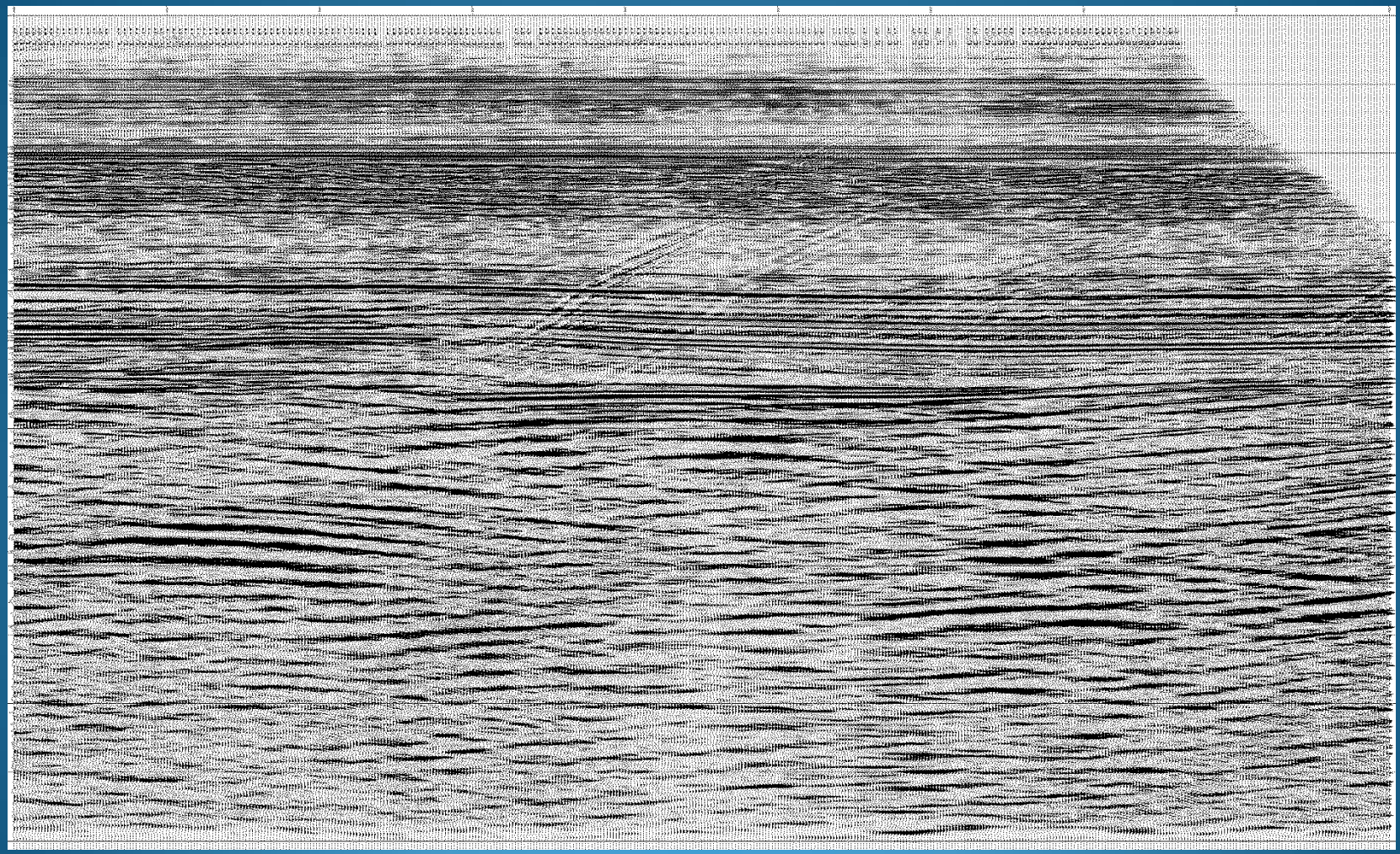


Step 3 – QC Visuals - NTG

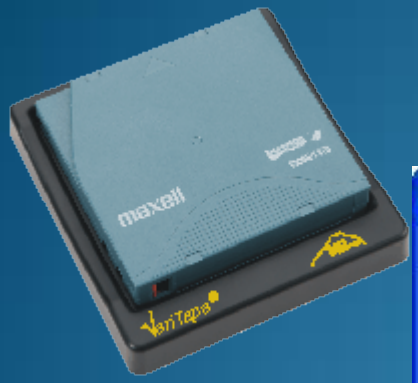




Step 3 – QC Post-Stack



Step 4 – Random Checks



3592 and LTO – less than 8 seconds

VeriTape®

File Edit Action Help

Overview | Cartridges | Basic Info. | Cart. Info. | Drives

Drive Files read from D:\doc\MP\VeriTape\SampleHist

Manufacturer	Min	Max	Avg	SD	HP	HP	HP	HP	HP
Serial Number					HU1061012G	HU106103JL	HU106103L2	HU106103LG	HU1
Drive Score	46.00	100.00	90.40	10.23	94	95	87	99	93
Records	1	167	32.4043	34.7573	19	24	12	21	12
Total Data Read	0	218 GB	20.8 GB	50.5 GB	20.9 GB	1.27 GB	342 MB	836 MB	336
Total Data Written	0	5.11 TB	962 GB	1.01 TB	1.26 TB	2.24 TB	963 GB	35 GB	347
Total Write Retries	0	3.95 / GB	305 / TB	665 / TB	0	16 (7.16 / TB)	1 (1.04 / TB)	0	0
Total Read Retries	0	1.24 / MB	39.2 / GB	183 / GB	0	0	0	0	0
Total Servo Errors	0	4.21 / GB	526 / TB	865 / TB	58 (45.9 / TB)	27 (12.1 / TB)	532 (552 / TB)	20 (572 / TB)	175
Total Fatal Write Errors	0	1.5 / TB	103 / PB	315 / PB	0	0	0	0	0
Total Fatal Read Errors	0	1.39 / GB	51.1 / TB	225 / TB	0	0	0	0	0
Total Fatal Servo Errors	0	8.6 / TB	411 / PB	1.42 / TB	0	0	0	0	0

