SEG Y2 overview
SEGD3.1 for publication

SEG Technical Standards Committee

http://www.seg.org/ts and tsc

Standards Leadership Council 18th
February, 2014

SEG History

- 1930 On 11 March, twenty-nine men and one woman met in Houston at the University Club to found the Society of Economic Geophysicists.
- 1931 The group's name was changed to Society of Petroleum Geophysicists (SPG), and the first convention was held in conjunction with AAPG
- 1937 Once again the name of the organization was changed, this time to Society of Exploration Geophysicists. Accepted as an Affiliated Society by AAPG
- 1955 SEG held its last joint meeting with AAPG, then celebrated its twenty-fifth anniversary with a separate meeting in Denver.
- 1973 Sheriff produced SEG's all time best-seller, Encyclopaedic Dictionary of Exploration Geophysics. The creation of a Technical Standards Committee
- 1975 Publication of the Technical Standards Book for SEGA, SEGB, SEGC and SEGD

In The Beginning and Now

Less Processing Power Than Your Microwave!
20 Mbytes Storage

250 Mbytes/ second Transfer, runs in a 2.5 Ebyte library, capacity 4 Terabytes.

Early 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 analogue 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.

7-Track The Wild West

Standards Leadership Council 18th
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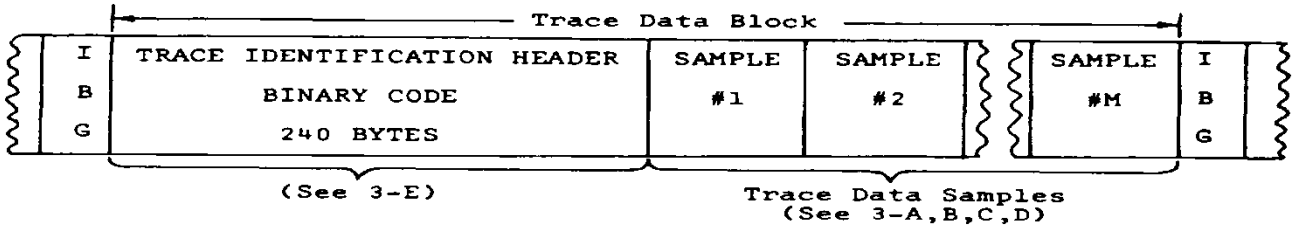
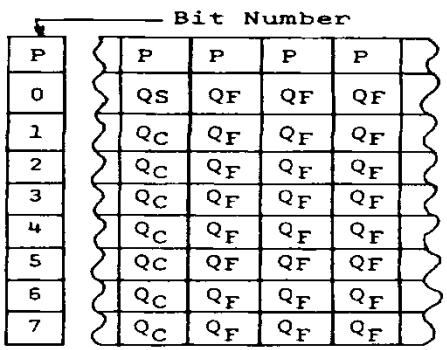
SEG

1975 – SEGA, Limited number of channels
1975 – SEGB, 2.5 bytes per sample
1975 – SEGC, 4 bytes per sample
1975 – SEGD
1983 – SEG-P1 and SEG-P2
1990 – SEG-2
1994 – SEGD1
1995 – SEG SPS
1996 – SEG RODE (1997 update)
1997 – SEGD2
2002 – SEGY1
2006 – SEGD2.1
2006 – SEG SPS
2009 - SEGD3