Found LTO CM Reader version 6.7

SEGY

```
C01 CLIENT : G.S.I. NON-EXCLUSIVE SURVEY   AREA : NORTH SEA NETHERLANDS PHASE II
C02 LINE   : N85-52              SHOTPOINTS :   1 - 3038
C03 DATA SHOT BY          - G.S.I. P.E. HAGGERTY      DATE: MAR/APR 1985
C04 RECORDING INSTRUMENTS    - DFS V
C05 RECORDING FILTERS       - HIGH FILTER AND SLOPE 128 HZ  72 DB/OCT
C06                    LOW  FILTER AND SLOPE 5.3 HZ  18 DB/OCT
C07 RECORDING POLARITY      - A POSITIVE PRESSURE AT THE GEOPHONE PRODUCES A
C08                    NEGATIVE NUMBER ON TAPE
C09 DIGITAL TAPE FORMAT     - SEG B  6250 BPI
C10 RECORD LENGTH/SAMPLE RATE- 6.0 SECONDS AT 2 MILLISECOND SAMPLE RATE
C11 ENERGY SOURCE / DEPTH    - 4250 CU.IN. AIRGUN ARRAY AT 2000 PSI; 6 M AVERAGE
C12 SHOTPOINT INTERVAL      - 25 M;    1 POP/SHOTPOINT;  TIMING DELAY 51.2MSEC
C13 CABLE LENGTH / DEPTH    - 3000 M; 120GRPS; 27 GEOPHONES/GROUP; 8 M AVERAGE
C14 COVERAGE              - 60 FOLD,  120 TRACE
C15 NAVIGATION SYSTEM       - PRIMARY: PULSE 8       SECONDARY: SATNAV
C16 POLARITY CONVENTION     - WAS MAINTAINED THROUGHOUT PROCESSING AND DISPLAY
C17 PROCESSING RECORD LENGTH - 6.0 SECS. 2 MSEC RESAMPLED TO 4 MSEC MIN PHASE
C18 STATIC CORRECTIONS      - SHOT AND STREAMER 9.5 MSEC;TIMING DELAY 51.2 MSEC
C19 TRUE AMPLITUDE RECOVERY  - 5 DB PER SECOND FROM 0 TO 4.0 SECONDS
C20                    SPHERICAL DIVERGENCE CORRECTION APPLIED
C21 PRE DECONVOLUTION MUTE   - RAMP LENGTH TR. 120 - 100 MSEC  START   50 MSEC
C22                          TR.  1 - 100 MSEC  START 2400 MSEC
C23 VELOCITY FILTERING      - DIPS +14/-7 MSEC/TR FULL COSINE TAPER APPLIED
C24 DESIGNATURE           - OFFSET DEPENDENT MARINE WAVELET. V5;  FMIN= 5HZ,
C25                    FMAX=125HZ, HCSLOPE= 72DB/OCT, LCSLOPE=18DB/OCT
C26 VELOCITY ANALYSIS       - USING 9 DEPTH POINT VELSCAN ANAL. 1 EVERY 2.0 KM
C27 DEMULTIPLE APPLIED      - VELNP: 120000 M/SEC
C28 EQUAILSATION          - USING A 3000 MSEC GATE,START TR. 120 -  200 MSEC
C29                               TR.  1 - 2500 MSEC
C30 INSIDE TRACE MUTE       - APPLIED
C31 NORMAL MOVEOUT CORRECTION AND FIRST BREAK SUPPRESSION APPLIED
C32 COMMON DEPTH POINT STACK - 60 FOLD CDP STACK
C33                  -
C34                  -
C35                  -
C36 ********************************************************************************
C37 *   PROCESSED BY GEOPHYSICAL SERVICE INTERNATIONAL  BEDFORD  ENGLAND      *
C38 * CC 82-6723        PROJECT NUMBER 148119        JUN/AUG  1985        *
C39 ********************************************************************************
C40 END EBCDIC:
```

Job number: 8119
Line number: 22
Reel number: 25493505
Data traces per ensemble: 1
Sample interval (this reel): 4000
Samps per trace (this reel): 1516
Sample format code: 1 (IBM 32-bit floating-point)
CDP fold: 1
Trace sort code: 4 (horizontally stacked)
Vertical sum code: 1
Gain recovered flag: 1
Amplitude recovery method: 4
Measurement units: 1 (metres)
Impulse signal polarity: 1

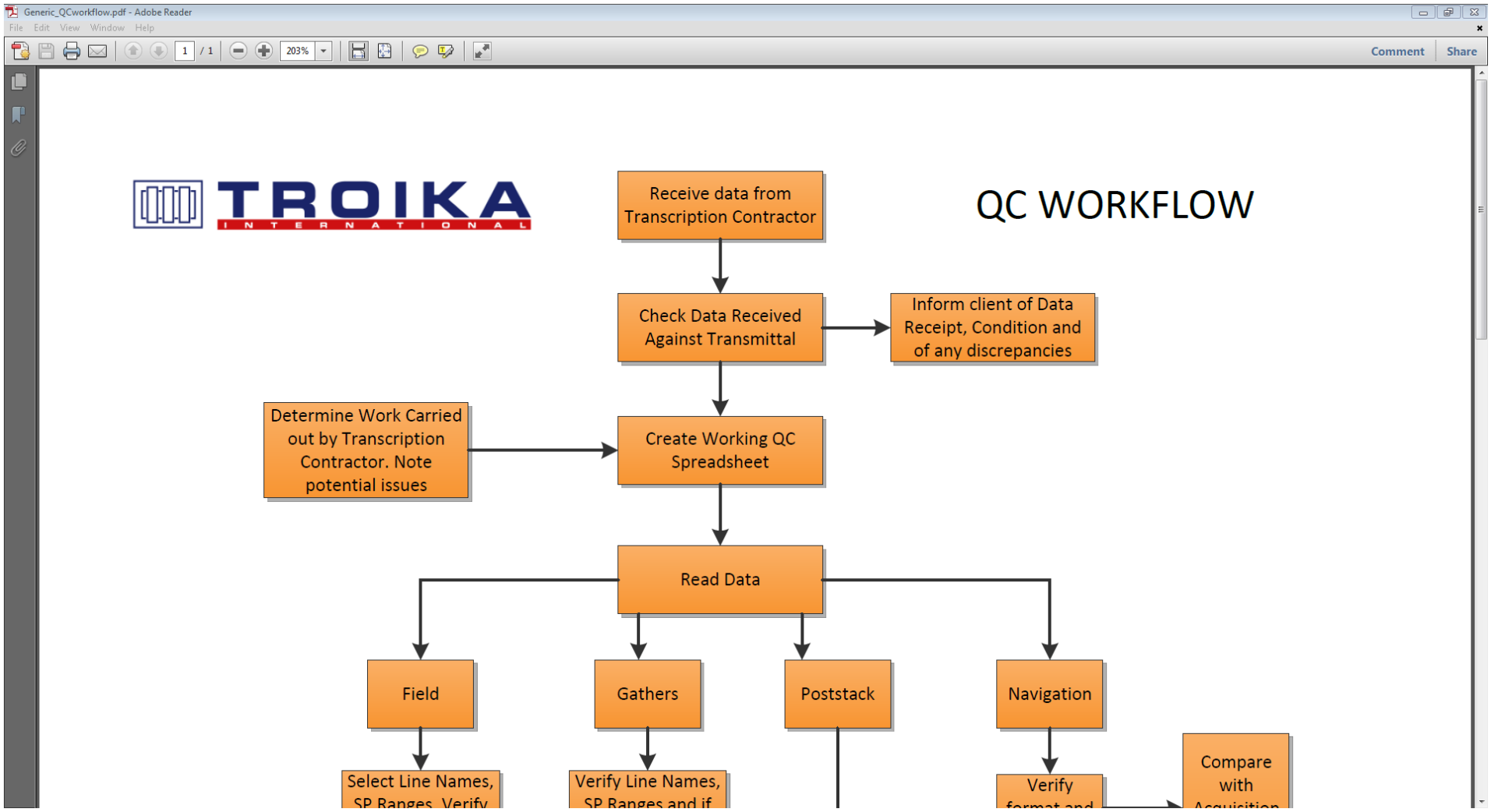
Line Id extracted from header: 'N85-22A'
Expected length of trace records: 6304 bytes
Normal {Normal completion}

Free Software

Magma 5.x for read and list

```
tcl> input read -listmode pattern -idbyte 1 -todeof
Read  Input tape: N85-22A.sgy
                                        Record Parity Error          Super
        Id bytes   1 to 16                                 Length Status File Record  File
c3f0 f140 c3d3 c9c5 d5e3 407a 40c7 4be2                    3200   n/a   -     1      1      1
0000 1fb7 0000 0016 0185 0001 0001 0000                     400   n/a   -     1      2      1
0000 0001 0000 0001 0000 0001 0000 0000                    6304   n/a   -     1      3      1
---- 2996 records of same length omitted from listing ----
0000 0bb6 0000 0bb6 0000 059a 0000 0000                    6304   n/a   -     1   3000      1
/\/\ End-of-file (File 1, 3000 records)
/\/\ End-of-file (File 2, 0 records)
Normal {Normal completion}
```

QC Workflow


Generic_QCworkflow.pdf - Adobe Reader
File Edit View Window Help
Comment
Share
TROIKA
INTERNATIONAL
QC WORKFLOW
Receive data from Transcription Contractor
Check Data Received Against Transmittal
Inform client of Data Receipt, Condition and of any discrepancies
Determine Work Carried out by Transcription Contractor. Note potential issues
Create Working QC Spreadsheet
Read Data
Field
Gathers
Poststack
Navigation
Select Line Names,
Verify Line Names,
Verify
Compare with

Challenges

Life of field – NPD The Petroleum Act addresses this issue in section 55 below. No data can be deleted in Norway without prior permission being granted by the authorities. So far LOF has not been addressed in this respect.

SeaBed acqusition

MicroSeismic

Etc.

You Can Do It

Make Data Management of Structured Data Easier

Check Data – don't let the contractors give you want they want to

Utilise the work of Format Bodies – so lets see what they have been up to.....

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SEGD3

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Extended source support

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- **Support for complex shooting schemes**
  - **Multiple source initiations per shot record**
  - **Multiple sources firing simultaneously**
- **Support for complex source configurations**
  - **Traces and measurements for sources and parts of sources**
- **Support more source types**
  - **Electromagnetic source**
  - **No source/record not synchronized with source**
- **Align SEG-D with SPS standard and/or SEG-Y revision 1 and Px/12 positioning support**

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Support for New Technology

- Microseismic
- Under over cabling
- Seabed
- EM
- CSEM
- Transition
- Complex Arrays
- Receiver Organised Data

Support tape, disk, network transfer

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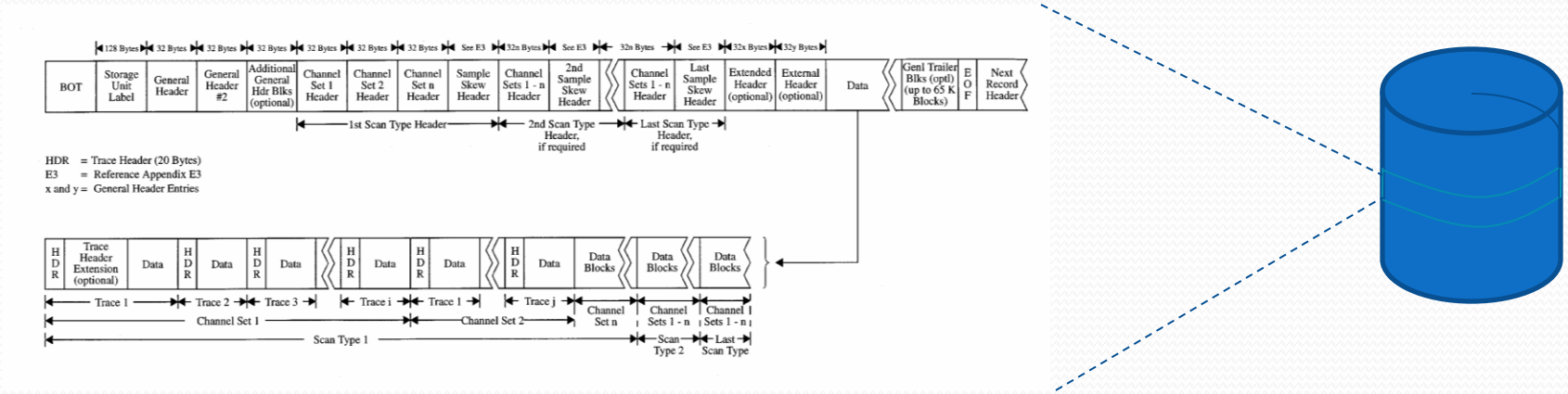
- **Appendix F (Tape device block size) - ?**
- **Storage of SEGD records**
  - **One header block spanning multiple tape blocks**
  - **A trace spanning multiple tape blocks**
  - **Fixed/variable block devices**
  - **Disk storage**
  - **Transfer across network**



New features in revision 3.0 proposal

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- **Table Of Contents file**
  - **Stored at end (or beginning) of tape**
  - **Lists all SEGD records on a tape**
  - **Enable fast access to data**
  - **May be stored on disk (to simplify data mgt)**

CHAPTER I.

PRELIMINARY DEFINITIONS AND THEOREMS.