TAPE MAP



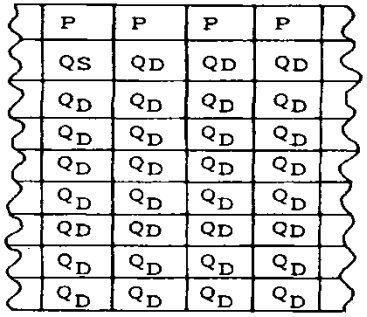
TRACE DATA SAMPLE FORMATS



32 Bit Floating Point Format

Sample Code= 1

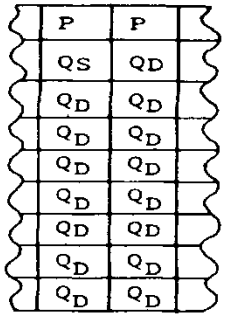
3-A



32 Bit Fixed Point Format

Sample Code= 2

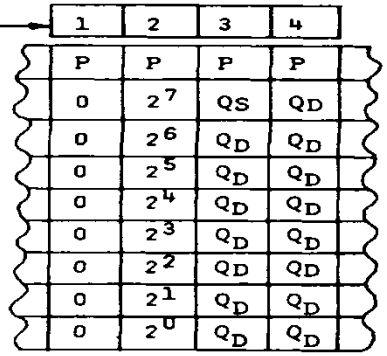
3-B



16 Bit Fixed Point Format

Sample Code= 3

3-C



32 Bit Fixed Point Format With Gain Values

Sample Code= 4

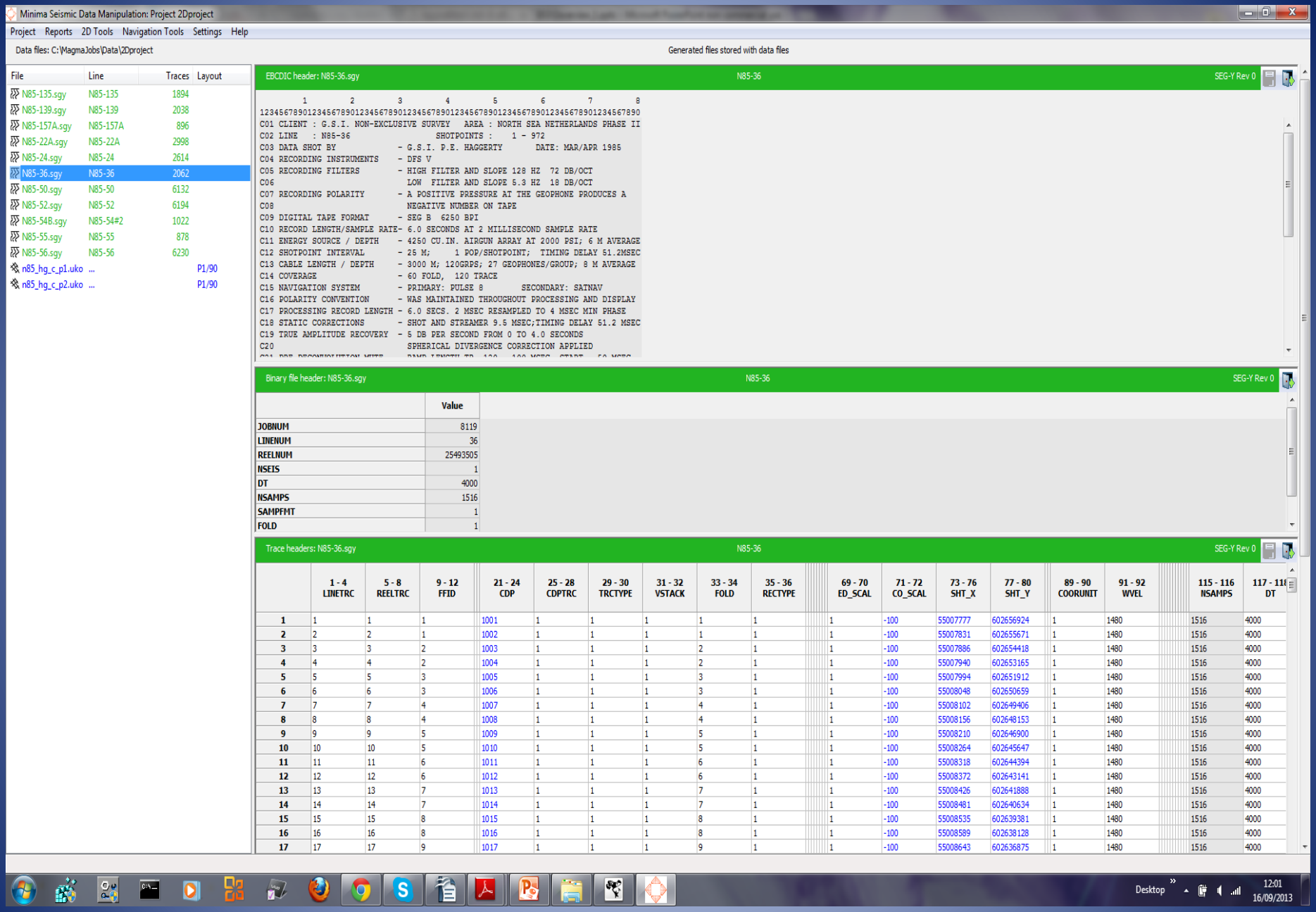
3-D

SEGY – EBCDIC Header

C01
C02
C03
C04
C05
C06
C07
C08
C09
C10
…..
C40

Binary Header

3201-3204		Job number: 375860
3205-3208	*	Line number: 1234
3209-3212	*	Reel number: 1
3213-3214	*	Data traces per ensemble: 240
3215-3216	*	Aux traces per ensemble: 2
3221-3222	*	Sample interval (this reel): 2000
3221-3222	*	Samples per trace (this reel): 3072
3225-3226	*	Sample format code: 1 (IBM 32-bit FP)
3229-3230		Trace sort code: 1 (as recorded (field))