Survey information

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- **Standardizing storage of common survey information**
  - **Vessel/crew identification**
  - **Survey area name**
  - **Client identification**
  - **Job identification**
  - **Line identification (Record set ID)**

Trailer

- Positioning Edits, Trust Flag
- Data Edits
- Comments
- Freeform for other information
- In other words the Observers Logs

Timestamp

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- **All records, traces, measurements and events tagged with an absolute, microsecond accurate timestamp.**
- **Counting microseconds since 6 Jan 1980 (GPS epoch)**
  - **8 byte integer**
  - **Negative timestamps allowed**
  - **292471 years range**
  - **Defined back to 1 jan 1970 (SEG-D epoch)**
  - **Leap seconds must be added to UTC timestamp (General Header)**

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Positions

- Coordinate Reference System information stored as General Header
- SEG-Y Rev 1 stanza format + support for EPSG CRS ID.
  - Manual entry of parameters or using EPSG ID
- Any geographic, projected, or earth referenced CRS supported (1, 2 or 3 coordinates)
- Any number of CRS supported (One or two recommended)
- Position coordinates stored in Trace Header (receivers/sources) or General Header (sources)
- Two coordinate tuples per 96 byte position header
  - Most common: One geographic and one projected
- Contains type, timestamp and quality information
- A trace may contain any number of positions

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General

- All header blocks (with a few exceptions) have a identification byte (byte 32) to allow blocks to be optional and be placed in e.g. Trace header in any order.
- A table in SEGD standard will identify all types of header
  - Client info
  - Channelset block 1
  - Channelset block 2
  - Position block 1
  - Position block 2
  - Airgun source
  - Vibroseis source
  - Additional source info
  - Extended trace header info 1
  - Etc etc
- Goal: Selfdescribing data, enable automated processing

General headers

- Added header blocks
  - Vessel/crew identification (with abbreviation?) ASCII*32
  - Area name (with abbreviation?) ASCII*32
  - Client name (with abbreviation?) ASCII*32
  - Job name/number/identification ASCII*32
  - Line name/number/identification ASCII*32
- More accurate timestamp defined (exactly defines time of first sample)
  - Used in general header
  - Source header
  - Trace header

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Source header

- Used to be General header N
- Expand source header to contain most of SPS (needed to process SEGD automatically)
- Needed more than 32 bytes -> put common info into extended source info header
- One header block per source (single/combined)
- Can be put into trace header (e.g. in case of slipsweep acquisition)
- Quality information, timing

Channelset

- Reformatted due to large number of new requirements
  - Samplerate
  - Starttime/endtime
  - Number of channels/samples
  - Filter definition extended
- 64 bytes (Channelset header block 1 & 2)
- Notch filter frequencies? Keep, remove or extend?

- Removed sensitivity from chset header (put into trace header) (only sensors with same sensitivity could be in same channelset, each sensor have different sensitivity)

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Trace header

- Increased in size (255*32 byte)
- Partly defined in SEGD standard
- Partly user defined (more space available than in rev 2.x)
- Can contain position of trace
- Can contain source headers

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General trailer

- Completely reformatted from Rev 2.x
- Consists of separate blocks of different (userdefined) information
- Each block starts with a description block defining type and size.
- Some blocks predefined
  - Edits
  - Positions (SEGD, P1, P2)
  - Text comments
  - Observer log
  - TOC?

[GT Desc Block (32 byte)][Block 1 (x*32byte)][GTDB][Block2][GTDB][Block3]….

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SEGD3.1

SUPPORT FOR LITTLE ENDIAN DATA TYPES

9015 20 bit binary
9022 8 bit quaternary
9024 16 bit quaternary
9036 24 bit 2's complement integer
9038 32 bit 2's complement integer
9042 8 bit hexadecimal
9044 16 bit hexadecimal
9048 32 bit hexadecimal
9058 32 bit IEEE
9080 64 bit IEEE

SEG Y rev 2 – under review

SEG Technical Standards Committee

http://www.seg.org/web/technical-standards-committee/documents/-/document_library/view/6062543

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Unchanged Items

- **2.1. Unchanged Items**
- EBCDIC encoding allowed for text
- The size of the original 3200-byte
- Textual File Header, 400-byte Binary
- File Header and initial 240-byte Trace

Unchanged Items

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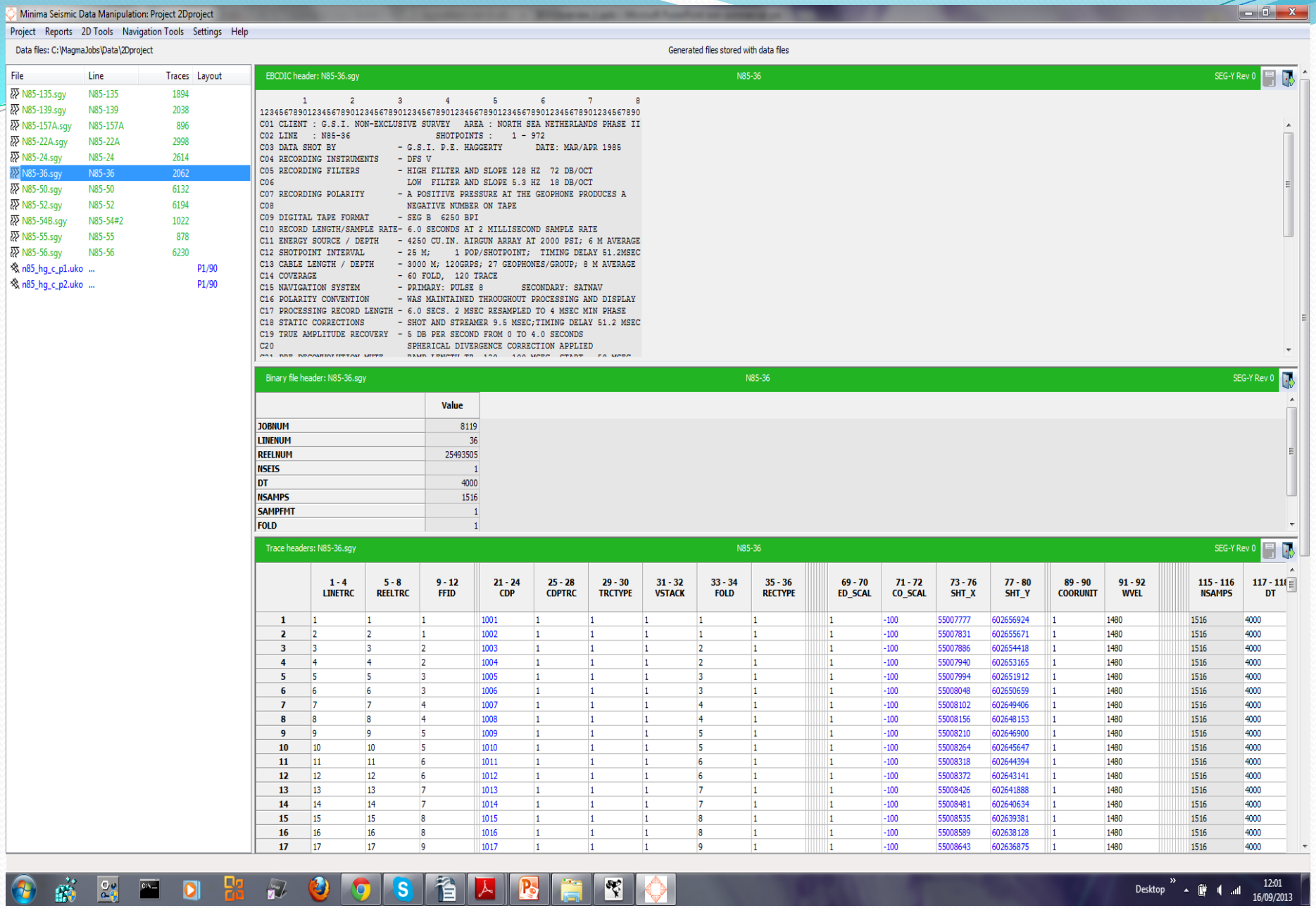
```
Magma Utility Shell Program Version 5.1.0.alpha1
Copyright (c) 1995-2013 by Troika International
All rights reserved
[Tcl version 8.4.16]
====
Magma license checked out
====
tcl> tdevs
tcl> tdevs21
tcl> tchanger devices
tcl> rtapi installed
0
tcl> tmount diskfile auto N85-24.sgy -name input -access read -directory C:/MagmaJobs/Data/2Dproject
input
tcl> input read -listmode pattern -idbyte 1 -records 50
Read  Input tape: N85-24.sgy

        Id bytes   1 to 16                          Length          Count Status File Record  File
c3f0 f140 c3d3 c9c5 d5e3 407a 40c7 4be2           3200   n/a      -              1     1     1
0000 1fb7 0000 0018 0185 0001 0001 0000            400   n/a      -              1     2     1
0000 0001 0000 0001 0000 0002 0000 0000           6304   n/a      -              1     3     1
---- 46 records of same length omitted from listing ----
0000 0030 0000 0030 0000 0019 0000 0000           6304   n/a      -              1    50     1
Normal {Normal completion}
```


Minima Seismic Data Manipulation: Project 2Dproject
Project Reports 2D Tools Navigation Tools Settings Help
Data files: C:\MagmaJobs\Data\2Dproject
Generated files stored with data files
File Line Traces Layout
N85-135.sgy N85-135 1894
N85-139.sgy N85-139 2038
N85-157A.sgy N85-157A 896
N85-22A.sgy N85-22A 2998
N85-24.sgy N85-24 2614
N85-36.sgy N85-36 2062
N85-50.sgy N85-50 6132
N85-52.sgy N85-52 6194
N85-54B.sgy N85-54#2 1022
N85-55.sgy N85-55 878
N85-56.sgy N85-56 6230
n85_hg_c_p1.uko ... P1/90
n85_hg_c_p2.uko ... P1/90
EBCDIC header: N85-36.sgy
N85-36
SEG-Y Rev 0
1 2 3 4 5 6 7 8
C01 CLIENT : G.S.I. NON-EXCLUSIVE SURVEY AREA : NORTH SEA NETHERLANDS PHASE II
C02 LINE : N85-36 SHOTPOINTS : 1 - 972
C03 DATA SHOT BY - G.S.I. P.E. HAGGERTY DATE: MAR/APR 1985
C04 RECORDING INSTRUMENTS - DFS V
C05 RECORDING FILTERS - HIGH FILTER AND SLOPE 128 HZ 72 DB/OCT
C06 LOW FILTER AND SLOPE 5.3 HZ 18 DB/OCT
C07 RECORDING POLARITY - A POSITIVE PRESSURE AT THE GEOPHONE PRODUCES A
C08 NEGATIVE NUMBER ON TAPE
C09 DIGITAL TAPE FORMAT - SEG B 6250 BPI
C10 RECORD LENGTH/SAMPLE RATE- 6.0 SECONDS AT 2 MILLISECOND SAMPLE RATE
C11 ENERGY SOURCE / DEPTH - 4250 CU.IN. AIRGUN ARRAY AT 2000 PSI; 6 M AVERAGE
C12 SHOTPOINT INTERVAL - 25 M; 1 POP/SHOTPOINT; TIMING DELAY 51.2MSEC
C13 CABLE LENGTH / DEPTH - 3000 M; 120GRPS; 27 GEOPHONES/GROUP; 8 M AVERAGE
C14 COVERAGE - 60 FOLD, 120 TRACE
C15 NAVIGATION SYSTEM - PRIMARY: PULSE 8 SECONDARY: SATNAV
C16 POLARITY CONVENTION - WAS MAINTAINED THROUGHOUT PROCESSING AND DISPLAY
C17 PROCESSING RECORD LENGTH - 6.0 SECS. 2 MSEC RESAMPLED TO 4 MSEC MIN PHASE
C18 STATIC CORRECTIONS - SHOT AND STREAMER 9.5 MSEC;TIMING DELAY 51.2 MSEC
C19 TRUE AMPLITUDE RECOVERY - 5 DB PER SECOND FROM 0 TO 4.0 SECONDS
C20 SPHERICAL DIVERGENCE CORRECTION APPLIED
Binary file header: N85-36.sgy
N85-36
SEG-Y Rev 0
Value
JOBNUM 8119
LINENUM 36
REELNUM 25493505
NSEIS 1
DT 4000
NSAMPS 1516
SAMPFMT 1
FOLD 1
Trace headers: N85-36.sgy
N85-36
SEG-Y Rev 0
1 - 4 LINETRC
5 - 8 REELTRC
9 - 12 FFID
21 - 24 CDP
25 - 28 CDPTRC
29 - 30 TRCTYPE
31 - 32 VSTACK
33 - 34 FOLD
35 - 36 RECTYPE
69 - 70 ED_SCAL
71 - 72 CO_SCAL
73 - 76 SHT_X
77 - 80 SHT_Y
89 - 90 COORUNIT
91 - 92 WVEL
115 - 116 NSAMPS
117 - 11(DT
1 1 1 1 1001 1 1 1 1 1 1 -100 55007777 602656924 1 1480 1516 4000
2 2 2 1 1002 1 1 1 1 1 1 -100 55007831 602655671 1 1480 1516 4000
3 3 3 2 1003 1 1 1 2 1 1 -100 55007886 602654418 1 1480 1516 4000
4 4 4 2 1004 1 1 1 2 1 1 -100 55007940 602653165 1 1480 1516 4000
5 5 5 3 1005 1 1 1 3 1 1 -100 55007994 602651912 1 1480 1516 4000
6 6 6 3 1006 1 1 1 3 1 1 -100 55008048 602650659 1 1480 1516 4000
7 7 7 4 1007 1 1 1 4 1 1 -100 55008102 602649406 1 1480 1516 4000
8 8 8 4 1008 1 1 1 4 1 1 -100 55008156 602648153 1 1480 1516 4000
9 9 9 5 1009 1 1 1 5 1 1 -100 55008210 602646900 1 1480 1516 4000
10 10 10 5 1010 1 1 1 5 1 1 -100 55008264 602645647 1 1480 1516 4000
11 11 11 6 1011 1 1 1 6 1 1 -100 55008318 602644394 1 1480 1516 4000
12 12 12 6 1012 1 1 1 6 1 1 -100 55008372 602643141 1 1480 1516 4000
13 13 13 7 1013 1 1 1 7 1 1 -100 55008426 602641888 1 1480 1516 4000
14 14 14 7 1014 1 1 1 7 1 1 -100 55008481 602640634 1 1480 1516 4000
15 15 15 8 1015 1 1 1 8 1 1 -100 55008535 602639381 1 1480 1516 4000
16 16 16 8 1016 1 1 1 8 1 1 -100 55008589 602638128 1 1480 1516 4000
17 17 17 9 1017 1 1 1 9 1 1 -100 55008643 602636875 1 1480 1516 4000
Desktop
12:01
16/09/2013