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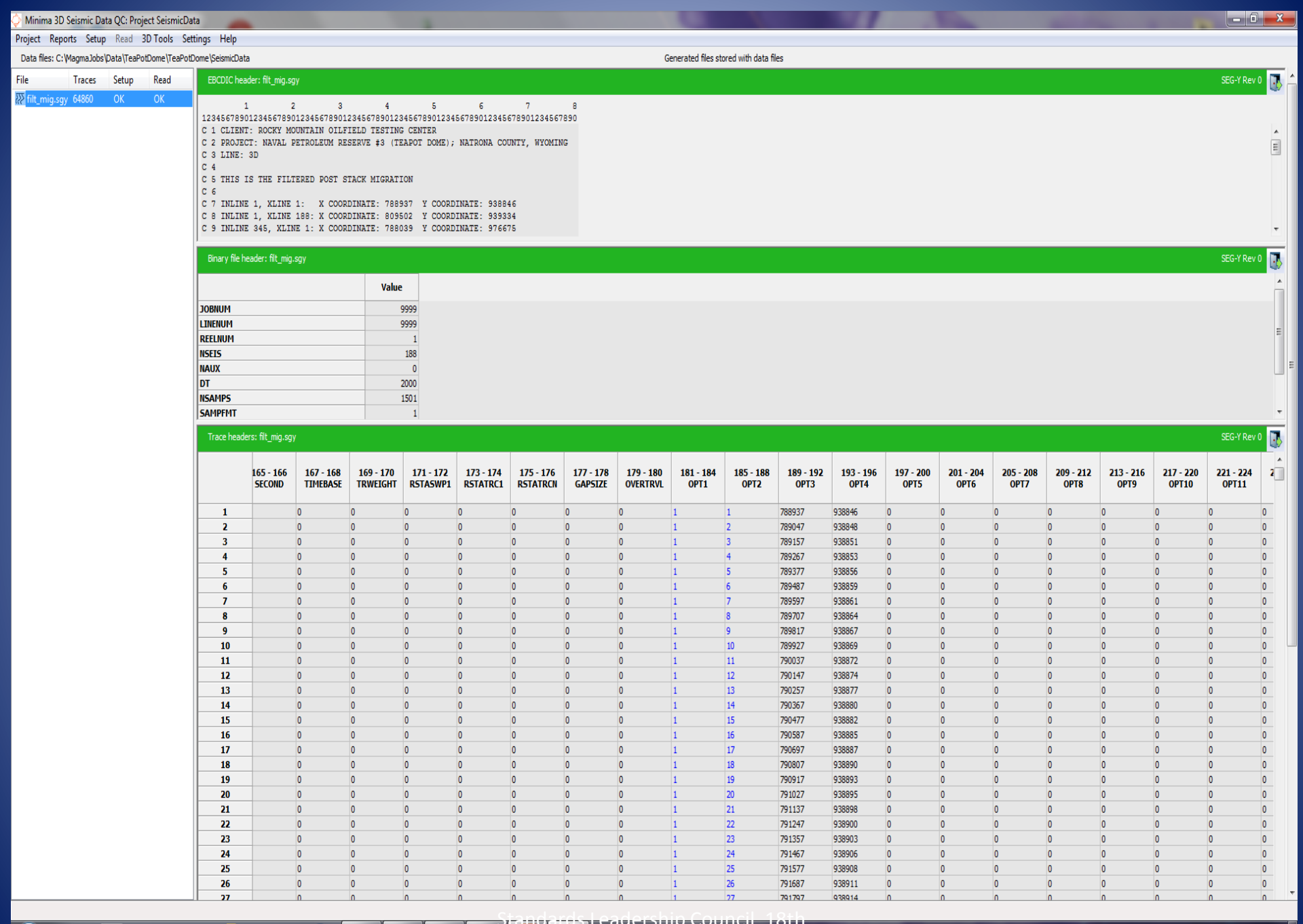
Downward Compatibility to SEGY1.0

Society of Exploration Geophysicists
The international society of applied geophysics

- 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
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
Desktop
17:42
16/09/2013