Downward Compatibility to SEGY1.0

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- First 240 bytes of trace headers to remain the same.
- Edit to binary header - as long as undefined fields were filled with binary zeros
- Multiple EBCDIC headers as per SEGY Rev 1.0 under same rules to provide downward compatibility to SEGY.
- Deprecate Rev 1.0 name and rename SEGY Rev 1.0 to SEGY1.0

SEGY1.0 – Trace Header

181-184	X coordinate of ensemble (CDP) position of this trace (scalar in Trace Header bytes 71-72 applies). The coordinate reference system should be identified through an extended header Location Data stanza (see section D-1).
185-188	Y coordinate of ensemble (CDP) position of this trace (scalar in bytes Trace Header 71-72 applies). The coordinate reference system should be identified through an extended header Location Data stanza (see section D-1).
189-192	For 3-D poststack data, this field should be used for the in-line number. If one in-line per SEG Y file is being recorded, this value should be the same for all traces in the file and the same value will be recorded in bytes 3205-3208 of the Binary File Header.
193-196	For 3-D poststack data, this field should be used for the cross-line number. This will typically be the same value as the ensemble (CDP) number in Trace Header bytes 21-24, but this does not have to be the case.

Minima 3D Seismic Data QC: Project SeismicData

Project Reports Setup Read 3D Tools Settings Help

Data files: C:\MagmaJobs\Data\TeaPotDome\TeaPotDome\SeismicData — Generated files stored with data files

File	Traces	Setup	Read
filt_mig.sgy	64860	OK	OK

EBCDIC header: filt_mig.sgy — SEG-Y Rev 0

```
        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
C 1 CLIENT: ROCKY MOUNTAIN OILFIELD TESTING CENTER
C 2 PROJECT: NAVAL PETROLEUM RESERVE #3 (TEAPOT DOME); NATRONA COUNTY, WYOMING
C 3 LINE: 3D
C 4
C 5 THIS IS THE FILTERED POST STACK MIGRATION
C 6
C 7 INLINE 1, XLINE 1:   X COORDINATE: 788937  Y COORDINATE: 938846
C 8 INLINE 1, XLINE 188: X COORDINATE: 809502  Y COORDINATE: 939334
C 9 INLINE 345, XLINE 1: X COORDINATE: 788039  Y COORDINATE: 976675
```

Binary file header: filt_mig.sgy — SEG-Y Rev 0

	Value
JOBNUM	9999
LINENUM	9999
REELNUM	1
NSEIS	188
NAUX	0
DT	2000
NSAMPS	1501
SAMPFMT	1

Trace headers: filt_mig.sgy — SEG-Y Rev 0

	165 - 166 SECOND	167 - 168 TIMEBASE	169 - 170 TRWEIGHT	171 - 172 RSTASWP1	173 - 174 RSTATRC1	175 - 176 RSTATRCN	177 - 178 GAPSIZE	179 - 180 OVERTRVL	181 - 184 OPT1	185 - 188 OPT2	189 - 192 OPT3	193 - 196 OPT4	197 - 200 OPT5	201 - 204 OPT6	205 - 208 OPT7	209 - 212 OPT8	213 - 216 OPT9	217 - 220 OPT10	221 - 224 OPT11	2
1		0	0	0	0	0	0	0	1	1	788937	938846	0	0	0	0	0	0	0	0
2		0	0	0	0	0	0	0	1	2	789047	938848	0	0	0	0	0	0	0	0
3		0	0	0	0	0	0	0	1	3	789157	938851	0	0	0	0	0	0	0	0
4		0	0	0	0	0	0	0	1	4	789267	938853	0	0	0	0	0	0	0	0
5		0	0	0	0	0	0	0	1	5	789377	938856	0	0	0	0	0	0	0	0
6		0	0	0	0	0	0	0	1	6	789487	938859	0	0	0	0	0	0	0	0
7		0	0	0	0	0	0	0	1	7	789597	938861	0	0	0	0	0	0	0	0
8		0	0	0	0	0	0	0	1	8	789707	938864	0	0	0	0	0	0	0	0
9		0	0	0	0	0	0	0	1	9	789817	938867	0	0	0	0	0	0	0	0
10		0	0	0	0	0	0	0	1	10	789927	938869	0	0	0	0	0	0	0	0
11		0	0	0	0	0	0	0	1	11	790037	938872	0	0	0	0	0	0	0	0
12		0	0	0	0	0	0	0	1	12	790147	938874	0	0	0	0	0	0	0	0
13		0	0	0	0	0	0	0	1	13	790257	938877	0	0	0	0	0	0	0	0
14		0	0	0	0	0	0	0	1	14	790367	938880	0	0	0	0	0	0	0	0
15		0	0	0	0	0	0	0	1	15	790477	938882	0	0	0	0	0	0	0	0
16		0	0	0	0	0	0	0	1	16	790587	938885	0	0	0	0	0	0	0	0
17		0	0	0	0	0	0	0	1	17	790697	938887	0	0	0	0	0	0	0	0
18		0	0	0	0	0	0	0	1	18	790807	938890	0	0	0	0	0	0	0	0
19		0	0	0	0	0	0	0	1	19	790917	938893	0	0	0	0	0	0	0	0
20		0	0	0	0	0	0	0	1	20	791027	938895	0	0	0	0	0	0	0	0
21		0	0	0	0	0	0	0	1	21	791137	938898	0	0	0	0	0	0	0	0
22		0	0	0	0	0	0	0	1	22	791247	938900	0	0	0	0	0	0	0	0
23		0	0	0	0	0	0	0	1	23	791357	938903	0	0	0	0	0	0	0	0
24		0	0	0	0	0	0	0	1	24	791467	938906	0	0	0	0	0	0	0	0
25		0	0	0	0	0	0	0	1	25	791577	938908	0	0	0	0	0	0	0	0
26		0	0	0	0	0	0	0	1	26	791687	938911	0	0	0	0	0	0	0	0
27		0	0	0	0	0	0	0	1	27	791797	938914	0	0	0	0	0	0	0	0

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Changes for SEGY2.0

- Allow 240 byte trace header extensions, using a text string in the last 8 bytes of each exten-sion to identify its contents
- Support up to 2^{31} samples per trace and traces per ensemble
- Permit arbitrarily large and small sample intervals (double precision option)
- Added 3-byte and 8-byte sample formats

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Changes for SEGY2.0

- Support microsecond date and time stamps
- Provide for additional precision in coordinates, depths, elevations (Can use lat/long and UTM directly)
- Synchronize coordinate reference system specification with SEG-D rev 3
- Backward compatible with rev 1 (with edit to binary header) as long as undefined fields were filled with binary zeros

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On Tape and On Disk

One important class of media that does not conform to the variable length record model is the disk file, which is defined on modern systems as a byte stream without any structure. It has become common practice to write SEG Y data to disk, including CDROM, for data distribution. Certain rules have to be followed for this to work
correctly. Appendix A defines how SEG Y data should be written to a disk file.
In order to make SEG Y consistent with the SEG D Rev 3.0 standard, Appendix B defines a tape label for SEG Y tapes, using a format based on the RP66 Storage Unit Label.

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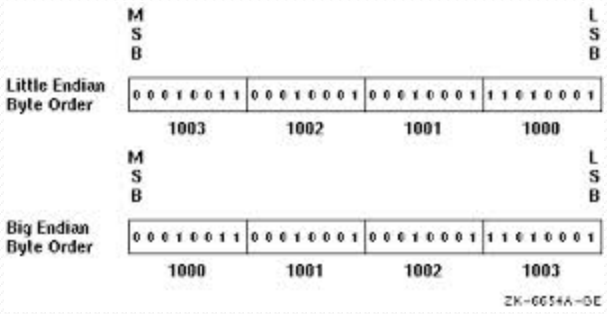
Big Endian

3.3. Number Formats

In the 1975 SEG Y standard, all binary values are defined as using "big-endian" byte ordering. This conformed to the IBM tape standard and means that, within the bytes that make up a number, the most significant byte (containing the sign bit) is written closest to the beginning of the file and the least significant byte is written closest to the end of the file. This byte ordering convention is maintained in this revision of the SEG Y format and it should be adhered to for all conforming versions of SEG Y. This is independent of the medium to which a particular SEG Y file is written (i.e. the byte ordering is no different if the file is written to tape on a mainframe or to disk on a PC).

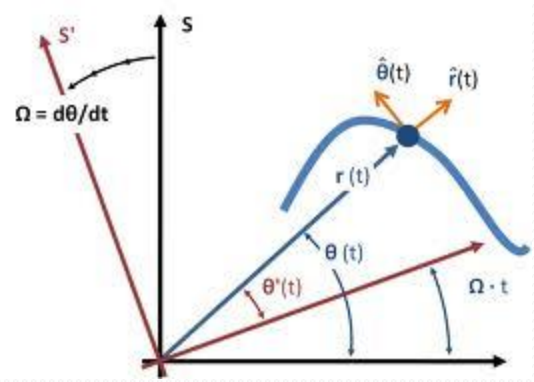


CRS

3.5. Coordinates

Knowing the source and trace locations is a primary requirement for processing seismic data, and knowing the location of the processed data with respect to other data is essential for interpretation. Traditionally seismic coordinates have been supplied as geographic coordinates and/or grid coordinates. SEG Y accommodates either form. However locations are ambiguous without clear coordinate reference system (CRS) definition. SEG Y rev 1 significantly expands the ability to define the CRS used for the coordinates contained within the Binary Header, the Extended Textual Headers and the Trace Headers. **A SINGLE CRS MUST** be used for all coordinates within an individual SEG Y data set. Additionally the coordinate units must be the

EPSG reference is not considered to be enough on it's own.



Binary Header

BYTE NUMBER

3213-32141 Number of data traces per ensemble. Mandatory for prestack data

3215-3216 Number of auxiliary traces per ensemble. Mandatory for prestack data.

3217-3218 Sample internval in microseconds (μs). Mandatory for all data types

3221-3222 Number of samples per data trace. Mandatory for all types of data.

Note: The sample interval and number of samples in the Binary File Header should be for the primary set of seismic data traces in the file

3225-3226 Data sample format code. Mandatory for all data.

1 = 4-byte IBM floating-point

2 = 4-byte, two's complement integer

3 = 2-byte, two's complement integer

4 = 4-byte fixed-point with gain (obsolete)

5 = 4-byte IEEE floating-point

6 = Not currently used

7 = Not currently used

8 = 1-byte, two's complement integer

Binary Header

BYTE NUMBER

3227-32286 Ensemble fold — The expected number of data traces per trace ensemble (e.g. the CMP fold). **Mandatory**

3229-32306 Trace sorting code (i.e. type of ensemble) :

-1 = Other (should be explained in user Extended Textual File Header stanza

0 = Unknown

1 = As recorded (no sorting)

2 = CDP ensemble

3 = Single fold continuous profile

4 = Horizontally stacked

5 = Common source point

6 = Common receiver point

7 = Common offset point

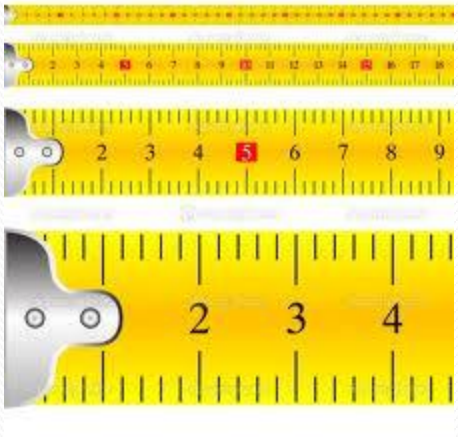
8 = Common mid-point

9 = Common conversion point

Mandatory.