Changes for SEGY2.0

- Allow 240 byte trace header extensions, using a text string in the last 8 bytes of each extension 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

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

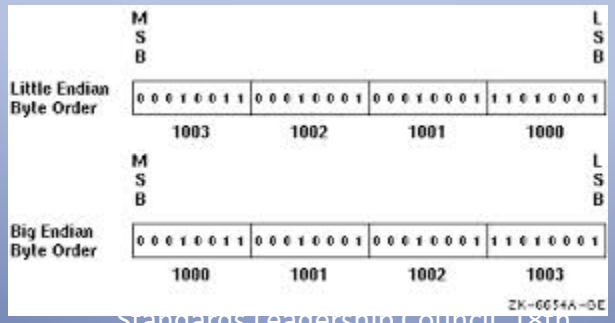
On Tape and On Disk

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.

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).

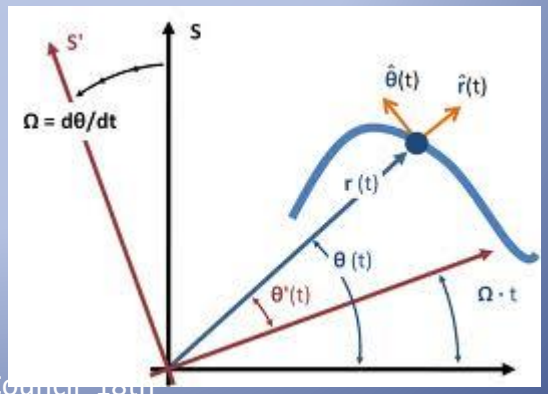


CRS

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 same for all coordinates.

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 interval 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

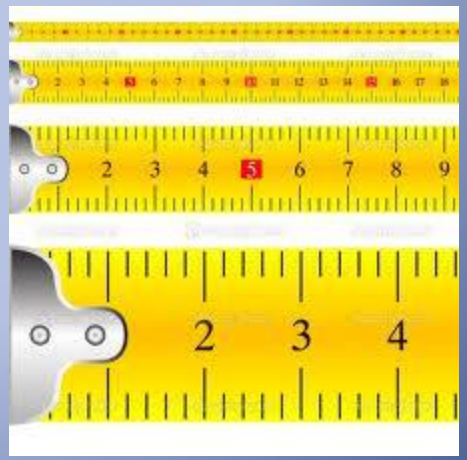
8 = 1-byte, two's complement integer

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**

EBCDIC Extended Hdrs

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

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

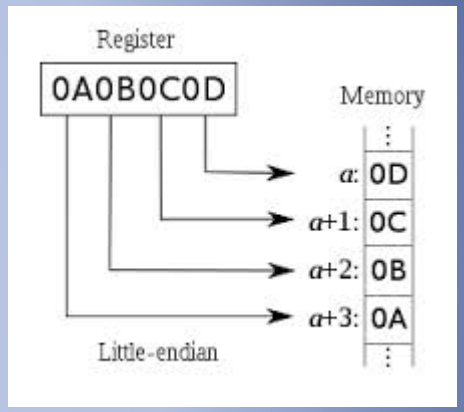
Encapsulation

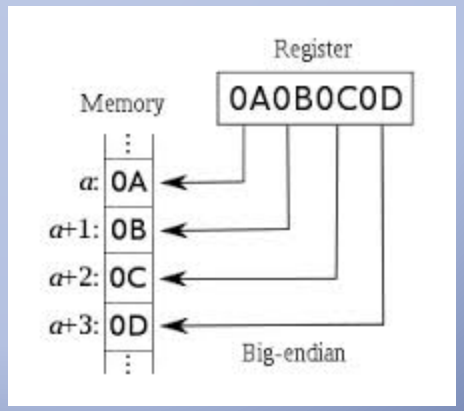
- **Hardware summary**
- Linear Serpentine recording
- 4 TB capacity using JC/JY media
- 1.6 TB capacity using JB/JX media
- 500 GB capacity using JK media
- 800 MBps burst data rate
- Compact 3.8 in x 7.8 in x 18.4 in dimensions

SEGD3.1 – Publication and Ratificatio

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





SEGY2 Mapping To PPDM

Mandatory Fields

Binary Header
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 interval 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.

Trace Headers
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.**

Input Now

Meetings with:

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

New Disciplines

PLEASE PLEASE GET INVOLVED WHILE YOU STILL HAVE THE CHANCE

Standards Leadership Council

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 specific data 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 fulfills its mission through publications, conferences, forums, web sites, and educational opportunities.