Binary Header

3255-32566
Measurement system: **Mandatory**.
If Location Data stanzas are included in the file, this entry must agree with the Location Data stanza. If there is a disagreement, the last Location Data stanza is the controlling authority.
1 = Meters
2 = Feet



Binary Header

3501-35026
SEG Y Format Revision Number. This is a 16-bit unsigned value. **This field is mandatory for all versions of SEG Y, although a value of zero indicates "traditional" SEG Y conforming to the 1975 standard.**

3503-35046
Fixed length trace flag. A value of one indicates that all traces in this SEG Y
file are guaranteed to have the same sample interval and number of samples. **This field is mandatory for all versions of SEG Y, although a value of zero indicates "traditional" SEG Y conforming to the 1975 standard.**

Binary Header

3505-35066
Number of 3200-byte, **Extended Textual File Header** records following the Binary Header. A value of zero indicates there are no Extended Textual File Header records (i.e. this file has no Extended Textual File Header(s)). A value of -1 indicates that there are a variable number of Extended Textual File Header records and the end of the Extended Textual File Header is denoted by an ((SEG: EndText)) stanza in the final record. A positive value indicates that there are exactly that many Extended Textual File Header records. Note that, although the exact number of Extended Textual File Header records may be a useful piece of information, it will not always be known at the time the Binary Header is written and it is not mandatory that a positive value be recorded here. **This field is mandatory for all versions of SEG Y, although a value of zero indicates "traditional" SEG Y conforming to the 1975 standard**

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6.3. Stanza Example
((JJ ESeis: Microseismic Geometry Definition ver 1.0))
Definer name = J and J Example Seismic Ltd.
Line Name Convention = CDA
Line Name = Sample MicroSeismic 1
First Trace In Data Set = 101
Last Trace In Data Set = 1021
First SP In Data Set = 2001
Last SP In Data Set = 6032
((SEG: Coverage Perimeter ver 1.0))
Coverage type =full-fold
Perimeter coordinate type =I,J
Perimeter node number =10
Perimeter node coordinates =334.0000,908.0000
Perimeter node coordinates =654.0000,908.0000
Perimeter node coordinates =654.0000,833.0000
Perimeter node coordinates =900.0000,833.0000
Perimeter node coordinates =900.0000,721.0000
Perimeter node coordinates =1352.0000,721.0000
Perimeter node coordinates =1352.0000,289.0000
Perimeter node coordinates =802.0000,289.0000
Perimeter node coordinates =802.0000,368.0000
Perimeter node coordinates =334.0000,368.0000
Perimeter node coordinates =334.0000,908.0000
Coverage Perimeter comment =48 fold data
((SEG: Measurement Units ver 1.0))
Data Sample Measurement Unit =Millivolts
Volt conversion =0.001
... additional stanzas or blank records to end of 3200-byte Extended Textual Header
((SEG: EndText))

Trace Headers

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1-4 Trace sequence number within line — Numbers continue to increase if the same line continues across multiple SEG Y files. **Mandatory.**
9-12 Original field record number. **Mandatory.**
13-16 Trace number within the original field record. **Mandatory.**
-1 = Other
0 = Unknown
1 = Time domain seismic data
2 = Dead
3 = Dummy
4 = Time break
Etc Etc Etc to 39 = Rotational sensor – Pitch
40 = Rotational sensor – Roll
41 = Rotational sensor – Yaw
42 … 64 = Reserved
65 … N = optional use, (maximum N = 32,767) **Mandatory.**

Trace Headers

73-76 Source coordinate - X.
77-80 Source coordinate - Y.
81-84 Group coordinate - X.
85-88 Group coordinate - Y.
The coordinate reference system should be identified through an extended header Location Data stanza (see section D-1). If the coordinate units are in seconds of arc, decimal degrees or DMS, the X values represent longitude and the Y values latitude. A positive value designates east of Greenwich Meridian or north of the equator and a negative value designates south or west.
89-90 Coordinate units:
1 = Length (meters or feet)
2 = Seconds of arc
3 = Decimal degrees
4 = Degrees, minutes, seconds (DMS)

Trace Headers

115-116 Number of samples in this trace. **Mandatory.**
117-1188 - Sample interval for this trace. Microseconds (μs) for time data, Hertz (Hz) for frequency data, meters (m) or feet (ft) for depth data. The number of bytes in a trace record must be consistent with the number of samples written in the trace header. This is important for all recording media; but it is particularly crucial for the correct processing of SEG Y data in disk files (see Appendix C). **Mandatory**

128 byte Tape Label

Compatible with SEGD

Table 4 SEG Y Tape Label
Field Description Bytes Start - end byte
1 Storage Unit Sequence Number 4 1 - 4
2 SEG Y Revision 5 5 - 9
3 Storage Unit Structure (fixed or variable) 6 10 - 15
4 Binding Edition 4 16 - 19
5 Maximum Block Size 10 20 - 29
6 Producer Organization Code 10 30 - 39
7 Creation Date 11 40 - 50
8 Serial Number 12 51 - 62
9 Reserved 6 63 - 68
10 Storage Set Identifier 60 69 - 128

Encapsulation

- Necessary with High Capacity Media
- Hardware summary
- Linear Serpentine recording
- 4 TB capacity using JC/JY media
- 1.6 TB capacity using JB/JX media
- 500 GB capacity using JK media
- 800 MBps burst data rate
- Compact 3.8 in x 7.8 in x 18.4 in dimensions

Standards Leadership Coun

Energistics serves as the facilitator, custodian and advocate for the development and adoption of technical open data exchange standards in the upstream oil and gas industry.

MIMOSA, an operations and maintenance open systems alliance, is a not-for-profit trade association dedicated to developing and encouraging the adoption of open information standards for Operations and Maintenance in manufacturing, fleet, and facility environments.

PIDX International provides a global forum for delivering the process, information and technology standards that facilitates seamless, efficient electronic business within the oil and natural gas industry and its trading community.

POSC Caesar Association (PCA) is a non-profit global- standardization member organization that shall promote the development of open specifications to be used as standards for enabling the interoperability of data, software and related matters.

Professional Petroleum Data Management Association (PPDM) is a global not-for-profit organization within the petroleum industry to promote professional petroleum data management through the development and dissemination of best practices.

The Open Geospatial Consortium (OGC) is an international industry consortium of over 480+ companies, government agencies and universities participating in a consensus process to develop publicly available interface standards.

The OPC Foundation is dedicated to ensuring interoperability in automation by creating and maintaining open specifications that standardize the communication of acquired process data, alarm and event records, historical data, and batch data to multi-vendor enterprise systems and between production devices.

The Pipeline Open Data Standard Association (PODS) was created to develop and support open data storage and interchange standards to meet the specificdata management needs of pipeline companies.

SEG The Society of Exploration Geophysicists is a not-for-profit organization that promotes the science of applied geophysics and the education of geophysicists. The Society fulfils its mission through its publications, conferences, forums, web sites, and educational opportunities.

SEG EarthIQ ????

Input Now

Meetings with:

Acquisition
Programmers
Geophysicists
Data Managers
GIS
Processing Teams
Interpreters
Contractors
Negotiators
International Branches
NOC's
NDR's

New Disiplines

PLEASE PLEASE GET INVOLVED WHILE YOU STILL HAVE THE CHANCE

In Conclusion

- Standards
  - Standards
    - Standards
      - Standards
        - Standards
          - Standards
            - Standards
              - Standards
                - Standards
                - Standards
- And Good Logical Workflows